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SOLUBILITY DATA SERIES

Volume 47

ALKALI METAL AND AMMONIUM CHLORIDES IN WATER AND HEAVY WATER (BINARY SYSTEMS)

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ALKALI METAL AND AMMONIUM CHLORIDES IN WATER AND HEAVY WATER (BINARY SYSTEMS)

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FOREWORD

If the knowledge is
undigested or simply wrong,
more is not better.

The Solubility Data Series is a project of Commission V.8 (Solubility Data) of the International Union of Pure and Applied Chemistry (IUPAC). The project had its origins in 1973, when the analytical Chemistry Division of IUPAC set up a Subcommission on Solubility Data under the chairmanship of the late Prof. A.S. Kertes. When publication of the Solubility Data Series began in 1979, the Committee became a full commission of IUPAC, again under the chairmanship of Prof. Kertes, who also became *Editor-In-Chief* of the Series. The Series has as its goal the preparation of a comprehensive and critical compilation of data on solubilities in all physical systems, including gases, liquids and solids.

The motivation for the Series arose from the realization that, while solubility data are of importance in a wide range of fields in science and technology, the existing data had not been summarized in a form that was at the same time comprehensive and complete. Existing compilations of solubility data indeed existed, but they contained many errors, were in general uncritical, and were seriously out-of-date.

It was also realized that a new series of compilations of data gave educational opportunities, in that careful compilations of existing data could be used to demonstrate what constitutes data of high and lasting quality. As well, if the data were summarized in a sufficiently complete form, any individual could prepare his or her own evaluation, independently of the published evaluation. Thus, a special format was established for each volume, consisting of individual data sheets for each separate publication, and critical evaluations for each separate system, provided sufficient data from different sources were available for comparison. The compilations and, especially, the evaluations were to be prepared by active scientists who were either involved in producing new data, or were interested in using data of high quality. With minor modifications in format, this strategy has continued throughout the Series.

In the standard arrangement of each volume, the Critical Evaluation gives the following information:

(i) A text which discusses the numerical solubility information which has been abstracted from the primary sources in the form of compilation sheets. The text concerns primarily the quality of the data, after consideration of the purity of the materials and their characterization, the experimental method used, the uncertainties in the experimental values, the reproducibility, the agreement with accepted test values, and, finally, the fitting of the data to suitable functions, along with statistical tests of the fitted data.

(ii) A set of recommended data, whenever possible, including weighted averages and estimated standard deviations. If applicable, one or more smoothing equations which have been computed or verified by the evaluator are also given.

(iii) A graphical plot of the recommended data, in the form of phase diagrams where appropriate.

The Compilation part consists of data sheets which summarize the experimental data from the primary literature. Here much effort is put into obtaining complete coverage; many good data have appeared in publications from the late nineteenth and early twentieth centuries, or in obscure journals. Data of demonstrably low precision are not compiled, but are mentioned in the Critical Evaluation. Similarly, graphical data, given the uncertainty of accurate conversion to numerical values, are compiled only where no better data are available. The documentation of data of low precision can serve to alert researchers to areas where more work is needed.

A typical data sheet contains the following information:

(i) list of components: names, formulas, Chemical Abstracts Registry Numbers;
(ii) primary source of the data;
(iii) experimental variables;
(iv) compiler's name;
(v) experimental values as they appear in the primary source, in modern units with explanations if appropriate;
(vi) experimental methods used;
(vii) apparatus and procedure used;
(viii) source and purity of materials used;
(ix) estimated error, either from the primary source or estimated by the compiler;
(x) references relevant to the generation of the data cited in the primary source.

Each volume also contains a general introduction to the particular type of system, such as solubility of gases, of solids in liquids, etc., which contains a discussion of the nomenclature used, the principle of accurate determination of solubilities, and related thermodynamic principles. This general introduction is followed by a specific introduction to the subject matter of the volume itself.

The Series embodies a new approach to the presentation of numerical data, and the details continue to be influenced strongly by the perceived needs of prospective users. The approach used will, it is hoped, encourage attention to the quality of new published work, as authors become more aware that their work will attain permanence only if it meets the standards set out in these volumes. If the Series succeeds in this respect, even partially, the Solubility Data Commission will have justified the labour expended by many scientists throughout the world in its production.

January, 1989

J.W. Lorimer,
London, Canada

PREFACE TO THE VOLUME

SCOPE OF THE VOLUME

This volume surveys the data available in the literature for solid-liquid solubility equilibria, plus selected solid-liquid-vapor equilibria, for binary systems containing alkali and ammonium chlorides in water or in heavy water. Inclusion of the very large number of papers, and the extensive information, on solubilities in multicomponent systems and in non-aqueous and mixed solvents would have made the volume excessively large. These will be subjects for future volumes. The specific features of the binary systems which are discussed will be described later in this Preface.

Bibliographical searches have been carried out in several stages, using first the relevant volumes of D'Ans (1), Gmelin (2), Landolt-Bornstein (3), Mellor (4), Pascal (5), Linke-Seidell (6), and Stephen and Stephen (7). Exhaustive manual and automated searches of Chemical Abstracts were then made, up to the end of 1983. A large number of references were found in publications which had already been collected, and some references have been included which are more recent than 1983.

As far as we are aware, the entire literature has been covered but, in some cases, it has not been possible to obtain copies of original papers. Data from these papers have not been compiled, but references are given in the critical evaluations. Translated versions of papers from the Russian have been used as the basis of compilations in many cases; these are indicated by an asterisk beside the reference to the translation.

Original data are presented on compilation sheets with the units used by the authors. Data not given in customary units have been converted into mass percent or mole fraction in order to facilitate their use; a conversion chart is given at the end of this Preface. Where the data were originally expressed in other units, conversions have been performed using atomic weights of elements given in the 1977 IUPAC tables. In some cases, the absence of density data has not permitted conversion of data given in amount concentration units.

While extensive data are available for the binary systems alkali metal (or ammonium) chloride - water, many were obtained with insufficient attention being paid to purification of salts, to control of temperature, and to selection of the most suitable methods for analysis of saturated solutions. The determination of solubility under high pressure presents some specific difficulties due to the volatility of water at high temperatures. In several such cases it was very difficult to check whether the compiled data were correct or to estimate errors.

Fortunately, the solubility curves for alkali and ammonium chlorides and their hydrates can be fairly well represented by semi-empirical fitting equations. In the most favorable cases, such equations provide a way of checking the coherence of results given by an author at different temperatures. If results from several authors are available, a fitting equation allows a comparison among experiments performed using different techniques and procedures. Further, it permits estimation of the dispersion of data from rounded values, assessment of the reliability and quality of the data and recommendations of the best values. A fitting equation also allows extrapolation of the liquidus curve and checking or calculation of the composition of invariant points where two solid phases are in equilibrium with saturated liquid, and gives some information on possible metastable equilibria.

Estimation of errors in experimental data cannot be made in every case and systematic errors cannot be detected if the available data are those of a single author. The procedure used in critical evaluations is summarized later in this Preface. Solubilities at rounded temperatures are given on the evaluation sheets in various units, and, in some cases, they can be recommended as the best values.

Finally, we should like to acknowledge all those who have contributed to the final version of this volume, in particular Dr. Mark Salomon for continual advice and encouragement, translations from the Russian, Anne-Marie Gotard for very careful work in preparing the draft manuscript, Nancy Lorimer for translations, Shirley Lorimer for preparation of the final manuscript, and the staff of the Science Library, The University of Western Ontario, for their efficient help in locating copies of rare publications.

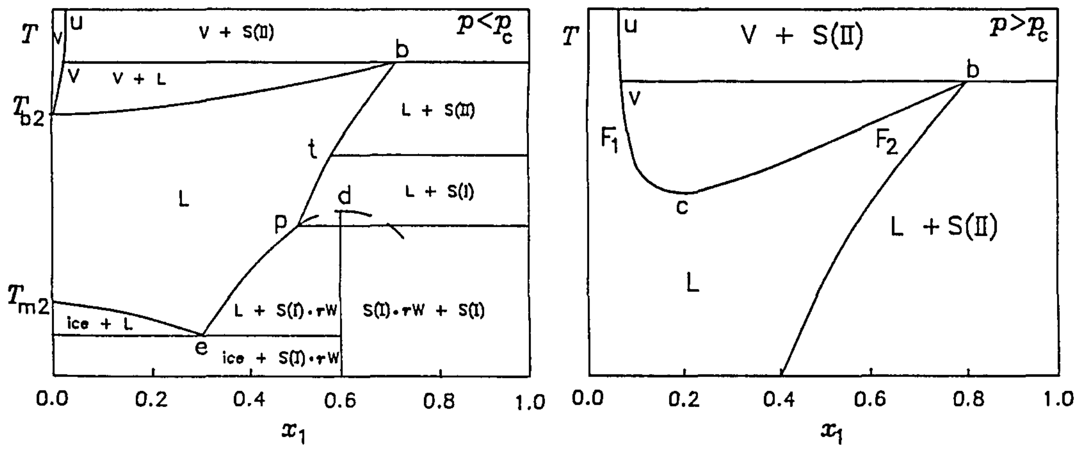
SURVEY OF THE SOLUBILITIES OF ALKALI METAL AND AMMONIUM HALIDES IN WATER AND DEUTERIUM WATER

1. *General Considerations*

All the alkali metal and ammonium chlorides have solubility curves which extend to the melting point of the pure anhydrous salt. This melting point is either the triple point of the pure salt or the melting point at an applied pressure greater than the pressure of the triple point. Existing data indicate that the triple point pressures are of the order of 0.05 mbar, and that the difference between the melting point at atmospheric pressure and the temperature of the triple point is negligible. In addition, the solubility curves do not intersect the critical curves, and the phase diagrams are therefore of the type 2 described by Morey (8).

In this volume, only those solubility data which involve a solid phase are considered. All solubility data, whatever the saturating phase, can be represented on the complete p-T-x surface for the system MCl-H_2O. However, three projections and sections of this surface are of particular relevance for the representation of solubility data: (1) T-x diagrams at constant pressure (a) below the critical point of water; (b) above the critical point of water; (2) T-x diagrams at the vapor pressure of the solid-saturated liquid; (3) p-x diagrams, where p is the vapor pressure of the solid-saturated liquid. The general features of these diagrams will now be discussed.

At a constant pressure below the critical pressure of pure water, the T-x phase diagram has the general form shown in Fig. 1(a).



(a) (b)

Fig. 1. Schematic T-x phase diagrams for the system S-W (here, MCl-H_2O) at a constant pressure: (a) below, (b) above the critical pressure of water. V - vapor (below critical temperature), gas (above critical temperature); L -liquid; S(I), S(II) - polymorphs of solid. Points identified in text.

The diagram consists of a number of regions bounded by curves along which two phases are in equilibrium, and intersecting at points where three phases are in equilibrium. These points, according to the phase rule, are invariant points at constant pressure. Starting from zero mole fraction of salt, $x_1 = 0$, the freezing point curve, or solubility curve for ice, extends from the melting point of pure ice, T_{m2}, to lower temperatures, until it intersects the solubility curve of the anhydrous salt, or of a salt hydrate, at a eutectic point e. Stable salt hydrates hydrates occur only in the systems LiCl-H_2O (mono-, di-, tri- and pentahydrates) and in NaCl-H_2O (dihydrate only). The solid phase LiCl·2D_2O also occurs; no information is available on other solid phases containing deuterium water. The solubility curve for a stable salt hydrate extends to a peritectic point *p*. In a few cases, data on solubility of the metastable hydrate are available; generally, the metastable congruent melting point T_m at mole fraction of salt $x_1 = 1/(r + 1)$ of a salt hydrate S·$r$$H_2O$ (or the *dystectic point*, *d*) can be estimated by careful analysis of the data by means of fitting equations. While other peritectic points may occur, eventually the solubility curve of the anhydrous salt is reached, which extends to point *b*, with coordinates the boiling point and composition of the saturated solution at the given pressure. In two cases (CsCl and NH_4Cl), a solid-solid phase transition occurs (solid phases S(I) and S(II) in Fig. 1(a)) so that the solubility curve for the anhydrous salt has two branches intersecting at *t*, the transition temperature and corresponding solubility. The difference in the slopes of these two branches is determined by the difference in enthalpies of solution of the two solids, which is generally much smaller than the enthalpy of solution of either solid. Thus, the change in slope of the solubility curve at the solid-solid phase transition is detectable only through very precise solubility measurements or by calculation from directly-measured enthalpies.

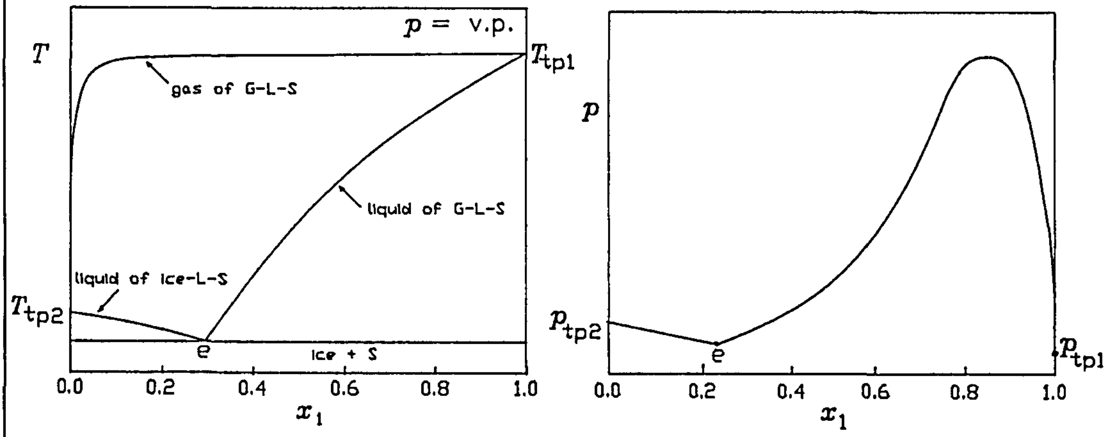
Boundaries of regions in which two stable phases are in equilibrium are indicated by horizontal limiting tie-lines, and by vertical lines, as appropriate. In Fig. 1(a), the region below the eutectic temperature consists of a heterogeneous mixture of ice and solid hydrate or anhydrous salt; that to the right of the hydrate composition and below the peritectic temperature consists of anhydrous salt and solid hydrate.

The boiling point T_{b_2} of pure water serves as the starting point for another two-phase equilibrium curve, the boiling curve, which extends upwards until it intersects the solubility curve at *b*. The region above this temperature consists of mixtures of steam and anhydrous salt. The resulting phase diagram may be considered to be a superposition of the solubility curve and the liquid-vapor equilibrium curves, taking into account the requirement that the three-phase equilibria S-L-G are invariant at constant pressure. In principle, because the triple point pressures in the MCl-H_2O systems are of the order of 0.05 mbar, at higher temperatures a second boiling point can occur, corresponding to a second intersection of the solubility and liquidus curves; see, for example, Bakhuis Roozeboom (9)for details. Eventually, at sufficiently high pressures, the liquid-vapor equilibrium curve can be expected to separate completely from the solubility curve. In practice, the boiling points of the MCl-H_2O systems are very much higher than their melting points, even at atmospheric pressure. As well, because of the large difference in volatility between salt and water, the liquidus curve will be very steep near the melting and boiling temperatures of the salt; *i.e.*, the composition of the liquidus will be almost pure salt component. Under these circumstances, the second intersection of the liquid-vapor curve and the solubility curve will occur essentially at the melting point of the pure salt, and will be unobservable. The separation of the solubility and liquid-vapor equilibrium curves has not been observed, presumably because of the high boiling points of the pure salts.

Only the boiling equilibria corresponding to the temperature at *b* are compiled, *i.e.*, the composition and boiling temperature of the saturated liquid solution. The boiling curve T_{b_2}-*b* may be calculated from vapor pressure data for unsaturated solutions.

In principle, there is a finite solubility of salt in the ice phase and in the vapor phase. Curve T_{b_2}-*v*-*u* in Fig. 1(a) represents the finite solubility of salt in the vapor phase, so that the region to the left of this curve is the field of unsaturated vapor. A similar curve starting from T_{m_2} and extending sharply downwards to lower temperatures would represent the finite solubility of salt in ice. In practice, for MCl-H_2O systems, the solubilities of salt in the solid or vapor phases are so small at pressures below the critical pressure of water that they have never been measured, so that curve T_{b_2}-*v*-*u* coincides with the $x_1 = 0$ axis, and the solubility curve for salt in ice, in practical terms, does not exist.

At the critical pressure of pure water, the maximum boiling point of pure water is reached. At the same time, the solubility of salt in the vapor phase, while still much smaller than that in the liquid phase, becomes measurable. Above the critical pressure of pure water, the phase diagram takes the form shown in Fig. 1(b). Only the high-temperature portion of the phase diagram is shown; the low-temperature portion is essentially the same as in Fig. 1(a). Copeland *et al.* (10) and Sourirajan and Kennedy (11) give good examples of the corresponding diagram for constant temperature; see (11), in particular, for good examples of other representations of equilibria, including a complete *p-T-x* surface. The main difference in the phase diagram above the critical pressure is in the boiling curve. The concept of a boiling point for pure water has disappeared, and effectively curve *v-c-b* in Fig. 1*b* becomes continuous, with two branches intersecting at the critical point *c* at the particular pressure. One branch (*b-c*) consists of vapor-saturated liquid solutions (supercritical fluid phase F_2), the other (*v-c*) of liquid-saturated vapor solutions (supercritical fluid phase F_1). The curve for vapor-saturated liquid solutions intersects the solubility curve at *b*, which is an invariant point at constant pressure. The region above the boiling point of the solid-saturated solution consists of anhydrous solid in equilibrium with solid-saturated vapor, a region referred to in the literature as "unsaturated steam". Only the temperatures and compositions of the boiling saturated solutions and their equilibrium vapor phases (*i.e.*, point *v*) are compiled; references are given to the rather sparse data for the liquid-vapor equilibrium curves (solubility in saturated steam for a given composition of liquid), the critical temperatures, and the solubility in unsaturated steam.



(a) (b)

Fig. 2. (a) Schematic *T-x* phase diagrams for $MCl-H_2O$ under the vapor pressure of the solid-saturated solution.
(b) Schematic diagram for $MCl-H_2O$ of the vapor pressure of solid-saturated solutions.

The schematic T-x phase diagram for $MCl-H_2O$ under the vapor pressure of the solid-saturated solution is shown in Fig. 2(a). For convenience, only one solid phase is shown. The diagram is essentially identical to that in Fig. 1(a) at low temperatures, except that point T_{m_2} becomes the triple point of water, T_{tp_2}, and point e becomes a quadruple (binary invariant) point. At higher temperatures, the solubility of the solid in the vapor phase increases, and eventually becomes, at $x_1 = 1$, pure salt vapor at the triple point of the salt, T_{tp_1}. It should be noted that the amount of salt in the vapor phase is very small, so that, on the scale of the complete phase diagram, the curve representing the gas of G-L-S consists of a vertical line at $x_1 = 0$ and a horizontal line through the triple point temperature (essentially the melting temperature) of the pure solid.

Figure 2(b) shows the schematic vapor pressure-composition curve for $MCl-H_2O$. For the nature of the curves near the triple point of water, see (8); no solubility data are available in this region, so these details have been omitted. The main features of the diagram are a vapor pressure which has a maximum, is steeper on the high salt side, and has a discontinuity in the slope at the eutectic composition. Both these features arise from the large difference in volatility between anhydrous salt and water at all temperatures. At compositions below that corresponding to the maximum vapor pressure, the increase in solubility with temperature is more pronounced than the decrease in vapor pressure with increasing salt content, and the vapor pressure increases more or less exponentially with increasing temperature. At compositions above that for the maximum vapor pressure, the contribution to the vapor pressure from the salt is small compared to that from the liquid, but the decrease in vapor pressure from increasing salt content now dominates, and the vapor pressure falls more or less linearly with increasing temperature.

2. *Summary of Evaluated Characteristic Points of the Phase Diagrams*

Tables 1 and 2, at the end of this Preface, give the coordinates of the various stable and metastable points which characterize the phase diagrams of the alkali metal or ammonium chloride-water systems. These coordinates have been calculated from the fitting equations or directly from literature values, as discussed in detail in the various Critical Evaluations.

In Table 1, note that all dystectic points (congruent melting points) and corresponding compositions of pure salt hydrates in equilibrium with their saturated solutions are metastable. The ice - $LiCl \cdot 3H_2O$ eutectic is also metastable, but is sufficiently close to the ice - $LiCl.5H_2O$ eutectic that a reliable estimate of its coordinates can be made from the fitting equations. The other possible metastable ice-salt hydrate/anhydrous salt eutectics cannot be estimated with any reliability because of the long extrapolations involved.

PROCEDURE USED IN CRITICAL EVALUATIONS

1. *Analytical Expressions*

1.1 *Solubility of a Hydrate* $MCl \cdot rH_2O$

In a system alkali chloride-water, the solubility of a stoichoimetric compound can be represented conveniently by an empirical relation, which has, however, a thermodynamic basis, as discussed in the *Introduction to the Solubility of Solids in Liquids* in this volume (henceforth referred to as the *Introduction*), and, in a somewhat different way, in (12-14):

$$Y = A/T + B \ln(T/T_f) + CT + D \qquad [1]$$

where A, B, C and D are adjustable coefficients. The quantity Y is the natural logarithm of the solubility product of the solid in equilibrium with the solution, and is given by:

$$Y = \ln\{x_1{}^2(1 - x_1)^r(2 + r)^{(2+r)}/[r^r(1 + x_1)^{2+r}]\} \qquad [2]$$

where x_1 is the mole fraction solubility of the solute (labelled as component 1). The reference temperature T_f in formulas [1] and [2]is the melting point of the pure hydrated or unhydrated solid phase. At this temperature, $Y = 0$ and $x_1 = 1/(1 + r)$.

The choice of reference state for the activity coefficients must take into account the fact that solubility data for the systems of interest here extend over the whole range of compositions from pure water to pure salt. This problem has been discussed by Pitzer (15), who pointed out the utility of supercooled, liquid, completely-ionized salt at a given temperature and pressure as a reference state, a choice which we adopt here. The simplifying assumption can then be introduced that the activity coefficients of ions and molecules depend on temperature according to an equation of the form of eqn. [1].

Given eqns. [1] and [2], the adjustment of the coefficients A, B, C and D to fit an experimental curve permits tracing the liquidus branch with precision and carrying out a critical evaluation effectively. It does not permit, in general, a thermodynamic analysis to find the enthalpy or entropy of fusion.

When the enthalpy of fusion, $\Delta_{fus}H$, (or fusion plus dissociation for a salt hydrate), the melting point, T_f, and the heat capacity of fusion, $\Delta_{fus}C$ of a pure compound are known, one can write, approximately:

$$A = -(\Delta_{fus}H - T_f\Delta_{fus}C)/R \qquad [3]$$

$$B = \Delta_{fus}C/R \qquad [4]$$

$$D = \Delta_{fus}H/RT_f - B \ln(T_f/\mathrm{K}) - CT_f \qquad [5]$$

and adjust the coefficients C and D, using the experimental data and eqn. [1], by a least squares procedure which is outlined below.

1.2 *Solubility of an Anhydrous Salt* MCl

Equation 2 is simplified, and can be written:

$$Y = 2 \ln[2x_1/(1 + x_1)] \qquad [6]$$

1.3 *Solubility of Ice*

Equation [1] can be written in standard form by introducing the melting point of ice, T_f = 273.15 K, the enthalpy of fusion of ice, $\Delta_{fus}H$ = 6.008 kJ mol^{-1} (16), and the molar heat capacity of fusion, $\Delta_{fus}C$ = 38 J K^{-1} mol^{-1} (16). One thus obtains

$$Y = -(\Delta_{fus}H - T_f\Delta_{fus}C)(1/T - 1/T_f)/R + (\Delta_{fus}C/R)\ln(T/T_f) \qquad [7]$$

Two different expressions for Y have been used, depending on the nature of the cation. If the salt is strongly solvated (large deviations from ideality), the analytical representation of the solubility curves is improved by using an expression of the form

$$Y = \ln\{[1 - (E + 1)x_1 - Fx_1^2]/[1 - (E - 1)x_1 - Fx_1^2]\} \qquad [8]$$

where E and F are adjustable coefficients related to the average hydration numbers. In other cases, the activity coefficient of water, f_2, is taken into account by

$$Y = \ln f_2 + \ln[(1 - x_1)/(1 + x_1)] \qquad [9]$$

and the activity coefficient is expressed by the series

$$\ln f_2 = [x_1/(1 + x_1)]^{3/2}(E + Fz + Gz^2 + Hz^3)/T \qquad [10]$$

with $z = \ln[x_1/(1 + x_1)]$, and E, F, G and H coefficients which are found by cubic regression of experimental values of the quantity

$$T[(1 + x_1)/x_1]^{3/2}\Psi = E + Fz + Gz^2 + Hz^3 \qquad [11]$$

where

$$\Psi = \ln[(1 + x_1)/(1 - x_1)] + (\Delta_{fus}H - T\Delta_{fus}C)(1/T - 1/T_f)/R + (\Delta C_{fus}/R)\ln(T/T_f) \qquad [12]$$

1.4 *Vapor Pressure of Saturated Solutions*

Consider a saturated liquid solution of salt (component 1) in water (component 2) at temperature T and at the vapor pressure p of the solution. The vapor pressure p corresponding to mole fraction x_1 is given by the equation (*cf.* (17))

$$\ln(p/p^{\circ}) = \ln[(1 - x_1)/(1 + x_1)] + \ln(p_2/p^{\circ}) + \ln f_2 + \int_0^p (V_2 - RT/p')\mathrm{d}p'/RT \qquad [13]$$

where p_2, V_2 are the vapor pressure and molar volume of pure water vapor at temperature T, p° is the standard pressure (= 1 bar) and f_2 is the activity coefficient of water in the saturated solution. Ionic mole fractions have been used, as in eqns. [1] and [2], and it has been assumed that there is a negligible amount of component 1 in the vapor. The first term on the right-hand side of eqn. [13] is negative, and is the main contribution of the salt to the decrease in vapor pressure relative to that of pure water (term 2). The remaining contribution of the salt comes from the activity coefficient term 3. The final term contains the effect of non-ideality of the vapor.

The term in the vapor pressure of pure water follows an equation of the same form as the right-hand side of eqn. [1], and it is assumed that the remaining relatively small terms 3, 4 and 5 can be fitted by an equation of the same type, giving as a fitting equation:

$$\ln(p/p^{\circ}) = \ln[(1 - x_1)/(1 + x_1)] + a/T + b\ln(T/T_2) + cT + d \qquad [14]$$

where T_2 is the standard boiling point of pure water.

1.5 *Pressure Effects on Solubility*

The general equation for the dependence of solubility on both pressure and temperature is, from eqn. [37] in the *Introduction*, using ionic mole fractions and the pure liquid reference state * discussed above:

$$Y + \ln\{(f_1/f_1^*)^2(f_2/f_2^*)^r = -\int_{T_m}^{T}(\Delta_{fus}H/R)\mathrm{d}(1/T) + \int_{T_m}^{T}\Delta_{fus}V\mathrm{d}p/RT \qquad [15]$$

Two cases arise: (a) the applied pressure is greater than the vapor pressure of the saturated solution; (b) the pressure is equal to the vapor pressure of the saturated solution.

(a) Applied pressure greater than vapor pressure of saturated solution

The volume change on melting is generally negative for the hydrated or unhydrated alkali metal and ammonium chlorides. Thus, eqn. [15] shows that the solubility decreases approximately linearly with increasing pressure, at constant temperature.

(b) Pressure equal to vapor pressure of saturated solution

In the last term in eqn. [15], the volume change on melting is of the order of 1 x 10^{-5} m^3 mol^{-1} for the alkali and ammonium chlorides (2), and the maximum vapor pressures of about 200 bar occur near $x_1 = 0.5$. The last term in eqn. [15] is thus of the order of 3 % of Y, and can thus be assumed to incorporated in an equation of the form of eqn. [1]. The variation of the melting point of the pure solid salt (anhydrous at the maximum vapor pressure) is of the order of a few kelvins (2), and can also be accommodated within the adjusted coefficients of the fitting equation. Equation [1] is thus equally useful for solubility at constant pressure or at the vapor pressure of the saturated solution.

2. *Calculation of Adjustable Coefficients*

Before any calculation, a large-scale plot of the solubility curve is made, and the most aberrant points are eliminated after critical examination of the data on the compilation sheets. All the remaining data are then examined, and a set of coefficients A_1, B_1, C_1 and D_1 is calculated by a method of least squares. The experimental points, with coordinates x_{1j}, T_j, are then compared with the calculated points $x_1(T_j)$, $T(x_{1j})$ and the relative ranges are calculated:

$$\Delta x_{1j}/x_1(T_j) = [x_{1j} - x_1(T_j)]/x_1(T_j) \qquad [16]$$

$$\Delta T_j/T_j(x_{1j}) = [T_j - T(x_{1j})]/T(x_{1j}) \qquad [17]$$

The experimental points then become the object of a new selection of coefficients, and the points retained for the calculation of a new set of coefficients are those that satisfy one or other of the conditions:

$$\Delta x_{1j}/x_1(T_j) < \rho, \quad \Delta T_j/T_j(x_{1j}) < \tau \qquad [18]$$

where ρ and τ are the maximum tolerated ranges. A new equation for the liquidus is then obtained, and a new analysis of all the experimental points is carried out. The calculation is repeated until a curve defined by a set of constant parameters is obtained:

$$A_n = A_{n-1},\quad B_n = B_{n-1},\quad C_n = C_{n-1}, \ldots$$

The relative ranges ρ and τ are chosen arbitrarily in such a way that the largest number of experimental points are retained. The evaluator's choice is guided, however, by analysis of the compilation sheets. The flowchart (Table 3) at the end of this Preface summarizes the method used.

3. *Conversions Between Units*

For the convenience of the reader, Table 4 at the end of this Preface gives conversions among the various common composition terms used to express solubilities.

The formulas in Table 4 also hold for a solute *B* dissolved in a mixed solvent containing components *A* and *C*, if M_A is replaced by the average molar mass of the solvent,

$$M = x_A{}'M_A + (1 - x_A{}')M_C \qquad [19]$$

where $x_A{}' = n_A/(n_A + n_B)$ is the known solvent mole fraction of component *A*. In this volume, these formulas for mixed solvents are used with $A = D_2O$, molar mass $M(D_2O) = 0.0200276$ kg mol^{-1}, and $C = H_2O$, molar mass $M(H_2O) = 0.0180153$ kg mol^{-1}.

4. *Using the Fitting Equations*

Calculation of solubility from a fitting equation, given the temperature, or the converse problem, given the solubility, calculate the equilibrium temperature, are in general not trivial exercises. The following recipes should be of help to those wishing to make their own calculations.

(a) Calculation of solubility, given the temperature.

The right-hand side of eqn. [1] gives $Y(T)$. Define

$$\begin{aligned} z &= e^Y/(2 + r)(2/r + 1) && \text{for } r > 0 \\ &= e^Y/4 && \text{for } r = 0 \end{aligned} \qquad [20]$$

Then, the mole fraction solubility *x* is a real root of the polynomial equation

$$\begin{aligned} f(x) &= z(1 + x)^{2 + r} - x^2(1 - x)^r \\ &= z + (2 + r)zx + \sum_{n=0}^{r}\left[\frac{z(2 + r)!}{(n + 2)!} - \frac{(-1)^n\, r!}{n!}\right]\frac{x^{n + 2}}{(r - n)!} \end{aligned} \qquad [21]$$

As the amount of hydration of the solid phase increases, the mole fraction solubility becomes smaller, and, approximately, from eqn. [21], $x = 1/(2 + r)$, independent of *z*. Thus, the solubilities of a hydrate, in the stable range, concentrate about this value of *x*, which becomes closer to the dystectic composition $1/(1 + r)$ as *r* increases. This trend is seen clearly in the system LiCl-H_2O. The value $x = 1/(2 + r)$ is a satisfactory starting value for the solution of eqn. [21] by the Newton-

Raphson method. For cases where the solid phase is anhydrous salt, a direct calculation is possible; from eqn. [6],

$$x_1 = 1/[2\exp(-Y/2) - 1] \qquad [22]$$

Calculation of the mole fraction solubility of ice from eqns. [7] through [12] can be carried out in a similar way.

(b) Calculation of the equilibrium temperature, given the solubility. Equations [2], [6] and [8] through [12] make possible, in the several cases, calculation of $Y(x)$. Solution of eqns. [1], [7] or [12], as appropriate, by the Newton-Raphson method, yields the equilibrium temperature.

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Table 1

Characteristic Points of the Phase Diagrams for LiCl-H_2O and NaCl-H_2O

phases	congruent m.p.	eutectic temp.	peritectic temp.	x_1	w_1	
		/(T/K - 273.15)				
System: LiCl-H_2O						
ice	0.00	-	-	0.0000	0.0000	t
ice-Li·5[a]	-	-74.75	-	0.124	0.250	t
ice-Li·3(m)	-	-90.8(m)	-	0.133(m)	0.265(m)	f
Li·5-Li·3	-	-	-65.4	0.149	0.291	t
Li·5	-63.6(m)	-	-	0.1667(m)	0.3201(m)	f
Li·3-Li·2	-	-	-19.0	0.206	0.378	f
Li·3	-10.4(m)	-	-	0.2500(m)	0.4396(m)	f
Li·2-Li·1	-	-	19.2	0.260	0.452	f
Li·2	29.3(m)	-	-	0.3333(m)	0.5405(m)	f
Li·1-Li·0	-	-	93.5	0.353	0.562	f
Li·1	123.1(m)	-	-	0.5000(m)	0.7017(m)	f
Li·0	610	-	-	1.0000	1.0000	t
System: NaCl-H_2O						
ice	0.00	-	-	0.0000	0.0000	t
ice-Na·2	-	-21.6	-	0.0850	0.2316	t
Na·2-Na·0	-	-	0.00	0.0990	0.2627	t
Na·2	54.09(m)	-	-	0.3333(m)	0.6186(m)	f
Na·0	801	-	-	1.0000	1.0000	f

[a] Abbreviations: M·n = MCl·$n$$H_2O$; m - metastable; t - tabulated data;
f - calculated from fitting equation

Table 2

Characteristic Points of the Phase Diagrams for MCl-H_2O
(excluding hydrate phases; see Table 1)

phases	congruent m.p.	eutectic temp.	transition temp.	x_1	w_1	
		/(T/K - 273.15)				
LiCl	610	-	-	1.0000	1.0000	t
ice-LiCl		(see Table 1)				
NaCl	801	-	-	1.0000	1.0000	t
ice-NaCl		(see Table 1)				
KCl	1044	–	–	1.0000	1.0000	t
ice-KCl	-	-10.646	-	0.0556	0.1959	t
RbCl	715	-	-	1.0000	1.0000	t
ice-RbCl	-	-16.5	-	0.0896	0.3977	f
fcc CsCl	645	-	-	1.0000	1.0000	t
cubic CsCl	553(m)	-	-	1.0000	1.0000	f
cubic - fcc	-	-	470	0.6637	0.9486	t,f
ice - cubic	-	-22.6	-	0.114	0.545	f
β-NH_4Cl	520.0	-	-	1.0000	1.0000	t
α-NH_4Cl	331	-	-	1.0000	1.0000	f
β - α	-	-	184.5	0.3350	0.5993	t,f
ice - α-NH_4Cl	-	-15.7	-	0.0743	0.1924	f

[a] Abbreviations: m - metastable; t - tabulated data;
f - calculated from fitting equation

Table 3

Flow chart for evaluation of solubility data

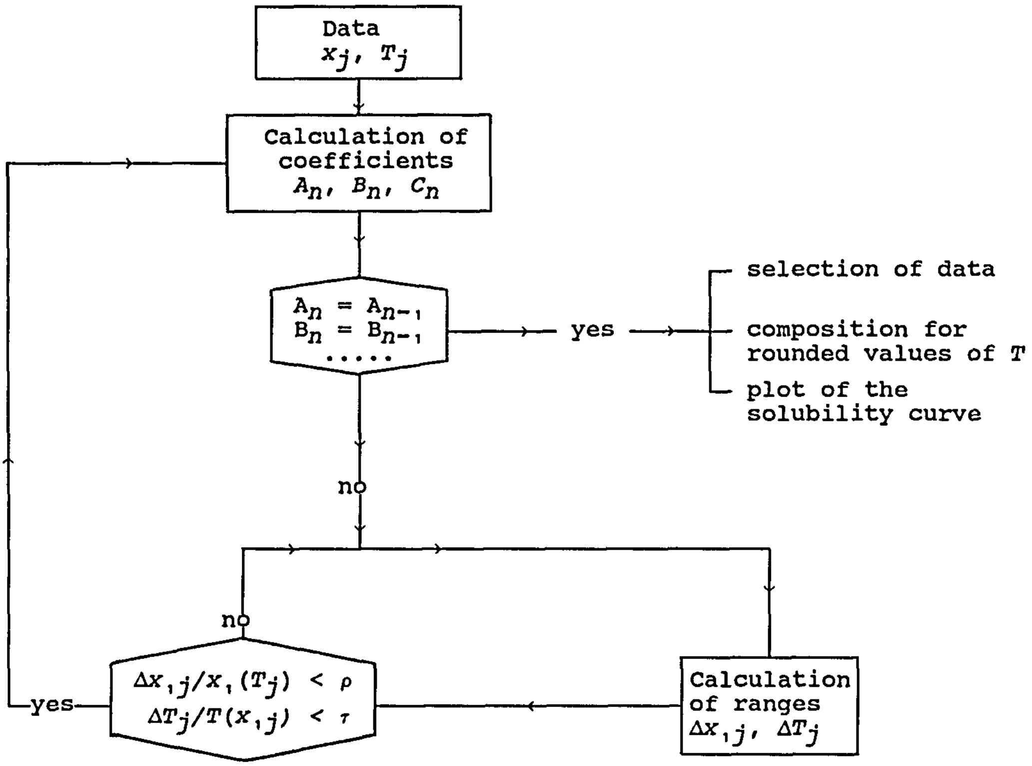

Table 4

Quantities Used as Measures of Solubility

Conversion Table for 2-Component Systems Containing Solvent *A* and Solute *B*

	mole fraction x_B =	mass fraction w_B =	molality m_B =	concentration c_B =
x_B	x_B	$\dfrac{1}{1 + M_A(1/x_B - 1)/M_B}$	$\dfrac{1}{M_A(1/x_B - 1)}$	$\dfrac{\rho}{M_B + M_A(1/x_B - 1)}$
w_B	$\dfrac{1}{1 + M_B(1/w_B - 1)/M_A}$	w_B	$\dfrac{1}{M_B(1/w_B B - 1)}$	$\rho w_B/M_B$
m_B	$\dfrac{1}{1 + 1/m_B M_A}$	$\dfrac{1}{1 + 1/M_B m_B}$	m_B	$\dfrac{\rho}{M_B + 1/m_B}$
c_B	$\dfrac{1}{1 + (\rho/c_B - M_B)/M_A}$	$M_B c_B/\rho$	$\dfrac{1}{\rho/c_B - M_B}$	c_B

ρ = density of solution; M_A, M_B = molar masses of solvent, solute

INTRODUCTION TO THE SOLUBILITY OF SOLIDS IN LIQUIDS

Nature of the Project

The Solubility Data Project (SDP) has as its aim a comprehensive search of the literature for solubilities of gases, liquids, and solids in liquids or solids. Data of suitable precision are compiled on data sheets in a uniform format. The data for each system are evaluated, and where data from different sources agree sufficiently, recommended values are proposed. The evaluation sheets, recommended values, and compiled data sheets are published on consecutive pages.

Definitions

A *mixture* (1, 2) describes a gaseous, liquid, or solid phase containing more than one substance, when the substances are all treated in the same way.

A *solution* (1, 2) describes a liquid or solid phase containing more than one substance, when for convenience one of the substances, which is called the *solvent*, and may itself be a mixture, is treated differently than the other substances, which are called *solutes*. If the sum of the mole fractions of the solutes is small compared to unity, the solution is called a *dilute solution*.

The *solubility* of a substance B is the relative proportion of B (or a substance related chemically to B) in a mixture which is saturated with respect to solid B at a specified temperature and pressure. *Saturated* implies the existence of equilibrium with respect to the processes of dissolution and precipitation; the equilibrium may be stable or metastable. The solubility of a substance in metastable equilibrium is usually greater than that of the corresponding substance in stable equliibrium. (Strictly speaking, it is the activity of the substance in metastable equilibrium that is greater.) Care must be taken to distinguish true metastability from supersaturation, where equilibrium does not exist.

Either point of view, mixture or solution, may be taken in describing solubility. The two points of view find their expression in the quantities used as measures of solubility and in the reference states used for definition of activities, activity coefficients and osmotic coefficients.

The qualifying phrase "substance related chemically to B" requires comment. The composition of the saturated mixture (or solution) can be described in terms of any suitable set of thermodynamic components. Thus, the solubility of a salt hydrate in water is usually given as the relative proportion of anhydrous salt in solution, rather than the relative proportions of hydrated salt and water.

Quantities Used as Measures of Solubility

1. *Mole fraction* of substance B, x_B:

$$x_B = n_B/\sum_{s=1}^{c} n_s \qquad [1]$$

where n_s is the amount of substance of s, and c is the number of distinct substances present (often the number of thermodynamic components in the system). *Mole per cent* of B is $100\ x_B$.

2. *Mass fraction* of substance B, w_B:

$$w_B = m_B'/\sum_{s=1}^{c} m_s' \qquad [2]$$

where m_s' is the mass of substance s. *Mass per cent* is $100\ w_B$. The equivalent terms *weight fraction* and *weight per cent* are not used.

3. *Solute mole (mass) fraction* of solute B (3, 4):

$$x_{s,B} = m_B/\sum_{s=1}^{c'} m_s = x_B/\sum_{s=1}^{c'} x_s \qquad [3]$$

$$w_{s,B} = m_B'/\sum_{s=1}^{c'} m_s' = w_B/\sum_{s=1}^{c'} w_s \qquad [3a]$$

where the summation is over the solutes only. For the solvent A, $x_{S,A} = x_A/(1 - x_A)$, $w_{S,A} = w_A/(1 - w_A)$. These quantities are called *Jänecke mole (mass) fractions* in many papers.

4. *Molality* of solute B (1, 2) in a solvent A:

$$m_B = n_B/n_A\ M_A \qquad \text{SI base units: mol kg}^{-1} \qquad [4]$$

where M_A is the molar mass of the solvent.

5. *Concentration* of solute B (1, 2) in a solution of volume V:

$$c_B = [B] = n_B/V \qquad \text{SI base units: mol m}^{-3} \qquad [5]$$

The symbol c_B is preferred to $[B]$, but both are used. The terms *molarity* and *molar* are not used.

Mole and mass fractions are appropriate to either the mixture or the solution point of view. The other quantities are appropriate to the solution point of view only. Conversions among these quantities can be carried out using the equations given in Table I-1 following this Introduction. Other useful quantities will be defined in the prefaces to individual volumes or on specific data sheets.

In addition to the quantities defined above, the following are useful in conversions between concentrations and other quantities.

6. *Density*: $\rho = m/V$ SI base units: kg m^{-3} [6]

7. *Relative density*: d; the ratio of the density of a mixture to the density of a reference substance under conditions which must be specified for both (1). The symbol $d_{t'}^{t}$ will be used for the density of a mixture at t°C, 1 bar divided by the density of water at t'°C, 1 bar. (In some cases 1 atm = 101.325 kPa is used instead of 1 bar = 100 kPa.)

8. *A note on nomenclature*. The above definitions use the nomenclature of the IUPAC *Green Book* (1), in which a solute is called B and a solvent A In compilations and evaluations, the first-named component (component 1) is the solute, and the second (component 2 for a two-component system) is the solvent. The reader should bear these distinctions in nomenclature in mind when comparing nomenclature and theoretical equations given in this Introduction with equations and nomenclature used on the evaluation and compilation sheets.

Thermodynamics of Solubility

The principal aims of the Solubility Data Project are the tabulation and evaluation of: (a) solubilities as defined above; (b) the nature of the saturating phase. Thermodynamic analysis of solubility phenomena has two aims: (a) to provide a rational basis for the construction of functions to represent solubility data; (b) to enable thermodynamic quantities to be extracted from solubility data. Both these are difficult to achieve in many cases because of a lack of experimental or theoretical information concerning activity coefficients. Where thermodynamic quantities can be found, they are not evaluated critically, since this task would involve critical evaluation of a large body of data that is not directly relevant to solubility. The following is an outline of the principal thermodynamic relations encountered in discussions of solubility. For more extensive discussions and references, see books on thermodynamics, e.g., (5-12).

Activity Coefficients (1)

(a) *Mixtures*. The activity coefficient f_B of a substance B is given by

$$RT\ \ln\ (f_B x_B) = \mu_B - \mu_B{}^* \qquad [7]$$

where $\mu_B{}^*$ is the chemical potential of pure B at the same temperature and pressure. For any substance B in the mixture,

$$\lim_{x_B \to 1} f_B = 1 \qquad [8]$$

(b) *Solutions*.

(i) *Solute B*. The molal activity coefficient γ_B is given by

$$RT\ \ln(\gamma_B m_B) = \mu_B - (\mu_B - RT\ \ln\ m_B)^{\infty} \qquad [9]$$

where the superscript $^{\infty}$ indicates an infinitely dilute solution. For any solute B,

$$\gamma_B{}^{\infty} = 1 \qquad [10]$$

Activity coefficients y_B connected with concentrations c_B, and $f_{x,B}$ (called the *rational activity coefficient*) connected with mole fractions x_B are defined in analogous ways. The relations among them are (1, 9), where ρ^* is the density of the pure solvent:

$$f_B = (1 + M_A\sum_s m_s)\gamma_B = [\rho + \sum_s(M_A - M_s)c_s]y_B/\rho^* \qquad [11]$$

$$\gamma_B = (1 - \sum_s x_s)f_{x,B} = (\rho - \sum_s M_s c_s)y_B/\rho^* \qquad [12]$$

$$y_B = \rho^* f_{x,B}[1 + \sum_s(M_s/M_A - 1)x_B]/\rho = \rho^*(1 + \sum_s M_s m_s)\gamma_B/\rho \qquad [13]$$

For an electrolyte solute $B \equiv C_{\nu+}A_{\nu-}$, the activity on the molality scale is replaced by (9)

$$\gamma_B m_B = \gamma_\pm{}^\nu m_B{}^\nu Q^\nu \qquad [14]$$

where $\nu = \nu_+ + \nu_-$, $Q = (\nu_+{}^{\nu+}\nu_-{}^{\nu-})^{1/\nu}$, and $\gamma_\pm$ is the mean ionic activity coefficient on the molality scale. A similar relation holds for the concentration activity, $y_B c_B$. For the mole fractional activity,

$$f_{x,B}x_B = Q^\nu f_\pm{}^\nu x_\pm{}^\nu \qquad [15]$$

where $x_\pm = (x_+x_-)^{1/\nu}$. The quantities x_+ and x_- are the ionic mole fractions (9), which are

$$x_+ = \nu_+x_B/[1 + \sum_s(\nu_s - 1)x_s]; \quad x_- = \nu_-x_B[1 + \sum_s(\nu_s - 1)x_s] \qquad [16]$$

where ν_s is the sum of the stoichiometric coefficients for the ions in a salt with mole fraction x_s. Note that the mole fraction of solvent is now

$$x_A' = (1 - \sum_s \nu_s x_s)/[1 + \sum_s(\nu_s - 1)x_s] \qquad [17]$$

so that

$$x_A' + \sum_s \nu_s x_s = 1 \qquad [18]$$

The relations among the various mean ionic activity coefficients are:

$$f_\pm = (1 + M_A\sum_s \nu_s ms)\gamma_\pm = [\rho + \sum_s(\nu_s M_A - M_s)c_s]y_\pm/\rho^* \qquad [19]$$

$$\gamma_\pm = \frac{(1 - \sum_s x_s)f_\pm}{1 + \sum_s(\nu_s - 1)x_s} = (\rho - \sum_s M_s c_s)y_\pm/\rho^* \qquad [20]$$

$$y_\pm = \frac{\rho^*[1 + \sum_s(M_s/M_A - 1)xs]f_\pm}{\rho[1 + \sum_s(\nu_s - 1)x_s]} = \rho^*(1 + \sum_s M_s m_s)\gamma_\pm/\rho \qquad [21]$$

(ii) *Solvent, A*:

The *osmotic coefficient*, ϕ, of a solvent A is defined as (1):

$$\phi = (\mu_A{}^* - \mu_A)/RT\ M_A \sum_s m_s \qquad [22]$$

where $\mu_A{}^*$ is the chemical potential of the pure solvent.

The *rational osmotic coefficient*, ϕ_x, is defined as (1):

$$\phi_x = (\mu_A - \mu_A{}^*)/RT\ln x_A = \phi M_A \sum_s m_s/\ln(1 + M_A \sum_s m_s) \qquad [23]$$

The activity, a_A, or the activity coefficient, f_A, is sometimes used for the solvent rather than the osmotic coefficient. The activity coefficient is defined relative to pure A, just as for a mixture.

For a mixed solvent, the molar mass in the above equations is replaced by the average molar mass; i.e., for a two-component solvent with components J, K, M_A becomes

$$M_A = M_J + (M_K - M_J)x_{v,K} \qquad [24]$$

where $x_{v,K}$ is the *solvent mole fraction* of component K.

The osmotic coefficient is related directly to the vapor pressure, p, of a solution in equilibrium with vapor containing A only by (12, p.306):

$$\phi M_A\sum_s \nu_s m_s = -\ln(p/p_A{}^*) + (V_{m,A}^* - B_{AA})(p - p_A{}^*)/RT \qquad [25]$$

where $p_A{}^*$, $V_{m,A}^*$ are the vapor pressure and molar volume of pure solvent A, and B_{AA} is the second virial coefficient of the vapor.

The Liquid Phase

A general thermodynamic differential equation which gives solubility as a function of temperature, pressure and composition can be derived. The approach is similar to that of Kirkwood and Oppenheim (7); see also (11, 12). Consider a solid mixture containing c thermodynamic components i. The Gibbs-Duhem equation for this mixture is:

$$\sum_{i=1}^{c} x_i'(S_i'dT - V_i'dp + d\mu_i') = 0 \qquad [26]$$

A liquid mixture in equilibrium with this solid phase contains c' thermodynamic components i, where c' > c. The Gibbs-Duhem equation for the liquid mixture is:

$$\sum_{i=1}^{c} x_i(S_i dT - V_i dp + d\mu_i') + \sum_{i=c+1}^{c'} x_i(S_i dT - V_i dp + d\mu_i) = 0 \qquad [27]$$

Subtract [26] from [27] and use the equation

$$d\mu_i = (d\mu_i)_{T,p} - S_i dT + V_i dp \qquad [28]$$

and the Gibbs-Duhem equation at constant temperature and pressure:

$$\sum_{i=1}^{c} x_i(d\mu_i')_{T,p} + \sum_{i=c+1}^{c'} x_i(d\mu_i)_{T,p} = 0 \qquad [29]$$

The resulting equation is:

$$RT\sum_{i=1}^{c} x_i'(d\ln a_i)_{T,p} = \sum_{i=1}^{c} x_i'(H_i - H_i')dT/T - \sum_{i=1}^{c} x_i'(V_i - V_i')dp \qquad [30]$$

where

$$H_i - H_i' = T(S_i - S_i') \qquad [31]$$

is the enthalpy of transfer of component i from the solid to the liquid phase at a given temperature, pressure and composition, with H_i and S_i the partial molar enthalpy and entropy of component i.

Use of the equations

$$H_i - H_i^0 = -RT^2(\partial \ln a_i/\partial T)_{x,p} \qquad [32]$$

and

$$V_i - V_i^0 = RT(\partial \ln a_i/\partial p)_{x,T} \qquad [33]$$

where superscript o indicates an arbitrary reference state gives:

$$RT\sum_{i=1}^{c} x_i' d\ln a_i = \sum_{i=1}^{c} x_i'(H_i^0 - H_i')dT/T - \sum_{i=1}^{c} x_i'(V_i^0 - V_i')dp \qquad [34]$$

where

$$d\ln a_i = (d\ln a_i)_{T,p} + (\partial \ln a_i/\partial T)_{x,p} + (\partial \ln a_i/\partial p)_{x,T} \qquad [35]$$

The terms involving enthalpies and volumes in the solid phase can be written as:

$$\sum_{i=1}^{c} x_i'H_i' = H_s^* \qquad \sum_{i=1}^{c} x_i'V_i' = V_s^* \qquad [36]$$

With eqn [36], the final general solubility equation may then be written:

$$R\sum_{i=1}^{c} x_i' d\ln a_i = (H_s^* - \sum_{i=1}^{c} x_i'H_i^0)d(1/T) - (V_s^* - \sum_{i=1}^{c} x_i'V_i^0)dp/T \qquad [37]$$

Note that those components which are not present in both phases do not appear in the solubility equation. However, they do affect the solubility through their effect on the activities of the solutes.

Several applications of eqn [37] (all with pressure held constant) will be discussed below. Other cases will be discussed in individual evaluations.

(a) *Solubility as a function of temperature.*

Consider a binary solid compound A_nB in a single solvent A. There is no fundamental thermodynamic distinction between a binary compound of A and B which dissociates completely or partially on melting and a solid mixture of A and B; the binary compound can be regarded as a solid mixture of constant composition. Thus, with $c = 2$, $x_A' = n/(n + 1)$, $x_B' = 1/(n + 1)$, eqn [37] becomes:

$$\mathrm{d}\ln(a_A{}^n a_B) = -\Delta H_{AB}{}^0\,\mathrm{d}(1/RT) \qquad [38]$$

where

$$\Delta H_{AB}{}^0 = nH_A + H_B - (n + 1)H_s{}^* \qquad [39]$$

is the molar enthalpy of melting and dissociation of pure solid A_nB to form A and B in their reference states. Integration between T and T_0, the melting point of the pure binary compound A_nB, gives:

$$\ln(a_A{}^n a_B) = \ln(a_A{}^n a_B)_{T=T_0} - \int_{T_0}^{T} \Delta H_{AB}{}^0\,\mathrm{d}(1/RT) \qquad [40]$$

(i) Non-electrolytes

In eqn [32], introduce the pure liquids as reference states. Then, using a simple first-order dependence of $\Delta H_{AB}{}^*$ on temperature, and assuming that the activitity coefficients conform to those for a simple mixture (6):

$$RT \ln f_A = w x_B{}^2 \qquad RT \ln f_B = w x_A{}^2 \qquad [41]$$

then, if w is independent of temperature, eqn [32] and [33] give:

$$\ln\{x_B(1-x_B)^n\} + \ln\left\{\frac{n^n}{(1 + n)^{n+1}}\right\} = G(T) \qquad [42]$$

where

$$G(T) = -\left\{\frac{\Delta H_{AB}{}^* - T^*\Delta C_p{}^*}{R}\right\}\left\{\frac{1}{T} - \frac{1}{T^*}\right\} + \frac{\Delta C_p{}^*}{R}\ln(T/T^*) - \frac{w}{R}\left\{\frac{x_A{}^2 + n x_B{}^2}{T} - \frac{n}{(n + 1)T^*}\right\} \qquad [43]$$

where $\Delta C_p{}^*$ is the change in molar heat capacity accompanying fusion plus decomposition of the pure compound to pure liquid A and B at temperature T^*, (assumed here to be independent of temperature and composition), and $\Delta H_{AB}{}^*$ is the corresponding change in enthalpy at $T = T^*$. Equation [42] has the general form:

$$\ln\{x_B(1-x_B)^n\} = A_1 + A_2/(T/\mathrm{K}) + A_3\ln(T/\mathrm{K}) + A_4(x_A{}^2 + n x_B{}^2)/(T/\mathrm{K}) \qquad [44]$$

If the solid contains only component B, then $n = 0$ in eqn [42] to [44].

If the infinite dilution reference state is used, then:

$$RT \ln f_{x,B} = w(x_A{}^2 - 1) \qquad [45]$$

and [39] becomes

$$\Delta H_{AB}{}^\infty = nH_A{}^* + H_B{}^\infty - (n + 1)H_s{}^* \qquad [46]$$

where $\Delta H_{AB}{}^\infty$ is the enthalpy of melting and dissociation of solid compound A_nB to the infinitely dilute reference state of solute B in solvent A; $H_A{}^*$ and $H_B{}^\infty$ are the partial molar enthalpies of the solute and solvent at infinite dilution. Clearly, the integral of eqn [32] will have the same form as eqn [35], with $\Delta H_{AB}{}^\infty$ replacing $\Delta H_{AB}{}^*$, $\Delta C_p{}^\infty$ replacing ΔCp^*, and $x_A{}^2 - 1$ replacing $x_A{}^2$ in the last term.

See (5) and (11) for applications of these equations to experimental data.

(ii) Electrolytes

(a) Mole fraction scale

If the liquid phase is an aqueous electrolyte solution, and the solid is a salt hydrate, the above treatment needs slight modification. Using rational mean activity coefficients, eqn [34] becomes:

$$\ln\left\{\frac{x_B^{\nu}(1 - x_B)^n}{[1 + (\nu - 1)x_B]^{n+\nu}}\right\} - \ln\left\{\frac{n^n}{(n + \nu)^{n+\nu}}\right\} + \ln\left\{\left[\frac{f_B}{f_B^*}\right]^{\nu}\left[\frac{f_A}{f_A^*}\right]^n\right\}$$
$$= - \left\{\frac{\Delta H_{AB}^* - T^*\Delta C_p^*}{R}\right\}\left\{\frac{1}{T} - \frac{1}{T^*}\right\} + \frac{\Delta Cp^*}{R} \ln(T/T^*) \qquad [47]$$

where superscript * indicates the pure salt hydrate. If it is assumed that the activity coefficients follow the same temperature dependence as the right-hand side of eqn [47] (13-16), the thermochemical quantities on the right-hand side of eqn [47] are not rigorous thermodynamic enthalpies and heat capacities, but are apparent quantities only. Data on activity coefficients (9) in concentrated solutions indicate that the terms involving these quantities are not negligible, and their dependence on temperature and composition along the solubility-temperature curve is a subject of current research.

A similar equation (with $\nu = 2$ and without the heat capacity terms or activity coefficients) has been used to fit solubility data for some $MOH-H_2O$ systems, where M is an alkali metal (13); enthalpy values obtained agreed well with known values. The full equation has been deduced by another method in (14) and applied to MCl_2-H_2O systems in (14) and (15). For a summary of the use of equation [47] and similar equations, see (14).

(2) Molality scale

Substitution of the mean activities on the molality scale in eqn [40] gives:

$$\nu\ln\left\{\frac{\gamma_{\pm}m_B}{\gamma_{\pm}^*m_B^*}\right\} - \nu(m_B/m_B^* - 1) - \nu\{m_B(\phi - 1)/m_B^* - \phi^* + 1\}$$
$$= G(T) \qquad [48]$$

where $G(T)$ is the same as in eqn [47], $m_B^* = 1/nM_A$ is the molality of the anhydrous salt in the pure salt hydrate and $\gamma_{\pm}$ and ϕ are the mean activity coefficient and the osmotic coefficient, respectively. Use of the osmotic coefficient for the activity of the solvent leads, therefore, to an equation that has a different appearance to [47]; the content is identical. However, while eqn [47] can be used over the whole range of composition ($0 < x_B < 1$), the molality in eqn [48] becomes infinite at $x_B = 1$; use of eqn [48] is therefore confined to solutions sufficiently dilute that the molality is a useful measure of composition. The essentials of eqn [48] were deduced by Williamson (17); however, the form used here appears first in the *Solubility Data Series*. For typical applications (where activity and osmotic coefficients are not considered explicitly, so that the enthalpies and heat capacities are apparent values, as explained above), see (18).

The above analysis shows clearly that a rational thermodynamic basis exists for functional representation of solubility-temperature curves in two-component systems, but may be difficult to apply because of lack of experimental or theoretical knowledge of activity coefficients and partial molar enthalpies. Other phenomena which are related ultimately to the stoichiometric activity coefficients and which complicate interpretation include ion pairing, formation of complex ions, and hydrolysis. Similar considerations hold for the variation of solubility with pressure, except that the effects are relatively smaller at the pressures used in many investigations of solubility (5).

(b) Solubility as a function of composition.

At constant temperature and pressure, the chemical potential of a saturating solid phase is constant:

$$\mu_{A_nB}^* = \mu_{A_nB}(\text{sln}) = n\mu_A + \mu_B \qquad [49]$$
$$= (n\mu_A^* + \nu_+\mu_+^{\infty} + \nu_-\mu_-^{\infty}) + nRT\ \ln f_Ax_A$$
$$+ \nu RT\ \ln(\gamma_{\pm}m_{\pm}Q)$$

for a salt hydrate A_nB which dissociates to water (A), and a salt (B), one mole of which ionizes to give ν_+ cations and ν_- anions in a solution in which other substances (ionized or not) may be present. If the saturated solution is sufficiently dilute, $f_A = x_A = 1$, and the quantity K_s in

$$\Delta G^{\infty} = (\nu_+\mu_+^{\infty} + \nu_-\mu_-^{\infty} + n\mu_A^* - \mu_{AB}^*)$$
$$= -RT\ \ln\ K_s$$

$$= -\nu RT \ln(Q\gamma_{\pm}m_B) \qquad [50]$$

is called the *solubility product* of the salt. (It should be noted that it is not customary to extend this definition to hydrated salts, but there is no reason why they should be excluded.) Values of the solubility product are often given on mole fraction or concentration scales. In dilute solutions, the theoretical behaviour of the activity coefficients as a function of ionic strength is often sufficiently well known that reliable extrapolations to infinite dilution can be made, and values of K_S can be determined. In more concentrated solutions, the same problems with activity coefficients that were outlined in the section on variation of solubility with temperature still occur. If these complications do not arise, the solubility of a hydrate salt $C_\nu A_\nu \cdot n\mathrm{H_2O}$ in the presence of other solutes is given by eqn [50] as

$$\nu \ln\{m_B/m_B(0)\} = -\nu \ln\{\gamma_{\pm}/\gamma_{\pm}(0)\} - n \ln\{a_A/a_A(0)\} \qquad [51]$$

where a_A is the activity of water in the saturated solution, m_B is the molality of the salt in the saturated solution, and (0) indicates absence of other solutes. Similar considerations hold for non-electrolytes.

Consideration of *complex mixed ligand equilibria* in the solution phase are also frequently of importance in the interpretation of solubility equilibria. For nomenclature connected with these equilibria (and solubility equilibria as well), see (19, 20).

The Solid Phase

The definition of solubility permits the occurrence of a single solid phase which may be a pure anhydrous compound, a salt hydrate, a non-stoichiometric compound, or a solid mixture (or solid solution, or "mixed crystals"), and may be stable or metastable. As well, any number of solid phases consistent with the requirements of the phase rule may be present. Metastable solid phases are of widespread occurrence, and may appear as polymorphic (or allotropic) forms or crystal solvates whose rate of transition to more stable forms is very slow. Surface heterogeneity may also give rise to metastability, either when one solid precipitates on the surface of another, or if the size of the solid particles is sufficiently small that surface effects become important. In either case, the solid is not in stable equilibrium with the solution. See (21) for the modern formulation of the effect of particle size on solubility. The stability of a solid may also be affected by the atmosphere in which the system is equilibrated.

Many of these phenomena require very careful, and often prolonged, equilibration for their investigation and elimination. A very general analytical method, the "wet residues" method of Schreinemakers (22), is often used to investigate the composition of solid phases in equilibrium with salt solutions. This method has been reviewed in (23), where [see also (24)] least-squares methods for evaluating the composition of the solid phase from wet residue data (or initial composition data) and solubilities are described. In principle, the same method can be used with systems of other types. Many other techniques for examination of solids, in particular X-ray, optical, and thermal analysis methods, are used in conjunction with chemical analyses (including the wet residues method).

COMPILATIONS AND EVALUATIONS

The formats for the compilations and critical evaluations have been standardized for all volumes. A brief description of the data sheets has been given in the FOREWORD; additional explanation is given below.

Guide to the Compilations

The format used for the compilations is, for the most part, self-explanatory. The details presented below are those which are not found in the FOREWORD or which are not self-evident.

Components. Each component is listed according to IUPAC name, formula, and Chemical Abstracts (CA) Registry Number. The formula is given either in terms of the IUPAC or Hill (25) system and the choice of formula is governed by what is usual for most current users: i.e., IUPAC for inorganic compounds, and Hill system for organic compounds. Components are ordered according to:

(a) saturating components;
(b) non-saturating components in alphanumerical order;
(c) solvents in alphanumerical order.

The saturating components are arranged in order according to a 18-column periodic table with two additional rows:

Columns 1 and 2: H, alkali elements, ammonium, alkaline earth elements
3 to 12: transition elements
13 to 17: boron, carbon, nitrogen groups; chalcogenides, halogens
18: noble gases
Row 1: Ce to Lu
Row 2: Th to the end of the known elements, in order of atomic number.

Salt hydrates are generally not considered to be saturating components since most solubilities are expressed in terms of the anhydrous salt. The existence of hydrates or solvates is carefully noted in the text, and CA Registry Numbers are given where available, usually in the critical evaluation. Mineralogical names are also quoted, along with their CA Registry Numbers, again usually in the critical evaluation.

Original Measurements. References are abbreviated in the forms given by *Chemical Abstracts Service Source Index* (CASSI). Names originally in other than Roman alphabets are given as transliterated by *Chemical Abstracts*.

Experimental Values. Data are reported in the units used in the original publication, with the exception that modern *names* for units and quantities are used; e.g., mass per cent for weight per cent; mol dm^{-3} for molar; etc. Both mass and molar values are given. Usually, only one type of value (e.g., mass per cent) is found in the original paper, and the compiler has added the other type of value (e.g., mole per cent) from computer calculations based on 1983 atomic weights (26).

Errors in calculations and fitting equations in original papers have been noted and corrected, by computer calculations where necessary.

Method. Source and Purity of Materials. Abbreviations used in *Chemical Abstracts* are often used here to save space.

Estimated Error. If these data were omitted by the original authors, and if relevant information is available, the compilers have attempted to estimate errors from the internal consistency of data and type of apparatus used. Methods used by the compilers for estimating and and reporting errors are based on the papers by Ku and Eisenhart (27).

Comments and/or Additional Data. Many compilations include this section which provides short comments relevant to the general nature of the work or additional experimental and thermodynamic data which are judged by the compiler to be of value to the reader.

References. See the above description for Original Measurements.

Guide to the Evaluations

The evaluator's task is to check whether the compiled data are correct, to assess the reliability and quality of the data, to estimate errors where necessary, and to recommend "best" values. The evaluation takes the form of a summary in which all the data supplied by the compiler have been critically reviewed. A brief description of the evaluation sheets is given below.

Components. See the description for the Compilations.

Evaluator. Name and date up to which the literature was checked.

Critical Evaluation

(a) Critical text. The evaluator produces text evaluating *all* the published data for each given system. Thus, in this section the evaluator reviews the merits or shortcomings of the various data. Only published data are considered; even published data can be considered only if the experimental data permit an assessment of reliability.

(b) Fitting equations. If the use of a smoothing equation is justifiable the evaluator may provide an equation representing the solubility as a function of the variables reported on all the compilation sheets.

(c) Graphical summary. In addition to (b) above, graphical summaries are often given.

(d) Recommended values. Data are *recommended* if the results of at least two independent groups are available and they are in good agreement, and if the evaluator has no doubt as to the adequacy and reliability of the applied experimental and computational procedures. Data are considered as *tentative* if only one set of measurements is available, or if the evaluator considers some aspect of the computational or experimental method as mildly undesirable but estimates that it should cause only minor errors. Data are considered as *doubtful* if the evaluator considers some aspect of the computational or experimental method as undesirable but still considers the data to have some value in those instances where the order of magnitude of the solubility is needed. Data determined by an inadequate method or under ill-defined conditions are *rejected*. However references to these data are included in the evaluation together with a comment by the evaluator as to the reason for their rejection.

(e) References. All pertinent references are given here. References to those data which, by virtue of their poor precision, have been rejected and not compiled are also listed in this section.

(f) Units. While the original data may be reported in the units used by the investigators, the final recommended values are reported in S.I. units (1, 28) when the data can be accurately converted.

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COMPONENTS	EVALUATOR:
(1) Lithium chloride; LiCl; [7447-41-8] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987.

CRITICAL EVALUATION

Solubility data for the binary system $LiCl-H_2O$ are presented in forty-nine publications. Within the limits of the accuracy of the analyses, the solid phases in equilibrium with saturated solutions are stoichiometric. Six solubility curves can be identified, involving the phases ice, anhydrous salt, and four hydrates:

$LiCl\cdot H_2O$ [16712-20-2]
$LiCl\cdot 2H_2O$ [16712-19-9]
$LiCl\cdot 3H_2O$ [38851-62-6]
$LiCl\cdot 5H_2O$ - no C.A. Registry Number listed

The tetrahydrate, $LiCl\cdot 4H_2O$, listed in the Index of Chemical Abstracts under the number [56088-71-2], has been indicated by Azizov *et al.* (73) in 1979 in connection with a study by NQR and NMR of complexes that form hydrogen bonds, but no solubility branch for this supposed hydrate was detected in the solid-liquid equilibrium diagram.

EXPERIMENTAL METHODS

The solubility of lithium chloride in water has been measured by various methods. These include:

(a) Analytical methods (1, 2, 5, 19, 31, 33, 34, 36, 38, 39, 40, 41, 45, 47, 48, 51, 54, 55, 56, 57, 58, 60, 61, 64, 69, 70, 71, 72, 74, 75) in which a sample of the saturated solution is taken and analyzed;

(b) Synthetic methods, in which no chemical analysis is carried out: one property of the system is measured continuously, at constant composition, as the temperature is varied (14, 16, 35, 44, 46, 50, 53, 59, 60, 61, 62, 66, 67, 68, 76). At each change of phase, a break in the curve of property vs. temperature is observed. The principal properties used are the temperature of disappearance of the final crystals during slow heating of an unsaturated solution (44,59,62); the temperature of appearance of the first crystals during cooling (35,62,68); the saturated vapor pressure as a function of temperature (or sometimes as a function of composition) (30, 43, 46, 63); the density (45,64); the viscosity (31,64); the electrical conductivity (24, 64); the volume (dilatometry) (41). Some authors seed the mixture with crystals of the hydrate being studied to avoid supersaturation (2, 35 ,57, 59). At high temperatures, measurements by the synthetic method are carried out in sealed tubes (45) or in an autoclave (63). A major difficulty in taking measurements at high pressure is that the composition of the mixture may become indeterminate due to the volatility of water. Ravich and Yastrebova (63) make a correction to take the volume of the vapor into account.

Methods of establishing the points of double saturation in salt (eutectic, peritectic points) are mentioned only in a limited number of papers. A common method is thermal analysis (35, 57, 60, 61, 76).

(continued)

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CRITICAL EVALUATION (continued)

Extrapolation of curves of temperature T as a function of a property x has been established by measurement of solubilities (59), of dilation (44), of density (3, 40), of vapor pressure (30, 43), or through Tammann diagrams. In this latter method one notes the duration of the invariant stage obtained in thermal analysis by varying the composition of the mixture being studied.

ANALYSIS OF SOLUTIONS

The composition of the sample being studied or of the saturated solution is determined by evaporation to dryness and weighing (1, 2, 31, 39, 40, 50, 54, 60, 70), or by chemical analysis (determination of Cl^- by argentimetry (36, 38, 40, 45, 48, 53, 54, 57, 61, 64, 72, 74)), or of lithium as the sulfate (1, 2, 40). In dilute solutions, the concentration of LiCl is often measured by conductimetry (24).

CHEMICALS USED

Friend and Colley (39), Kremers (1, 2), and Blidin (54) prepared LiCl by the reaction of Li_2CO_3 with a solution of HCl and crystallization of the solution. Most often, the LiCl used is a pure reagent, sometimes recrystallized two or three times in the form of the monohydrate.

DATA NOT COMPILED

These are the data of: (a) Collins and Cameron (37), which are based on a badly-defined temperature value; (b) Moran (57), presented in the form of a graph; (c) Applebey and Cook (44) and Ueda (43), who indicate only the temperature of double saturation; (d) Biltz (8), Jahn (11), Jones and Getman (9), Rivett (14), Washburn and McInnes (16) for highly dilute solutions of lithium chloride (ice branch). The results of these authors have nevertheless been put to use in the critical evaluation.

CRITICAL EVALUATION OF RESULTS

1. *Fitting Equations*

All the data in the compilation sheets have been analyzed following the procedure described in the Preface to this volume. The curves are represented by equations of the form:

$$Y = f(T) = A/T + B \ln T + CT + D$$

According to the extent of the domain of crystallization in temperature and in composition, two, three or four coefficients were used, the values of which are given in Table I.

2. *Melting Temperature of* LiCl

Numerous measurements of the melting temperature of LiCl have been carried out (4, 6, 7, 10, 12, 13, 15, 17, 20, 21, 22, 23, 25, 26, 27, 28,

(continued)

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CRITICAL EVALUATION (continued)

29, 32). These data were analyzed by Scientific Group Thermodata Europe who recommended the value 883 K (610°C), a value we have adopted.

Table 1

solid phase	A/K	B	C/K^{-1}	D	E	F	$\rho=\tau$
LiCl	263.521	-0.2722	3.80x10^{-3}	-1.8084			0.015
$LiCl\cdot H_2O$	-1725.54	-12.6739	2.5991x10^{-2}	69.8715			0.008
$LiCl\cdot 2H_2O$	-10195.4	-79.5935	1.5849x10^{-1}	440.405			0.015
$LiCl\cdot 3H_2O$	293.156	2.2693		-13.7584			0.009
$LiCl\cdot 5H_2O$	-258.128	0.2021		0.1515			
ice					6.651	-11.318	

3. *Critical Evaluation of the Data*

3.1 Solubility Branch for LiCl [7447-41-8]

The calculation was carried out using thirty-seven experimental points taking as relative ranges of composition expressed in mole fractions and of temperature $\rho = \tau = 0.015$. All the experimental values and calculations are presented in Table 2, to give an appreciation of the quality of the experimental measurements.

The most certain values seem to be those of Friend, Hale and Ryder (50). The measurements of Applebey, Gordon and Crawford (45) are more scattered but can nevertheless be recommended as less precise values. The same is true for the measurements of other authors (1, 2, 30, 33).

Table 2

Solubility of LiCl in aqueous solutions (solid phase LiCl)

T/K - 273.15	mass % 100w_1 exp.	mass % 100w_1 calc.	mole fraction x_1 exp.	mole fraction x_1 calc.	density g cm^{-3} exp.	density g cm^{-3} calc.	status	ref.
95	56.50	56.19	0.3558	0.3528			r	1,2
95.15	55.83	56.20	0.3494	0.3529	1.347	1.347	r	45
96	56.18	56.22	0.3527	0.3531			r	1,2
98	56.7	56.28	0.3575	0.3536			P,r	62
99.5	55.84	56.33	0.3495	0.3540			t	41
100	55.84	56.31	0.3495	0.3541			t	74
100.2	56.3	56.35	0.3538	0.3542	1.347	1.347	r	45
100.5	56.5	56.37	0.3558	0.3543			P,r	30,35
101.8	56.40	56.40	0.3547	0.3547			t	50
102	56.9	56.40	0.3594	0.3548			t	48,51
107.6	56.52	56.58	0.3558	0.3564			r	50
115.4	56.95	56.85	0.3599	0.3589			r	50
117.0	57.00	56.90	0.3603	0.3594			r	50
120.2	56.9	57.02	0.3594	0.3605	1.344	1.344	r	45
123.0	57.28	57.12	0.3630	0.3615			r	50
130.5	57.58	57.41	0.3658	0.3642			r	50
140	58.1	57.80	0.3712	0.3679			r	1,2
140	58.2	57.80	0.3712	"			r	30
140.3	57.6	57.81	0.3660	0.3680	1.339	1.340	r	45
140.5	57.90	57.82	0.3689	0.3681			r	50

(continued)

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CRITICAL EVALUATION (continued)

Table 2 (continued)

Solubility of LiCl in aqueous solutions (solid phase LiCl)

T/K − 273.15	mass % $100w_1$ exp.	calc.	mole fraction x_1 exp.	calc.	density g cm^{-3} exp.	calc.	status	ref.
143.6	57.98	57.95	0.3696	0.3694			r	50
154.0	58.46	58.42	0.3742	0.3738			r	50
155.6	58.3	58.49	0.3727	0.3745	1.338	1.337	r	45
160	59.2	58.70	0.3811	0.3765			r	1,2
160	59.2	58.70	0.3811	0.3765			t	30
250	62.7	63.87	0.4167	0.4289			t	63
250	63.3	63.87	0.4230	0.4289			t	63
300	66.3	67.45	0.4554	0.4683			t	63
350	70.3	71.51	0.5015	0.5161			t	63
350	70.4	"	0.5027	"			t	63
400	75.3	76.02	0.5644	0.5740			t	63
400	76.0	76.02	0.5737	0.5740			t	63
450	81.3	80.99	0.6488	0.6441			t	63
450	81.5	"	0.6518	"			t	63
500	86.7	86.41	0.7348	0.7298			t	63
556	93.5	93.03	0.8594	0.8502			t	63
610	100	99.99	1	0.9997			F,*	

r = recommended value $e < 0.008$
t = tentative value $0.008 < e < 0.018$
* = value adopted *a priori*
P = peritectic point
F = melting point
$e = \Delta w/w$(calc)

At the highest temperatures, the results of Ravich and Yastrebova (63) are less precise due to experimental difficulties (correction of the composition of the mixture to take into account the dead volume of vapor above the solution; attack of the walls of the autoclave by the mixture). They can be considered, nevertheless, to have a precision better than 1.8 percent by mass.

3.2 Solubility Branch for $LiCl \cdot H_2O$ [16712-20-2]

Ninety-nine experimental points are located on this liquidus branch. The transfer of these points to a large-scale diagram permits the rejection of five aberrant values. The first, at 285.7 K (12.5°C), is presented by Hüttig and his collaborators (30,35) as a peritectic point:

$LiCl \cdot 2H_2O = LiCl \cdot H_2O + liq.$

It differs by almost 8 K from the temperature indicated by several other authors. The other rejected values, at 293 K (20°C) and 298 K (25°C), correspond to the results of Akopov (62), whose results in general are very scattered and quite distant from other data in the bibliography.

The calculation of the liquidus curve was made with four adjustable coefficients, taking as density ranges $\rho = \tau = 0.008$. The results are

(continued)

COMPONENTS	EVALUATOR:
(1) Lithium chloride; LiCl; [7447-41-8] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987.

CRITICAL EVALUATION (continued)

presented in Table 3. Four other points, corresponding to differences greater than 0.008, were not taken into account in the final calculation of the coefficients and must be considered as tentative values.

For the solubility branch of lithium chloride monohydrate, the most coherent and reliable results are those of Kessis (61), Friend *et al.* (39,50), and of Applebey, Crawford and Gordon (45).

Table 3

Solubility of LiCl in aqueous solutions (solid phase $LiCl \cdot H_2O$)

T/K - 273.15	mass % $100w_1$		mole fraction x_1		density g cm^{-3}		status	ref.
	exp.	calc.	exp.	calc.	exp.	calc.		
12.5	40.5	44.62	0.2242	0.2550			P,a	35
18.0	45.31	45.11	0.2604	0.2588			r	39
18	45.32	"	0.2605	"			r	46
18.5	45.0	45.15	0.2580	0.2592			P,r	62
19.0	45.22	45.20	0.2597	0.2595			r	39
19.0	45.2	"	0.2595	"			P,r	59
19.4	45.15	45.24	0.2592	0.2598			P,r	61
20	44.7	45.29	0.2552	0.2603			t	1,2
20	44.7	"	0.2554	"			t	30
20.0	45.20	"	0.2595	"			r	61
20	45.41	"	0.2612	"	1.203	1.293	r	69
20	45.5	"	0.2619	"			r	65
20	45.28	"	0.2817	"			P,r	41
20	48.0	"	0.2817	"			a	62
20.5	45.6	45.33	0.2626	0.2605			P,r	48,51
21.2	45.47	45.40	0.2593	0.2611			r	39
24.15	45.47	45.68	0.2616	0.2633	1.2962	1.2951	r	45
24.6	45.89	45.72	0.2649	0.2636			r	39
25	44.90	45.76	0.2572	0.2639			a	19
25	44.90	"	0.2572	"			a	72
25	45.18	"	0.2594	"			a	33
25	45.37	"	0.2609	"			t	34
25	45.4	"	0.2611	"			r	55
25.00	45.40	"	0.2611	"			r	71
25.0	45.5	"	0.2619	"			r	56
25	45.50	"	0.2619	"			r	70
25	45.62	"	0.2628	"	1.202	1.295	r	64
25	45.65	"	0.2630	"			r	48
25.0	45.70	"	0.2634	"			r	61
25.0	45.77	"	0.2640	"			r	36,38
25	45.79	"	0.2641	"			r	74
25	45.8	"	0.2642	"			r	31
25	45.8	"	0.2642	"			r	51
25	45.8	"	0.2642	"			r	59
25	45.83	"	0.2644	"			r	52
25	45.90	"	0.2650	"			r	41
25	45.94	"	0.2654	"			r	47
25	45.95	"	0.2654	"			r	54
25	45.98	"	0.2656	"			r	40
25.0	46.0	"	0.2658	"			r	51
25	48.5	45.76	0.2858	0.2639			a	62
29.0	46.32	46.15	0.2683	0.2670			r	39

(continued)

COMPONENTS

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

EVALUATOR:

R. Cohen-Adad,

Université Claude Bernard
(Lyon I), Laboratoire de
Physico-chimie Minérale II,
69622 Villeurbanne, France.

April, 1987.

CRITICAL EVALUATION (continued)

Table 3 (continued)
Solubility of LiCl in aqueous solutions (solid phase $LiCl.H_2O$)

T/K - 273.15	mass % 100w_1		mole fraction x_1		density g cm^{-3}		status	ref.
	exp.	calc.	exp.	calc.	exp.	calc.		
30	45.48	46.25	0.2617	0.2678			t	54
30	45.9	"	0.2650	"			r	30
30.0	46.24	46.25	0.2677	0.2678			r	61
30.0	46.1	"	0.2664	"			r	48,51
30.0	46.2	"	0.2674	"			r	48,51
30	46.21	"	0.2674	"	1.28	1.298	r	69
34.5	46.67	46.72	0.2711	0.2714			r	39
35	46.97	46.77	0.2735	0.2719			r	70
35.05	46.70	46.77	0.2713	0.2719			r	61
40.0	47.14		0.2748	0.2762			r	61
40	47.98	"	0.2810	"			r	54
40.05	47.09	47.31	0.2744	0.2762	1.3034	1.3033	r	45
40.5	47	47.36	0.2767	0.2766			r	30
40.5	47.27	"	0.2759	"			r	33,41
41.0	47.47	47.42	0.2775	0.2771			r	39
47.0	48.23	48.11	0.2836	0.2827			r	39
50	47.69	48.48	0.2799	0.2855			t	74
50	48.18	"	0.2832	"			r	41
50	48.3	"	0.2841	"			r	65
50	48.7	"	0.2876	"			r	30
50.0	48.31	"	0.2843	"			r	61
50	49.06	"	0.2904	"			r	58
50.20	48.23	48.50	0.2836	0.2858	1.3080	1.3094	r	45
60.0	49.76	49.79	0.2962	0.2964			r	61
61.6	50.05	50.01	0.2986	0.2983			r	39
64.95	50.26	50.50	0.3004	0.3024	1.3173	1.3200	r	45
65	51.0	50.50	0.3068	0.3025			r	1,2
65	51.0	"	0.3067	"			r	30
70	51.04	51.27	0.3070	0.3090			r	41
70	51.2	"	0.3084	"			r	48,51
71.5	51.61	51.51	0.3119	0.3110			r	50
72.0	51.71	51.59	0.3127	0.3117			r	39
75	52.18	52.10	0.3186	0.3161			r	58
75	52.53	"	0.3203	"			r	74
80	52.88	52.98	0.3229	0.3238			r	41
80	52.71	"	0.3214	"			r	40
80	53.47	"	0.3281	"			r	1,2
80	53.5	"	0.3284	"			t	30
80.85	52.94	53.14	0.3234	0.3252	1.3372	1.3346	r	45
81.6	53.37	53.28	0.3272	0.3264			r	39
81.60	53.37	53.28	0.3272	0.3264			r	50
86.6	54.60	54.27	0.3382	0.3352			r	39
87.0	54.46	54.35	0.3370	0.3359			r	50
88.0	54.54	54.56	0.3377	0.3378			r	39
89.55	54.82	54.89	0.3402	0.3408	1.3418	1.3445	r	45
90	54.21	54.99	0.3447	0.3417			r	41
92.0	55.27	55.44	0.3443	0.3458			r	50
94.6	55.84	56.04	0.3495	0.3514			r	50
95	56.5	56.14	0.3557	0.3523			r	1
95.3	56.01	56.21	0.3511	0.3530			r	50
95.5	55.99	56.26	0.3509	0.3534			r	50
96	56.3	56.38	0.3527	0.3546			r	30

(continued)

COMPONENTS	EVALUATOR:
(1) Lithium chloride; LiCl; [7447-41-8] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987.

CRITICAL EVALUATION (continued)

Table 3 (continued)
Solubility of LiCl in aqueous solutions (solid phase $LiCl.H_2O$)

T/K - 273.15	mass % $100w_1$ exp.	calc.	mole fraction x_1 exp.	calc.	density g cm^{-3} exp.	calc.	status	ref.
96.2	56.57	56.43	0.3563	0.3550			m	50
97.1	56.60	56.66	0.3566	0.3571			m	50
98	56.7	56.89	0.3575	0.3593			P,r	62
98.2	57.55	56.94	0.3655	0.3598			a,m	50
100.5	56.5	57.56	0.3557	0.3656			P,a	30,35

r = recommended value $e < 0.008$ P = peritectic point
t = tentative value $0.008 < e < 0.01$ m = metastable equilibrium
a = aberrant value $e > 0.01$ e = $\Delta w/w$(calc)

3.3 Solubility Branch for $LiCl\cdot 2H_2O$ [16712-19-9]

These experimental results are more scattered than those for the solubility of the monohydrate. Of sixty data in the bibliography, eight have not been taken into account in the initial calculation of the coefficients. These correspond to the measurements carried out by Akopov (62), Hüttig and his collaborators (30, 35, 36a), Voskresenskaya and Yanat'eva (51) and Kremers (1).

The calculation of the liquidus curve was carried out with four adjustable coefficients taking as density differences $\rho = \tau = 0.011$. Eight points, corresponding to the greatest differences, were not taken into account in the final calculation of the coefficients (Table 4).

Recommended Values:

The recommended values correspond to the differences $e = \Delta w/w$(calc) smaller than 1 per cent. Those between 1 and 2 per cent are classed as tentative values; outside this range the numerical values are rejected.

The most precise measurements are those of Friend and Colley (39), of Kessis (61) and of Schimmel (59).

Table 4
Solubility of LiCl in aqueous solutions (solid phase $LiCl\cdot 2H_2O$)

T/K - 273.15	mass % $100w_1$ exp.	calc.	mole fraction x_1 exp.	calc.	density exp.	calc.	status	ref.
-35.5	35.77	38.89	0.1914	0.1922			r	36a
-25.2	37.3	37.17	0.2019	0.2009			r	59
-20.5	37.80	37.72	0.2052	0.2048			P,r	61
-20	37.0	"	0.1997	"			P,a	35
-20	36.9	"	0.1990	"			a	36a
-19.05	37.95	37.88	0.2063	0.2058			r	61
-19.0	38.0	37.89	0.2067	0.2059			P,r	59
-18.0	38.5	38.01	0.2101	0.2057			P,r	62
-15.6	37.2	38.29	0.2011	0.2037			P,a	51

(continued)

COMPONENTS	EVALUATOR:
(1) Lithium chloride; LiCl; [7447-41-8] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987.

CRITICAL EVALUATION (continued)

Table 4 (continued)
Solubility of LiCl in aqueous solutions (solid phase $LiCl\cdot 2H_2O$)

T/K - 273.15	mass % $100w_1$ exp.	calc.	mole fraction x_1 exp.	calc.	density g cm^{-3} exp.	calc.	status	ref.
-15.0	38.3	38.36	0.2087	0.2092			r	59
-12.0	38.6	38.74	0.2108	0.2118			r	59
-11.7	38.32	38.77	0.2089	0.2121			a	36a
-10.0	39.08	38.99	0.2142	0.2136			r	61
-8.5	38.9	39.19	0.2129	0.2150			r	59
-5.3	39.25	39.64	0.2154	0.2132			r	36a
0	38.8	40.47	0.2122	0.2241			a	48,51
0	38.9	"	0.2129	"			a	48,51
0	38.9	"	0.2129	"			a	30
0	38.9	"	0.2130	"			a	1,2
0	40.20	"	0.2222	"			r	61
0	40.51	"	0.2244	"			r	41
0	40.85	"	0.2269	"			r	39
0	40.85	"	0.2269	"			r	75
0	40.89	"	0.2272	"			r	58
0	41.47	"	0.2314	"			a	41
0	42.2	"	0.2368	"			a	62
1.05	40.90	40.65	0.2273	0.2255	1.2678	1.2681	r	45
3.0	41.2	41.00	0.2294	0.2280			r	59
3.0	41.0	41.00	0.2280	0.2280			r	56
4.8	40	41.35	0.2208	0.2305			a	48,51
6.0	41.1	41.60	0.2287	0.2324			r	56
8.0	42.38	42.02	0.2381	0.2355			r	39
8.5	42.7	42.14	0.2405	0.2364			r	56
10	41.9	42.49	0.2356	0.2390			t	30
10.0	42.14	"	0.2364	"			r	61
10	45.85	"	0.2646	"			a	58
10	46.5	"	0.2697	"			a	62
10.05	42.71	42.50	0.2406	0.2391	1.2789	1.2786	r	45
10.2	42.75	42.54	0.2409	0.2393			r	39
12.1	43.2	43.03	0.2443	0.2430			r	59
12.5	40.5	43.14	0.2244	0.2438			P,a	35
13.0	43.32	43.27	0.2452	0.2448			r	39
13.3	43.07	43.36	0.2433	0.2455			r	41
13.8	43.50	43.50	0.2465	0.2465			r	39
14.0	43	43.56	0.2428	0.2470			t	48,51
14.2	43.86	43.62	0.2493	0.2474			r	48,51
14.2	43.86	"	0.2493	"			r	39
15.0	43.30	43.86	0.2450	0.2493	1.2827	1.2865	r	3
15.0	43.77	"	0.2486	"			r	61
15.70	44.06	44.08	0.2508	0.2509	1.2875	1.2876	r	45
16.2	44.60	44.24	0.2549	0.2522			r	39
16.4	44.23	44.31	0.2521	0.2527			r	39
17.5	44.48	44.69	0.2540	0.2556			r	41
17.5	44.61	"	0.2550	"			r	41
18.25	44.86	44.96	0.2569	0.2577	1.2926	1.2928	r	45
18.5	45.0	45.05	0.2580	0.2584			P,r	62
19.0	45.2	45.25	0.2595	0.2599			P,r	59
19.4	45.15	45.40	0.2592	0.2611			P,r	61
20	45.28	45.65	0.2602	0.2630			P,t	41
20.5	45.6	46.17	0.2627	0.2671			P,t	48,51

r = recommended value $e \leqslant 0.008$
t = tentative value $0.008 < e \leqslant 0.01$
a = aberrant value $e > 0.01$

P = peritectic point
m = metastable equilibrium
e = $\Delta w/w$(calc)

(continued)

COMPONENTS	EVALUATOR:
(1) Lithium chloride; LiCl; [7447-41-8]	R. Cohen-Adad,
(2) Water; H_2O; [7732-18-5]	Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France.
	April, 1987.

CRITICAL EVALUATION (continued)

3.4 Solubility Branch for $LiCl\cdot 3H_2O$ [38851-62-6]

Of the forty-two experimental points situated on this liquidus branch, five are rejected since they are very distant from the solubility curve traced on a large-scale diagram. These are essentially the results of Akopov (62) and of Voskresenskaya (51), already criticized for other domains of crystallization. The calculation of the liquidus curve was carried out with three adjustable coefficients, taking as relative differences $\rho = \tau = 0.009$. The results are presented in Table 5. Five points, corresponding to the greatest differences, are not taken into account in the calculation of the coefficients and must be considered as tentative values. The most precise and coherent values in this domain are those of Kessis (61) and of Schimmel (59).

Table 5

Solubility of LiCl in aqueous solutions (solid phase $LiCl\cdot 3H_2O$)

$T/K - 273.15$	mass % $100w_1$ exp.	mass % $100w_1$ calc.	mole fraction x_1 exp.	mole fraction x_1 calc.	status	ref.
-68	28.7	28.79	0.1461	0.1466	P,r	35
-67.5	29.2	28.85	0.1491	0.1470	t	59
-67.2	29.3	28.89	0.1497	0.1472	P,t	59
-65.4	29.15	29.10	0.1488	0.1485	P,r	61
-64.5	29.25	29.21	0.1494	0.1492	r	61
-64.5	31.2	"	0.1616	"	P,a	62
-61	29.52	29.65	0.1511	0.1512	r	36a
-60.0	30.0	29.78	0.1541	0.1527	r	59
-60.0	29.78	"	0.1527	"	r	61
-57.0	30.4	30.18	0.1566	0.1552	P,r	48,51
-55.0	30.48	30.45	0.1571	0.1569	r	61
-54.5	30.6	30.52	0.1578	0.1573	r	59
-54.0	30.5	30.59	0.1572	0.1578	r	48,51
-51.0	30.8	31.03	0.1591	0.1605	r	59
-50.6	30.90	31.09	0.1597	0.1609	r	36a
-50	31.0	31.18	0.1603	0.1614	r	48,51
-50	31.7	"	0.1647	"	t	76
-50.0	31.21	"	0.1616	0.1614	r	61
-49.5	31.4	31.25	0.1628	0.1619	r	59
-48.0	30.8	31.48	0.1591	0.1634	a	48,51
-45.0	32.03	31.96	0.1668	0.1664	r	61
-42.2	32.14	32.43	0.1675	0.1694	r	36a
-41.2	32.66	32.60	0.1709	0.1705	r	61
-41.0	32.45	32.64	0.1695	0.1707	r	59
-36.0	33.5	33.56	0.1763	0.1768	r	59
-35.1	34.00	33.74	0.1796	0.1779	r	61
-34.5	34.1	33.86	0.1803	0.1787	r	59
-31.0	33.4	34.60	0.1757	0.1834	r	48,51
-30	34.4	34.82	0.1822	0.185	r	48,51
-29.8	35.14	34.87	0.1871	0.1853	r	61
-29.0	35.0	35.05	0.1862	0.1866	r	59
-27.7	34.61	35.36	0.1936	0.1886	a	36a
-27.0	35.5	35.53	0.1896	0.1898	r	59
-26.0	35.8	35.79	0.1916	0.1915	r	59

(continued)

COMPONENTS	EVALUATOR:
(1) Lithium chloride; LiCl; [7447-41-8] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987.

CRITICAL EVALUATION (continued)

Table 5 (continued)
Solubility of LiCl in aqueous solutions (solid phase $LiCl \cdot 3H_2O$)

T/K - 273.15	mass % $100w_1$ exp.	mass % $100w_1$ calc.	mole fraction x_1 exp.	mole fraction x_1 calc.	status	ref.
-25.5	36.15	35.91	0.1939	0.1923	r	59
-25.0	36.21	36.05	0.1943	0.1932	r	61
-23.7	35.85	36.40	0.1919	0.1956	t	36a
-20.5	37.80	37.36	0.2052	0.2022	P,t	61
-20	36.9	37.52	0.1990	0.203	P,t	35
-20.0	37.3	"	0.2018	"	r	59
-19.2	36.4	37.80	0.1956	0.2052	a	48,51
-19.0	38.0	37.87	0.2066	0.2057	P,r	59
-18.0	38.5	38.23	0.2101	0.2082	P,r	62
-15.6	37.2	39.22	0.2011	0.2152	P,a	48,51

r = recommended value $e < 0.01$
t = tentative value $0.01 < e < 0.02$
a = aberrant value $e > 0.02$
P = peritectic point
$e = \Delta w/w$(calc)

3.5 Solubility Branch for $LiCl \cdot 5H_2O$

The results, which are much less numerous and much less reliable than for other areas of crystallization, are very scattered. In particular, one notes a systematic difference of approximately 10 K between the data of Voskresenskaya (51) and those of Schimmel (59) (fig. 1). The most certain numerical data appear to be those for the points of double saturation in salts, as established by Kessis (61) and Vuillard (60), namely:

peritectic point: $LiCl \cdot 5H_2O = LiCl \cdot 3H_2O$ + liq. 207.8 K or -65.4°C
29.15 mass % LiCl

eutectic point: liq. = ice + $LiCl \cdot 5H_2O$ 198.40 K or -74.75°C
25.0 % LiCl

The calculation of the liquidus has been carried out by restricting the solubility curve so that it passes through these two points. The results are presented in Table 6 and in the figure. All the numerical data, experimental or calculated, must be considered as tentative values in this region of solubility.

3.6 Solubility of Ice [7732-18-5]

The numerical values from refs. (8, 9, 11, 16) have not been reported on the compilation sheets. They have, nevertheless, been used for the calculation of the liquidus curve and are presented in Table 7. The best graphic representation of the solubility curve of ice in solutions of LiCl has been obtained with the relations [6, 7] given in the Preface to this volume. The equation used takes solvation of ions into account

(continued)

COMPONENTS	EVALUATOR:
(1) Lithium chloride; LiCl; [7447-41-8] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987.

CRITICAL EVALUATION (continued)

empirically, and contains only two adjustable coefficients, E = 6.651 and F = -11.318. Of the 133 experimental values, one differs more than 50 per cent from the calculated value and is not taken into account in the calculation of the coefficients. Another, distant by approximately 10 per cent, is considered to be a tentative value.

Table 6
Solubility of LiCl in aqueous solutions (solid phase $LiCl{\cdot}5H_2O$)

T/K - 273.15	mass % $100w_1$		mole fraction x_1		status	ref.
	exp.	calc.	exp.	calc.		
-84.0	25.2	22.53	0.1252	0.1100	E,a	59
-80	25.3	23.51	0.1259	0.1155	E,a	35
-78.5	25.9	23.91	0.1293	0.1178	r	59
-75.0	24.8	24.92	0.1229	0.1236	E,a	62
-74.75	25	25.00	0.1241	0.1241	E,r	60
-73.9	26.05	25.28	0.1302	0.1257	a	36a
-73	24.85	25.57	0.1232	0.1274	E,a	53
-73.0	27.2	"	0.1370	0.1274	a	59
-70.0	28.2	26.69	0.1416	0.1340	a	59
-70	27.57	"	0.1332	0.1340	a	36a
-68	28.7	27.58	0.1452	0.1393	P,a	35
-67.2	29.3	28.00	0.1497	0.1418	P,a	59
-67.0	29.5	28.11	0.1510	0.1425	m,a	59
-67.0	24.0	"	0.1180	0.1425	E,a	68
-66	24.4	28.70	0.1206	0.1462	E,a	48,51
-66	30.90	"	0.1597	"	m,a	36a
-65.4	29.15	29.15	0.1488	0.1488	P,r	61
-65.0	30.8	29.47	0.1591	0.1508	m,a	59
-64.5	31.2	29.98	0.1616	0.1540	P,a	62
-63	26.4	-	0.1323	-	a	48,51
-60.4	28.2	-	0.1430	-	a	48,51
-58.0	29.6	-	0.1516	-	a	48,51
-57.0	30.4	-	0.1566	-	P,a	48,51

r = recommended value   E = eutectic point
t = tentative value $0.01 < e < 0.02$ P = peritectic point
a = aberrant values $e > 0.02$ m = metastable equilibrium

Table 7
Solubility of ice in aqueous solutions of LiCl

T/K - 273.15	mass % $100w_1$		mole fraction x_1		status	ref.
	exp.	calc.	exp.	calc.		
-0.0030	0.00345	-	0.000015	-		42
-0.0036	0.00424	-	0.000018	-		42
-0.0050	0.00588	-	0.000025	-		42
-0.0069	0.00801	-	0.000034	-		42
-0.0121	0.01420	-	0.000060	-		42
-0.0135	0.01571	-	0.0000668	-		42
-0.0216	0.02535	0.02872	0.000108	0.000122	t	42
-0.0388	0.04580	0.04308	0.000195	0.000183	t	42
-0.0508	0.060	0.05743	0.000254	0.000244	r	66
-0.0611	0.07249	0.07179	0.000308	0.000305	r	42

(continued)

COMPONENTS	EVALUATOR:
(1) Lithium chloride; LiCl; [7447-41-8]	R. Cohen-Adad,
(2) Water; H_2O; [7732-18-5]	Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France.
	April, 1987.

CRITICAL EVALUATION (continued)

Table 7 (continued)
Solubility of ice in aqueous solutions of LiCl

T/K - 273.15	mass % $100w_1$ exp.	mass % $100w_1$ calc.	mole fraction x_1 exp.	mole fraction x_1 calc.	status	ref.
-0.0909	0.1060	0.1041	0.0004507	0.000443	r	11
-0.1024	0.12207	0.1166	0.0005091	0.0004959	r	42
-0.1050	0.125	0.1202	0.0005310	0.0005117	r	66
-0.1352	0.1596	0.1543	0.0006788	0.0006485	r	11
-0.1483	0.17743	0.1686	0.0007548	0.0007172	t	42
-0.159	0.1925	0.1802	0.0008189	0.0007668	r	8
-0.1794	0.2137	0.2035	0.0009092	0.0008659	r	11
-0.2134	0.256	0.2411	0.001090	0.001026	t	66
-0.2192	0.26350	0.2474	0.001122	0.001053	t	42
-0.240	0.2537	0.2707	0.001080	0.001152	t	9
-0.2648	0.3153	0.2993	0.001342	0.001274	r	11
-0.2925	0.35195	0.3297	0.001499	0.001404	t	42
-0.3138	0.378	0.3592	0.001608	0.001530	t	66
-0.3431	0.4109	0.3860	0.001750	0.001644	r	11
-0.363	0.419	0.4081	0.00178	0.00174	r	4a
-0.3786	0.45604	0.4254	0.001943	0.001812	t	42
-0.381	0.451	0.4280	0.00192	0.001823	r	14
-0.4302	0.519	0.4825	0.002213	0.002056	t	66
-0.440	0.5061	0.4932	0.002157	0.002102	r	9
-0.4663	0.56137	0.5222	0.002393	0.002226	t	42
-0.5232	0.6352	0.5842	0.002709	0.002491	r	11
-0.5355	0.64459	0.5980	0.002750	0.002550	t	42
-0.5847	0.704	0.6517	0.003002	0.002780	t	66
-0.606	0.698	0.6751	0.002960	0.002880	r	4a
-0.6660	0.79905	0.7401	0.003411	0.003159	t	42
-0.701	0.836	0.7782	0.00358	0.003322	r	14
-0.7093	0.8565	0.7871	0.003658	0.003360	r	11
-0.7098	0.851	0.7875	0.003636	0.003362	t	66
-0.7892	0.94398	0.8731	0.004034	0.003729	t	42
-0.862	1.0072	0.9510	0.004305	0.004064	r	9
-0.867	1.0379	0.9566	0.004437	0.004087	r	8
-0.8879	1.0669	0.9788	0.004562	0.004183	r	11
-0.8997	1.0737	0.9914	0.004591	0.004237	t	42
-1.019	1.167	1.118	0.004937	0.004782	r	4a
-1.0333	1.227	1.133	0.005243	0.004847	t	42
-1.0377	1.2302	1.138	0.005265	0.004867	r	11
-1.1071	1.311	1.208	0.005615	0.005181	t	66
-1.4271	1.672	1.543	0.007176	0.006615	t	66
-1.177	1.4002	1.284	0.005998	0.005497	r	16
-1.2395	1.4625	1.349	0.006268	0.005777	t	42
-1.4051	1.6499	1.520	0.007079	0.006517	t	42
-1.439	1.679	1.555	0.007205	0.006668	r	14
-1.529	1.7905	1.647	0.007688	0.007066	t	16
-1.5559	1.8150	1.674	0.007795	0.007185	t	42
-1.729	1.945	1.850	0.008211	0.007945	r	4a
-1.7394	2.013	1.860	0.008655	0.007988	t	66
-1.7634	2.0423	1.884	0.008782	0.008092	t	42

(continued)

COMPONENTS

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

EVALUATOR:

R. Cohen-Adad,

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April, 1987.

CRITICAL EVALUATION (continued)

Table 7 (continued)
Solubility of ice in aqueous solutions of LiCl

T/K - 273.15	mass % $100w_1$ exp.	mass % $100w_1$ calc.	mole fraction x_1 exp.	mole fraction x_1 calc.	status	ref.
-1.853	2.1309	1.973	0.009168	0.008482	r	8
-1.9549	2.2465	2.074	0.009672	0.008922	t	42
-2.005	2.3108	2.124	0.009952	0.009139	r	16
-2.1771	2.4826	2.292	0.010703	0.009872	t	42
-2.216	2.511	2.330	0.010827	0.01004	r	14
-2.242	2.4401	2.356	0.010517	0.01015	r	9
-2.3016	2.606	2.413	0.011245	0.01040	t	66
-2.4	4	2.508	0.0174	0.01081	a	51
-2.4310	2.7457	2.538	0.011856	0.01094	t	42
-2.7692	3.0851	2.858	0.013348	0.01235	t	42
-2.945	3.2559	3.022	0.014100	0.01307	r	8
-3.053	3.3665	3.121	0.014588	0.01351	r	16
-3.0618	3.3714	3.129	0.014611	0.01354	t	42
-3.120	3.402	3.183	0.01475	0.01378	r	14
-3.4354	3.7286	3.468	0.016192	0.01504	t	42
-3.4643	3.752	3.494	0.01630	0.01515	t	66
-3.790	4.0625	3.783	0.017677	0.01643	r	16
-3.8212	4.0863	3.810	0.017783	0.01655	t	42
-3.849	4.085	3.834	0.01777	0.01666	r	14
-4.0100	4.254	3.974	0.018532	0.01728	t	66
-4.3144	4.5312	4.235	0.019771	0.01845	t	42
-4.699	4.832	4.558	0.02112	0.01989	r	14
-4.799	4.7640	4.640	0.020815	0.02026	r	9
-4.8798	5.0163	4.707	0.021951	0.02055	t	42
-5.0875	5.181	4.876	0.022694	0.02132	t	66
-5.11	5.19	4.894	0.022757	0.02140	r	24
-6.0055	5.927	5.600	0.026076	0.02459	t	66
-6.0655	5.7986	5.646	0.025491	0.02480	r	67
-6.5450	6.3519	6.008	0.02802	0.02645	r	67
-7.5752	7.0896	6.754	0.03141	0.02986	r	67
-8.5932	7.8157	7.453	0.03478	0.03309	r	67
-9.0	8	7.721	0.0356	0.03434	r	51
-9.0134	8.070	7.730	0.035964	0.03438	r	66
-9.8933	8.627	8.293	0.038574	0.03700	r	66
-10.8	9.87	8.848	0.0445	0.03961	t	36a
-11.8020	9.5825	9.434	0.04310	0.04239	r	67
-11.8729	9.781	9.474	0.044042	0.04258	r	66
-12.22	9.65	9.671	0.043414	0.04351	r	24
-14.9302	11.283	11.10	0.05127	0.05040	r	67
-15	13.05	11.14	0.05996	0.05057	a	76
-15.4496	11.617	11.36	0.052903	0.05164	r	66
-18.75	13.0	12.87	0.0597	0.05905	r	59
-18.75	13.07	12.87	0.06005	0.05905	r	24
-18.7540	13.071	12.87	0.060064	0.05906	r	66
-20.9583	13.942	13.78	0.064429	0.06359	r	66
-21.5387	14.174	14.00	0.065563	0.06473	r	66
-22.5	14.93	14.37	0.0694	0.06657	r	36a
-23.0	14.0	14.56	0.0647	0.06751	r	51

(continued)

COMPONENTS

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

EVALUATOR:

R. Cohen-Adad,

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69622 Villeurbanne, France.

April, 1987.

CRITICAL EVALUATION (continued)

Table 7 (continued)
Solubility of ice in aqueous solutions of LiCl

T/K - 273.15	mass % $100w_1$ exp.	calc.	mole fraction x_1 exp.	calc.	status	ref.
-24	16.08	14.92	0.0753	0.06935	a	76
-25.44	15.67	15.42	0.0732	0.07191	r	24
-27	17.01	15.94	0.0801	0.07456	a	76
-34	18.35	17.98	0.0872	0.08524	a	76
-36.0	18.0	18.50	0.0853	0.08796	r	51
-38	19.36	18.99	0.0926	0.09056	a	76
-39.0	18.8	19.22	0.0896	0.09182	r	59
-43.4	19.86	20.18	0.0953	0.09704	r	36a
-44	20.73	20.73	0.1000	0.09771	r	76
-48.5	21.2	21.18	0.1026	0.1025	r	59
-50.0	21.0	21.46	0.1015	0.1040	r	51
-53	22.46	21.97	0.1096	0.1069	r	76
-55.0	22.2	22.30	0.1081	0.1087	r	59
-57.2	22.23	22.65	0.1083	0.1106	r	36a
-58	22.5	22.77	0.1098	0.1113	r	36a
-62	23.35	23.35	0.1146	0.1146	r	76
-62	24.0	23.35	0.1183	0.1146	r	51
-63.6	23.21	23.57	0.1138	0.1158	r	36a
-64.0	23.6	23.62	0.1160	0.1161	r	59
-65.0	23.8	23.75	0.1172	0.1169	r	59
-66	24.4	23.88	0.1206	0.1176	E,r	51
-67	23.95	24.01	0.1180	0.1184	E,r	71
-67.0	24.0	"	0.1183	"	E,t	68
-68.0	24.2	24.13	0.1195	0.1191	r	59
-68	24.22	24.13	0.1196	0.1191	r	76
-69.2	24.2	24.28	0.1195	0.1199	r	36a
-70	25.18	24.38	0.1251	0.1251	r	76
-73	24.85	24.72	0.1232	0.1225	E,r	56
-74.75	25	25.05	0.1241	0.1244	E,r	60
-75.0	24.8	24.94	0.1229	0.1238	E,r	65
-75.7	25.2	25.01	0.1252	0.1242	r	36a
-80	25.3	25.46	0.1259	0.1268	E,r	35
-84.0	25.2	25.84	0.1252	0.1290	E,r	59
-90	26.17	26.44	0.1309	0.1325	m	76
-91	26.34	26.52	0.1319	0.1330	m	76
-94	26.49	26.76	0.1328	0.1344	m	76
-99.0	26.64	27.14	0.1337	0.1366	m	76
-118.4	26.94	28.29	0.1355	0.1436	m	76
-123.6	27.20	28.53	0.1370	0.1451	m	76
-125.4	27.36	28.61	0.1380	0.1455	m	76
-126	27.61	28.64	0.1395	0.1457	m	76

r = recommended value $e \leq 0.05$
t = tentative value $0.1 < e \leq 0.5$
a = aberrant value $e > 0.5$

E = eutectic point
$e = \Delta w/w$(calc)

(continued)

COMPONENTS	EVALUATOR:
(1) Lithium chloride; LiCl; [7447-41-8] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987.

CRITICAL EVALUATION (continued)

3.7 Points of Double Saturation

The bibliographical data are very scattered. They are collected in Table 8. The best values are those of Applebey *et al.* (44,45), Kessis (61), Moran (57) and Vuillard (60).

Table 8

Saturation in two solids in the system LiCl - H_2O

Solid phases	T/K - 273.15	mass % LiCl	status	ref.
Peritectic point LiCl + LiCl·H_2O	93.5 ± 0.5		r	45
	93.51 ± 0.03		r	44
	94.0		r	57
	96 - 98		a	5
	98	56.7	a	69
	100.5	56.5	a	30, 35, 36a
Peritectic point LiCl·H_2O + LiCl·$2H_2O$	12.5	40.5	a	30, 35, 36a
	18.5	45.0	a	62
	19.0 ± 0.1		r	57
	19.0 ±0.25	45.2	r	59
	19.07 ± 0.02		r	73
	19.10 ± 0.25		r	45
	19.10		r	43
	19.4 ± 0.1	45.15 ± 0.07	r	61
	20	45.28	t	41
	20.5	45.6	a	48, 51
	21.5		a	5
Peritectic point LiCl·$2H_2O$ + LiCl·$3H_2O$	-20.5 ± 0.1	37.80 ±0.07	r	61
	-20.5 ± 0.1		r	57
	-20	36.9	a	35, 36a
	-19.0 ± 0.25	38.0	a	59
	-18.0	38.5	a	62
	-17, -18		a	5
	-16.5		a	30
	-15.6	37.2	a	48,51
Peritectic point LiCl.$3H_2O$ + LiCl.$5H_2O$	-68	28.7	a	35, 36a
	-67.2 ± 0.5	29.3	a	59
	-65.6 ± 0.1		r	57
	-65.4 ± 0.1	29.15 ± 0.07	r	61
	-64.5	31.2	a	62
	-62, -64		a	76
	-57.0	30.4	a	48,51
Eutectic point LiCl.$5H_2O$ + ice	-84.0	25.2	a	59
	-80	25.3	a	35, 36a
	-75.0	24.8	r	62
	-74.75 ± 0.3	25.0	r	60
	-73, -74		a	76
	-73	24.85	a	53
	-67.0	24.0	a	68
	-66	24.4	a	48,51

r - recommended values a - aberrant values

(continued)

COMPONENTS	EVALUATOR:
(1) Lithium chloride; LiCl; [7447-41-8] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987.

CRITICAL EVALUATION (continued)

3.8 Densities of Saturated Solutions

The relative densities of saturated solutions were measured between 378 and 428.8 K (105 and 155.6°C) by Applebey, Crawford, and Gordon (recommended values) (45). Other measurements at more closely-spaced temperatures were carried out by Belayev (64) and by Skortskov (69) in the area of crystallization of the monohydrate. Skortskov's values are very different from those of the other authors, seem aberrant, and are not taken into account in the calculation of an analytical expression for the density. Generally, the density of the saturated solution can be represented in each area of crystallization by an equation in the form: $d = a + bx_1$, where d is the density relative to the density of water at 277 K. Values of the coefficients are as follows:

a	b	solid phase
1.5171	-0.481	LiCl
1.12710	0.6380	$LiCl \cdot H_2O$
1.0949	0.7681	$LiCl \cdot 2H_2O$

The experimental values are presented on the compilation sheets. The calculated values are given in Table 10 where the solubilities and densities are tabulated at rounded temperatures.

3.9 Vapor Pressures of Saturated Solutions

The experimental data are collected in Table 9. At low temperatures, the measurements by Ueda (43) and by Applebey *et al.* (45) can be recommended, while those of Hüttig and Reuscher (30) are not very precise because of insufficient sensitivity of their measuring device. The results of Ravich and Yastrebova (63) at high pressure are not precise because of experimental difficulties.

The vapor pressure can be calculated starting from the following empirical equations:

$$p/\text{mmHg} = 11.969 - 3289\ \text{K}/T \qquad (257 < T/\text{K} < 293)$$

$$p/\text{mmHg} = 7.969 - 3302\ \text{K}/T + 0.014\ T/\text{K} \qquad (293 < T/\text{K} < 363)$$

$$p/\text{MPa} = p_0(1 - x_1 - y_1 - 2y_2 - 3y_3)/(1 + x_1 - y_1 - 2y_2 - 3y_3)$$

where T and x_1 are the coordinates of the points of the solubility curve, and the other terms are defined as:

$$p_0 = (512.2 - T/\text{K})(1/373 - \text{K}/T)$$

$$y_1 = 0.72\ x_1(1 - x_1)/(1 + x_1)$$

$$y_2 = 0.45\ x_1(1 - x_1)^2/(1 + x_1)^2$$

$$y_3 = 2.6\ x_1(1 - x_1)^3/(1 + x_1)^3$$

(continued)

COMPONENTS	EVALUATOR:
(1) Lithium chloride; LiCl; [7447-41-8] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987.

CRITICAL EVALUATION (continued)

Table 9

Experimental vapor pressures of saturated solutions of LiCl in water

T/K - 273.15	100w_1 exp.	p/MPa	p/mmHg	solid phase	status	ref.
-16.5			0.8	$LiCl\cdot 2H_2O$	a	30
-15			0.8	"	a	30
-10			0.8	"	a	30
-5			0.8	"	a	30
0	38.9		0.8	"	a	30
5			0.8	"	a	30
10	41.9		1.0	"	a	30
12.5			2	$LiCl\cdot 2H_2O + LiCl\cdot H_2O$*	a	30
15			2.0	$LiCl\cdot H_2O$*	a	30
15			1.75	$LiCl\cdot 2H_2O$	r	43
16			1.83	"	r	
17			1.90	"	r	43
18			1.96	"	r	43
19			2.07	"	r	43
20	44.7		2.2	$LiCl\cdot H_2O$	r	30
20			2.21	"	r	43
22.5			2.54	"	r	43
25			2.6	"	r	30
25			2.91	"	r	43
27.5			3.29	"	r	43
30	45.9		3.6	"	r	30
30			3.71	"	r	43
35	47		4.6	"	r	30
40.5			6.2	"	r	30
45			7.4	"	r	30
50	48.7		10.2	"	r	30
51			10.0	"	r	30
55			12.4	"	r	30
58.5			13.8	$LiCl\cdot H_2O$	r	30
60.45			14.9	"	r	45
61.35			15.9	"	r	45
70.00			26.6	"	r	45
70.45			26.2	"	r	45
80.15			37.9	"	r	45
85.15			46.0	"	r	45
90.10			51.2	"	r	45
91.0			53.5	"	r	45
95.25			62.2	LiCl	r	45
99.95			80.0	"	r	45
100.30			78.3	"	r	45
100.5			90	$LiCl\cdot H_2O$ + LiCl	a	30
109.75			115.6	LiCl	r	45
119.85			173.9	"	r	45
130.20			242.7	"	r	45
140.05			334.4	"	r	45
150.15			446.3	"	r	45
160.30			615.4	"	r	45
170.2			799.0	"	r	45
180.2			1035.8	"	r	45

(continued)

COMPONENTS

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

EVALUATOR:

R. Cohen-Adad,

Université Claude Bernard
(Lyon I), Laboratoire de
Physico-chimie Minérale II,
69622 Villeurbanne, France.

April, 1987.

CRITICAL EVALUATION (continued)

Table 9 (continued)

Experimental vapor pressures of saturated solutions of LiCl in water

T/K - 273.15	$100w_1$ exp.	p/MPa	p/mmHg	solid phase	status	ref.
250	62.7	0.60		LiCl	t	63
250	63.3	0.62		"	t	63
300	66.3	1.23		"	t	63
350	70.3	2.4		"	t	63
350	70.4	2.30		"	t	63
400	75.3	3.3		"	t	63
400	76	3.38		"	t	63
450	81.3	≈ 4.07		"	t	63
450	81.5	≈ 4.19		"	t	63
450		≈ 4.07-4.19		"	t	63
455		≈ 4.17		"	t	63
475		≈ 4.4		"	t	63
479		≈ 4.46		"	t	63
500	86.7	≈ 4.3		"	t	63
525		≈ 4.17		"	t	63
556	93.5	≈ 3.29		"	t	63

3.10 Boiling Temperature at Atmospheric Pressure

Kremers (1) indicates 444 K (171°C). The best value seems to be that of Applebey, Crawford, and Gordon (45) at 441.8 K (168.6°C).

SOLUBILITY, VAPOR PRESSURE AND DENSITY FOR ROUNDED VALUES OF TEMPERATURE

These are summarized in Table 10 and by the plot.

Table 10

Solubility of LiCl in water at rounded temperatures

T/K - 273.15	mass % $100w_1$	mole fraction x_1	molality /mol kg^{-1}	rel. dens.	p/mmHg	solid phase	
0	0	0	0			ice	
-5	4.805	0.02101	1.191			"	
-10	8.359	0.03732	2.152			"	
-15	11.14	0.05058	2.957			"	
-20	13.39	0.06165	3.647			"	
-25	15.27	0.07114	4.251			"	
-30	16.87	0.07937	4.786			"	
-35	18.24	0.08661	5.264			"	
-40	19.45	0.09305	5.695			"	
-45	20.51	0.09881	6.086			"	
-50	21.46	0.1040	6.443			"	
-55	22.30	0.1087	6.770			"	
-60	23.06	0.1130	7.071			"	
-65	23.75	0.1169	7.348			"	
-70	24.38	0.1205	7.603			"	
-75	24.94	0.1238	7.840			"	
-80	25.46	0.1268	8.058			"	m
-85	25.94	0.1295	8.260			"	m

(continued)

COMPONENTS	EVALUATOR:
(1) Lithium chloride; LiCl; [7447-41-8] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987.

CRITICAL EVALUATION (continued)

Table 10 (continued)
Solubility of LiCl in water at rounded temperatures

T/K - 273.15	mass % $100w_1$	mole fraction x_1	molality /mol kg^{-1}	rel. dens.	p/mmHg	solid phase	
-90	26.37	0.1321	8.447			ice	m
-82	23.01	0.1127	7.050			$LiCl\cdot5H_2O$	
-78	24.05	0.1186	7.471			"	m
-74	25.25	0.1255	7.968			"	
-70	26.70	0.1340	8.591			"	
-66	28.73	0.1463	9.511			"	
-60	29.77	0.1527	10.00			$LiCl\cdot3H_2O$	
-50	31.17	0.1614	10.68			"	
-40	32.81	0.1719	11.52			"	
-30	34.82	0.1850	12.60			"	
-20	37.51	0.2033	14.16			"	
-10	38.97	0.2135	15.04	1.256	0.59	$LiCl\cdot2H_2O$	
0	40.45	0.2240	16.00	1.265	0.93	"	
10	42.46	0.2388	17.37	1.277	1.42	"	
20	45.29	0.2602	19.53	1.293	2.21	$LiCl\cdot H_2O$	
30	46.25	0.2678	20.30	1.298	3.69	"	
40	47.30	0.2761	21.18	1.303	6.01	"	
50	48.47	0.2856	22.19	1.309	9.57	"	
60	49.78	0.2964	23.38	1.316	14.95	"	
70	51.27	0.3089	24.81	1.324	22.95	"	
80	52.98	0.3237	26.57	1.334	34.64	"	
90	54.98	0.3417	28.81	1.345	51.53	"	
					p/MPa		
100	56.34	0.3541	30.44	1.346	0.018	LiCl	
125	57.19	0.3622	31.52	1.342	0.039	"	
150	58.23	0.3720	32.88	1.337	0.078	"	
175	59.43	0.3836	34.55	1.331	0.145	"	
200	60.77	0.3970	36.54	1.325	0.249	"	
225	62.25	0.4120	38.90			LiCl	
250	63.86	0.4289	41.68			"	
275	65.59	0.4476	44.97			"	
300	67.45	0.4684	48.87			"	
325	69.42	0.4910	53.54		1.6	"	
350	71.50	0.5160	59.18		2.13	"	
375	73.70	0.5436	66.10		2.64	"	
400	76.01	0.5739	74.75		3.17	"	
425	78.44	0.6072	85.81		3.67	"	
450	80.98	0.6440	100.4		4.08	"	
475	83.65	0.6849	120.5		4.35	"	
500	86.40	0.7297	149.8		4.39	"	
525	89.30	0.7801	196.5		4.14	"	
550	92.31	0.8360	282.2		3.49	"	
575	95.43	0.8987	490.0		2.38	"	
600	98.67	0.9692	-		0.78	"	
610	100	1	-		-	"	

m = metastable point.
Compositions above 225°C = 498 K are tentative.
Pressures above 125°C = 398 K are tentative.

(continued)

COMPONENTS	EVALUATOR:
(1) Lithium chloride; LiCl; [7447-41-8] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987.

CRITICAL EVALUATION (continued)

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(continued)

COMPONENTS	EVALUATOR:
(1) Lithium chloride; LiCl; [7447-41-8] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987.

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COMPONENTS	EVALUATOR:
(1) Lithium chloride; LiCl; [7447-41-8] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987.

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(continued)

COMPONENTS	EVALUATOR:
(1) Lithium chloride; LiCl; [7447-41-8] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987.

CRITICAL EVALUATION (continued)

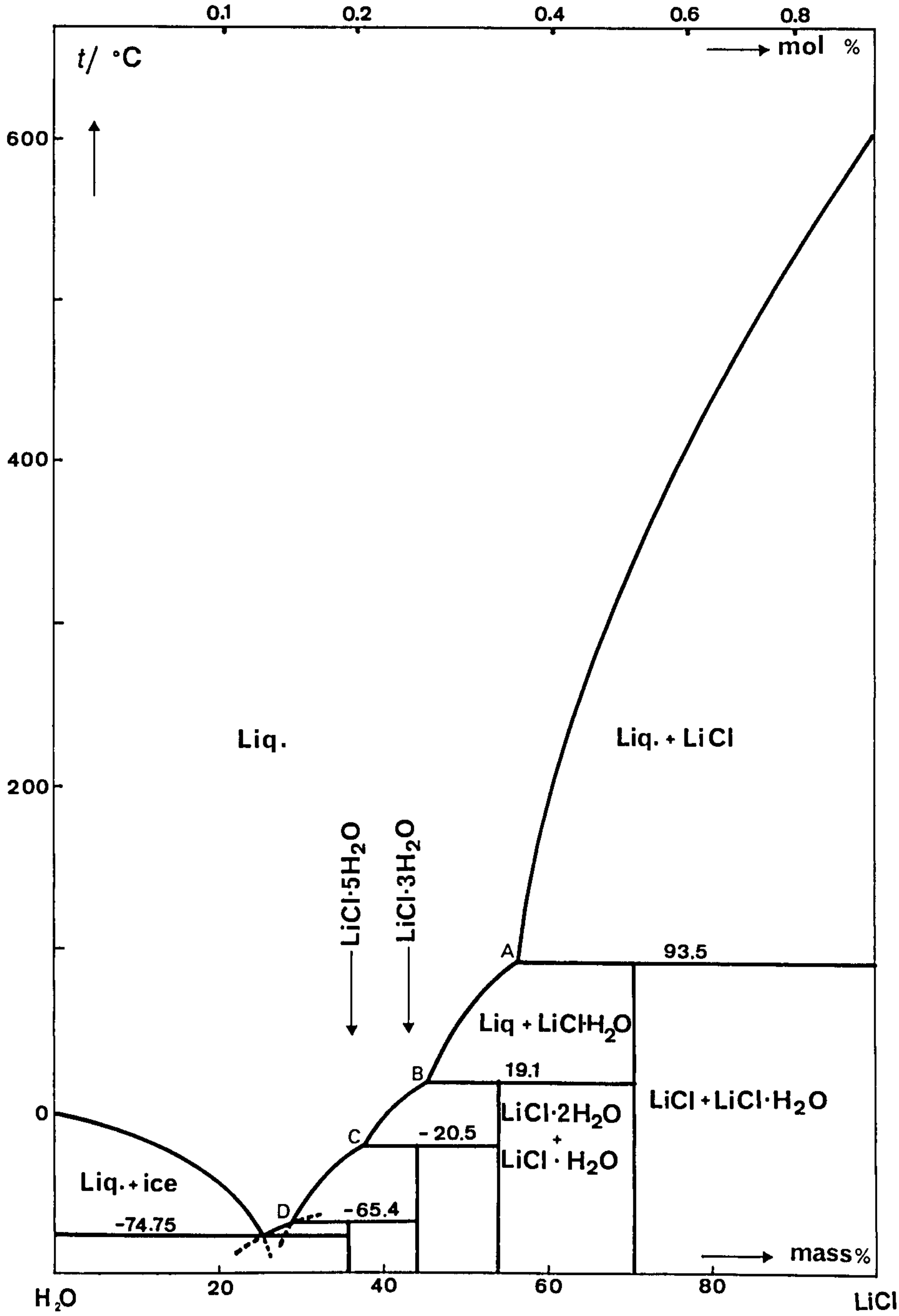

Fig. 1. Temperature-composition phase diagram for the binary system $LiCl-H_2O$ under the vapor pressure of the saturated solution.

(continued)

COMPONENTS	EVALUATOR:
(1) Lithium chloride; LiCl; [7447-41-8] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987.

CRITICAL EVALUATION (continued)

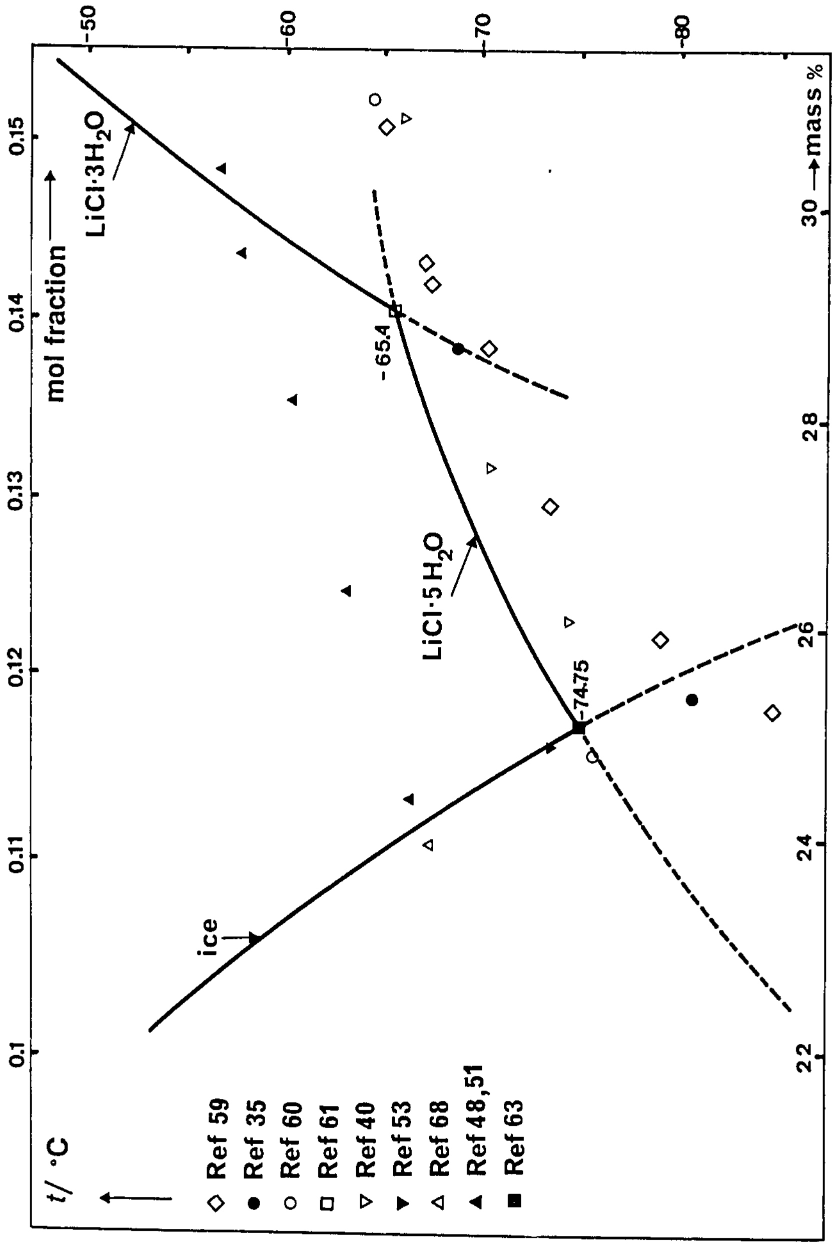

Fig. 2. Temperature-composition phase diagram for the binary system $LiCl-H_2O$ at p = 1 bar in the vicinity of the eutectic.

COMPONENTS:

(1) Lithium chloride; LiCl;
[7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kremers, P.

Ann. Phys. Chem. 1856, *99*, 25-63;
Ann. Phys. Chem. 1858, *103*, 57-8.

VARIABLES:

$T/K = 273-444$

PREPARED BY:

M. Ferriol

EXPERIMENTAL DATA:

t/°C	mass ratio $H_2O/LiCl$	100 mass H_2O /mol $LiCl^a$	mass % (compiler)	solid phase (compiler)
0	1.57	0.66	38.9	$LiCl\cdot 2H_2O$
20	1.24	0.52	44.7	$LiCl\cdot H_2O$
40		0.46	47.7	"
60		0.41	50.0	"
65	0.96		51.0	"
80	0.87	0.36	53.5	"
95	0.77		56.5	LiCl
96	0.78	0.31	56.2	"
100			58.3	"
140	0.72		58.1	"
160	0.69		59.2	"
171				$LiCl^b$

---

[a] Atomic weights Li = 6.5, Cl = 35.5 according to author.
[b] boiling point of saturated solution

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

After complete dissolution at a higher temperature, the mixture was stirred for 1 h at the desired temperature. The solution was then drawn off, but was not filtered because of its high viscosity.

The composition was determined at 95, 140 and 160°C by evaporation and weighing. At 20 and 65°C, LiCl was transformed into Li_2SO_4, which was weighed after filtration and calcination.

SOURCE AND PURITY OF MATERIALS:

LiCl was prepared from a hot solution of lithium carbonate and hydrochloric acid.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Lithium Chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Gerlach, Th. G. *Spezifische Gewichte der gebrauchlichsten Salzlosungen bei Verschiedenen Concentrationsgraden.* J.G. Engelhardt. Freiberg. 1859. pp. 1-7, 10.

VARIABLES:

$T/K = 288$

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

$t = 15°C$

mass %	relative density, d_{15}^{15}
10	1.0580
20	1.1172
30	1.1819
40	1.2557
satd sln	1.2827 solid phase: $LiCl\cdot 2H_2O$ (compiler)

The author found the solubility from graphical extrapolation. The compiler found that the density could be represented by the equation $(d_{15}^{15} - 1)/100w_1 = A_1 + A_2(100w_1) + A_3(100w_1)^2$ where w_1 is the mass fraction of the salt, with least-square coefficients:

$A_1 = 5.87 \times 10^{-3}$ $s(A_1) = 6.2 \times 10^{-6}$
$A_2 = -1.40 \times 10^{-5}$ $s(A_2) = 5.7 \times 10^{-7}$
$A_3 = 6.75 \times 10^{-7}$ $s(A_3) = 1.1 \times 10^{-8}$

and overall estimated std dev. 2.2×10^{-6}. Solution of this equation gave the solubility as: 43.30 mass %.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solutions were made up by mass, using calibrated weights and vacuum corrections. Densities were measured by hydrostatic weighing, using a glass sinker attached to a balance. The method of saturation is not given.

SOURCE AND PURITY OF MATERIALS:

Completely dried or lightly ignited LiCl was used.

ESTIMATED ERROR:

Temperature: precision ±0.1 K.
Solubility: no estimates possible.

REFERENCES:

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Arrhenius, S.

Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1888, *2*, 491-505; *K. Sven. Vetenskapsakad. Hand., Bihang* 1888, *14(1)*, no. 9, 1-24.

VARIABLES:

$T/K = 271-273$

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	g/100 cm^3 water	mass % (compiler)[a]	solid phase
-0.363	0.419	0.418	ice
-0.606	0.698	0.694	ice
-1.019	1.167	1.154	ice
-1.729	1.945	1.911	ice

---

[a] Calculated using densities of water from (1).

COMMENTS: It appears that solutions were made using anhydrous LiCl (compiler).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

A double-walled freezing point apparatus was used, with a thermometer that could be read to 0.002 K. The apparatus was filled with solution, then cooled to about 0.1 K below the f.p. with a mixture of salt, water and ice at about 2 K below the f.p. Addition of an ice crystal caused a rise in temperature, which attained a constant value for several minutes. This value was taken to be the freezing point. The concentration of the solution was determined by titration.

SOURCE AND PURITY OF MATERIALS:

The salts were "chosen by Prof. van't Hoff with special consideration as to their purity".

ESTIMATED ERROR:

Precision in f.p. within ±0.005 K above -2°C, 0.005-0.1 K below -2°C.

REFERENCES:

1. *International Critical Tables.* McGraw-Hill. New York. 1928. Vol. III, p. 26.

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Bogorodskij, A.Ya.

Zh. Russ. Fiz.-Khim. O-va, <u>1893</u>, *25*, 316-42.

VARIABLES:

T/K = 256 - 271

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mass %	solid phases
-17 to -18	44.04	peritectic $LiCl\cdot 2H_2O^a \longrightarrow LiCl\cdot 3H_2O$
21.5	47.98	peritectic $LiCl\cdot H_2O \longrightarrow LiCl\cdot 2H_2O$
96 to 98	17.7	peritectic $LiCl \longrightarrow LiCl\cdot H_2O$

---

[a] Composition 8.69 mass % Li, 45 mass % Cl; theoretical for $LiCl\cdot 2H_2O$, 8.85 mass % Li, 45.21 mass % Cl (compiler).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

No details given; presumably the isothermal saturation method was used. Analyses: gravimetric, for Cl as AgCl; for Li as Li_2SO_4.

SOURCE AND PURITY OF MATERIALS:

LiCl: (a) from commercial Li_2CO_3 by dissolving in HCl + NH_3, then precipitating with $(NH_4)_2CO_3$, washing with water; (b) from pure Li_2CO_3 by dissolving in pure HCl and recrystallizing on a water bath. Purity checked spectroscopically.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Lithium chloride; LiCl; [7447-41-8] (2) Water; H_2O; [7732-18-5]	Rivett, A.C.D. *K. Sven. Vetenskapsakad. Medd., Nobel-inst.* <u>1911</u>, *2*(9), 1-32.
VARIABLES:	PREPARED BY:
T/K = 268-273	M. Ferriol

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
-0.381	0.451	ice
-0.701	0.836	"
-1.439	1.679	"
-2.216	2.511	"
-3.120	3.402	"
-3.849	4.085	"
-4.699	4.832	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The mixture was supercooled in a bath 4 K below the freezing point until a large quantity of ice separated out, which was thawed until only a very small amount remained. The solution was placed in an air jacket and stirred until the temperature was stationary. Supercooling for 0.01-0.02 K was allowed and hand stirring continued until the temperature rose to its maximum.

SOURCE AND PURITY OF MATERIALS:

Salt from Kemista Fabriken Ion.

ESTIMATED ERROR

Temperature (mean of five readings): ± 0.003 K.

REFERENCES:

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Piña de Rubies, S.

An. Soc. Esp. Fis. Quim. 1913, *11*, 422-435; *An. Soc. Esp. Fis. Quim.* 1914, *12*, 343-349; *Arch. Sci. Phys. Nat. Ser. 4* 1914, *38*, 414-422 (same data in all papers)

VARIABLES:

T/K = 298

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mass %	mole fraction (compiler)	solid phase
25	44.90	0.2572	$LiCl \cdot H_2O$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothermal saturation method was used, with samples in sealed flasks in a thermostat. Equilibrium was reached in 5 h, then shaking was continued for another 5 h. Samples filtered at the temperature of the thermostat were analyzed for Cl by Mohr titration.

SOURCE AND PURITY OF MATERIALS:

LiCl: Merck; "pure" by analysis, no residue on volatilization. desiccator. Dried at 250°C, stored in a desiccator.

ESTIMATED ERROR:

Temperature: precision ±0.05 K.

Solubility: No estimates possible.

REFERENCES:

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Rodebush, W.H.

J. Am. Chem. Soc. 1918, 40, 1204-13.

VARIABLES:

$T/K = 248-268$

PREPARED BY:

M. Ferriol

EXPERIMENTAL VALUES:

t/°C	100x mass ratio LiCl/H_2O	mass % (compiler)	solid phase
- 5.11	5.48	5.19	ice
-12.22	10.68	9.65	"
-18.75	15.04	13.07	"
-25.44	18.58	15.67	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The method consisted of a direct measurement of the freezing-point lowerings by means of a Cu-constantan thermocouple connected to a potentiometer. The saturation point was taken as the point where the temperature stopped falling and began to rise slowly. The composition of the saturated solution was determined by conductivity measurements. The reference temperature for the thermocouple was maintained to within ±0.001 K.

SOURCE AND PURITY OF MATERIALS:

Commercial LiCl was recrystallized, and checked for purity by determining the salt-ice eutectic before and after recrystallization.

ESTIMATED ERROR:

Temperature: precision ±0.01 to ±0.02 K.

REFERENCES:

COMPONENTS:

(1) Lithium chloride; $LiCl$; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Hüttig, G.F.; Reuscher, F.

Z. *Anorg. Allg. Chem.* 1924, *137*, 155-80.

VARIABLES:

$T/K = 257-433$
p = vapor pressure of solution

PREPARED BY:

M. Ferriol

EXPERIMENTAL VALUES:

t/°C	100x mass ratio $LiCl/H_2O$	mass % (compiler)	vapor pressure p/mmHg	solid phase
-16.5			0.8	$LiCl\cdot3H_2O + LiCl\cdot2H_2O$
0	63.7	38.9	0.8	$LiCl\cdot2H_2O$
10	72	41.9	1.0	"
12.5			2	$LiCl\cdot2H_2O + LiCl\cdot H_2O$
20	80.7	44.7	2.2	$LiCl\cdot H_2O$
30	85	45.9	3.6	"
40.5	90	47	6.2	"
50	95	48.7	10.2	"
65	104.2	51.0		"
80	115	53.5		"
96	129	56.3		"
100.5	130	56.5	90	$LiCl\cdot H_2O + LiCl$
140	139	58.2		$LiCl$
160	145	59.2		"

The solid phases are in equilibrium with saturated solution and vapor.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The method is described in other publications (1, 2).

SOURCE AND PURITY OF MATERIALS:

Very pure Kahlbaum lithium chloride hydrate was used, whose purity was found to be at least 99.2% by analysis for Cl (as $AgCl$) and Li (as Li_2SO_4).

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Hüttig, G.F.; Reuscher, F. Z. *Anorg. Allg. Chem.* 1920, *114*, 162; 1922, *121*, 245; 1922, *122*, 46; 1922, *124*, 326; 1923, *126*, 168.
2. Zsigmondy, R. *Kolloidchemie*, 4th ed., Leipzig, 1922, pp. 110 ff.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Lithium chloride; LiCl; [7447-41-8] (2) Water; H_2O; [7732-18-5]	Smits, A.; Elgersma, J.; Hardenberg, M.E. *Recl. Trav. Chim. Pays-Bas* 1924, *43*, 671-6.
VARIABLES:	PREPARED BY:
$T/K = 298$	M. Ferriol

EXPERIMENTAL VALUES:

$t/°C$	mass %	solid phase (compiler)
25	45.8	$LiCl \cdot H_2O$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The authors investigated the ternary system $LiCl-NaCl-H_2O$ at 25°C. Saturated solutions were prepared in an apparatus described by Meyer (1), filtered, and in the case of binary mixtures, analyzed by evaporation of water.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Meyer, G. *Recl. Trav. Chim. Pays-Bas* 1923, *42*, 301.

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Benrath, H.

Z. Anorg. Allg. Chem. 1927, *163*, 396-404; 1932, *205*, 417-24.

VARIABLES:

T/K = 273-373

PREPARED BY:

M. Ferriol; J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase	remarks
0	41.47	$LiCl\cdot 2H_2O$	
0	40.51	"	
13.3	43.07	"	
17.5	44.48	"	
17.5	44.61	"	
20	45.28	$LiCl\cdot 2H_2O$ + $LiCl\cdot H_2O$	peritectic point
25	45.18[a]	$LiCl\cdot H_2O$	
25	45.90	"	
40.5	47.27	"	
50	48.18	"	
70	51.04	"	
80	52.88	"	
90	54.21	"	
99.5	55.84	LiCl	

---

[a] Original data from 1927 paper: mol H_2O/mol Li_2Cl_2 = 5.71.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method (compiler).

SOURCE AND PURITY OF MATERIALS:

Analysis of $LiCl\cdot 2H_2O$ crystals isolated at 17.5°C: 52.68, 52.05, 52.73 mass% Li; calc. 54.05 mass%.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Deacon, G.E.R.

J. Chem. Soc. 1927, 2063-5.

VARIABLES:

T/K = 298

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	g/kg H_2O	mass % (compiler)	solid phase
25	83.05	45.37	$LiCl\cdot H_2O$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothermal saturation method was used. Chloride was determined gravimetrically as AgCl.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

Temperature: procision probably within ±0.1 K (compiler).

Solubility: No estimates possible.

REFERENCES:

COMPONENTS:

(1) Lithium chloride; LiCl;
[7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Hüttig, G.F.; Steudemann, W.
Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1927, *126*, 105-17; Steudemann, W. *Die thermische Analyse der Systeme des Wassers mit den Alkalihalogeniden.* Jena. 1927.

VARIABLES:

T/K = 193-374

PREPARED BY:

M. Ferriol

EXPERIMENTAL VALUES:

t/°C	100X mass ratio LiCl/H_2O	mass %	solid phase	remarks
-10.8 t0 -11		9.87	ice	
-22.5		14.93	"	
-43.4		19.86	"	
-57.2		22.23	"	
-58		22.5	"	
-63.6		23.21	"	
-69.2		24.20	"	
-75.7		25.20	"	
-80	33.9	25.3[a]	ice + $LiCl\cdot 5H_2O$	eutectic point
-73.9		26.05	$LiCl\cdot 5H_2O$	
-70		27.57	"	
-66		30.90	"	metastable point
-68	40.3	28.7[a]	$LiCl\cdot 5H_2O$ + $LiCl\cdot 3H_2O$	peritectic point
-61		29.52	$LiCl\cdot 3H_2O$	
-50.6		30.90	"	
-42.2		32.14	"	
-27.7		34.61	"	
-23.7		35.85	"	
-20	58.4	58.4[a]	$LiCl\cdot 3H_2O$ + $LiCl\cdot 2H_2O$	peritectic point
-35.5		35.77	$LiCl\cdot 2H_2O$	metastable point
-20 (about)		37.0	"	
-11.7		38.32	"	
-5.3		39.25	"	
12.5	68	40.5[a]	$LiCl\cdot 2H_2O$ + $LiCl\cdot H_2O$	peritectic point
100.5	130	56.5[a]	$LiCl\cdot H_2O$ + LiCl	peritectic point

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[a] Huttig and Steudemann, from intersections of solubility curves; all data are given by Steudemann.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Measurements were performed by thermal analysis in a tight apparatus fitted with a rotating stirrer. On account of small thermal effects, a check by visual observation was necessary.

To avoid supersaturation, crystallization was induced by seeding with a crystal.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

Temperature: ±1 K

REFERENCES:

COMPONENTS:

(1) Lithium chloride; $LiCl$; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Palitzsch, S.

Z. *Phys. Chem., Abt. A* 1928, *138*, 379-98; *Studier over Oplosnigers Overfladespaending*. Habilitation Thesis. Levin & Munksgaards Forlag. Copenhagen 1927.

VARIABLES:

$T/K = 298$

PREPARED BY:

R. Tenu; J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	molality mol kg^{-1}	mass %	relative density d_4^{25}	solid phase
25	19.91	45.77	1.29699	$LiCl \cdot H_2O$

COMMENTS AND ADDITIONAL DATA: Solubilities were measured in connection with studies of surface tensions. The experimental molalities and densities are given on pp. 386-95 of the paper. In the Thesis, the primary data are mass of solution and titer of 0.1 mol dm^{-3} $AgNO_3$. The compiler has calculated molalities and mass fractions from these data, which differ in the last figure from the values given by the author. The primary data follow.

mass of sln/g	titer/cm^3	molality/mol kg^{-1}	mass %
0.5132	55.41	19.91	45.77
0.4901	52.92	19.91	45.77

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solution and solid were rotated in sealed flasks in a thermostat. After saturation, which was continued up to 15 h, the mixture was filtered through cotton wool. Cl was determined by titration with $AgNO_3$. densities were measured by pycnometer.

SOURCE AND PURITY OF MATERIALS:

$LiCl$ (Kahlbaum or Merck) was recrystallized and checked by analysis. Chloride was determined volumetrically. Water was redistilled over alkaline permanganate.

ESTIMATED ERROR:

Temperature: precision to 0.02 K.
Solubility: precision within 0.05 mass %, from data in thesis.
Density: precision 1-10 x 10^{-5}.

REFERENCES:

COMPONENTS:

(1) Lithium chloride; $LiCl$; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Friend, J.A.N.; Colley, A.T.W.

J. Chem. Soc. 1931, 3148-9.

VARIABLES:

T/K = 273-361

PREPARED BY:

M. Ferriol

EXPERIMENTAL VALUES:

t/°C	mass % LiCl	solid phases
0	40.85	$LiCl\cdot 2H_2O$
8.0	42.38	"
10.2	42.75	."
13.0	43.32	"
13.8	43.50	"
14.2	43.86	"
16.2	44.60	"
16.4	44.23	"
18.0	45.31	$LiCl\cdot H_2O$
19.0	45.22	"
21.2	45.47	"
24.6	45.89	"
29.0	46.32	"
34.5	46.67	"
41.0	47.47	"
47.0	48.23	"
61.6	50.05	"
72.0	51.71	"
81.6	53.37	"
86.6	54.60	"
88.0	54.54	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Saturated solutions at various temperatures were prepared in an apparatus described previously in (1). The mixture was stirred vigorously for a few hours and the solution taken off by means of a filtering pipet. A weighed quantity of the filtered solution was evaporated and dried in an electric oven at 150-180°C and then heated with a gas flame to ensure complete removal of water. The residue was weighed, and the composition was deduced.

SOURCE AND PURITY OF MATERIALS:

LiCl, prepared by dissolution of pure carbonate in dilute acid, was recrystallized twice. Analysis for Cl gave differences between found and calc. LiCl within 0.2%.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Friend, J.A.N. *J. Chem. Soc.* 1930, 1633.

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Bassett, H.; Sanderson, I.

J. Chem. Soc. 1932, 1855-64.

VARIABLES:

T/K = 273-353

PREPARED BY:

M. Ferriol

EXPERIMENTAL VALUES:

t/°C	mass % LiCl	solid phase
0	40.87	$LiCl\cdot 2H_2O$
25	45.85	$LiCl\cdot H_2O$
	45.98[a]	"
40	47.47	"
80	52.71	"

---

[a] Analysis by evaporation, conversion to sulfate, and weighing. Other analyses by gravimetric AgCl method.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The mixtures were prepared in hard-glass bottles closed by corks. The solid was dissolved by heating and the mixtures were allowed to crystallize at the experimental temperature. The bottles were frequently shaken by hand. Equilibrium was attained quickly and the saturated solutions were filtered in a jacketed filter tube.

The composition of the saturated solutions was determined gravimetrically as AgCl or by evaporation followed by conversion to sulfate and weighing.

SOURCE AND PURITY OF MATERIALS:

Anhydrous LiCl was used.

ESTIMATED ERROR:

Solubility: precision within ±0.2 mass%.

REFERENCES:

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Scatchard, G.; Prentiss, S.S.

J. Am. Chem. Soc. 1933, 55, 4355-62.

VARIABLES:

$T/\mathrm{K} \approx 268-273$

PREPARED BY:

M. Ferriol

EXPERIMENTAL VALUES:

t/°C	molality /mol kg^{-1}	mass %	solid phase
-0.0030	0.000815	0.00345	ice
-0.0036	0.001000	0.00424	ice
-0.0050	0.001388	0.00588	ice
-0.0069	0.001889	0.00801	ice
-0.0121	0.003350	0.01420	ice
-0.0135	0.003706	0.01571	ice
-0.0216	0.005982	0.02535	ice
-0.0388	0.010810	0.04580	ice
-0.0611	0.017113	0.07249	ice
-0.1024	0.028830	0.12207	ice
-0.1483	0.041929	0.17743	ice
-0.2192	0.062321	0.26350	ice
-0.2925	0.083317	0.35195	ice
-0.3786	0.10807	0.45604	ice
-0.4663	0.13317	0.56137	ice
-0.5355	0.15304	0.64459	ice
-0.6660	0.19001	0.79905	ice
-0.7892	0.22480	0.94398	ice
-0.8997	0.25602	1.0737	ice
-1.0333	0.29320	1.2277	ice
-1.2395	0.35012	1.4625	ice
-1.4051	0.39572	1.6499	ice
-1.5559	0.43607	1.8150	ice
-1.7634	0.49181	2.0423	ice
-1.9549	0.54212	2.2465	ice
-2.1771	0.60053	2.4826	ice
-2.4310	0.66599	2.7457	ice
-2.7692	0.75093	3.0851	ice
-3.0618	0.82305	3.3714	ice
-3.4354	0.91361	3.7286	ice
-3.8212	1.0050	4.0863	ice
-4.3144	1.1196	4.5312	ice
-4.8798	1.2458	5.0163	ice

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Freezing points were measured by "equilibrium method" and concs. were determined by conductivity, as in (1,2). Nitrogen was precooled and saturated in an ice-water mixture, then bubbled through the solution to stir it.

REFERENCES:

1. Scatchard, G.; Prentiss, S.S.; Jones, P.T. *J. Am. Chem. Soc.* 1932, 54, 2690.
2. Scatchard, G.; Prentiss, S.S. *J. Am. Chem. Soc.* 1932, 54, 2696.

SOURCE AND PURITY OF MATERIALS:

LiCl (C.P.) in aq. sln. was pptd. by ammonium carbonate satd. with ammonia. The ppt. was diss. in HCl and again pptd. as above. This ppt. was washed, dried at 270°C, and fused. A stock sln. was made by titrating an HCl sln. of the ppt. to pH 6.6 and boiling to expel CO_2. Its conc. was detd. by evaporation and conversion to Li_2SO_4.

ESTIMATED ERROR:

Temperature: precision $\pm 3 \times 10^{-5}$ K for slns. more dilute than 0.01 *M*.

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Applebey, M.P.; Crawford, F.H.; Gordon, K.

J. Chem. Soc. 1934, 1665-71.

VARIABLES:

T/K = 274-429

PREPARED BY:

M. Ferriol

EXPERIMENTAL VALUES:

t/°C	mass % LiCl	d_4^t	solid phase	remarks
1.05	40.90	1.2678	$LiCl\cdot 2H_2O$	
10.05	42.71	1.2789	"	
15.70	44.06	1.2875	"	
18.25	44.86	1.2926	"	
19.10 ±0.25			$LiCl\cdot 2H_2O$ + $LiCl\cdot H_2O$	peritectic point
24.15	45.47	1.2962	$LiCl\cdot H_2O$	
40.05	47.09	1.3034	"	
50.20	48.23	1.3080	"	
64.95	50.26	1.3173	"	
80.85	52.94	1.3372	"	
89.55	54.82	1.3418	"	
93.5 ±0.5			$LiCl.H_2O$ + LiCl	peritectic point
95.15	55.83	1.3471	LiCl	
100.2	56.3	1.347	"	
120.2	56.9	1.344	"	
140.3	57.6	1.339	"	
155.6	58.3	1.338	"	

d_4^t = density relative to water at 4°C.

Vapor pressures of saturated solutions

t/°C	p/mmHg	t/°C	p/mmHg	t/°C	p/mmHg	t/°C	p/mmHg
60.45	14.9	85.15	46.0	99.95	80.0	150.15	446.3
61.35	15.9	90.10	51.2	109.75	115.6	160.30	615.4
70.00	26.6	91.00	53.5	119.85	173.9	170.20	799.0
70.45	26.2	95.25	62.2	130.20	242.7	180.20	1035.8
80.15	37.9	100.30	78.3	140.05	334.4		

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Densities and solubilities were determined in pipets specially designed for this work as described previously (1). The salt and solution were stirred together for periods varying from 12 to 24 h before the pipet was introduced with a glass wool filter attached. After a further four hours' stirring the solid was allowed to settle and the pipet was filled. After weighing, the saturated solution was analyzed for chloride by titration with silver nitrate. Three determinations of solubility were made at each temperature.

SOURCE AND PURITY OF MATERIALS:

LiCl from Kalhbaum and Harrington was used as the monohydrate after three recrystallizations.

ESTIMATED ERROR:

Solubility: precision ±0.05 mass %
Density: precision ±0.0005

REFERENCES:

1. Farrow, M. *J. Chem. Soc.* 1926, 49.

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water, H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Lannung, A.

Z. Phys. Chem., Abt. A 1934, *170*, 134-44.

VARIABLES:

$T/K = 291$
$p/kPa = 1.4$

PREPARED BY:

J.J. Counioux

EXPERIMENTAL VALUES:

$t/°C$	$p/mmHg$	molality $m_1/mol\ kg^{-1}$	mass %	solid phase
18	1.71	19.55	45.32	$LiCl \cdot H_2O$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The vapor pressure of the solution was plotted against the concentration. The solubility was deduced from the break in this curve.

SOURCE AND PURITY OF MATERIALS:

The purity of the salt has been described in a previous paper (1).

ESTIMATED ERROR:

Temperature: precision ±0.003 K
Pressure: ±7 Pa

REFERENCES:

1. Lannung, A. *Z. Phys. Chem., Abt. A* 1932, *161*, 255.

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Simmons, J.P.; Freimuth, H.; Russell, H.

J. Am. Chem. Soc. 1936, *58*, 1692-1695.

VARIABLES:

$T/K = 623, 673$

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

$t/°C$	molality $m_1/mol\ kg^{-1}$ (compiler)	mass %	solid phase
25	20.05	45.94	$LiCl.H_2O$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Salt and water were equilibrated in solubility tubes at const. temp. Cl was determined by Mohr titration of weighed aliquots of solution. Solid phase compositions were detd. by initial complex modification of the wet residue method (1).

SOURCE AND PURITY OF MATERIALS:

LiCl: 3x recryst. hydrate treated with abs. ethanol, filtered to remove LiOH, filtrate evap. to dryness, giving 99.90% pure salt.

ESTIMATED ERROR:

Temperature: precision ±0.02 K.

REFERENCES:

1. Hill, A.E.; Ricci, J.E. *J. Am. Chem. Soc.* 1931, *53*, 4305.

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Voskresenskaya, N.K.; Yanat'eva, O.K.

Izv. Akad. Nauk. SSSR, Otd. Mat. Estestv. Nauk, Ser. Khim. 1937, 97-121; *Izv. Sekt. Fiz.-Khim. Anal., Inst. Neorg. Khim., Akad. Nauk SSSR* 1936, 9, 291-3.

VARIABLES:

T/K = 242-271

PREPARED BY:

M. Ferriol

EXPERIMENTAL VALUES:

t/°C	mass % LiCl	solid phases
-2.4	4	ice
9.0	8	"
-23.0	14.0	"
36.0	18.0	"
50.0	21.0	"
62	24.0	"
-66	24.4	ice + $LiCl\cdot5H_2O$
-63	26.4	$LiCl\cdot5H_2O$
-60.4	28.2	"
-58.0	29.6	"
-57.0	30.4	$LiCl\cdot5H_2O$ + $LiCl\cdot3H_2O$
-54.0	30.5	$LiCl\cdot3H_2O$
-50	31.0	"
-48.0	30.8	"
-30	34.4	"
-31.0	33.4	"
-19.2	36.4	"
-15.6	37.2	$LiCl\cdot3H_2O$ + $LiCl\cdot2H_2O$
0	38.8	$LiCl\cdot2H_2O$
0	38.9	"
4.8	40	"
14.0	43	"
14.2	43.86	"
20.5	45.6	$LiCl\cdot2H_2O$ + $LiCl\cdot H_2O$
25	45.65[a]	$LiCl\cdot H_2O$
25.0	46.0	"
25.0	45.8	"
30.0	46.2	"
30.0	46.1	"
70	51.2	"
102	56.9	LiCl

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[a] This is the only value reported in the second (and earlier) paper.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The authors investigated the ternary system NH_4Cl-LiCl-H_2O. Mixtures were stirred in a thermostat for 24 h. Saturated solution was removed and analyzed for Cl gravimetrically.

SOURCE AND PURITY OF MATERIALS:

Anhydrous LiCl (Kahlbaum) was recrystallized.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Friend, J.N.; Hale, R.W.; Ryder, S.B.A.

J. Chem. Soc. 1937, 970.

VARIABLES:

T/K = 345-427

PREPARED BY:

M. Ferriol

EXPERIMENTAL VALUES:

t/°C	mass % LiCl	solid phases
71.5	51.61	$LiCl\cdot H_2O$
81.6	53.37	"
87.0	54.46	"
92.0	55.27	"
94.6	55.84	"
95.3	56.01	"
95.5	55.99	"
96.2	56.57[a]	"
97.1	56.60[a]	"
98.2	57.55[a]	"
101.8	56.40	LiCl
107.6	56.52	"
115.4	56.95	"
117.0	57.00	"
123.0	57.28	"
130.5	57.58	"
140.5	57.90	"
143.6	57.98	"
154.0	58.46	"

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[a] metastable points

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Mixtures of anhydrous salt and water were heated in sealed tubes in an oil bath with repeated shaking until the solid phase disappeared, the mean temperature after repeated trials being measured. The concentration of LiCl was determined by evaporation followed by momentary heating to render the salt anhydrous or by titration with silver nitrate solution.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Robinson, R.A.

Trans. Faraday Soc. 1945, 41, 756-8.

VARIABLES:

T/K = 298

PREPARED BY:

M. Ferriol

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase (compiler)
25	45.83	$LiCl \cdot H_2O$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isopiestic method. A saturated solution of LiCl was found to be in equilibrium with 17.822 mol dm^{-3} H_2SO_4 solution.

SOURCE AND PURITY OF MATERIALS:

Lithium chloride was made by neutralization of Eimer and Amend's lithium hydrate ($LiCl \cdot 2H_2O$, compiler) followed by four recrystallizations.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Garrett, A.B.; Woodruff, S.A.

J. Phys. Coll. Chem. 1951, 55, 477-90.

VARIABLES:

T/K = 200

PREPARED BY:

R. Cohen-Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase[a]
-73	24.85	ice + $LiCl \cdot 5H_2O$

[a] compiler

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The test solution was cooled with stirring until copious amounts of crystals formed. The temperature was then raised slowly until the last crystal disappeared. The eutectic point was found by extrapolation of graphical data.

SOURCE AND PURITY OF MATERIALS:

No information available.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Lithium chloride; LiCl; [7447-41-8] (2) Water; H_2O; [7732-18-5]	Blidin, V.P. *Izv. Akad. Nauk. SSSR, Ser. Khim.* 1953, (5), 814-9; *Dokl. Akad. Nauk SSSR* 1953, *88*, 457-9. ,
VARIABLES:	PREPARED BY:
T/K = 298-313	M. Ferriol

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase	
25	45.95	$LiCl.H_2O$	(1st.ref.)
30	45.48	"	(2nd. ref.)
40	47.98	"	(1st. ref.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method.
Saturation was obtained by addition of small quantities of salt. A sample of clear solution was weighed and analyzed. The remaining salt was weighed.

SOURCE AND PURITY OF MATERIALS:

LiCl was prepared by dissolution of Li_2CO_3 in distilled water and precipitation with hydrochloric acid. LiCl was dissolved in alcohol and dried.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Campbell, A.N.; Kartzmark, E.M.

Can. J. Chem. 1956, *34*, 672-78.

VARIABLES:

$T/K = 298$

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mass %	mole fraction (compiler)	solid phase
25	45.4	0.2611	$LiCl\cdot H_2O$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothermal saturation method was used, with samples in sealed flasks in a thermostat. Equilibrium was reached in 5 h, then shaking was continued for another 5 h. Samples filtered at the temperature of the thermostat were analyzed for Cl by Mohr titration.

SOURCE AND PURITY OF MATERIALS:

LiCl: Merck "reagent" or BDH "Analar", with no further purification.

ESTIMATED ERROR:

Temperature: precision ±0.05 K.
Solubility: No estimates possible.

REFERENCES:

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Campbell, A.N.; Griffiths, J.E.

Can. J. Chem. 1956, *34*, 1647-60.

VARIABLES:

$T/K = 276 - 298$

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mass %	mole fraction (compiler)	solid phase
3.0	41.0	0.2280	$LiCl\cdot 2H_2O$
6.0	41.1	0.2287	"
8.5	42.7	0.2405	"
25.0	45.5	0.2619	$LiCl\cdot H_2O$

Thermal analysis gave 12.5 ± 0.1 °C for the transition temperature for

$$LiCl\cdot 2H_2O\ (s) = LiCl\cdot H_2O\ (s) + H_2O\ (l)$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal saturation method was used, with equilibrium approached from both directions. Equilibrium time was 2-3 d up to 10 % LiCl, 5-6 5-6 d at higher mass %. Solids determined by the wet residue method in the system $LiClO_3$-LiCl-H_2O. ClO_3 detd. by iodimetry, Cl by titration with $AgNO_3$ or gravimetrically.

SOURCE AND PURITY OF MATERIALS:

LiCl: no information given.

ESTIMATED ERROR:

Temperature: precision ±0.05 K.
Solubility: analyses for ClO_3, ±0.4 %

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Lithium chloride; LiCl; [7747-41-8] (2) Water; H_2O; [7732-18-5]	Plyushchev, V.E.; Kuznetsova, G.P.; Stepina, S.B. *Zh. Neorg. Khim.* 1959, *4*, 1449-53; **Russ. J. Inorg. Chem. (Engl. Transl.)* 1959, *4*, 652-4.
VARIABLES:	PREPARED BY:
T/K = 273-348	R. Cohen-Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
0	40.89	$LiCl \cdot 2H_2O$
10	45.85	"
50	49.06	$LiCl \cdot H_2O$
75	52.18	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method: equilibrium was reached in 4 d by stirring solid in contact with satd solution. Cl in satd solution was determined as AgCl.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperatures above 0°C: ±0.1 K

REFERENCES:

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Schimmel, F.A.

J. Chem. Eng. Data 1960, 5, 519-20.

VARIABLES:

T/K = 189-292

PREPARED BY:

M. Ferriol

EXPERIMENTAL VALUES:

t/°C	mass % LiCl	solid phase	remarks
0	0	ice	
-18.75	13.0	"	
-39.0	18.8	"	
-48.5	21.2	"	
-55.0	22.2	"	
-64.0	23.6	"	
-65.0	23.8	"	
-68.0	24.2	"	
-84.0	25.2	ice + $LiCl\cdot 5H_2O$	eutectic point[b]
-78.5	25.9	$LiCl\cdot 5H_2O$	
-73.0	27.2	"	
-70.0	28.2	"	
-67.0	29.5[a]	"	
-65.0	30.8[a]	"	
-67.2	29.3	$LiCl\cdot 5H_2O$ + $LiCl\cdot 3H_2O$	peritectic point
-67.5	29.2	$LiCl\cdot 3H_2O$[a]	
-60.0	30.0	"	
-54.5	30.6	"	
-51.0	30.8	"	
-49.5	31.4	"	
-41.0	32.45	"	
-36.0	33.5	"	
-34.5	34.1	"	
-29.0	35.0	"	
-27.0	35.5	"	
-26.0	35.8	"	
-25.5	36.15	"	
-20.0	37.3	"	
-19.0	38.0	$LiCl\cdot 3H_2O$ + $LiCl\cdot 2H_2O$	peritectic point
-25.2	37.3[a]	$LiCl\cdot 2H_2O$	
-15.0	38.3	"	
-12.0	38.6	"	
- 8.5	38.9	"	
3.0	41.2	"	
12.1	43.2	"	
19.0	45.2	$LiCl\cdot 2H_2O$ + $LiCl\cdot H_2O$	peritectic point
25	45.8	$LiCl\cdot H_2O$	

[a] metastable points; [b] eutectic point: see METHOD section.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

A quantity of solution was crystallized quickly by cooling to low temperature. The temperature of the system was then raised slowly (about 1 K per 15 minutes) and the solubility was found by determining the temperature at which the solid phase disappeared. Seeding with the proper hydrates was necessary, because otherwise the entire system turned into a glass-like mass which was not crystallized.
The eutectic temperature was found by thermal analysis and by graphical interpolation of solubility curves.

SOURCE AND PURITY OF MATERIALS:

Commercial product purified by several recrystallizations until free from sulfate and amount of Ca + Ba < 0.001%.

ESTIMATED ERROR:

Temperatures given to a precision ±0.25 K for the medium range and ±0.5 K for the very low range.

REFERENCES:

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Vuillard, G; Kessis, J.J.

Bull. Soc. Chim. Fr. 1960, 2063-7.

VARIABLES:

$T/K = 198$

PREPARED BY:

M. Ferriol

EXPERIMENTAL VALUES:

t/°C	mass % LiCl	solid phase	remark
-74.75	25	ice + $LiCl \cdot 5H_2O$	eutectic point

ADDITIONAL DATA

The following equilibrium temperatures were determined by thermal analysis:

$LiCl \cdot 5H_2O$ + $LiCl \cdot 3H_2O$ + satd sln	-65.4°C	(eutectic)
$LiCl \cdot 3H_2O$ + $LiCl \cdot 2H_2O$ + satd sln	-20.5°C	(peritectic)
$LiCl \cdot 5H_2O$ + satd sln	-62.9°C	(congruent m.p.)

Limiting glass transition temperature (extrapolated to zero mass %) -132.5°C

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The composition of samples was determined by titration or evaporation to dryness.

The stoichiometry of solid phases was deduced from Tammann's diagrams; i.e., from the duration of invariant halts in temperature-time heating curves, or from the areas of triangles constructed on DTA curves (1).

SOURCE AND PURITY OF MATERIALS:

LiCl, Prolabo, was purified by recrystallization of the monohydrate.

ESTIMATED ERROR:

Temperature: precision within ±0.3 K.

REFERENCES:

1. Vuillard, G. *Thèse*, Paris, 1957; *Ann. Chim.* 1957, *2*, 233.

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kessis, J.J.

Bull. Soc. Chim. Fr. 1961, 1503-4.

VARIABLES:

$T/K = 208\text{-}333$

PREPARED BY:

M. Ferriol

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase	method	remarks
-65.4	29.15	$LiCl\cdot 5H_2O + LiCl\cdot 3H_2O$	E	peritectic point
-64.5	29.25	$LiCl\cdot 3H_2O$	S.M.	
-60.0	29.78	"	"	
-55.0	30.48	"	"	
-50.0	31.21	"	"	
-45.0	32.03	"	"	
-41.2	32.66	"	"	
-35.1	34.00	"	"	
-29.8	35.14	"	"	
-25.0	36.21	"	"	
-20.5	37.80	$LiCl\cdot 3H_2O + LiCl\cdot 2H_2O$	E	peritectic point
-19.05	37.95	$LiCl\cdot 2H_2O$	S.M.	
-10.0	39.08	"	"	
0.0	40.20	"	"	
10.0	42.14	"	"	
15.0	43.77	"	"	
19.4	45.15	$LiCl\cdot 2H_2O + LiCl\cdot H_2O$	E	peritectic point
20.0	45.20	$LiCl\cdot H_2O$	S.M.	
25.0	45.70	"	"	
30.0	46.24	"	"	
35.05	46.70	"	"	
40.0	47.14	"	"	
50.0	48.31	"	"	
60.0	49.76	"	"	

S.M. = Solubility measurement
E = Estimated from previously-determined invariant temperatures (1) and solubility curves.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The samples were set into tight test tubes provided with helicoidal glass stirrers and kept in a thermostat. The saturated solution was removed through a filter pipet. The composition was deduced from chloride titration by Mohr's method. Data were the mean of three experiments.

The peritectic points were determined by thermal analysis (1).

SOURCE AND PURITY OF MATERIALS:

"Prolabo"reagent purified by recrystallization of monohydrate.

ESTIMATED ERROR:

Temperature: ±0.1 K
Solubility: highest variation with respect to average: 0.07%

REFERENCES:

1. Vuillard, G.; Kessis, J.J. *Bull. Soc. Chim. Fr.* 1960, 2063.

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Akopov, E.K.

Zh. Neorg. Khim. 1962, 7, 385-9;
**Russ. J. Inorg. Chem. (Engl. Transl.)* 1962, 7, 195-8.

VARIABLES:

$T/K = 198\text{-}371$

PREPARED BY:

M. Ferriol

EXPERIMENTAL VALUES:

$t/°C$	mass %	solid phase	remark
-75.0	24.8	ice + $LiCl \cdot 5H_2O$	eutectic point
-64.5	31.2	$LiCl \cdot 5H_2O$ + $LiCl \cdot 3H_2O$	peritectic point
-18.0	38.5	$LiCl \cdot 3H_2O$ + $LiCl \cdot 2H_2O$	peritectic point
0	42.2	$LiCl \cdot 2H_2O$	
10	46.5	$LiCl \cdot 2H_2O$	
18.5	45.0	$LiCl \cdot 2H_2O$ + $LiCl \cdot H_2O$	peritectic point
20	48.0	$LiCl \cdot H_2O$	
25	48.5	$LiCl \cdot H_2O$	
98	56.7	$LiCl \cdot H_2O$ + LiCl	peritectic point

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Solubility was determined by visual observation of the temperature at which the first crystals appeared on cooling (or the last crystals disappeared on heating). A test tube provided with a glass stirrer and a thermometer was used. The temperature difference between appearance of the first and disappearance of the last crystals was 0.2-0.3 K. The observation was repeated until the interval between these temperatures was a minimum and then the mean of the two values was taken.

SOURCE AND PURITY OF MATERIALS:

"Chemically pure" grade LiCl was twice recrystallized and dehydrated by evaporating a solution to dryness in a flow of HCl. Doubly-distilled water was used.

ESTIMATED ERROR:

Temperature: ±0.2-0.3 K

REFERENCES:

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Ravich, M.I.; Yastrebova, L.F.

Zh. Neorg. Khim. 1963, 8, 202-7;
**Russ. J. Inorg. Chem. (Engl. Transl.)* 1963, 8, 102-5.

VARIABLES:

T/K = 523-829
p = vapor pressure of solution

PREPARED BY:

M. Ferriol

EXPERIMENTAL VALUES:

t/°C	mass % LiCl	vapor pressure kg cm^{-2}	solid phase	apparatus
250	62.7	6.1	LiCl	a
250	63.3	6.3	"	a
300	66.3	12.5	"	a
350	70.3	24	"	b
350	70.4	23.5	"	a
400	75.3	34	"	a
400	76.0	34.5	"	a
450	81.3	41.5	"	a
450	81.5	42	"	b
500	86.7	44	"	a
556	93.5	33.5	"	b

a = rocking autoclave
b = autoclave with stirrer

Vapor pressures above 450°C are approximate because of uncertain errors arising from gas evolution.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The solubility was deduced from pressure vs concentration curves at constant temperature and sometimes from pressure vs temperature curves. Most results were obtained with a rocking autoclave and the others with an autoclave with a stirrer, described previously (1).

SOURCE AND PURITY OF MATERIALS:

Anhydrous LiCl was obtained from twice-recrystallized "chemically pure" grade LiCl by heating samples gradually up to 160°C.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Ravich, M.I.; Borovaya, F.E. *Zh. Neorg. Khim.* 1959, 4, 2100; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1959, 4, 951.

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Belyaev, I.N.; Le T'yuk

Zh. Neorg. Khim. 1966, *11*, 1919-25; *Russ. J. Inorg. Chem.* 1966, *11*, 1025-8.

VARIABLES:

T/K = 298

PREPARED BY:

M. Ferriol

EXPERIMENTAL VALUES:

t/°C	mass %	viscosity mPa s	density g cm^{-3}	electrical conductivity S cm^{-1}	solid phase
25	45.62	10.7280	1.291	0.058	$LiCl{\cdot}H_2O$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The method was described in earlier publications (1,2).

Solubility, electrical conductivity, viscosity and density were determined.

SOURCE AND PURITY OF MATERIALS:

"Analytical reagent" grade lithium chloride was recrystallized twice before use.

ESTIMATED ERROR:

Temperature: ±0.1 K.

REFERENCES:

1. Belyaev, I.N.; Le T'yuk *Zh. Neorg. Khim.* 1965, *10*, 1229; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1965, *10*, 664.
2. Belyaev, I.N.; Le T'yuk. *Zhur. Neorg. Khim.* 1965, *10*, 2355; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1965, *10*, 1279.

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sheveleva, A.D.

Uch. Zap. Permsk. Univ. im. A.M. Gor'kogo 1966, *No. 159*, 3-14.

VARIABLES:

T/K = 293, 323

PREPARED BY:

T. Mioduski

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
20	45.95	$LiCl.H_2O$
50	45.48	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothermal saturation method was used. Equilibrium was checked by constancy of the refractive index. The compositions of saturated solutions were found from inflection points on plots of refractive index vs composition.

SOURCE AND PURITY OF MATERIALS:

$LiCl\cdot H_2O$: pure grade, recrystallized before use; contained 29.8 mass % H_2O (theoretical: 29.82 mass %), presumably found from weight loss on heating.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Lithium chloride; LiCl; [7447-41-8] (2) Water; H_2O; [7732-18-5]	Momicchioli, F.; Devoto, O.; Grandi, G.; Cocco, G. *Atti Soc. Nat. Modena* 1968, *99*, 226-32; *Ber. Bunsen-Ges. Phys. Chem.* 1970, *74*, 59-66.
VARIABLES:	**PREPARED BY:**
T/K = 264-273	R. Cohen-Adad

EXPERIMENTAL VALUES:

t/°C (compiler)	molality /mol kg^{-1}	$\Delta T/m$ /K kg mol^{-1}	mass % (compiler)	solid phase
-0.0508	0.01408	3.608	0.060	ice
-0.1050	0.02949	3.561	0.125	ice
-0.2134	0.06058	3.523	0.256	ice
-0.3138	0.08939	3.512	0.378	ice
-0.4302	0.12309	3.495	0.519	ice
-0.5847	0.16716	3.498	0.704	ice
-0.7098	0.2025_8	3.504	0.851	ice
-1.1071	0.3134_4	3.332	1.311	ice
-1.4271	0.4012_0	3.557	1.672	ice
-1.7394	0.4846_3	3.589	2.013	ice
-2.3016	0.6312_9	3.646	2.606	ice
-3.4643	0.9196_9	3.767	3.752	ice
-4.0100	1.0481_1	3.826	4.254	ice
-5.0875	1.2889_6	3.947	5.181	ice
-6.0055	1.4861_5	4.041	5.927	ice
-9.0134	2.0707_7	4.353	8.070	ice
-9.8933	2.2270_7	4.422	8.627	ice
-11.8729	2.5573_2	4.643	9.781	ice
-15.4496	3.1005_8	4.983	11.617	ice
-18.7540	3.5471_1	5.287	13.071	ice
-20.9583	3.8216_4	5.484	13.942	ice
-21.5387	3.8946_3	5.530	14.174	ice

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

A precision apparatus for measuring freezing point depressions by the equilibrium method was used, as described in (1). Temperatures were measured by a Pt resistance thermometer and Mueller bridge. Efficient stirring was accomplished by a high-quality air-driven stirrer. Concentrations were determined by a Hilger-Rayleigh interferometer.

SOURCE AND PURITY OF MATERIALS:

Not stated; probably Merck "Suprapur", cat. no. 4438.

ESTIMATED ERROR:

Temperature: precision ±3 x 10^{-4} K.
Composition: Absolute error almost independent of molality, and about 4-5 x 10^{-5} mol kg^{-1}.

REFERENCES:

(1) Chiorboli, P.; Momicchioli, F.; Grandi, G. *Boll. Sci. Fac. Chim. Ind. Bologna* 1966, *24*, 133.

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Vilcu, R.; Irenei, F.

An. Univ. Bucuresti, Chim. 1971, *20*(2), 103-11.

VARIABLES:

T/K = 258-267

PREPARED BY:

M. Ferriol

EXPERIMENTAL VALUES:

t/°C	molality of LiCl/mol kg^{-1}	mass %	solid phase
- 6.0655	1.5000	5.9786	ice
- 6.5450	1.6000	6.3519	"
- 7.5752	1.8000	7.0896	"
- 8.5932	2.0000	7.8157	"
-11.8020	2.5000	9.5825	"
-14.9302	3.0000	11.2827	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Cryometric measurements.

The method is described in a previous publication (1).

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Vilcu, R.; Irenei, F. *Rev. Roum. Chim.* 1968, *13*, 258.

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Ennan, A.A.; Lapshin, V.A.

Zh. Strukt. Khim. 1973, *14*, 21-9;
**J. Struct. Chem. (Engl. Transl.)* 1973, *14*, 18-25.

VARIABLES:

$T/k = 206$

PREPARED BY:

M. Ferriol; J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	LiCl mol/kg solution	mass % (compiler)	solid phase
-67.0	5.65	24.0	eutectic point[a] $LiCl \cdot 5H_2O$ + ice

---

[a] compiler's interpretation

COMMENTS: The authors also give the value 4.65 mol/kg solution in their Table 1, which appears to be a typographical error.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The method was described in a previous publication (1).

The experiments were carried out in a cryostat designed to prevent supercooling of the substance and to observe visually the formation of the first crystals. The cooling was carried out after preliminary crystallization and melting.

A mixture of dry ice and heptane was used as cooling agent.

The freezing point was determined with totally immersed mercury and alcohol thermometers.

SOURCE AND PURITY OF MATERIALS:

C.P. grade LiCl and doubly-distilled water were used.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Ennan, A.A.; Lapshin, V.A. *Zh. Strukt. Khim.* 1972, *13*, 596.

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Skvortsov, V.G.

Zh. Neorg. Khim. 1975, 20, 3149-51; *Russ. J. Inorg. Chem. (Engl. Transl.) 1975, 20, 1743-4.

VARIABLES:

T/K = 298, 303

PREPARED BY:

M. Ferriol

EXPERIMENTAL VALUES:

t/°C	mass % LiCl	density g cm^{-3}	solid phase	viscosity η/mPa s
20	45.41	1.203	$LiCl\cdot H_2O$	11.429
30	46.21	1.224	"	16.232

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The solubility was studied by the method of isothermal saturation (1). Equilibrium was reached after 24 hours. The chloride ion concentration was determined by argentimetry.

SOURCE AND PURITY OF MATERIALS:

"Analytical reagent" grade LiCl was recrystallized and used.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Skvortsov, V.G. Zh. Neorg. Khim. 1973, 18, 243; Russ. J. Inorg. Chem. (Engl. Transl.) 1973, 18, 127.

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Filippov, V.K.; Mikehl'son, K.N.

Zh. Neorg. Khim. 1977, *22*, 1689-94;
**Russ. J. Inorg. Chem. (Engl. Transl.)* 1977, *22*, 915-9.

VARIABLES:

$T/K = 298, 308$

PREPARED BY:

M. Ferriol

EXPERIMENTAL VALUES:

$t/°C$	mass % LiCl	molality mol kg^{-1}	solid phase
25	45.50	19.69	$LiCl\cdot H_2O$
35	46.97	20.74	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The solubility was studied by the method of isothermal saturation. The mixtures were analyzed by evaporation of the saturated solution and heating to constant mass at 350-400°C.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Relative error in the determination of the concentration did not exceed 0.2%.

REFERENCES:

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kartzmark, E.M.

Can. J. Chem. 1977, 55, 2792-8.

VARIABLES:

$T/K = 298$

PREPARED BY:

R. Tenu; J.W. Lorimer

EXPERIMENTAL VALUES:

$t/°C$	mass % LiCl	molality mol kg^{-1}	solid phase
25.00	45.40	19.61	$LiCl\cdot H_2O$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothermal method was used. The mixture was equlibrated by stirring at 25.00°C for 2 or 3 days. The phases were separated by filtration through sintered glass and were analyzed for chloride by precipitation as AgCl.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Vaisfel'd, M.I.; Onishchenko, M.K.; Shevchuk, V.G.

Zh. Neorg. Khim. 1977, *22*, 1994-8; *Russ. J. Inorg. Chem.* 1977, *22*, 1082-4.

VARIABLES:

$T/K = 298$

PREPARED BY:

T. Mioduski

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase (compiler)
25	44.90	$LiCl \cdot H_2O$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothermal saturation method was used. A mixture of salt and water was equilibrated with stirring for 5-7 days. The chloride content of saturated solutions was found by Mohr titration with 0.1 mol dm^{-3} $AgNO_3$.

SOURCE AND PURITY OF MATERIALS:

$LiCl \cdot H_2O$: "analytical reagent", or "chemically pure" grade, twice recrystallized.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sharina, A.S.; Tyutina, S.N.; Chernykh, L.V.

Zh. Neorg. Khim. 1983, *28*, 3171-3; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1983, *28*, 1797-9.

VARIABLES:

$T/K = 273$

PREPARED BY:

T. Mioduski

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase[a]
0	40.85	$LiCl \cdot 2H_2O$

[a] erroneously reported as $LiCl \cdot H_2O$ (compiler) in the Russian original, but correct in the translation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothermal saturation method was used. Equilibrium was reached within 6-8 hours. LiCl was determined as chloride by titration with $AgNO_3$ solution.

SOURCE AND PURITY OF MATERIALS:

No information available.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Lithium chloride; LiCl; [7447-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Lazorenko, N.M.; Kiesel', N.N.; Storozhenko, D.A.; Shevchuk, V.G.

Zh. Neorg. Khim. 1982, *27*, 1575-7; **Russ. J. Inorg. Chem. (Engl. Transl.)* 1982, *27*, 888-90.

VARIABLES:

T/K = 298, 323, 348, 473

PREPARED BY:

T. Mioduski

EXPERIMENTAL VALUES:

$t/°C$	mass %	solid phase
25	45.79	$LiCl.H_2O$
50	47.69	"
75	52.53	"
100	55.84	LiCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothermal saturation method was used. Equilibrium was reached with continuous stirring within 15-20 hours. Compositions of saturated solutions and solid phases were determined by analysis for chloride by the Volhard method.

SOURCE AND PURITY OF MATERIALS:

LiCl: C.P. grade; recrystallized.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

COMPONENTS:

(1) Lithium chloride; LiCl; [7747-41-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Claudy, P.; Létoffé, J.M.; Counioux, J.J.; Cohen-Adad, R.

J. Therm. Anal. 1984, *29*, 423-31.

VARIABLES:

$T/K = 203-258$

PREPARED BY:

R. Cohen-Adad

EXPERIMENTAL VALUES:

$t/°C$	mass %	mole fraction x_1	solid phase
-15	13.05	0.06	ice
-24	16.08	0.0753	"
-27	17.01	0.0801	"
-34	18.35	0.0872	"
-38	19.36	0.0926	"
-44	20.73	0.10	"
-53	22.46	0.1096	"
-62	23.35	0.1146	"
-68	24.22	0.1196	"
-70	25.18	0.1251	"
-90	26.17	0.1309	ice[a]
-91	26.34	0.1319	"
-94	26.49	0.1328	"
-99.0	26.64	0.1337	"
-118.4	26.94	0.1355	"
-123.6	27.20	0.1370	"
-125.4	27.36	0.1380	"
-126	27.61	0.1395	"
-73, -74			ice + $LiCl \cdot 5H_2O$ [b]
-62, -64			$LiCl \cdot 3H_2O + LiCl \cdot 5H_2O$ [b]

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[a] Calculated from ΔC_p; metastable equilibrium (compiler).
[b] determined by DTA.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The sample (40-50 mg) was placed in a small sealed Al crucible, then quenched in liquid N_2 and placed in a differential scanning calorimeter (Mettler 2000) previously cooled to -150°C. DSC scan rate: 2 K min^{-1}. A glass was observed at all temps. (T_g = -135 to -133°C). In the $0.1354 < x_1 < 0.149$ the samples did not crystallize. In the remaining composition range, crystallization occurred between -126 and 90°C.

SOURCE AND PURITY OF MATERIALS:

LiCl: Merck Suprapur, heated for 24 h at 130°C before use.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION

Solubility data for the binary system $NaCl-H_2O$ are given in more than 110 publications. The solid phase in equilibrium with the saturated solution is, according to the composition range, ice, the anhydrous salt or the dihydrate $NaCl\cdot 2H_2O$ [23724-877-0].

EXPERIMENTAL METHODS

The solubility has been measured making use of analytical methods (1, 2, 4-6, 11, 12, 17, 22, 24, 25, 27, 30, 35, 37, 49, 52-54, 56, 59, 63, 65-70, 72-74, 77-80, 82, 83, 86, 87, 90, 91, 93, 95, 97-99, 104, 110-113, 115, 116, 118, 120, 122, 127, 129-133, 140, 144, 151, 153) or synthetic synthetic (9, 16-19, 26, 29, 33, 36, 40, 50, 58, 60, 87, 90, 96, 97, 103, 106, 107, 114, 121, 122, 126, 130, 135, 136, 138, 141-143, 145, 147-149). One modern variant of the synthetic method is measurement of the dissolution temperatures of crystals in fluid inclusions in healed fractures in quartz (158). One paper reports solubility data obtained via thermal analysis (153). Most other determinations have been carried out isothermally.

ANALYSIS OF SOLUTIONS

The composition of the saturated solutions have been determined either by evaporation to dryness and weighing (1-6, 11, 12, 17, 22, 24, 25, 30, 37, 49, 52, 56, 59, 68, 70, 74, 79, 80, 87, 95, 98, 131, 151), or by chemical analysis for chloride (3, 10, 20, 21, 29, 31, 35, 45, 52-54, 59, 63, 65-69, 72, 77, 78, 80, 82, 86, 90, 91, 93, 97, 99, 104, 111-113, 116, 120, 144) or for sodium (113).

CHEMICALS USED

Most frequently the NaCl was a chemically pure reagent, sometimes recrystallized twice or more (7, 9, 11, 31, 40, 48, 52, 77, 82, 94, 98, 106, 107, 114, 115, 118, 121, 122, 125, 126, 129, 130) and dried by heating to 100 (5), to 120 (111) or to 350°C (56), or dehydrated by $CaCl_2$ (125) or by H_2SO_4 (25).

Fehling (4) and Andraeae (22) prepared the salt from sodium carbonate and hydrochloric acid. Guthrie and Andraeae used the crystalline salt, extrememly pure and washed in distilled water (17) or recrystallized several times (22).

The purity of the sample is checked, in each case, by the method of Lewis (58). Water used in the preparation of mixtures was most often doubly-distilled.

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION (continued)

CRITICAL EVALUATION OF RESULTS

1. *Fitting Equations*

All the data on the compilation sheets have been analysed according to the procedure outlined in the Preface. Solubility curves of the anhydrous salt and of the dihydrate $NaCl\cdot 2H_2O$ are represented by equations of the form:

$$Y(x_1) - Y(x_0) = A(1/T - 1/T_0) + B\ \ln(T/T_0) + C(T - T_0) \qquad (1)$$

with $Y(x_1) = 2\ \ln\ [x_1/(1 + x_1)]$ for the anhydrous salt (2)

and $Y(x_1) = 2\ \ln\ [8x_1(1 - x_1)/(1 + x_1)^2]$ for the dihydrate. (3)

Here, x_1, T are the coordinates of a point on the curve; x_0, T_0 are the coordinates of a particular point; A, B, C are coefficients adjusted by the method of least squares.

The equation for the solubility curve of ice is given by:

$$\ln\{(1 - x_1)/(1 + x_1)\} = A(1/T - 1/T_0) + B\ \ln(T/T_0) - \ln f_2$$

where $T_0 = 273.15$ K is the fusion temperature of the ice at atmospheric pressure, and A and B have been evaluated from the molar enthalpy and molar heat capacity for fusion of ice:

$$A = -(\Delta H_0 - T_0\Delta C_0)/R \qquad B = \Delta C_0/R$$

The quantities ΔH_0 and ΔC_0 are given in tables of constants as:

$\Delta H_0 = 6009\ \mathrm{J\ mol^{-1}}$ $\Delta C_0 = 37.7\ \mathrm{J\ K^{-1}\ mol^{-1}}$ $R = 8.314\ \mathrm{J\ K^{-1}\ mol^{-1}}$

The logarithm of the activity of water in the solution is given by:

$$\ln f_2 = X^{3/2}[E + F\ \ln X + G\ (\ln X)^2 + H\ (\ln X)^3/T] \qquad (5)$$

where

$$X = x_1/(1 + x_1)$$

and E, F, G, H are the coefficients, adjusted by cubic regression of the experimental values, of the quantity:

$$\begin{aligned} Z &= (T/X^{3/2})\ln f_2 \\ &= (T/X^{3/2})\{-\ln[(1 - x_1)/(1 + x_1)] + A(1/T - 1/T_0) + B\ln(T/T_0)\} \qquad (6) \end{aligned}$$

2. *Temperature and Enthalpy of Fusion of NaCl*

Numerous measurements have been carried out (39, 41, 42, 44, 46, 57, 62, 84, 119, 124, 128, 134, 137, 139). For the calculation of the solubility curve of the salt we have kept the following values:

temperature of fusion: 1073.8 ± 1.0 K (137)
enthalpy of fusion: 28.2 ± 0.2 kJ $\mathrm{mol^{-1}}$

The variation of the enthalpy of fusion with temperature is negligible.

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION (continued)

3. *Critical Evaluation of the Data*

3.1 Solubility of NaCl

Four hundred and eighty-one sets of numerical data are available in the literature, to which should be added the analytical expressions proposed by different authors (1, 10, 21, 23, 29, 152, 156, 158). Thirteen values give a divergence of more than 10% when compared to the whole of the data and have been eliminated by graphical analysis. The others have been analyzed by the procedure given in the Preface.

The data of Bodnar *et al.* (154), obtained from the dissolution temperatures of NaCl or ice in fluid inclusions in quartz, have not been compiled. The dissolution temperatures are not given, and the tabulated compositions were calculated from these temperatures from the equations of Potter *et al.* (147, 149). The dissolution temperatures exhibit ranges corresponding to 0.5 to 2.3 mass %, which may arise from the appreciable solubility of NaCl in the vapor phase. at the high temperatures used. Chou (156) has re-analyzed these data to show the effects of solubility in the vapor phase, and has concluded that the recalculated ranges are consistent with the higher solubilities reported by Gunter *et al.* (153), which have also been recalculated by Chou (156), and of more recent work by Bodnar and his collaborators (158) obtained from fluid inclusions for which the amount of vapor phase was negligible.

An equation with four adjustable coefficients was used as the fitting equation. The following constraints were imposed:

(a) the melting point of NaCl and the peritectic point of $NaCl{\cdot}2H_2O$ are points on the curve;

(b) the experimental points retained for the calculation correspond to relative deviations:

$$|\{x_1(\text{exp}) - x_1(\text{calc})\}/x_1(\text{calc})| < 0.01 \quad \text{for } t < 110°\text{C}$$

$$|\{x_1(\text{exp}) - x_1(\text{calc})\}/x_1(\text{calc})| < 0.025 \text{ for } t > 110°\text{C}.$$

In all, 409 experimental points have been retained for the calculation and six iterations have been necessary to obtain a set of stationary coefficients. The values of the coefficients are given in Table 1, and the results of the analysis are summarized in Table 2.

3.2 Peritectic $NaCl{\cdot}2H_2O = NaCl + \text{sln}$

Seven values are given in the literature (18, 21, 82, 85, 95, 111, 112), to which eight others have been added which are attributed to the crystallization of NaCl but in fact correspond to the peritectic (3, 6, 14, 22, 29, 66, 91, 101). Meyerhoffer and Saunders (32a) measured, by thermal analysis, the incongruent temperature of fusion of $NaCl{\cdot}2H_2O$ (0.15°C) but did not measure the composition. Two values are seriously erroneous in

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION (continued)

temperature (82, 91) and two in composition (29, 101).

The coordinates retained in our critical analysis are:

$T/K = 273.15 \pm 0.05$; $w_1 = 0.2627 \pm 0.0001$; $x_1 = 0.0990$

Table 1

System $NaCl-H_2O$: Coefficients of Fitting Equations for Solubility

solid phase	coefficients	conditions introduced in calculation	range/K
NaCl	$A = 99.14456$ K	melting point of NaCl	273 - 1073
	$B = -1.53935$	peritectic point, $NaCl \cdot 2H_2O$	
	$C = 7.24959\ 10^{-3}$ K^{-1}	$\lvert \Delta x_1/x_1(\text{calc}) \rvert < 0.01$ if $t < 110°C$	
	$D = 2.86411$	$\lvert \Delta x_1/x_1(\text{calc}) \rvert < 0.25$ if $t > 110°C$	
$NaCl \cdot 2H_2O$	$A = -44938.02$ K	peritectic point, $NaCl \cdot 2H_2O$	251 - 273
	$B = -338.3888$	eutectic point, ice + $NaCl \cdot 2H_2O$ + sln	
	$C = 0.647019$ K^{-1}		
	$D = 1885.0997$		
ice	$A = 514.778$ K	melting point of ice	251 - 273
	$B = 4.532$	peritectic point, ice + $NaCl \cdot 2H_2O$ + sln	
	$C = -27.307$ K^{-1}	heat of fusion of ice	
	$E = -2483.365$	heat capacity of fusion	
	$F = -995.349$	$A = -(\Delta H_0 - T_0 \Delta C_0)/R$	
	$G = -76.396$	$B = \Delta C_0/R$	
	$H = -0.653$	$C = -A/(T_0/K) - B\ln(T_0/K)$	

Table 2

Solubility of NaCl in Water

T/K -273.15	mass % $100w_1$ exp.	mass % $100w_1$ calc.	mole fraction x_1 exp.	mole fraction x_1 calc.	status	ref
0	26.00	26.27	0.0977	0.09896	t	86
0	26.02	"	0.0978	"	t	101
0	26.18	"	0.0985	"	r	64
0	26.2	"	0.0986	"	r	6
0	26.2	"	0.0986	"	r	21
0	26.21	26.27	0.0987	0.09896	r	3
0	26.25	"	0.0989	"	r	11
0	26.25	"	0.0989	"	r	66
0	26.25	"	0.0989	"	r	91
0	26.25	"	0.0989	"	r	123
0	26.26	26.27	0.0989	0.09896	r	111
0.0	26.268	"	0.09895	"	r	143
0	26.27	"	0.0989	"	r	2
0	26.27	"	0.0989	"	r	18
0	26.272	"	0.09890	"	r	22

(continued)

COMPONENTS

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

EVALUATOR:

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October, 1990

CRITICAL EVALUATION (continued)

Table 2
Solubility of NaCl in Water (continued)

T/K -273.15	mass % $100w_1$ exp.	mass % $100w_1$ calc.	mole fraction x_1 exp.	mole fraction x_1 calc.	status	ref
0	26.30	26.27	0.0991	0.09896	r	89
0	26.3	"	0.0991	"	r	12
0	26.3	"	0.0991	"	r	63
0	26.31	"	0.09915	"	r	21
0	26.35	"	0.0993	"	r	48
0.1	26.267	26.27	0.09895	0.09896	r	22
0.1	26.27	"	0.0990	"	r	91
0.2	26.29	26.27	0.09905	0.09896	r	82
0.35	26.34	26.27	0.0993	0.09897	r	37
0.5	26.240	26.27	0.09882	0.09897	r	25
0.5	26.259	26.27	0.09891	0.09897	r	25
0.7	26.274	26.27	0.09898	0.09897	r	25
1.25	26.29	26.27	0.09905	0.09898	r	2
1.5	25.14	26.28	0.0938	0.09899	a	10
3.6	26.36	26.28	0.0994	0.09903	r	21
3.78	26.267	26.29	0.09895	0.09903	r	22
4.1	26.279	26.29	0.09900	0.09904	r	25
4.2	26.257	26.29	0.09890	0.09904	r	25
4.6	26.278	26.29	0.09900	0.09905	r	22
4.8	26.266	26.29	0.09894	0.09905	r	22
5	26.2	26.29	0.0986	0.09906	r	125
5	26.26	"	0.0989	"	r	75
5	26.27	"	0.0990	"	r	3
5	26.33	"	0.0992	"	r	54
5.3	26.44	26.29	0.0997	0.09907	r	21
6.5	26.28	26.30	0.0990	0.09910	r	82
6.5	26.281	"	0.0990	"	r	25
9	26.31	26.31	0.09915	0.09917	r	11
9	26.33	"	0.0992	"	r	3
10	22.9	26.32	0.0839	0.0992	a	16
10	26.12	26.32	0.0983	0.0992	r	101
10	26.30	"	0.0991	"	r	64
10.0	26.316	"	0.0992	"	r	143
10	26.33	"	0.0992	"	r	93
10	26.34	"	0.0993	"	r	91
10	26.35	26.32	0.0993	0.0992	r	111
10.1	26.315	26.32	0.09917	0.0992	r	22
10.2	26.296	26.32	0.09908	0.0992	r	22
10.2	26.297	"	0.09909	"	r	22
10.2	26.3	"	0.0991	"	r	82
10.5	26.307	26.32	0.09913	0.0992	r	25
10.8	26.298	26.33	0.09909	0.0992	r	22
12	26.337	26.34	0.09927	0.0993	r	4
12	26.338	"	0.09927	"	r	4
12.0	26.34	"	0.0993	"	r	11
12	26.411	26.34	0.09961	0.0993	r	4
12	26.463	"	0.09985	"	r	4

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION (continued)

Table 2
Solubility of NaCl in Water (continued)

T/K -273.15	mass % $100w_1$ exp.	calc.	mole fraction x_1 exp.	calc.	status	ref
12	26.489	26.34	0.09997	0.0993	r	4
12	26.500	"	0.09954	"	r	4
13.75	26.36	26.35	0.0994	0.0993	r	10
13.89	26.37	26.35	0.0994	0.0993	r	1
14	26.40	26.35	0.0996	0.0993	r	3
14.45	26.44	26.35	0.0998	0.0994	r	21
14.8	26.349	26.36	0.0993	0.0994	r	25
15	26.3	26.36	0.0991	0.0994	r	68
15	26.3	26.36	0.0991	0.0994	r	67
15.0	26.30	"	0.0991	"	r	11
15	26.332	"	0.0993	"	r	80
15	26.348	"	0.0993	"	r	80
15	26.35	"	0.0993	"	r	97
15	26.36	26.36	0.0994	0.0994	r	82
15	26.38	"	0.0995	"	r	5
15	26.42	"	0.0997	"	r	7
15	26.7	"	0.1010	"	t	29
15.20	26.38	26.36	0.0995	0.0994	r	37
15.3	26.33	26.36	0.0992	0.0994	r	75
15.5	26.43	26.36	0.0997	0.0994	r	27
15.6	26.34	26.36	0.0993	0.0994	r	16
15.6	26.61	"	0.1005	"	t	16
16.2	26.337	26.37	0.0993	0.0994	r	25
16.90	26.376	26.38	0.0995	0.0995	r	1
17.5	26.4	26.38	0.0996	0.0995	r	82
17.6	26.335	26.38	0.0993	0.0995	r	25
17.62	26.18	26.38	0.0986	0.0995	r	149
17.9	26.35	26.39	0.0993	0.0995	r	75
18	24.8	26.39	0.0923	0.0995	a	96
18.5	26.31	26.39	0.0992	0.0995	r	74
18.5	26.4	"	0.0996	"	r	31
18.75	26.75	26.39	0.10012	0.0995	t	2
20	22.6	26.41	0.0826	0.0996	a	20
20	26.20	26.41	0.0986	0.0996	r	101
20	26.27	"	0.0990	"	r	53
20	26.35	"	0.0993	"	r	11
20	26.36	"	0.0994	"	r	113
20	26.37	"	0.0994	"	r	93
20.0	26.370	26.41	0.0994	0.0996	r	143
20	26.4	"	0.0996	"	r	82
20	26.4	"	0.0996	"	r	8
20	26.405	"	0.0996	"	r	80
20.0	26.42	"	0.0997	"	r	152
20	26.43	26.41	0.0997	0.0996	r	86
20	26.5	"	0.1000	"	r	6
20	26.5	"	0.1000	"	r	79
20	26.50	"	0.1000	"	r	120
20.6	26.37	26.41	0.0994	0.0996	r	75

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION (continued)

Table 2
Solubility of NaCl in Water (continued)

T/K -273.15	mass % $100w_1$ exp.	mass % $100w_1$ calc.	mole fraction x_1 exp.	mole fraction x_1 calc.	status	ref
20.85	26.27	26.41	0.0990	0.0996	r	21
21.25	26.595	26.42	0.1005	0.0997	r	2
21.5	26.018	26.42	0.0978	0.0997	t	35
21.7	26.384	26.42	0.0995	0.0997	r	22
22.0	26.398	26.43	0.0996	0.0997	r	22
24.0	26.43	26.45	0.0997	0.0998	r	152
24.05	26.42	26.45	0.0997	0.0998	r	47
25	26.23	26.46	0.0988	0.0998	r	150
25	26.31	"	0.0992	"	r	48
25	26.32	"	0.0992	"	r	77
25	26.35	26.46	0.0993	0.0998	r	48
25	26.37	"	0.0994	"	r	11
25	26.38	"	0.0995	"	r	48
25	26.40	"	0.0996	"	r	100
25	26.4	"	0.0996	"	r	70
25	26.4	26.46	0.0996	0.0998	r	95
25.00	26.403	"	0.0996	"	r	78
25	26.41	"	0.0996	"	r	64
25	26.42	"	0.0997	"	r	117
25	26.42	"	0.0997	"	r	75
25	26.42	26.46	0.0997	0.0998	r	108
25	26.43	"	0.0997	"	r	52
25	26.44	"	0.0998	"	r	56
25	26.44	"	0.0998	"	r	104
25	26.442	"	0.0998	"	r	80
25	26.450	26.46	0.0998	0.0998	r	80
25	26.45	"	0.0998	"	r	132
25	26.45	"	0.0998	"	r	116
25	26.46	"	0.0998	"	r	59
25	26.47	"	0.0999	"	r	144
25.0	26.47	26.46	0.0999	0.0998	r	151
25	26.475	"	0.0999	"	r	80
25	26.477	"	0.0999	"	r	98
25	26.48	"	0.1000	"	r	93
25	26.484	"	0.1000	"	r	80
25	26.49	26.46	0.1000	0.0998	r	54
25	26.49	"	0.1000	"	r	129
25	26.5	"	0.1000	"	r	125
25	26.5	"	0.1000	"	r	34
25	26.5	"	0.1000	"	r	63
25.0	26.50	26.46	0.1000	0.0998	r	65
25	26.5	"	0.0100	"	r	73
25	26.5	"	0.0100	"	r	115
25	26.511	"	0.1001	"	r	80
25	26.54	"	0.1002	"	r	3
25	26.58	26.46	0.1004	0.0998	r	118
25	26.6	"	0.1005	"	r	82

(continued)

COMPONENTS

(1) Sodium chloride; NaCl;
[7647-14-5]

(2) Water; H_2O; [7732-18-5]

EVALUATOR:

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CRITICAL EVALUATION (continued)

Table 2
Solubility of NaCl in Water (continued)

T/K -273.15	mass % $100w_1$ exp.	mass % $100w_1$ calc.	mole fraction x_1 exp.	mole fraction x_1 calc.	status	ref
25	26.60	26.46	0.1005	0.0998	r	123
25	26.71	"	0.1010	"	t	130
25	35.96	"	0.1476	"	a	72
25.45	26.42	26.46	0.0997	0.0999	r	21
25.5	26.5	26.47	0.1000	0.0999	r	12
26	26.46	26.47	0.0998	0.0999	r	114
27	26.44	26.48	0.0998	0.1000	r	75
27	26.52	26.48	0.1001	"	r	145
28.64	26.35	26.50	0.0993	0.1000	r	149
28.77	26.40	26.51	0.0996	0.1001	r	149
28.85	26.475	26.51	0.0999	0.1001	r	22
28.86	26.40	26.51	0.0996	0.1001	r	149
28.9	26.463	26.51	0.0999	0.1001	r	22
29.93	26.47	26.52	0.0999	0.1001	r	87
30	22.3	26.52	0.0813	0.1001	a	20
30	26.47	"	0.0999	"	r	11
30.00	26.470	"	0.0999	"	r	87
30.0	26.490	"	0.1000	"	r	143
30	26.53	26.52	0.1001	0.1001	r	111
30	26.59	"	0.1004	"	r	53
30	26.6	"	0.1005	"	r	30
30.05	26.58	26.52	0.1004	0.1001	r	37
30.8	26.50	26.53	0.1000	0.1002	r	22
31	26.50	26.53	0.1000	0.1002	r	75
34.0	26.56	26.58	0.1003	0.1004	r	152
35	26.27	26.59	0.0990	0.1004	t	35
35	26.48	"	0.0999	"	r	116
35	26.56	"	0.1003	"	r	101
35	26.57	26.59	0.1004	0.1004	r	69
35	26.579	"	0.1004	"	r	131
35	26.588	"	0.1004	"	r	131
35	26.6	"	0.1004	"	r	82
35	26.76	"	0.1012	"	r	122
35.09	26.48	26.59	0.0999	0.1004	r	149
35.5	26.57	26.60	0.1004	0.1005	r	75
35.6	26.606	26.60	0.1005	0.1005	r	25
37.5	26.83	26.62	0.1016	0.1006	r	2
38.55	26.75	26.64	0.1012	0.1007	r	21
39.6	26.643	26.66	0.1007	0.1008	r	22
39.90	26.59	26.66	0.1004	0.1008	r	149
40	22.0	26.67	0.0800	0.1008	a	20
40	26.54	26.67	0.1002	"	r	146
40	26.64	26.67	0.1007	"	r	91
40.0	26.646	26.67	0.1007	0.1008	r	22
40.0	26.647	"	0.1007	"	r	143
40	26.65	"	0.1007	"	r	110
40	26.76	"	0.1012	"	r	53
40	26.76	"	0.1012	"	r	93

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION (continued)

Table 2
Solubility of NaCl in Water (continued)

T/K -273.15	mass % $100w_1$ exp.	calc.	mole fraction x_1 exp.	calc.	status	ref
40	26.8	26.67	0.1014	0.1008	r	6
40	26.81	"	0.1015	"	r	3
40	26.875	"	0.1018	"	r	2
40	26.9	"	0.1019	"	t	30
40.3	26.634	26.67	0.1006	0.1008	r	22
40.3	26.645	26.67	0.1007	0.1008	r	22
41.5	26.70	26.69	0.1010	0.1009	r	152
44.5	26.6	26.74	0.1005	0.1011	r	12
44.5	26.77	"	0.1013	0.1011	r	152
44.75	26.81	26.74	0.1015	0.1012	r	21
45.40	26.79	26.75	0.1014	0.1012	r	37
48	26.75	26.80	0.1012	0.1014	r	114
48.1	26.80	26.80	0.1014	0.1014	r	152
49	26.81	26.82	0.1015	0.1015	r	75
49.6	26.811	26.83	0.1015	0.1016	r	22
49.64	26.831	26.83	0.1016	0.1016	r	22
50	21.7	26.84	0.0787	0.1016	a	20
50	26.670	"	0.1008	"	r	131
50	26.740	"	0.1011	"	r	131
50	26.77	"	0.1013	"	r	118
50	26.80	26.84	0.1014	0.1016	r	126
50.0	26.829	"	0.1016	"	r	143
50	26.83	"	0.1016	"	r	69
50	26.84	"	0.1016	"	r	111
50	26.86	"	0.1017	"	r	54
50	26.87	26.84	0.1017	0.1016	r	101
50	26.87	"	0.1017	"	r	123
50	26.9	"	0.1019	"	r	82
50	26.90	"	0.1019	"	r	104
50	26.91	"	0.1019	"	r	86
50	26.9	26.84	0.1019	0.1016	r	125
50	26.93	"	0.1020	"	r	93
50	26.99	"	0.1023	"	r	150
50	27.00	"	0.1023	"	r	3
50	27.27	"	0.1036	"	t	2
52.5	27.03	26.88	0.1025	0.1018	r	21
53.00	26.79	26.89	0.1014	0.1019	r	149
53.25	26.86	26.90	0.1017	0.1019	r	152
53.75	27.305	26.91	0.1038	0.1019	t	2
55	26.8	26.93	0.1014	0.1020	r	29
55	26.93	26.93	0.1020	0.1020	r	75
55.0	27.00	"	0.1023	"	r	21
55.5	26.93	26.94	0.1020	0.1021	r	152
55.7	26.947	26.95	0.1021	0.1021	r	25
56.25	27.225	26.96	0.1034	0.1022	t	2
57.0	26.98	26.97	0.1022	0.1022	r	152
57	26.99	"	0.1023	0.1022	r	75

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION (continued)

Table 2
Solubility of NaCl in Water (continued)

T/K -273.15	mass % $100w_1$ exp.	mass % $100w_1$ calc.	mole fraction x_1 exp.	mole fraction x_1 calc.	status	ref
59	27.02	27.01	0.1024	0.1024	r	75
59.1	27.013	27.02	0.1024	0.1024	r	22
59.75	27.17	27.03	0.1031	0.1025	r	21
59.78	27.01	27.03	0.1024	0.1025	r	149
59.93	27.08	27.03	0.1027	0.1025	r	1
60	21.4	27.03	0.0774	0.1025	a	20
60	27.02	"	0.1024	"	r	93
60	27.03	"	0.1025	"	r	91
60	27.03	27.03	0.1025	0.1025	r	113
60.0	27.041	"	0.1025	"	r	143
60	27.1	"	0.1028	"	r	6
60	27.14	"	0.1030	"	r	3
60.02	27.046	27.04	0.1026	0.1025	r	22
60.07	27.032	27.04	0.1025	0.1025	r	22
61	27.06	27.06	0.1026	0.1026	r	75
61.70	27.16	27.07	0.1031	0.1027	r	37
62.5	27.60	27.09	0.1052	0.1028	t	2
64	27.13	27.12	0.1030	0.1029	r	75
64.6	27.138	27.13	0.1030	0.1030	r	25
65	27.02	27.14	0.1024	0.1030	r	101
65.2	27.163	27.15	0.1031	0.1030	r	25
67.6	27.17	27.20	0.1031	0.1033	r	152
67.8	27.211	27.20	0.1033	0.1033	r	25
68.0	27.27	27.21	0.1036	0.1033	r	152
69.2	27.274	27.24	0.1036	0.1034	r	25
70	21.1	27.26	0.0762	0.1036	a	20
70.0	27.274	"	0.1036	0.1036	r	143
70	27.28	"	0.1037	0.1036	r	111
70	27.36	27.26	0.1040	0.1036	r	93
70	27.47	"	0.1046	"	r	3
70.0	27.59	"	0.1051	"	t	10
71	27.30	27.28	0.1038	0.1037	r	75
71.3	27.52	27.29	0.1048	0.1037	t	21
72.0	27.322	27.30	0.1039	0.1038	r	22
72.05	27.325	27.31	0.1039	0.1038	r	22
72.33	27.24	27.31	0.1035	0.1038	r	149
73	27.35	27.33	0.1040	0.1039	r	114
73.25	27.38	27.33	0.1041	0.1039	r	152
74.45	27.52	27.36	0.1048	0.1041	r	21
75	27.24	27.38	0.1035	0.1041	r	118
75	27.4	"	0.1042	"	r	82
75	27.45	"	0.1045	"	r	86
75	27.45	"	0.1045	"	r	126
75	27.50	27.38	0.1047	0.1041	r	123
75	27.845	"	0.1063	"	t	2
75.65	27.44	27.39	0.1044	0.1042	r	37
77	28.0	27.43	0.1070	0.1043	a	29
80	20.9	27.50	0.0753	0.1047	a	20

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION (continued)

Table 2
Solubility of NaCl in Water (continued)

T/K -273.15	mass % $100w_1$ exp.	calc.	mole fraction x_1 exp.	calc.	status	ref
80	27.23	27.50	0.1034	0.1047	t	101
80.0	27.533	"	0.1048	"	r	143
80	27.65	"	0.1054	"	r	5
80	27.7	"	0.1056	"	r	6
80.87	27.49	27.53	0.1046	0.1048	r	149
80.9	27.562	27.53	0.1050	0.1048	r	22
82.05	27.75	27.56	0.1059	0.1050	r	21
83	27.60	27.58	0.1051	0.1051	r	75
83	27.67	"	0.1055	"	r	52
83	27.68	"	0.1055	"	r	26
86.7	27.78	27.68	0.1060	0.1055	r	21
90	20.7	27.77	0.0745	0.1060	a	20
90	27.80	"	0.1061	"	r	133
90.0	27.805	"	0.1061	"	r	143
90	27.99	"	0.1070	"	r	3
90	28.2	27.77	0.1080	0.1060	t	29
90.5	27.81	27.79	0.1061	0.1060	r	37
91	27.91	27.80	0.1066	0.1061	r	53
93.65	28.01	27.87	0.1071	0.1065	r	21
98	28.03	28.00	0.1072	0.1071	r	71
99.99	28.00	28.06	0.1070	0.1074	r	149
100	20.5	28.06	0.0736	0.1074	a	20
100	28.00	"	0.1070	"	r	91
100.0	28.078	"	0.1074	"	r	143
100	28.1	"	0.1075	"	r	79
100	28.13	28.06	0.1077	0.1074	r	111
100	28.17	"	0.1079	"	r	51
100	28.2	"	0.1080	"	r	54
100	28.20	"	0.1080	"	r	114
100	28.20	"	0.1080	"	r	126
100	28.23	28.06	0.1081	0.1074	r	104
100	28.29	"	0.1084	"	r	93
100	28.3	"	0.1085	"	t	6
100	28.37	"	0.1088	"	t	90
100	28.37	"	0.1088	"	t	3
100	28.416	28.06	0.1090	0.1074	t	2
100	28.452	"	0.1092	"	t	4
100	28.524	"	0.1095	"	t	4
100	28.6	"	0.1099	"	t	82
100	28.643	"	0.1101	"	a	4
101.7	28.96	28.12	0.1116	0.1076	a	21
101.9	28.1	28.12	0.1075	0.1076	r	106
105	26.905	28.22	0.1019	0.1081	a	2
105	28.25	"	0.1082	"	r	100
105	28.3	"	0.1085	"	r	82
106	28.39	28.25	0.1089	0.1082	r	114
107.0	28.39	28.28	0.1089	0.1084	r	37

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION (continued)

Table 2
Solubility of NaCl in Water (continued)

T/K -273.15	mass % $100w_1$ exp.	mass % $100w_1$ calc.	mole fraction x_1 exp.	mole fraction x_1 calc.	status	ref
108.5	28.26	28.33	0.1083	0.1086	r	10
108.668	28.379	28.33	0.1089	0.1086	r	49
108.7	28.30	28.33	0.1085	0.1087	r	91
108.8	26.27	28.34	0.0990	0.1087	r	17
109.7	28.75	28.37	0.1106	0.1088	t	3
109.73	28.76	28.38	0.1107	0.1088	t	1
110.0	28.618	28.38	0.1100	0.1088	t	143
110	28.67	"	0.1102	"	t	90
115	29.1	28.54	0.1123	0.1096	r	29
118	28.5	28.64	0.1094	0.1101	r	24
120	28.60	28.71	0.1099	0.1104	r	91
120.0	28.618	"	0.1100	"	r	143
120	28.98	"	0.1117	"	r	90
120	29.38	28.71	0.1137	0.1104	t	23
121	28.88	28.74	0.1113	0.1106	r	114
125	28.84	28.88	0.1111	0.1113	r	138
130	29.28	29.06	0.1132	0.1121	r	90
130.0	28.944	"	0.1116	"	r	143
132	29.23	29.14	0.1129	0.1125	r	114
135	28.9	29.24	0.1113	0.1130	r	29
140	28.8	29.44	0.1109	0.1140	t	29
140.0	29.296	"	0.1133	"	r	143
140	29.30	"	0.1133	"	r	91
140	29.58	29.44	0.1146	0.1140	r	90
140	29.6	"	0.1147	"	r	24
140	29.87	"	0.1161	"	r	23
142	29.7	29.52	0.1152	0.1143	r	83
145	29.65	29.63	0.1150	0.1149	r	114
148.6	29.62	29.78	0.1148	0.1156	r	147
149	29.78	29.79	0.1156	0.1157	r	114
150	29.6	29.83	0.1147	0.1159	r	29
150	29.6	"	0.1147	"	r	99
150	29.61	"	0.1148	"	r	138
150.0	29.616	29.83	0.1148	0.1159	r	143
150	29.87	"	0.1161	"	r	90
160.0	30.048	30.25	0.1169	0.1179	r	143
160	30.17	"	0.1175	"	r	90
160	30.37	"	0.1185	"	r	23
160	30.4	30.25	0.1187	0.1179	r	24
161	30.08	30.29	0.1171	0.1181	r	147
163	30.27	30.37	0.1180	0.1185	r	114
168.3	30.6	30.60	0.1197	0.1196	r	106
169.5	30.62	30.66	0.1197	0.1199	r	91
170	30.46	30.68	0.1190	0.1201	r	90
170.0	30.460	30.68	0.1190	"	r	143
172.4	30.61	30.79	0.1197	0.1206	r	147
173	30.4	30.81	0.1187	0.1207	r	99
175	30.68	30.90	0.1201	0.1212	r	138

(continued)

COMPONENTS

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

EVALUATOR:

R. Cohen-Adad; P. Vallée
Université Claude Bernard (Lyon I), 69622 Villeurbanne, France.
J.W. Lorimer
The University of Western Ontario, London, Ontario N6A 5B7, Canada.

October, 1990

CRITICAL EVALUATION (continued)

Table 2
Solubility of NaCl in Water (continued)

T/K -273.15	mass % $100w_1$ exp.	calc.	mole fraction x_1 exp.	calc.	status	ref
179	30.85	31.09	0.1209	0.1221	r	114
180	30.2	31.13	0.1177	0.1223	t	29
180	30.84	"	0.1208	"	r	90
180.0	30.946	"	0.1214	"	r	143
180	31.0	"	0.1216	"	r	24
181	31.1	31.18	0.1221	0.1225	r	83
183.0	30.7	31.27	0.120	0.1230	r	107
189.6	31.45	31.58	0.1239	0.1246	r	91
190	31.22	31.60	0.1228	0.1247	r	90
190.0	31.411	"	0.1237	0.1247	r	143
200	31.60	32.09	0.1247	0.1272	r	90
200	31.6	"	0.1247	"	r	99
200	31.79	"	0.1256	"	r	138
200.0	31.984	"	0.1266	"	r	143
202.3	32.05	32.21	0.1270	0.1277	r	147
205	31.8	32.35	0.1257	0.1285	r	83
205.1	31.5	32.35	0.1242	0.1285	t	107
208	32.01	32.50	0.1267	0.1292	r	114
214.5	32.66	32.84	0.1301	0.1310	r	147
215	31.6	32.87	0.1247	0.1311	t	29
218	33.39	33.02	0.1338	0.1319	r	114
220	32.11	33.13	0.1272	0.1325	t	90
225	33.02	33.40	0.1319	0.1339	r	138
225	33.2	"	0.1329	"	r	99
230	32.52	33.68	0.130	0.1354	t	90
230.2	32.52	33.69	0.1293	0.1354	t	107
236	33.17	34.02	0.1327	0.1371	t	114
246.7	33.61	34.64	0.135	0.1404	t	107
250	33.20	34.83	0.1329	0.1415	a	90
250	34.2	"	0.1381	"	r	99
250	34.44	34.83	0.1394	0.1415	r	138
254.6	34.18	35.11	0.138	0.1429	t	107
270	34.21	36.06	0.1381	0.1481	a	90
272.9	36.01	36.25	0.1478	0.1491	r	147
275	36.06	36.38	0.1481	0.1499	r	138
280	34.47	36.70	0.1395	0.1517	a	90
285	36.1	37.03	0.1483	0.1535	t	103
298.6	37.8	37.95	0.158	0.1586	r	158
299.3	37.31	38.00	0.155	0.1589	t	107
300	35.06	38.05	0.1427	0.1592	a	90
300	37.8	38.05	0.1578	0.1592	r	99
300	37.83	"	0.1579	"	r	138
300	39.4	"	0.1670	"	t	99
301	37.7	38.12	0.1572	0.1596	r	103
327.3	39.7	40.01	0.169	0.1706	r	107
329.4	40.07	40.17	0.1709	0.1715	r	147
334	40.6	40.52	0.1740	0.1736	r	103
344.4	41.26	41.32	0.1780	0.1784	r	107

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION (continued)

Table 2
Solubility of NaCl in Water (continued)

T/K -273.15	mass % $100w_1$ exp.	calc.	mole fraction x_1 exp.	calc.	status	ref
350	41.6	41.76	0.1800	0.1810	r	136
350	42.0	"	0.1825	"	r	99
354.3	42.08	42.11	0.1830	0.1831	r	107
356	42.6	42.24	0.1862	0.1840	r	103
364	43.3	42.89	0.1906	0.1880	r	103
384	45.1	44.58	0.2021	0.1987	r	103
385.7	45.55	44.73	0.2050	0.1997	t	107
388	45.6	44.93	0.2053	0.2009	r	103
393.3	46.9	45.39	0.214	0.2040	t	158
400	46.5	45.99	0.2113	0.2079	r	136
409	47.5	46.81	0.2181	0.2134	r	103
410.0	47.34	46.90	0.2170	0.2140	r	107
424.8	48.42	48.29	0.2244	0.2235	r	147
430	49.1	48.78	0.2292	0.2270	r	103
442.5	50.33	50.00	0.2380	0.2357	r	107
447	53.54	50.45	0.2621	0.2389	a	153,156
450	52.0	50.75	0.2503	0.2411	t	141
455	51.3	51.26	0.2451	0.2448	r	103
467.5	52.09	52.55	0.2510	0.2545	r	107
481.2	57.0	54.01	0.290	0.2658	a	158
485.5	54.54	54.47	0.2700	0.2694	r	107
500	59.5	56.07	0.3117	0.2824	a	141
507	62.44	56.87	0.3388	0.2890	a	153,156
514.2	56.39	57.69	0.2850	0.2959	t	107
518.0	62.4	58.13	0.338	0.2997	a	158
518.1	62.4	58.14	0.338	0.2998	a	158
550	65.2	61.97	0.3661	0.3343	a	141
550.5	62.04	62.03	0.3350	0.3349	r	107
600.0	69.36	68.44	0.4110	0.4006	t	107
604	76.17	68.98	0.4963	0.4067	a	153,156
604	76.56	"	0.5017	"	a	153,156
619	78.29	71.05	0.5264	0.4307	a	153,156
646	82.26	74.90	0.5884	0.4791	a	153,156
646.2	76.80	74.93	0.5051	0.4795	a	107
677	86.47	79.52	0.6633	0.5448	a	153,156
711	90.47	84.83	0.7453	0.6329	a	153,156
713.9	90.0	85.30	0.735	0.6413	a	158
801.0	100.00	100.00	1.0000	1.0000	r	

$e = |x_1(\text{exp}) - x_1(\text{calc})|/x_1(\text{calc})$

r = recommended value $e \leq 0.01$ up to 110°C $e \leq 0.025$ above 110°C

t = tentative value $0.01 < e \leq 0.025$ up to 110°C $25 \leq e \leq 0.05$ above 110°C

a = aberrant value $e > 0.025$ up to 110°C $e > 0.05$ above 110°C

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION (continued)

3.3 Solubility Curve of the Dihydrate $NaCl\cdot 2H_2O$ [23724-87-0]

The critical analysis was carried out with 41 numerical values, using a fitting equation with four coefficients (Table 2) and requiring the curve to pass through the eutectic ice-$NaCl\cdot 2H_2O$ and the peritectic $NaCl\cdot 2H_2O$ = sln + NaCl. Results are given in Table 3.

The experimental values recommended correspond to a relative range:

$$|\Delta x_1/x_1(\text{calc})| < 0.0151$$

Values are considered as aberrant when

$$|\Delta x_1/x_1(\text{calc})| > 0.025.$$

3.4 Eutectic sln = ice + $NaCl\cdot 2H_2O$

Ten values are given in the literature (18, 32, 45, 58, 82, 91, 111, 112, 142, 148). Two values deviate notably from the others in temperature (18, 32), while the values of the compositions vary between 22.84 and 23.6 mass %. We have adopted the following values:

T = 251.89 K (-21.26 ± 0.02°C); w_1 = 0.2316 ± 0.0005; x_1 = 0.0850

Table 3

Solubility of $NaCl\cdot 2H_2O$ [23724-87-0] in water

T/K -273.15	mass % $100w_1$ exp.	calc.	mole fraction x_1 exp.	calc.	status	ref
-22	23.6	23.04	0.0869	0.0845	a	18
-22 to -21	23.8874	23.04	0.0882	0.0845	a	17
-21.85	29.6	23.06	0.1147	0.0846	a	32
-21.6	22.9	23.10	0.0839	0.0847	r	82
-21.3	23.5	23.14	0.0865	0.0849	t	45
-21.25	23.19	23.15	0.0851	0.0850	r	111
-21.2	22.97	23.16	0.0842	0.0850	r	142
-21.12	23.3	23.17	0.0856	0.0851	r	58
-21.1	23.07	23.17	0.0846	0.0851	r	91
-21	23.7	23.19	0.0874	0.0851	a	29
-21	23.5	23.19	0.0865	0.0851	r	29
-20.81	23.225	23.22	0.0853	0.0853	r	148
-19.2	23.42	23.46	0.0861	0.0863	r	111
-18	23.5	23.64	0.0865	0.0871	r	29
-17	23.3	23.79	0.0856	0.0878	t	29
-16	24.1182	23.93	0.0892	0.0884	r	17
-15	24.66	24.07	0.0916	0.0890	a	3
-14	24.5	24.22	0.0909	0.0897	r	14
-14	24.53	"	0.0911	"	t	21
-14	24.68	"	0.0917	"	t	21
-13.8	24.30	24.25	0.0900	0.0898	r	21
-12.25	24.8	24.46	0.0923	0.0908	t	45
-12	25	24.50	0.0932	0.0909	t	18

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION (continued)

Table 3 (continued)

Solubility of $NaCl \cdot 2H_2O$ [23724-87-0] in water

T/K	mass % $100w_1$		mole fraction x_1		status	ref
-273.15	exp.	calc.	exp.	calc.		
-10.6	24.7	24.70	0.0918	0.0918	r	82
-10	24.60	24.78	0.0914	0.0922	r	89
-10	24.6187	24.78	0.0915	0.0922	r	17
-10	24.6528	"	0.0916	"	r	17
-10.0	24.70	"	0.0918	"	r	91
-10	24.86	"	0.0925	"	r	101
-10	25.09	"	0.0936	"	t	3
-9.8	24.86	24.81	0.0925	0.0923	r	111
-7	25.5	25.21	0.0954	0.0941	r	29
-6.25	25.50	25.32	0.0954	0.0946	r	21
-5.95	25.47	25.36	0.0953	0.0948	r	21
-5	17.83	25.49	0.0627	0.0954	a	105
-5	25.49	25.49	0.0954	0.0954	r	3
-5	25.50	"	0.0954	"	r	89
-5	24.60	"	0.0914	"	a	105
-2.5	25.625	25.87	0.0960	0.0971	r	2
0	24.2724	26.26	0.0899	0.0989	a	17
0	25.8	26.26	0.0968	0.0989	t	29
0	26.20	"	0.0986	"	r	21
0	26.23	"	0.0988	"	r	75
0	26.26	"	0.0989	"	r	111
0	26.27	"	0.0990	"	r	18
0.0	26.3	26.26	0.0991	0.0989	r	14
0	26.31	26.26	0.0991	0.0989	r	21
0.1	26.27	26.27	0.0990	0.0990	r	91
0.2	26.29	26.29	0.0991	0.0991	r	82

$e = |x_1(\text{exp}) - x_1(\text{calc})|/x_1(\text{calc})$

r = recommended value $e \leq 0.015$ t = tentative value $0.015 < e \leq 0.025$

a = aberrant value $e > 0.025$

3.5 Solubility Curve of Ice

The data of Jones (28), Jones and Getman (36), Dernby (55) and Klein and Svanberg (61), expressed in mol L^{-1}, have not been compiled.

One hundred and nineteen experimental points are given in the bibliography. One hundred and ninety-eight numerical values have been used for the calculation of the solubility curve, after the elimination of the most aberrant data by graphic selection or by an iterative calculation, rejecting those points for which the relative divergence $|\Delta x_1/x_1(\text{calc})| > 0.05$.

The coefficients A, B, C have been evaluated by using the coordinates of the melting point of ice and the eutectic point as well as the enthalpy

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION (continued)

of fusion and the heat capacity of the phase change.

The coefficients E, F, G, H have been adjusted by fitting the curve expressing $\ln\gamma_2$ as a function of composition; four iterations suffice to obtain stationary coefficients. The results of the solubility measurements, the calculated values, and the logarithm of the activity coefficient of water in the saturated solution are given in Table 4.

The recommended values correspond to a relative deviation $e = |\Delta x_1/x_1(\text{calc})| < 0.02$. They are considered as aberrant when $e > 0.05$.

Table 4

Solubility of Ice

T/K -273.15	mass % $100w_1$ exp.	calc.	mole fraction x_1 exp.	calc.	status	ref
-0.0031	0.00479	0.0049	0.000015	0.000015	r	94
-0.0069	0.01090	0.0109	0.000034	0.000033	r	94
-0.0187	0.02991	0.0298	0.000092	0.000092	r	94
-0.0311	0.05026	0.0498	0.000155	0.000153	r	94
-0.0486	0.07907	0.0783	0.000244	0.000242	r	94
-0.0652	0.104	0.1056	0.000321	0.000326	r	135
-0.0804	0.13218	0.1308	0.000408	0.000403	r	94
-0.0872	0.142	0.1421	0.000438	0.000438	r	135
-0.0890	0.1472	0.1451	0.000454	0.000448	r	40
-0.0900	0.1472	0.1467	0.000454	0.000453	r	40
-0.1098	0.176	0.1797	0.000543	0.000555	r	33
-0.117	0.272	0.1919	0.000840	0.000592	a	26
-0.1186	0.19533	0.1946	0.000603	0.000601	r	94
-0.1345	0.2216	0.2212	0.000684	0.000683	r	40
-0.1355	0.2224	0.2230	0.000687	0.000688	r	40
-0.1431	0.236	0.2358	0.000729	0.000728	r	135
-0.1757	0.2938	0.2911	0.000907	0.000899	r	40
-0.1765	0.2935	0.2924	0.000907	0.000903	r	40
-0.1928	0.31996	0.3202	0.000988	0.000989	r	94
-0.2048	0.342	0.3405	0.001057	0.001052	r	135
-0.2073	0.340	0.3449	0.00105	0.00107	r	33
-0.2646	0.4414	0.4430	0.00137	0.00137	r	40
-0.2650	0.4417	0.4437	0.00137	0.00137	r	40
-0.270	0.448	0.4523	0.00139	0.00140	r	19
-0.2746	0.45863	0.4602	0.00142	0.00142	r	94
-0.3	1	0.5040	0.00310	0.00156	a	18
-0.3415	0.570	0.5757	0.00176	0.00178	r	135
-0.3475	0.5837	0.5861	0.00181	0.00181	r	40
-0.3492	0.5836	0.5891	0.00181	0.00182	r	40
-0.3596	0.60245	0.6071	0.00187	0.00188	r	94
-0.4077	0.685	0.6905	0.00212	0.00214	r	33
-0.424	0.678	0.7189	0.00210	0.00223	a	26
-0.4342	0.72978	0.7366	0.00226	0.00228	r	94
-0.4508	0.760	0.7655	0.00236	0.00237	r	135
-0.4728	0.7932	0.8038	0.00246	0.00249	r	140

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION (continued)

Table 4 (continued)

Solubility of Ice

T/K -273.15	mass % $100w_1$ exp.	calc.	mole fraction x_1 exp.	calc.	status	ref
-0.5165	0.8735	0.8798	0.00271	0.00273	r	40
-0.5172	0.8724	0.8811	0.00271	0.00273	r	40
-0.518	0.873	0.8824	0.00283	0.00287	r	50
-0.5423	0.91293	0.9248	0.00307	0.00318	r	94
-0.6	0.99	1.0253	0.00307	0.00318	t	9
-0.6093	1.025	1.0417	0.00318	0.00323	r	135
-0.6411	1.0812	1.0971	0.00336	0.00341	r	94
-0.6770	1.143	1.1597	0.00355	0.00360	r	140
-0.687	1.125	1.1772	0.00350	0.00366	r	26
-0.6883	1.1592	1.1794	0.00360	0.00367	r	40
-0.6906	1.1662	1.1834	0.00362	0.00368	r	40
-0.7627	1.2875	1.3091	0.00400	0.00407	r	94
-0.7812	1.320	1.3413	0.00411	0.00417	r	135
-0.7998	1.356	1.3737	0.00422	0.00428	r	140
-0.8211	1.381	1.4107	0.00430	0.00439	t	33
-0.8598	1.4561	1.4780	0.00453	0.00460	r	40
-0.8626	1.4579	1.4829	0.00454	0.00461	r	40
-0.9	2	1.5478	0.00625	0.00482	a	18
-0.9026	1.523	1.5523	0.00474	0.00483	r	140
-0.9334	1.5757	1.6058	0.00491	0.00500	r	94
-1.0207	1.7237	1.7570	0.00538	0.00548	r	40
-1.0209	1.7374	1.7573	0.00542	0.00548	r	40
-1.042	1.747	1.7937	0.00545	0.00560	t	50
-1.1193	1.889	1.9271	0.00590	0.00602	r	135
-1.1301	1.906	1.9457	0.00695	0.00608	r	140
-1.135	1.860	1.954	0.00581	0.00610	t	26
-1.2	1.96	2.066	0.00612	0.00646	a	9
-1.2051	2.0321	2.075	0.00635	0.00649	r	94
-1.3759	2.318	2.366	0.00726	0.00741	r	140
-1.40797	2.3705	2.421	0.00743	0.00759	r	94
-1.4549	2.443	2.500	0.00766	0.00784	r	135
-1.4692	2.4720	2.525	0.00775	0.00792	r	94
-1.5	0.656	2.577	0.00203	0.00809	a	17
-1.5	1.970	2.577	0.00616	0.00809	a	17
-1.5	3	2.577	0.00944	0.00809	a	18
-1.584	2.650	2.718	0.00832	0.00854	t	50
-1.6095	2.698	2.761	0.00847	0.00867	t	140
-1.6447	2.7617	2.820	0.00868	0.00886	t	94
-1.6754	2.780	2.871	0.00874	0.00903	t	33
-1.72	3.00	2.94	0.00944	0.0093	r	157
-1.7319	2.906	2.966	0.00914	0.00933	t	135
-1.7947	3.0082	3.070	0.00947	0.00967	t	94
-1.894	3.155	3.234	0.00994	0.01019	t	26
-1.9	1.313	3.244	0.00408	0.01023	a	17
-1.9736	3.294	3.365	0.01039	0.01062	t	140
-2.0000	3.3418	3.409	0.01054	0.01076	t	94
-2.0506	3.432	3.491	0.0108	0.0110	r	135

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION (continued)

Table 4 (continued)

Solubility of Ice

T/K -273.15	mass % $100w_1$ exp.	calc.	mole fraction x_1 exp.	calc.	status	ref
-2.086	3.466	3.549	0.0110	0.0112	t	50
-2.1	2.627	3.572	0.0083	0.0113	a	17
-2.1912	3.6520	3.720	0.0116	0.0118	r	94
-2.2	4	3.734	0.0127	0.0118	a	18
-2.3088	3.836	3.909	0.0122	0.0124	r	140
-2.4	3.85	4.055	0.0122	0.0127	a	9
-2.4503	4.0658	4.135	0.0129	0.0131	r	94
-2.50	4.19	4.21	0.0133	0.0134	r	157
-2.5638	4.249	4.315	0.0135	0.0137	r	135
-2.618	4.319	4.401	0.0137	0.0140	r	50
-2.7018	4.459	4.532	0.0142	0.0144	r	140
-2.7072	4.4729	4.540	0.0142	0.0145	r	94
-2.9	3.33	4.840	0.0105	0.0154	a	13
-3.01	4.95	5.01	0.0158	0.0160	r	157
-3.0499	5.0040	5.070	0.0160	0.0162	r	94
-3.05	5	5.070	0.0160	0.0162	r	148
-3.174	5.182	5.258	0.0166	0.0168	r	50
-3.1983	5.239	5.295	0.0168	0.0169	r	140
-3.2429	5.304	5.362	0.0170	0.0172	r	135
-3.3149	5.411	5.470	0.0173	0.0175	r	140
-3.3825	5.5138	5.572	0.0177	0.0179	r	94
-3.4	5.254	5.598	0.0168	0.0179	a	17
-3.4237	5.527	5.633	0.0177	0.0178	r	33
-3.48	5.76	5.717	0.0185	0.0183	r	58
-3.6	5.66	5.894	0.0182	0.0189	t	9
-3.6984	5.992	6.038	0.0193	0.0194	r	140
-3.708	5.984	6.052	0.0192	0.0195	r	50
-3.8040	6.147	6.192	0.0198	0.0199	r	140
-3.9058	6.308	6.339	0.0203	0.0204	r	135
-3.9186	6.3181	6.357	0.0204	0.0205	r	94
-4.00	6.41	6.47	0.0207	0.0209	r	157
-4.1	6.567	6.617	0.0212	0.0214	r	17
-4.2	7	6.759	0.0227	0.0219	t	18
-4.210	6.712	6.773	0.0217	0.0219	r	50
-4.3457	6.9468	6.964	0.0225	0.0226	r	94
-4.3827	7.007	7.016	0.0227	0.0227	r	140
-4.4409	7.078	7.097	0.0229	0.0230	r	140
-4.7496	7.526	7.522	0.0245	0.0245	r	140
-4.8	7.41	7.591	0.0241	0.0247	t	9
-5.00	7.84	7.86	0.0256	0.0256	r	157
-5.0356	7.933	7.909	0.0259	0.0258	r	135
-5.17	8.19	8.089	0.0258	0.0264	r	58
-5.1824	8.127	8.105	0.0265	0.0265	r	140
-5.2239	8.185	8.160	0.0267	0.0267	r	140
-5.4	7.881	8.392	0.0257	0.0275	a	17
-5.8682	9.063	8.998	0.0298	0.0296	r	135
-5.9709	9.196	9.128	0.0303	0.0300	r	140
-6.0	9.09	9.165	0.0299	0.0302	r	9

(continued)

COMPONENTS

(1) Sodium chloride; NaCl;
[7647-14-5]

(2) Water; H_2O; [7732-18-5]

EVALUATOR:

R. Cohen-Adad; P. Vallée
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October, 1990

CRITICAL EVALUATION (continued)

Table 4 (continued)

Solubility of Ice

T/K -273.15	mass % $100w_1$ exp.	mass % $100w_1$ calc.	mole fraction x_1 exp.	mole fraction x_1 calc.	status	ref
-6.00	9.21	9.16	0.0303	0.0302	r	157
-6.0733	9.323	9.258	0.0307	0.0305	r	140
-6.1	9.09	9.291	0.0299	0.0306	t	13
-6.32	9.72	9.566	0.0321	0.0316	r	58
-6.4249	9.788	9.696	0.0324	0.0320	r	140
-6.6	9.9	9.912	0.0328	0.0328	r	45
-6.6	10	9.912	0.0331	0.0328	r	18
-6.60	10	"	0.0331	"	r	148
-6.7	9.194	10.03	0.0303	0.0332	a	17
-6.7494	10.205	10.09	0.0338	0.0334	r	140
-7.00	10.50	10.39	0.0349	0.0345	r	157
-7.0582	10.601	10.46	0.0353	0.0348	r	135
-7.2	10.71	11.63	0.0357	0.0354	r	9
-7.7	10.508	11.22	0.0349	0.0375	a	17
-7.7	10.821	11.87	0.0361	"	t	17
-8.00	11.72	11.56	0.0393	0.0387	r	157
-8.281	12.071	11.88	0.0406	0.0399	r	140
-8.4	12.28	12.01	0.0414	0.0404	t	9
-8.4987	12.328	12.12	0.0415	0.0408	r	135
-8.52	12.43	12.14	0.0419	0.0409	t	58
-8.791	12.658	12.44	0.0428	0.0420	r	140
-9.00	12.86	12.67	0.0435	0.0428	r	157
-9.1	13	12.78	0.0440	0.0432	r	18
-9.25	13.0	12.94	0.0440	0.0438	r	45
-9.4	13.130	13.10	0.0445	0.0444	r	17
-9.41	13.39	13.10	0.0445	0.0444	t	58
-9.692	13.654	13.40	0.0465	0.0455	r	140
-9.7	13.04	13.41	0.0442	0.0456	t	13
-9.715	13.680	13.43	0.0466	0.0456	r	140
-9.8	13.73	13.52	0.0468	0.0460	r	111
-10.03	14.00	13.75	0.0478	0.0468	r	157
-10.1341	14.129	13.86	0.0483	0.0473	t	135
-10.186	14.163	13.91	0.0484	0.0475	r	140
-10.204	14.203	13.93	0.0486	0.0475	t	140
-10.6	13.8	14.33	0.0470	0.0491	t	82
-10.97	15	14.70	0.0516	0.0505	t	148
-11.00	14.98	14.73	0.0515	0.0506	r	157
-11.0	15	14.73	0.0516	0.0506	r	18
-11.04	15.16	14.77	0.0522	0.0507	t	58
-11.1	14.448	14.83	0.0495	0.0509	t	17
-11.2064	15.228	14.94	0.0525	0.0513	t	135
-11.273	15.279	15.00	0.0527	0.0516	r	140
-11.45	14.89	15.17	0.0512	0.0523	r	13
-11.9	16	15.60	0.0555	0.0539	t	18
-12.00	15.96	15.70	0.0553	0.0543	r	157
-12.189	16.165	15.88	0.0561	0.0550	r	140
-12.4	15.762	16.07	0.0545	0.0558	t	17

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION (continued)

Table 4 (continued)

Solubility of Ice

T/K -273.15	mass % $100w_1$ exp.	mass % $100w_1$ calc.	mole fraction x_1 exp.	mole fraction x_1 calc.	status	ref
-12.7	16.7	16.35	0.0582	0.0568	t	45
-13.05	16.93	16.67	0.0591	0.0581	r	157
-13.6	16.67	17.17	0.0581	0.0601	t	13
-13.633	17.488	17.20	0.0613	0.0602	r	140
-14.00	17.77	17.52	0.0625	0.06115	r	157
-14.33	18.20	17.81	0.0642	0.0626	t	58
-14.77	18.69	18.18	0.0662	0.0641	t	58
-15.0	17.075	18.38	0.0597	0.0649	a	17
-15.00	18.62	18.38	0.0659	0.0649	r	157
-15.05	17.95	18.42	0.0632	0.0651	t	13
-15.4	18.389	18.72	0.0649	0.0663	r	17
-15.5	19	18.80	0.0674	0.0666	r	18
-16.21	19.84	19.38	0.0709	0.0690	t	58
-16.48	20	19.60	0.0715	0.0699	t	148
-16.67	20	19.75	0.0715	0.0705	r	45
-17.0	20	20.01	0.0715	0.0716	r	18
-17.01	20.22	20.02	0.0725	0.0716	r	157
-18.24	21.17	20.97	0.0765	0.0756	r	157
-18.73	21.69	21.34	0.0787	0.0712	r	58
-19.00	21.68	21.54	0.0786	0.0780	r	157
-19.2	21.8	21.69	0.0791	0.0787	r	111
-20.0	22	22.27	0.0800	0.0812	r	18
-20.00	22.37	"	0.0816	"	r	157
-20.56	22.90	22.67	0.0839	0.0829	r	58
-20.81	23.225	22.85	0.0853	0.0836	r	148
-21.00	23.04	22.98	0.0845	0.0842	r	157
-21.1	23.07	23.05	0.0846	0.0845	r	91
-21.12	23.3	23.06	0.0856	0.0846	r	58
-21.2	22.97	23.11	0.0842	0.0848	r	142
-21.21	23.20	23.13	0.0852	0.0849	r	157
-21.25	23.19	23.15	0.0851	0.0850	r	111
-21.3	23.5	23.18	0.0865	0.0851	r	45
-21.4	22.58	23.26	0.0825	0.0854	t	14
-21.6	22.9	23.39	0.0839	0.0860	r	82
-21.85	22.84	23.57	0.0836	0.0868	t	32
-22	23.6	23.67	0.0869	0.0872	r	18
-23.6	23.80	24.75	0.0878	0.0920	t	13

$e = |x_1(\text{exp}) - x_1(\text{calc})|/x_1(\text{calc})$ r = recommended value $e \leqslant 0.02$

t = tentative value $0.02 < e \leqslant 0.05$ a = aberrant value $e > 0.05$

3.6 Vapor Pressure of the Saturated Solution

Measurements are few at atmospheric pressure or below. Foote *et al.* (92) proposed an analytical relationship applicable between 0 and 30°C:

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION (continued)

$\log(p/\mathrm{mmHg}) = -28900.7\ \mathrm{K}/T - 4.715 \log(T/\mathrm{K}) + 22.612\ 9$. Leopold and Johnson (76) have measured the vapor pressure of the saturated solution between 20 and 50°C. Data at particular temperatures are also given: at 100°C (51) and at the boiling point of the saturated solution under atmospheric pressure (17, 37). Above atmospheric pressure, several series of measurements have been carried out (83, 107, 109, 127, 138).

Vapor pressures of saturated solutions have been calculated, for the whole domain of crystallization of NaCl, from the formulas in the Preface:

$$\ln(p/\mathrm{bar}) = \ln\{(1 - x_1)/(1 + x_1)\} + a/(T/\mathrm{K}) + b \ln(T/\mathrm{K}) + cT/\mathrm{K} + d$$

where x_1 and T are the coordinates of a point on the solubility curve, and p is the vapor pressure. The adjustable coefficients a, b, c and d have been calculated by least squares, and have the values:

$a = -4836.87$; $b = 2.3931$; $c = -0.0050148$; $d = 0.54266$

The critical evaluation of the data in the bibliography is given in Table 5. Most of the experimental data exhibit a relative deviation within 5 % of the calculated values, and are recommended. Three values, for which the deviation is greater than 10 %, are considered to be aberrant. The best data at high temperature are those of Sourirajan and Kennedy (127).

3.7 Composition of the Vapor in Three-Phase S-L-G Equilibria

Three papers give 40 values of vapor compositions for three-phase equilibria (109, 127, 155). Ten of these (109), in the range 380-475°C, were derived by the compiler from the authors' rounded values of T-p-composition data and of T and p for saturated solutions. Twelve values (155), over the range 324-503°C, were in general agreement with those from (109), but are considered to be more reliable (no rounding was involved), and they are used as the basis for evaluation. It is found that the data from (155) can be fitted to the equation

$$\ln y_1 = a_1 + b_1/T$$

with $a_1 = 7.85$, $b_1 = 12.55 \times 10^{-3}$ K. This equation does not extrapolate to the melting point of NaCl, and is restricted to the range 324-503°C.

There are 18 values in (111) over the range 350-700°C, of which seven agree roughly with those in (109) and (155) over the range 350-425°C, but show marked deviations between 430 and 503°C. Above 503°C, the data in (127) are the only ones available; while they extrapolate smoothly to the melting point of NaCl, they must be considered as aberrant over most of the range.

All data are included in Table 5, and are recommended if $e \leq 0.3$ (see

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION (continued)

Table), the high value indicating the experimental difficulties in obtaining precise values.

Table 5

Vapor Pressures of Saturated Solutions of NaCl and Composition of the Vapor Phase

T/K −273.15	mass % in: liq. $100w_1$ calc.	mass % in: vap. $100u_1$ obs.	mole fraction liq. x_1 calc.	mole fraction vapor 10^5y_1 obs.	mole fraction vapor 10^5y_1 calc.	status y_1	pressure p/bar obs.	pressure p/bar calc.	status p	ref
18	26.39		0.0995				0.01562	0.01570	r	96
20.42	26.41		0.0996				0.01820	0.01816	r	76
25.49	26.47		0.0999				0.02447	0.02441	r	76
29.96	26.52		0.1001				0.03173	0.03139	r	76
36.92	26.62		0.1006				0.04671	0.04575	r	76
40.55	26.67		0.1008				0.05672	0.05530	r	76
50	26.84		0.1016				0.09179	0.08874	r	76
75	27.38		0.1041				0.286	0.2727	r	138
100	28.05		0.1073				0.749	0.716	r	51
107	28.29		0.1084				1.013	0.915	a	17
108.8	28.33		0.1087				1.013	0.973	r	17
108.668	28.35		0.1086				1.013	0.969	r	37
108.81	28.35		0.1087				1.016	0.974	r	138
125	28.89		0.1113				1.707	1.651	r	138
142	29.51		0.1143				2.13	2.739	a	83
150	29.84		0.1159				3.48	3.42	r	138
175	30.91		0.1212				6.48	6.48	r	138
181	31.17		0.1225				6.59	7.47	a	83
183.0	31.27		0.1230				7.37	7.82	t	107
200	32.10		0.1272				11.19	11.38	r	138
205	32.36		0.1285				12.16	12.63	r	83
205.1	32.36		0.1285				11.92	12.65	t	107
219.5	33.11		0.1324				21.5	16.85	a	127
225	33.40		0.1339				18.17	18.70	r	138
230.2	33.69		0.1354				19.55	20.59	t	107
246.7	34.63		0.1404				25.41	27.50	t	107
249.5	34.80		0.1413				33.5	28.81	a	127
250	34.84		0.1415				27.97	29.05	r	138
254.6	35.10		0.1429				27.88	31.33	a	107
259.8	35.42		0.1446				38.38	34.06	a	127
275	36.39		0.1499				41.19	42.94	r	138
279.3	36.66		0.1514				52	45.73	a	127
280	36.71		0.1517				51	46.18	a	127
299.3	38.00		0.1589				56.78	60.22	t	107
300	38.05		0.1592				56.76	60.22	t	138
300.3	38.07		0.1593				57.6	61.01	t	155
300.8	38.10		0.1595				66.6	61.40	t	127
312.2	38.91		0.1641				75.1	71.00	t	127
313.2	38.98		0.1645				75.6	71.80	t	127
323	39.70		0.1687				84.8	80.80	r	127
323.7	39.75	0.0071	0.1690	0.22	0.19	r	78.8	81.47	r	155
327.3	40.02		0.1706				79.54	84.94	t	107

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION (continued)

Table 5

Vapor Pressures of Saturated Solutions of NaCl and Composition of the Vapor Phase (continued)

T/K -273.15	mass % in: liq. $100w_1$ calc.	vap. $100u_1$ obs.	mole fraction liq. x_1 calc.	vapor 10^5y_1 obs.	calc.	status y_1	pressure *p*/bar obs.	calc.	status *p*	ref
343.5	41.25		0.1779				105.8	101.6	r	127
343.5	41.25		0.1779				106	101.6	r	127
344.4	41.33		0.1784				97.57	102.6	r	107
348.5	41.64	0.0014	0.1803	0.43	0.44	r	105.3	107.0	r	155
350	41.76		0.1810				105.4	108.7	r	136
350	41.76		0.1810				110.8	108.7	r	109
350	"	0.0026	"	0.80	0.46	a	114	"	r	127
354.3	42.10		0.1831				107.8	113.6	t	107
360	42.57		0.1860				124.5	120.2	r	109
360	"	0.0035	"	1.08	0.63	a	127	"	t	127
363.5	42.86		0.1878				131.2	125.9	r	127
370	43.39		0.1911				138.3	132.2	r	109
370	"	0.0046	"	1.42	0.86	a	140	"	t	127
375	43.82		0.1938				146.5	138.4	t	127
375.1	43.85	0.0032	0.1940	0.99	1.00	r	137.4	139.1	r	155
375.5	43.85	0.0026	0.1940	0.80	1.02	r	138.4	139.1	r	155
380	44.24	0.0060	0.1965	1.85	1.16	t	152.0	144.8	r	109
380	"	0.0056	"	1.73	"	t	153	"	t	127
384.6	44.63		0.1990				160.6	150.7	t	127
385.7	44.72		0.1996				146.9	152.2	r	107
386.2	44.77		0.1999				161.6	152.8	t	127
390	45.11	0.0076	0.2021	2.34	1.55	t	165.7	157.8	r	109
390	"	0.0068	"	2.10	"	t	167	"	t	127
400	45.99		0.2079				173	171.3	r	136
400	"	0.0098	"	3.02	2.05	t	179.5	"	r	109
400	"	0.0080	"	2.47	"	r	182	"	t	127
400.2	46.01	0.0065	0.2080	2.00	2.06	r	172.7	171.6	r	155
405.3	46.47		0.2111				190.6	178.5	t	127
406.8	46.6		0.2120				191.9	180.7	t	127
410.0	46.9	0.013	0.2140	4.01	2.70	t	194.2	185.1	r	109
410.0	46.9		0.2140				181.3	185.1	r	107
420	47.82	0.017	0.2203	5.24	3.52	t	208.9	199.2	r	109
425	48.30	0.012	0.2236	3.54	4.00	r	220			127
425.8	48.39		0.2242				222.0	207.5	t	127
427.0	48.50	0.013	0.2250	4.01	4.21	r	214.1	209.2	r	155
430	48.79	0.021	0.2270	6.47	4.55	t	222.6	213.5	r	109
438.8	49.63		0.2330				240.0	226.3	t	127
440	49.76	0.027	0.2339	8.32	5.84	t	238.3	228.0	r	109
442.5	50.01		0.2357				233.2	231.6	r	107
444.3	50.19		0.2370				250.5	234.2	t	127
446.6	50.41		0.2386				253.0	237.6	t	127
450	50.75		0.2411				246.0	242.5	r	141
450	"	0.033	"	10.2	7.45	t	253.0	"	r	109

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION (continued)

Table 5

Vapor Pressures of Saturated Solutions of NaCl and Composition of the Vapor Phase (continued)

T/K -273.15	mass % in: liq. $100w_1$ calc.	vap. $100u_1$ obs.	mole fraction liq. x_1 calc.	vapor 10^5y_1 obs.	calc.	status y_1	pressure p/bar obs.	calc.	status p	ref
450	50.75	0.0157	0.2411	4.84	7.45	r	259	242.5	t	127
450.5	50.81	0.027	0.2415	8.32	7.54	r	251.5	243.2	r	155
451.8	50.94	0.031	0.2424	9.55	7.78	r	253.5	245.1	r	155
460	51.77	0.039	0.2486	12.0	9.44	r	267.7	256.9	r	109
465.0	52.3		0.2526				281.0	264.1	t	127
466.9	52.5		0.2541				283.0	266.8	t	127
467.5	52.55		0.2545				272.6	267.7	r	107
470.0	52.81		0.2565				288.0	271.3	t	127
475	53.34	0.051	0.2606	15.7	13.3	r	291.3	278.3	r	109
475	"	0.020	"	6.17	"	t	296	"	t	127
475.9	53.44	0.046	0.2613	14.2	13.6	r	288.8	279.6	r	155
477.0	53.56	0.049	0.2623	15.1	13.9	r	291.9	281.1	r	155
485.5	54.48		0.2695				298.7	292.9	r	107
488.9	54.84		0.2724				314.5	297.6	t	127
500	56.08		0.2824				326	312.3	r	141
500	"	0.0243	"	7.49	22.9	a	330	"	t	127
501.9	56.29		0.2842				332.2	314.8	t	127
502.5	56.36	0.070	0.2847	21.6	21.4	r	327.2	315.6	r	155
502.6	56.37		0.2848				333.5	315.7	t	127
503.4	56.46	0.075	0.2856	23.1	24.6	r	328.0	316.7	r	155
504.4	56.57		0.2865				334.5	318.0	t	127
514.2	57.69		0.2959				339.5	330.2	r	107
525	58.95	0.0292	0.3068	9.00	-	a	358.2	342.9	r	127
527.8	59.29		0.3098				360.0	345.9	r	127
550	61.96		0.3343				380	368.2	r	141
550	"	0.0342	"	10.5	-	a	379	"	r	127
550.5	62.03		0.3349				375.0	368.6	r	107
555.3	62.63		0.3406				381.5	372.7	r	127
558.6	63.04		0.3446				384.0	375.3	r	127
560.0	63.22		0.3463				384.0	376.4	r	127
575	65.13	0.0380	0.3654	11.7	-	a	389			127
577.5	65.45		0.3687				390.0	387.9	r	127
600.0	68.44	0.0414	0.4006	12.8	-	a	392.0	396.2	r	127
604.3	69.02		0.4072				391.0	396.9	r	127
609.3	69.71		0.4150				389.5	397.2	r	127
610.0	69.81		0.4161				388.0	397.3	r	127
625	71.89	0.0744	0.4408	23	-	a	379			127
633.9	73.15		0.4565				373.5	392.7	r	127
646.2	74.93		0.4795				373.4	386.1	t	107
650	75.48	0.1600	0.4869	49	-	a	356			127
668.1	78.17		0.5247				335.5	366.6	t	127
675.0	79.22	0.3815	0.5402	118	-	a	326.2	358.2	t	127
700	83.09	0.9416	0.6023	292	-	a	287			127
707.0	84.19		0.6215				269.5	305.1	a	127
708.5	84.43		0.6257				269.0	302.0	a	127

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION (continued)

Table 5

Vapor Pressures of Saturated Solutions of NaCl and Composition of the Vapor Phase (continued)

$e = |z(\text{exp}) - z(\text{calc})|/z(\text{calc})$, $z = p$ or y_1

r = recommended value $e(p) \leq 0.05$ $e(y_1) \leq 0.3$

t = tentative value $0.05 < e(p) \leq 0.1$ $0.3 < e(y_1) \leq 0.6$

a = aberrant value $e(p) > 0.1$ $e(y_1) > 0.6$

The compositions for ref. 109 have been estimated by the evaluator; the data from refs. 107 and 109 have been converted to bars.

3.8 Influence of pressure on the solubility of NaCl and of ice

This has been measured by different authors near ambient pressure, but, depending on the author, for different temperatures and pressures. The data are too fragmentary to permit a critical analysis. The totality of the results at 25°C is summarized in Table 6 and in Figure 1, which has been constructed according to Adams and Adams and Gibson (87, 88).

Table 6

Influence of Pressure on Solubility of Ice, $NaCl \cdot 2H_2O$ and NaCl

$T/K - 273.15$	range of pressure (exp)	solid phases	ref
0 - 30.0	< 40 bar	NaCl	11
18.5	500 bar	NaCl	31
24.05	< 1 500 bar	NaCl	47
25	< 735 bar	NaCl	56
-35,-25.7	571, 2 550 bar	ice I + $NaCl \cdot 2H_2O$ ice III′ + $NaCl \cdot 2H_2O$	60
0.05, 5.4	< 855 bar	$NaCl \cdot 2H_2O$ + NaCl	85
29.93	< 1 911 bar	NaCl	87
25	< 16 570 bar	NaCl; $NaCl \cdot 2H_2O$ (metastable)	88
25	< 9 800 bar	NaCl	108

3.9 Densities of saturated solutions

Four numerical values can be found in the bibliography for the solubility branch of ice, five for the solubility branch of $NaCl \cdot 2H_2O$, and 62 for the liquidus curve of NaCl up to 200°C.

The critical evaluation of the densities has been carried out by using a polynomial regression equation; the values of the constants a_1, b_1, c_1, d_1 and the calculated densities are given in Tables 7 and 8.

(continued)

COMPONENTS

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

EVALUATOR:

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October, 1990

CRITICAL EVALUATION (continued)

Table 7

Coefficients of Fitting Equations for Density of Saturated Solutions

a_1	b_1	c_1	d_1	solid phases	range/°C
0.9999	2.4422	-2.2383	0	ice	0 to -21.26
1.314	-3.3702	22.6397	0	$NaCl \cdot 2H_2O$	-21.26 to 0
8.1149	-171.543	1412.65	-3889	NaCl	0 to 250

Table 8

Densities of Saturated Solutions: Binary System $NaCl-H_2O$ (continued)

T/K -273.15	mole fraction x_1(calc)	density d/g cm^{-3}		solid phases	status	ref
		exp.	calc.			
0	0	0.9999	0.9999	ice	r	
-9.8	0.0460	1.1075	1.1077	ice	r	111
-19.2	0.0787	1.179	1.178	ice	r	111
-21.25	0.0850	1.191	1.191	ice + $NaCl \cdot 2H_2O$	r	111
-19.2	0.0863	1.193	1.192	$NaCl \cdot 2H_2O$	r	111
-10	0.0922	1.1898	1.1957	"	r	101
-9.8	0.0923	1.2015	1.1958	"	r	111
0	0.0989	1.209	1.2023	$NaCl \cdot 2H_2O$ + NaCl	r	111
0	"	1.209	"	"		91
0	"	1.202	"	"	r	101
0	"	1.2090	"	"	r	123
0.2	0.0989	1.209	"	"	r	82
0.35	0.0990	1.2090	1.2042	NaCl	r	37
10	0.0992	1.1994	1.2028	"	r	101
10	"	1.201	"	"	r	91
10	"	1.2047	"	"	r	111
15	0.0994	1.2024	1.2017	"	r	80
15	"	1.20433	"	"	r	7
15	"	1.207148	"	"	r	5
15.20	0.0994	1.2020	1.2017	"	r	37
15.5	0.0994	1.2025	1.2017	"	r	27
15.6	0.0994	1.20419	1.2017	"	r	16
15.6	0.0994	1.20403	1.2017	"	r	16
15.6	"	1.21148	"	"	r	16
15.6	"	1.20693	"	"	r	16
18.5	0.0995	1.2019	1.2008	"	r	74
20	0.0996	1.201	1.2004	"	r	101
20	"	1.193	"	"	r	53
20	"	1.2001	"	"	r	80
20	"	1.2021	"	"	r	8
25	0.0998	1.1979	1.1990	"	r	80
25	"	1.196	"	"	r	129
25	0.0998	1.199	1.1990	"	r	118
25	"	1.198	"	"	r	82
25	"	1.19814	"	"	r	77
25		1.1984	"	"	r	116
25	"	1.195	"	"	r	130

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION (continued)

Table 8

Densities of Saturated Solutions: Binary System $NaCl-H_2O$ (continued)

T/K -273.15	mole fraction x_1(calc)	density d/g cm^{-3} exp.	calc.	solid phases	status	ref
25	0.0998	1.2053	1.1990	NaCl	r	111
25	"	1.2053	"	"	r	123
30	0.1001	1.1957	1.1974	"	r	53
30	"	1.202	"	"	r	37
30.05	0.1001	1.1056	1.1974	"	a	101
35	0.1004	1.1910	1.1956	"	r	91
35	"	1.1935	"	"	r	116
40	0.1008	1.192	1.1937	"	r	53
40	"	1.197	"	"	r	37
45.40	0.1012	1.1891	1.1916	"	r	129
50	0.1016	1.188	1.1896	"	r	118
50	0.1016	1.187	"	"	r	111
50	"	1.1900	"	"	r	101
50	"	1.185	"	"	r	82
50	"	1.1928	"	"	r	123
60	0.1025	1.184	1.1853	"	r	91
61.70	0.1027	1.1823	1.1845	"	r	37
65	0.1030	1.1920	1.1831	"	r	101
70	0.1035	1.178	1.1808	"	r	111
75	0.1041	1.181	1.1786	"	r	118
75	0.1041	1.175	1.1786	"	r	82
75	"	1.1936	"	"	t	123
75.65	0.1042	1.1764	1.1783	"	r	37
80	0.1047	1.1926	1.1764	"	t	29
90.50	0.1060	1.1701	1.1719	"	r	37
91	0.1061	1.189	1.1716	"	t	53
100	0.1073	1.166	1.1680	"	r	91
100	"	1.168	"	"	r	111
100	"	1.167	"	"	r	90
100	"	1.164	"	"	r	82
105	0.1081	1.162	1.1661	"	r	82
107.0	0.1084	1.1631	1.1654	"	r	37
108.7	0.1086	1.162	1.1648	"	r	91
130	0.1121	1.161	1.1584	"	r	90
150	0.1159	1.155	1.1543	"	r	90
170	0.1200	1.152	1.1516	"	r	90
200	0.1272	1.148	1.1472	"	r	90

$e = \Delta d/d$(calc)   r = recommended value $e < 0.01$
t = tentative value $0.01 < e < 0.02$ a = aberrant value $e > 0.02$

SOLUBILITY, VAPOR PRESSURE AND DENSITY FOR ROUNDED VALUES OF TEMPERATURE

Values of these quantities are given in Table 9 and in Figures 2 and 3.

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION (continued)

Table 9

Solubility, Density, Vapor Pressure and Activity
of Water in Saturated Solutions for Rounded Values of Temperature
Binary System $NaCl-H_2O$

T/K -273.15	mass %	mole fraction	$\ln f_2$	d/g cm^{-3}	p/bar	solid phases
-1	1.721	0.0054	0.00104	1.013		ice
-2	3.409	0.0108	0.00212	1.026		"
-3	4.993	0.0159	0.00277	1.038		"
-4	6.474	0.0209	0.00294	1.050		"
-5	7.861	0.0256	0.00268	1.061		"
-6	9.165	0.0302	0.00201	1.072		"
-7	10.395	0.0345	0.00099	1.082		"
-8	11.560	0.0387	-0.00035	1.091		"
-9	12.668	0.0428	-0.00198	1.100		"
-10	13.724	0.0467	-0.00386	1.109		ice
-11	14.732	0.0506	-0.00599	1.118		"
-12	15.699	0.0543	-0.00832	1.126		"
-13	16.627	0.0579	-0.01086	1.134		"
-14	17.520	0.0615	-0.01358	1.142		"
-15	18.380	0.0649	-0.01646	1.149		"
-16	19.210	0.0683	-0.01950	1.156		"
-17	20.012	0.0716	-0.02269	1.163		"
-18	20.788	0.0749	-0.02602	1.170		"
-19	21.541	0.0780	-0.02947	1.177		"
-20	22.270	0.0811	-0.03305	1.183		"
-21	22.979	0.0842	-0.03675	1.190		"
-22	23.667	0.0873	-0.04055	1.196		"
-22	23.05	0.0845		1.191		$NaCl \cdot 2H_2O$
-21	23.20	0.0852		1.191		"
-20	23.35	0.0859		1.192		"
-19	23.50	0.0865		1.192		"
-18	23.65	0.0872		1.192		"
-17	23.80	0.0878		1.193		"
-16	23.94	0.0884		1.193		"
-15	24.08	0.0891		1.193		"
-14	24.23	0.0897		1.194		"
-13	24.37	0.0903		1.195		"
-12	24.51	0.0910		1.195		"
-11	24.65	0.0916		1.196		"
-10	24.79	0.0922		1.196		"
-9	24.93	0.0929		1.196		"
-8	25.08	0.0935		1.197		"
-7	25.22	0.0942		1.197		"
-6	25.36	0.0948		1.198		"
-5	25.51	0.0955		1.199		"
-4	25.66	0.0962		1.199		"
-3	25.81	0.0968		1.200		"
-2	25.96	0.0975		1.201		"
-1	26.11	0.0982		1.201		"
0	26.27	0.0990		1.2040	0.0050	$NaCl \cdot 2H_2O$ + NaCl
5	26.29	0.0991		1.2034	0.0069	NaCl
10	26.32	0.0992		1.2028	0.0096	"
15	26.35	0.0994		1.2016	0.0131	"

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION (continued)

Table 9 (continued)

Solubility, Density, Vapor Pressure and Activity of Water in Saturated Solutions for Rounded Values of Temperature Binary System $NaCl-H_2O$

T/K -273.15	mass %	mole fraction	lnf_2	*d*/g cm^{-3}	*p*/bar	solid phases
20	26.40	0.0996		1.2004	0.0177	"
25	26.46	0.0998		1.1992	0.0237	"
30	26.52	0.1001		1.1975	0.0315	"
35	26.59	0.1004		1.1959	0.0413	"
40	26.66	0.1008		1.1937	0.0537	"
45	26.74	0.1012		1.1916	0.0693	"
50	26.83	0.1016		1.1896	0.0887	"
55	26.93	0.1020		1.1877	0.1127	"
60	27.03	0.1025		1.1854	0.1420	"
65	37.14	0.1030		1.1832	0.1777	NaCl
70	27.25	0.1035		1.1811	0.2290	"
75	27.37	0.1041		1.1787	0.2727	"
80	27.50	0.1047		1.1764	0.3346	"
85	27.63	0.1053		1.1743	0.4081	"
90	27.77	0.1060		1.1720	0.4948	"
95	27.91	0.1066		1.1702	0.5967	"
100	28.06	0.1073		1.1682	0.716	"
105	28.21	0.1081		1.1661	0.854	"
110	28.37	0.1088		1.1645	1.014	"
115	28.54	0.1096		1.1628	1.198	"
120	28.71	0.1104		1.1612	1.41	"
125	28.88	0.1113		1.1597	1.65	"
130	29.06	0.1121		1.1585	1.93	"
135	29.24	0.1130		1.1572	2.24	"
140	29.43	0.1140		1.1561	2.59	"
160	30.24	0.1179		1.1529	4.46	"
180	31.13	0.1223		1.1506	7.30	"
200	32.09	0.1272		1.1472	11.4	"
220	33.13	0.1325		1.1397	17.0	"
240	34.24	0.1383		1.1227	24.5	"
260	35.43	0.1447			34.2	"
280	36.70	0.1516			46.2	"
300	38.05	0.1592			60.8	"
320	39.47	0.1674			78.0	"
340	40.98	0.1763			97.8	"
360	42.56	0.1860			120	"
380	44.23	0.1965			145	"
400	45.99	0.2079			171	"
420	47.83	0.2203			199	"
440	49.75	0.2339			228	"
460	51.77	0.2486			257	"
480	53.88	0.2648			285	"
500	56.07	0.2824			312	"
520	58.36	0.3017			337	"
540	60.74	0.3229			359	"
560	63.21	0.3463			376	"
580	65.78	0.3721			389	"
600	68.43	0.4006			396	"
620	71.18	0.4323			397	"
640	74.02	0.4677			390	"

(continued)

COMPONENTS

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

EVALUATOR:

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CRITICAL EVALUATION (continued)

Table 9 (continued)

Solubility, Density, Vapor Pressure and Activity of Water in Saturated Solutions for Rounded Values of Temperature
Binary System $NaCl-H_2O$

T/K -273.15	mass %	mole fraction	$\ln f_2$	d/g cm^{-3}	p/bar	solid phases
660	76.96	0.5073			374	"
680	79.98	0.5519			351	"
700	83.08	0.6023			318	"
720	86.27	0.6597			276	"
740	89.55	0.7254			224	"
760	92.90	0.8014			161	"
780	96.32	0.8899			88	"
800	99.82	0.9943			-	"
801	100.00	1.0000			-	"

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COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

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COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

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COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

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(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION (continued)

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(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION (continued)

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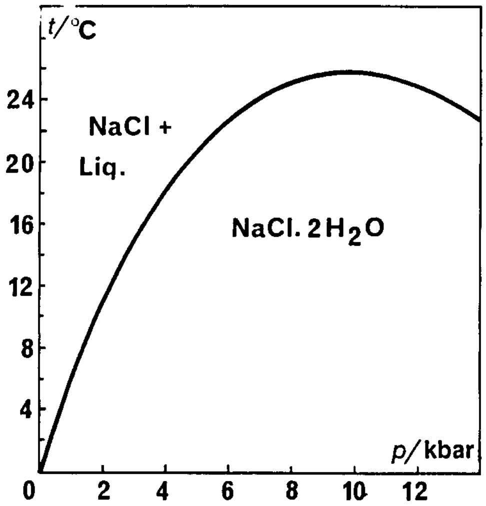

Fig. 1. Influence of pressure on the temperature of the peritectic transition $NaCl \cdot 2H_2O(s) = NaCl(s) + satd. sln.$

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION (continued)

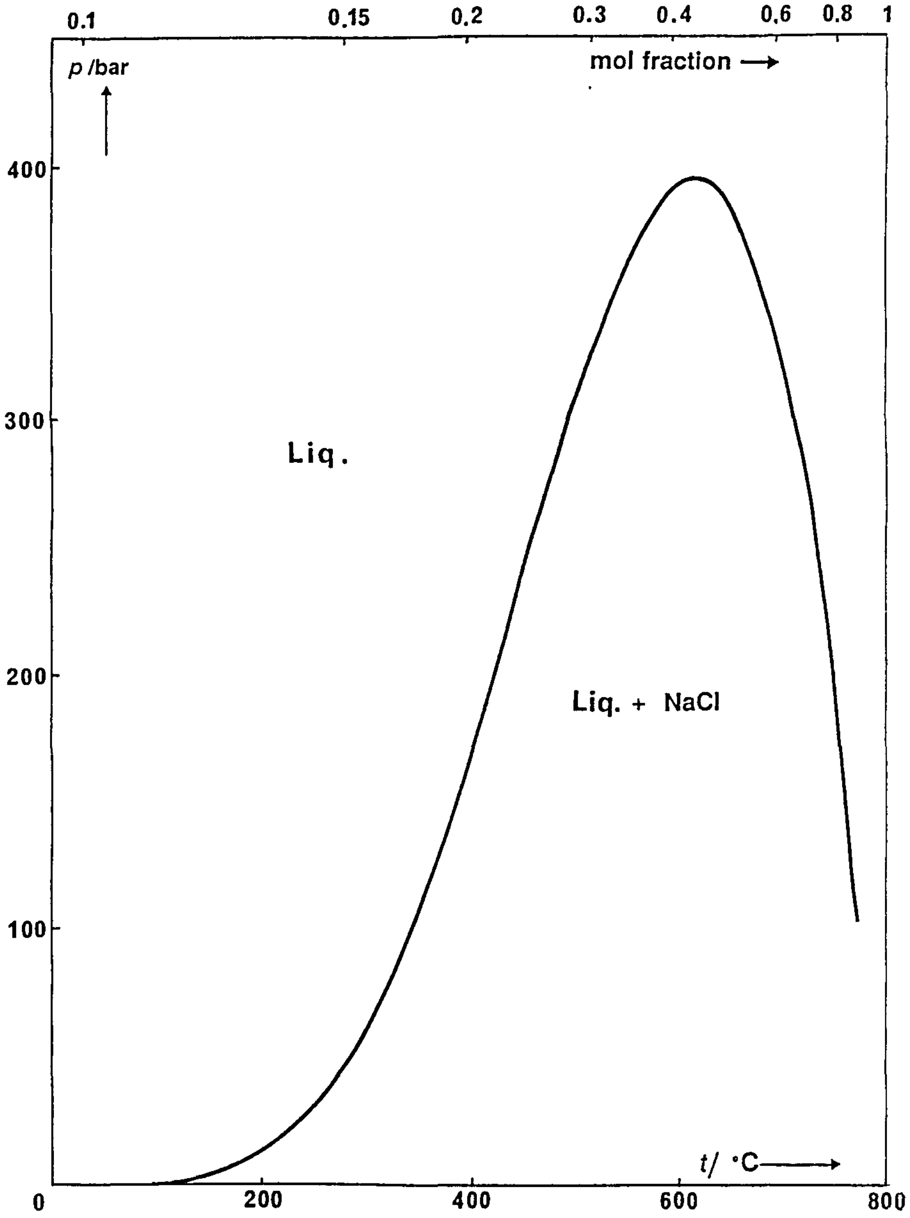

Fig. 2. Vapor pressure-temperature curve for three-phase solid-liquid-vapor equilibria in the binary system NaCl-H_2O.

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée *Université Claude Bernard (Lyon I),* 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. October, 1990

CRITICAL EVALUATION (continued)

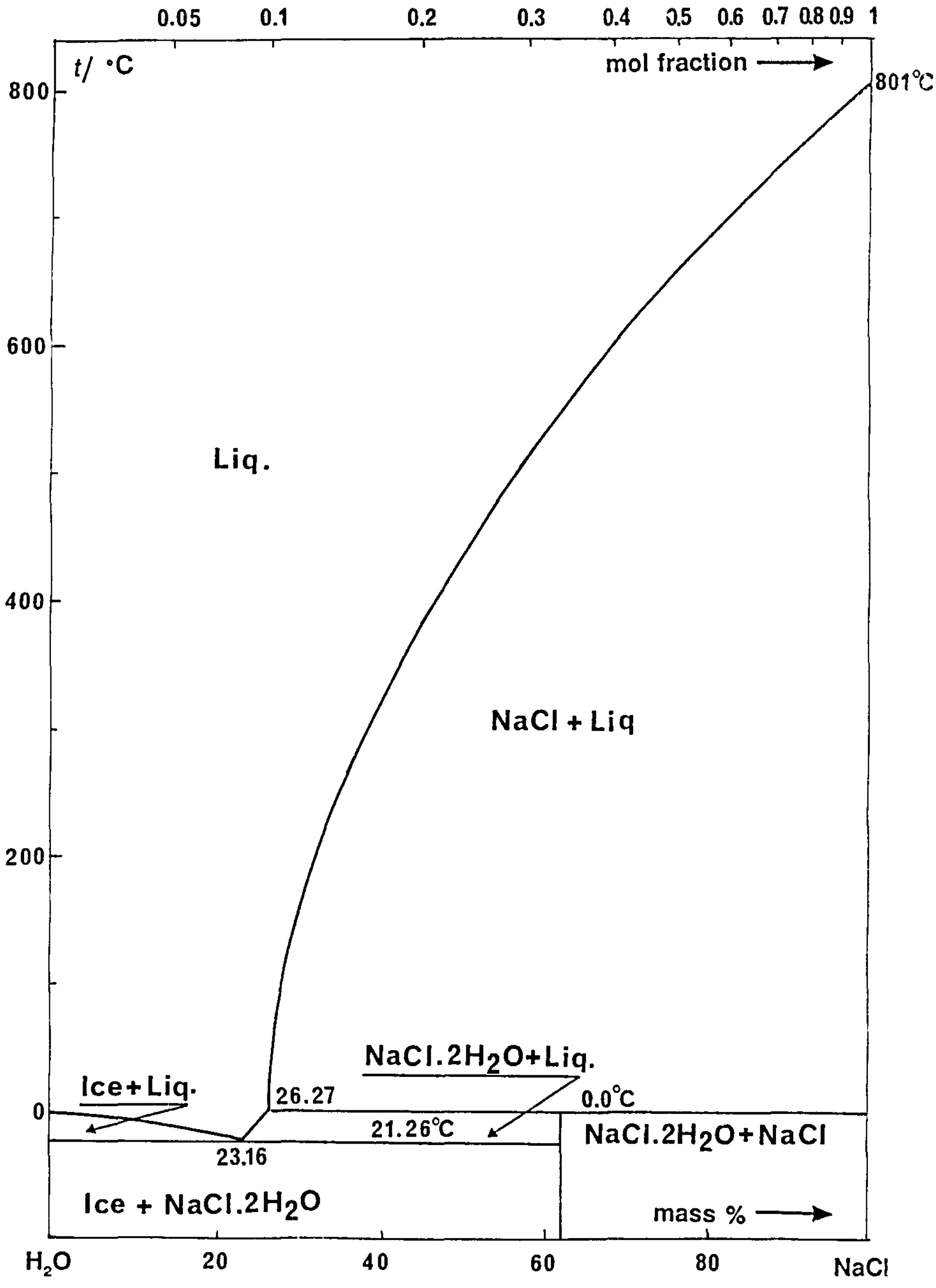

Fig. 3. Temperature-composition phase diagram for the binary system NaCl-H_2O under the vapor pressure of the saturated solution.

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Gay-Lussac, M.

Ann. Chim. Phys. [2] 1819, *11*, 296-315.

VARIABLES:

T/K = 287-383

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio NaCl/H_2O	mass % (compiler)	solid phase
13.89	35.81	26.37	NaCl
16.90	35.88	26.41	"
59.93	37.14	27.08	"
109.73	40.38	28.76	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Isothermal method. Samples were analyzed by heating to dryness.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Michel, A.; Krafft, L.

Ann. Chim. Phys. [3] 1854, *41*, 471-83.

VARIABLES:

T/K = 288

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	NaCl g dm^{-3}	NaCl mass %	relative density, d_{15}^{15}	solid phase
15	318.479	26.38	1.207148	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Mixtures of water and salt in excess were maintained for one month in the range 14-16°C and stirred frequently.
After one day at 15°C, samples of solution were drawn off and analyzed by evaporation to dryness and weighing.

SOURCE AND PURITY OF MATERIALS:

The pure salt was dried at 100°C.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Unger, U.

J. Prakt. Chem. 1836, *8*, 285-304.

VARIABLES:

T/K = 271-378

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°Re[a]	*t*/°C	100(mass ratio NaCl/H_2O)[b]	20(mass ratio NaCl/solution)	mass % (compiler)		solid phases (compiler)
-2	-2.5	34.0482	-	25.4000		NaCl·$2H_2O$
-2	-2.5	-	5.165	25.825	25.625[d]	"
0	0	-	5.275	26.375		NaCl
0	0	-	5.320	26.60		"
0	0	-	5.199	25.995		"
0	0	-	5.144	25.72		"
0	0	-	5.232	26.16	26.27[d]	"
1	1.25	35.2722	-	27.0750		"
1	1.25	-	5.269	26.345		"
1	1.25	-	5.248	26.24		"
1	1.25	-	5.265	26.325		"
1	1.25	-	5.245	26.225		"
1	1.25	-	5.307[c]	26.535	26.29[d]	"
15	18.75	35.9619	-	26.4500		"
15	18.75	-	5.410	27.05	26.75[d]	"
17	21.25	-	5.319[c]	26.595		"
30	37.5	-	5.390	26.95		"
30	37.5	-	5.337	26.685	26.83[d]	"
32	40	36.7521	-	26.8750		"
40	50	-	5.454	27.27		"
43	53.75	-	5.461[c]	27.305		"
45	56.25	37.4098	-	27.2250		"
50	62.5	-	5.520	27.60		"
60	75	38.6000	-	27.8499		"
80	100	39.6966	-	28.4163		"
84	105	-	5.655	28.275		"
normal b.p.		-	5.305	26.525		"
"		-	5.344	26.72		"
"		-	5.040	25.20		"
"		-	5.349	26.745		"
"		-	5.329	26.645		"
"		-	5.645[c]	28.225		"

---

[a] Réaumur temperature = 0.8 x Celsius temperature.
[b] Chemically pure salt prep. from NaOH and HCl used without purification.
[c] Analysis for Cl by titration with $AgNO_3$.
[d] Average value at the given temperature.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Mixtures of salt and water were heated to the b.p., then cooled. Samples of clear, satd. sln. were removed, and analyzed by evap. to dryness and weighing.

SOURCE AND PURITY OF MATERIALS:

NaCl: prep. from NaOH and HCl. Sulfate removed by ppt. with $BaCl_2$, then pptd. with excess $(NH_4)_2CO_3$ to remove excess Ba. Final sln. was evap. to dryness, residue calcined.

ESTIMATED ERROR:

See table for reproducibility.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Poggiale, M.

Ann. Chim. Phys. [3], 1843, *8*, 463-78.

VARIABLES:

T/K = 258-383

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass ratio $NaCl/H_2O$	mass %	solid phase (compiler)
- 15	0.3273	24.66	$NaCl\cdot 2H_2O$
- 10	0.3349	25.09	"
- 5	0.3422	25.49	"
0	0.3552	26.21	$NaCl\cdot 2H_2O$ + NaCl
5	0.3563	26.27	NaCl
9	0.3574	26.33	"
14	0.3587	26.40	"
25	0.3613	26.54	"
40	0.3664	26.81	"
50	0.3698	27.00	"
60	0.3725	27.14	"
70	0.3788	27.47	"
80	0.3822	27.65	"
90	0.3887	27.99	"
100	0.3961	28.37	"
109.7	0.4035	28.75	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The mixtures were heated to above the equilibrium temperature, then cooled. Samples of clear saturated solution were removed and analyzed gravimetrically.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Fehling, H.

Justus Liebigs Ann. Chem. 1851, 77, 382-4.

VARIABLES:

T/K = 285, 373

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass % NaCl	solid phase
12	26.489	NaCl
12	26.500	"
12	26.337	"
12	26.463	"
12	26.411	"
12	26.338	"
100	28.643	"
100	28.452	"
100	28.524	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Saturated solutions were prepared by evaporation of dilute solutions. Their composition was determined by evaporation to dryness at 100°C and heating at 250°C.

SOURCE AND PURITY OF MATERIALS:

Pure rock salt containing less than 0.01% impurity by weight or sodium chloride prepared from sodium carbonate and hydrochloric acid were used.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kremers, P.

Ann. Phys. Chem. 1856, *99*, 25-63.

VARIABLES:

$T/K = 273-382$

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	100 mass H_2O/mol NaCl[a]	mass % (compiler)	solid phase
0	1.65	26.2	NaCl
20	1.62	26.5	"
40	1.60	26.8	"
60	1.57	27.1	"
80	1.53	27.7	"
100	1.48	28.3	"
109[b]			

---

[a] Na = 23, Cl = 35.5, according to the author.
[b] boiling point of saturated solution

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

After complete dissolution at higher temperature, the mixture was stirred for 1 h at the desired temperature. Then the saturated solution was drawn off but not filtered because of its high viscosity. At 95, 140 and 160°C the composition was determined by evaporation and weighing.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Gerlach, Th. G.

Spezifische Gewichte der Gebrauchlichsten Salzlosungen bei verschidenen Concentrationsgraden. J.G. Engelhardt. Freiberg. 1859. pp. 9-10.

VARIABLES:

$T/K = 288$

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

$t = 15°C$

mass %	relative density, $d_r = d(15°C)/d(H_2O,\ 15°C)$	solid phase
5	1.03624	
10	1.07335	
15	1.11146	
20	1.15107	
satd sln	1.20433	NaCl

COMMENTS AND ADDITIONAL DATA:

The author found the solubility from graphical interpolation. The compiler found that the density could be represented by the equation $(d_r - 1)/100w_1 = A_1 + A_2(100w_1) + A_2(100w_1)^2$ where w_1 is the mass fraction of the salt, with least-square coefficients:

$A_1 = 7.18 \times 10^{-3}$ $s(A_1) = 6.1 \times 10^{-6}$

$A_2 = 1.12 \times 10^{-5}$ $s(A_2) = 2.8 \times 10^{-6}$

$A_3 = 3.63 \times 10^{-7}$ $s(A_3) = 3.0 \times 10^{-8}$

and standard error of estimate 2.8×10^{-6}. Solution of this equation gave the solubility as: 26.42 mass %.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Solutions were made up by mass, using calibrated weights and vacuum corrections. Densities were measured by hydrostatic weighing, using a glass sinker attached to a balance. The method of saturation is not given.

SOURCE AND PURITY OF MATERIALS:

NaCl: purified by chemical precipitation of impurities, recrystallized twice, then melted to remove all water.

ESTIMATED ERROR:

Temperature: precision ±0.1 K

Solubility: no estimates possible.

REFERENCES:

COMPONENTS:

(1) Sodium Chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Schiff, H.

Justus Liebigs Ann. Chem. 1859, *109*, 325-32.

VARIABLES:

$T/K = 293$

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass % NaCl	relative density	solid phase
20	26.4	1.2021	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The variation of volume during the dissolution of salt was calculated. The method is described in a previous paper (1).

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Schiff, H. *Justus Liebigs Ann. Chem.* 1858, *108*, 324.

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Nordenskjold, A.E.

Ann. Phys. Chem. 1869, *136*, 309-17.

VARIABLES:

$T/K = 275-382$

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass ratio $NaCl/H_2O$	mass % NaCl	solid phase
1.5	0.336	25.14	NaCl
13.75	0.358	26.36	"
70.0	0.381	27.59	"
108.5	0.394	28.26	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Saturated solutions were prepared in a thermostat. The amount of solute was estimated by silver nitrate titration.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Sodium Chloride, NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	Rudorff, F. *Ann. Phys. Chem.* [2] 1861, *114*, 63-81.
VARIABLES:	**PREPARED BY:**
T/K = 272-281	J. J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass ratio $NaCl/H_2O$	mass %	solid phase
-0.6	0.01	0.99	ice
-1.2	0.02	1.96	"
-2.4	0.04	3.85	"
-3.6	0.06	5.66	"
-4.8	0.08	7.41	"
-6.0	0.10	9.09	"
-7.2	0.12	10.71	"
-8.4	0.14	12.28	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The freezing points of solutions of known composition were measured.

SOURCE AND PURITY OF MATERIALS:

Pure salt was recrystallized several times.

ESTIMATED ERROR:

Temperature: precision within ±0.1 K

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Moller, K.

Ann. Phys. Chem. 1862, *117*, 386-416.

VARIABLES:

T/K = 273-303
p/MPa = 0.1-4

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	p/atm	mass %	solid phase
0	1	26.25	NaCl
0	20	26.36	"
0	20	26.34	"
0	40	26.40	"
0	40	26.48	"
9.0	1	26.31	"
9.0	20	26.33	"
9.0	20	26.38	"
12.0	1	26.34	"
12.0	1	26.35	"
15.0	1	26.32	"
15.0	1	26.28	"
15.0	1	26.34	"
15.0	1	26.27	"
15.0	1	26.30	average value at 15°C, 1 atm.
15.0	20	26.38	NaCl
15.0	20	26.39	"
15.0	40	26.40	"
20.0	1	26.34	"
20.0	1	26.36	"
20.0	20	26.36	"
20.0	20	26.38	"
25.0	1	26.38	"
25.0	1	26.36	"
25.0	20	26.44	"
25.0	20	26.49	"
30.0	1	26.47	"
30.0	20	26.53	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Mixtures of salt and water were kept in a U-yube for 5-18 h under constant temperature and pressure. A small sample of saturated sln. was removed and analyzed by evaporation to dryness, calcining at 300°C, and weighing.

SOURCE AND PURITY OF MATERIALS:

NaCl: C.P. salt recrystallized.

ESTIMATED ERROR:

Solubility: precision within ±0.05 mass %.

REFERENCES:

COMPONENTS: (1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Mulder, G.J. *Scheikundige Verhandelingen en Onderzoeken. Part 3, vol. 3. Bijdragen tot de Geschiedenis van het Scheikundig Gebonden Water.* H.A. Kramers. Rotterdam. 1864. pp. 51-6.
VARIABLES: $T/K = 273-318$	PREPARED BY: J.W. Lorimer

EXPERIMENTAL VALUES:

$t/°C$	100x mass ratio NH_4Cl/H_2O	mass %	solid phase
0	35.7	26.3	NaCl
25.5	36.1	26.5	"
44.5	36.2	26.6	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The method of isothermal saturation was used. Ice baths, cool cellars and heated water baths were used to control temperature. mixtures of salt and water were shaken for at least 7 d. The saturated solution was weighed and evaporated, and the residue was dried at 100°C, then weighed.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

Temperature: ±0.1 K at 0°C, ±1 K at other temperatures.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

de Coppet, L.C.

Ann. Chim. Phys. 1872, *25*, 502-27; *C. R. Hebd. Séances Acad. Sci.* 1872, *124*, 328; *Bull. Soc. Vaudoise Sci. Nat.* 1871, *11*, 7-126.

VARIABLES:

T/K = 249-273

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio $NaCl/H_2O$	mass %	solid phase
-2.9	5	3.33	ice
-6.1	10	9.09	"
-9.7	15	13.04	"
-11.45	17.5	14.89	"
-13.6	20	16.67	"
-15.05	21.87	17.95	"
-21.4	29.16	22.58	"
-23.6	31.24[a]	23.80	"
-14.0	32.5	24.5	$NaCl\cdot 2H_2O$
0.0	35.7	26.3	"

---

[a] metastable equilibrium

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The method is described in a previous paper (1). A sample of known composition was cooled in a mixture of ice and NaCl (or $CaCl_2$) maintained at some degrees below the freezing point. A small piece of ice was added to the sample when its temperature was a few tenths K below the freezing point.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

Temperature: precision ±0.1 K

REFERENCES:

1. de Coppet, L.C. *Ann. Chim. Phys.* 1871, *23*, 366.

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Page, D.; Keightley, A.

J. Chem. Soc. 1872, *25*, 566-70.

VARIABLES:

T/K = 289

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio NaCl/H_2O	mass %	density	method	solid phase
15.6	35.76	26.34	1.20419, 1.20403	a	NaCl
15.6	36.26	26.61	1.21148, 1.20693	b	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The isothermal method was used. Solutions were prepared in two different ways: (a) digestion of the salt in distilled water at a constantly maintained temperature of 15.6°C; (b) saturation with the salt of distilled water at 100°C and subsequent cooling to 15.6°C.

SOURCE AND PURITY OF MATERIALS:

Chemically pure salt was used.

ESTIMATED ERROR:

Temperature: precision within ±0.1 K

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Raoult, F.M.

C. R. Hebd. Séances Acad. Sci. 1878, *87*, 167-9.

VARIABLES:

T/K = 273

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass ratio NaCl/H_2O	mass % NaCl (compiler)	solid phase
-0.270	0.0045	0.448	ice

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Cryoscopic method.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Guthrie, F.

Philos. Mag. 1875, 49, 1-20.

VARIABLES:

T/K = 251-382

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass % NaCl	solid phases
0.0	0.000	ice
- 1.5	0.656	"
- 1.9	1.313	"
- 1.5	1.970	"
- 2.1	2.627	"
- 3.4	5.254	"
- 4.1	6.567	"
- 5.4	7.881	"
- 6.7	9.194	"
- 7.7	10.508	"
- 7.7	11.821	"
- 9.4	13.130	"
-11.1	14.448	"
-12.4	15.762	"
-15.0	17.075	"
-15.4	18.389	"
-21 to -22	23.8874	$NaCl\cdot 2H_2O$
-16	24.1182	"
-10	24.6187	"
-10	24.6528	"
0	24.2724	"
108.8	26.27	NaCl[a]
107.0		" [b]

---

[a] boiling point in liquid

[b] boiling point in vapor

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The freezing points of brines were measured for increasing concentrations up to the eutectic point. The liquidus of the sodium chloride dihydrate was determined by solubility measurements. The mixture was kept at constant temperature for an hour. The vessel was constantly shaken during crystallization. Samples of saturated solution were evaporated, heated to about 300°C and weighed.

SOURCE AND PURITY OF MATERIALS:

Extremely pure rock salt, washed in distilled water, and free from K, Li, Mg or H_2SO_4 was used.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Guthrie, F.

Philos. Mag. 1876, 5, 354-69.

VARIABLES:

T/K = 251-273

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass % NaCl	solid phases
- 0.3	1	ice
- 0.9	2	"
- 1.5	3	"
- 2.2	4	"
- 4.2	7	"
- 6.6	10	"
- 9.1	13	"
-11.0	15	"
-11.9	16	"
-15.5	19	"
-17.0	20	"
-20.0	22	"
-22.0	23.6	ice + $NaCl \cdot 2H_2O$
-12.0	25	$NaCl \cdot 2H_2O$
0.0	26.27	NaCl + $NaCl \cdot 2H_2O$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The salt solution was cooled in a test tube until some ice formed; this was very nearly completely remelted under constant stirring with the thermometer and then the tube was plunged momentarily into a freezing mixture. The minute spicula of ice so formed were again nearly remelted. The mean of four or five readings of the thermometer when the minute quantity of ice began to increase was taken as the true freezing point. For the determination of the temperature above 0°C at which salt and hydrate separate, a given weight of salt and water was warmed in a stoppered bottle.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Precht, H.; Wittjen, B.

Ber. Dtsch. Chem. Ges. 1881, *14*, 1667-75.

VARIABLES:

T/K = 283-373

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio $NaCl/H_2O$	mass % NaCl	solid phase
10	29.7	22.9	NaCl
20	29.2	22.6	"
30	28.7	22.3	"
40	28.2	22.0	"
50	27.7	21.7	"
60	27.2	21.4	"
70	26.8	21.1	"
80	26.4	20.9	"
90	26.1	20.7	"
100	25.8	20.5	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method. A sample of saturated solution was filtered and the solution analyzed.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Sodium chloride, NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

de Coppet, L.C.

Ann. Chim. Phys. 1883, *30*, 411-29.

VARIABLES:

T/K = 259-375

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass ratio $NaCl/H_2O$	mass % NaCl	solid phases
-14.0	0.364	24.69	$NaCl\cdot 2H_2O$
-14.0	0.325	24.53	"
-13.8	0.3215	24.30	"
- 6.25	0.3422	25.53	"
- 5.95	0.3417	25.47	"
0.0	0.3550	26.20	$NaCl\cdot 2H_2O$ + NaCl
0.0	0.3571	26.31	"
3.6	0.3579	26.36	NaCl
5.3	0.3594	26.44	"
14.45	0.3594	26.44	"
20.85	0.3563	26.27	"
25.45	0.3590	26.42	"
38.55	0.3652	26.75	"
44.75	0.3664	26.81	"
52.5	0.3704	27.03	"
55.0	0.3699	27.00	"
59.75	0.3731	27.17	"
71.3	0.3796	27.52	"
74.45	0.3796	27.52	"
82.05	0.3841	27.75	"
86.7	0.3847	27.78	"
93.65	0.3890	28.01	"
101.7	0.4076	28.96	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Salt and water were introduced into glass test tubes. Low temperatures were obtained using different eutectic mixtures. In the other cases, the tube was placed in a thermostat. Samples were removed from the saturated solution and analyzed.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: up to 20°C, precision ±0.1K

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Andreae, J.L.

J. Prakt. Chem. 1884, *29*, 456-77.

VARIABLES:

T/K = 273-354

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio NaCl/H_2O	mass %	method	NaCl
0.0	35.633	26.272	a	c
0.1	35.624	26.267	a	c
3.78	35.625	26.267	a	c
4.6	35.645	26.278	b	r
4.8	35.622	26.266	b	c
10.1	35.712	26.315	b	r
10.2	35.677	26.296	a	c
10.2	35.680	26.297	a	r
10.8	35.682	26.298	b	c
21.7	35.840	26.384	a	r
22.0	35.865	26.398	b	r
28.85	36.008	26.475	a	r
28.9	35.986	26.463	b	r
30.8	36.060	26.503	b	r
39.6	36.320	26.643	b	r
40.0	36.325	26.646	b	r
40.3	36.303	26.634	a	r
40.3	36.323	26.645	a	c
49.6	36.633	26.811	a	r
49.64	36.670	26.831	b	r
59.1	37.010	27.013	a	c
60.02	37.072	27.046	a	r
60.07	37.046	27.032	b	r
72.0	37.593	27.322	a	r
72.05	37.598	27.325	b	r
80.9	38.050	27.562	b	r

a heating; b cooling; c preparation by neutralization with sodium carbonate; r rock salt

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two methods were used:
(1) Heating method: the mixture of salt and water was stirred at constant temperature for 1 - 1.5 h.
(2) Cooling method: the mixture was previously heated above the temperature of equilibrium. A sample of saturated solution was analyzed by evaporation to dryness and weighing.

SOURCE AND PURITY OF MATERIALS:

Sodium chloride was prepared by neutralization of pure HCl solution with Na_2CO_3. Rock salt was recrystallized several times.

ESTIMATED ERROR:

Temperature: precision within ±0.01 K
100 x mass ratio: precision within ±0.0003

REFERENCES:

COMPONENTS:

(1) Sodium chloride, NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Etard, A..

C.R. Hebd. Séances Acad. Sci. Fr. 1884, *98*, 1276-9.

VARIABLES:

T/K = 393-433

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass % NaCl	solid phase
120	29.38	NaCl
140	29.87	"
160	30.37	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Mixtures of salt and water were sealed in a tube which was bent in the middle and placed in an oil thermostat. Part of the saturated solution was collected at one end of the tube, from where it was removed and analyzed gravimetrically.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Tilden, W.A., Shenstone, W.A.

Philos. Trans. R. Soc. London 1884, *175*, 23-36.

VARIABLES:

T/K = 391-453

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio $NaCl/H_2O$	mass % NaCl	solid phase
118	39.8	28.5	NaCl
140	42.1	29.6	"
160	43.6	30.4	"
180	44.9	31.0	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Water and salt were placed at one end of a tube divided in two parts screwed together and separated by a disk of platinum gauze. The tube was made of gun metal, electroplated with silver, and could be turned around its longitudinal axis. After heating in a paraffin bath at a steady temperature for 5 h, the end containing the sample was raised and the other depressed. The tube was cooled and opened. Then the saturated solution was weighed, evaporated to dryness and weighed again. The part of the tube not occupied by solution was filled by water vapor which condensed on cooling. By ascertaining the volume of this vapor, approximate correction of the results were made with the aid of tables of vapor pressures of salt solutions (1).

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Wüllner, A. *Ann. Phys. Chem.* 1860, *110*, 564.

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Raupenstrauch, G.A.

Monatsh. Chem. 1885, 6, 563-91.

VARIABLES:

T/K = 274-342

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass ratio $NaCl/H_2O$	mass % NaCl	material, method		solid phase
0.5	0.35575	26.240	a	h	NaCl
0.5	0.35610	26.259	a	c	"
0.7	0.35637	26.274	a	c	"
4.1	0.35646	26.279	a	h	"
4.2	0.35607	26.257	a	c	"
9.0	0.35651	26.281	a	h	"
10.5	0.35699	26.307	a	c	"
14.8	0.35776	26.349	b	c	"
16.2	0.35754	26.337	b	h	"
17.6	0.35750	26.335	a	h	"
35.6	0.36251	26.606	a	c	"
55.7	0.36887	26.947	a	h	"
64.6	0.37246	27.138	b	c	"
65.2	0.37292	27.163	a	c	"
67.8	0.37384	27.211	b	h	"
69.2	0.37503	27.274	a	h	"

a - purified natural sodium chloride
b - natural sodium chloride
h - the mixture was previously cooler than the thermostat
c - cooling method; the mixture was previously heated above the equilibrium temperature

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The mixture of salt and water was placed in a thermostat and stirred. At ordinary temperatures, a water bath was used; at higher temperatures, a Meyer's air-bath thermostat (1). The saturated solution was filtered and analyzed by evaporation to dryness and weighing.

SOURCE AND PURITY OF MATERIALS:

Natural sodium chloride was purified by several recrystallizations, then dried in a sulfuric acid desiccator.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Meyer, L. *Ber. Dtsch. Chem. Ges.* 1883, *16*, 1087.

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Arrhenius, S.

Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1888, *2*, 491-505. *K. Sven. Vetenskapsakad. Hand., Bihang* 1888, *14(1)*, no. 9, 1-24.

VARIABLES:

T/K = 271-273

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	g/100 cm^3 water	mass % (compiler)[a]	solid phase
-0.117	0.273	0.272	ice
-0.424	0.682	0.678	ice
-0.687	1.136	1.125	ice
-1.135	1.893	1.860	ice
-1.894	3.155	3.060	ice

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[a] Calculated using densities of water from (1).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

A double-walled freezing point apparatus was used, with a thermometer which could be read to 0.002 K. The apparatus was filled with solution, then cooled to about 0.1 K below the f.p. with a mixture of salt, water and ice at about 2 K below the f.p. Addition of an ice crystal caused a rise in temperature which attained a constant value for several minutes. This value was taken to be the freezing point. Solutions were prepared by weighing salt into a given volume (compiler) of water.

SOURCE AND PURITY OF MATERIALS:

The salts were "chosen by Prof. van't Hoff with special consideration as to their purity".

ESTIMATED ERROR:

Precision in f.p. within ±0.005 K above -2°C, 0.005-0.1 K below -2°C.

REFERENCES:

1. *International Critical Tables.* McGraw-Hill. New York. 1928. Vol. III, p.26.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	Bodlander, G. Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1891, 7, 358-61.
VARIABLES:	**PREPARED BY:**
T/K = 289	J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	concentration g dm^{-3}	mass % (compiler)	relative density	solid phase
15.5	317.8	26.43	1.2025	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The mixture of water and finely powdered salt was stirred at constant temperature during 24 h at least. A sample of saturated solution was evaporated to dryness and weighed.	Not stated. ESTIMATED ERROR: No estimates possible. REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	Von Stackelberg, E.F. Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1896, 20, 337-58.
VARIABLES:	**PREPARED BY:**
T/K = 292 p/MPa = 0, 50	J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	p/atm	mass %	solid phase
18.5	0	26.4	NaCl
	500	27.0	"

The solubilities are the means of several values obtained with mixtures initially at higher or lower temperature than the thermostat.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The salt-water mixture was confined in a steel bomb containing mercury. The selected pressure was obtained by means of a Cailletet pump and the temperature was controlled by a thermostat. The solution was stirred with a magnetic stirrer. Analysis was for Cl by titration with $AgNO_3$.	Kahlbaum's salt was purified by recrystallization. ESTIMATED ERROR: Pressure: precision within 1% Temperature and solubility: precision within 1%. REFERENCES:

COMPONENTS: (1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Etard, A. *Ann. Chim. Phys.* [7] 1894, *2*, 503-55.
VARIABLES: T/K = 252-488	PREPARED BY: J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass % NaCl	solid phase (compiler)
-21	23.7	$NaCl\cdot 2H_2O$
-21	23.4	"
-21	23.4	"
-18	23.5	"
-17	23.3	"
- 7	25.5	"
0	25.8	NaCl
15	26.7	"
55	26.8	"
77	28.0	"
90	28.2	"
115	29.1	"
135	28.9	"
140	28.8	"
150	29.6	"
180	30.2	"
215	31.6	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Below 40°C: Salt and water were cooled in a test tube and stirred constantly.
40 - 90°C: As above, but a thermostat was used.
Above 100°C: Salt and water were placed in one end of an inverted U-tube, and the tube was sealed. After equilibration (time or method not stated), some saturated solution was transferred to the other end of the tube. The tube was cooled and opened. The temperature at which the last crystal of NaCl disappeared was also observed. Analyses were for Cl by titration with $AgNO_3$ solution.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: no estimates possible.
Solubility: precision within ±0.01 mass %.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Bathrick, H.A.

J. Phys. Chem. 1896-7, *1*, 157-69.

VARIABLES:

T/K = 303, 313

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
30	26.6	NaCl
40	26.9	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Excess salt and water were placed in stoppered flasks and left for 24 h in a thermostat. Solutions were analyzed by evaporation.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

Temperature: precision probably within ±0.1 K (compiler).
Solubility: probably ±1 %.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

de Coppet, L.C.

Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1897, *22*, 239-40.

VARIABLES:

$T/K = 251$

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio $NaCl/H_2O$	mass % NaCl	solid phase
-21.85	29.6	22.84	$NaCl\cdot 2H_2O$ + ice

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Previously described (1).

SOURCE AND PURITY OF MATERIALS:

Not stated.

REFERENCES:

1. de Coppet, L.C. *Bull. Soc. Vaudoise Sci. Nat.* 1871, *11*(2), 1.

ESTIMATED ERROR:

No estimates possible.

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Raoult, F.-M.

Ann. Chim. Phys. 1899, *162*, 162-220.

VARIABLES:

$T/K = 234\text{-}273$

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass ratio $NaCl/H_2O$	mass % (compiler)	solid phase
-0.1098	0.00176	0.176	ice
-0.2073	0.00341	0.340	"
-0.4077	0.00690	0.685	"
-0.8211	0.01400	1.381	"
-1.6754	0.02859	2.780	"
-3.4237	0.05850	5.527	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Cryoscopic method. The mixture of salt 125 mL of water was stirred slowly and cooled to 0.5 K below the freezing point. Then the temperature of the thermostat was increased to 0.1 K below the estimated freezing point. A small crystal of ice was added to the sample, and the temperature was read every 2 or 3 min. Equilibrium was reached when the temperature variations were smaller than 0.002-0.003 K over 15 min.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: precision within ±0.001 K

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

van't Hoff, J.H.; Meyerhoffer, W.; Smith, N.

Sitzungsber. K. Preuss. Akad. Wiss. II 1901, 1033-44 (*part xxiii*);

van't Hoff, J.H.

Untersuchungen über die Bildungsverhaltnisse der ozeanischen Salzablagerungen. H. Precht, E. Cohen, eds. Akademische Verlagsges. Leipzig. 1912. pp. 173-182.

VARIABLES:

$T/K = 298$

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

$t/°C$	mol Na_2Cl_2 /1000 mol H_2O	mass % NaCl (compiler)	solid phase
25	55.5	26.5	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Presumably the method of isothermal saturation was used. The authors have rounded solubilities to the nearest ½ mol per 1000 mol H_2O.

SOURCE AND PURITY OF MATERIALS:

Not given.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	Seidell, A. *Am. Chem. J.* 1902, *27*, 52-62.
VARIABLES:	**PREPARED BY:**
T/K = 295, 308	J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mass/g of 100 cm³ sln	g NaCl /100 cm³ sln	mass % NaCl (compiler)	solid phase (compiler)
21.5	119.72	31.34	26.18	NaCl
35	119.30	31.34	26.27	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Salt and water were placed in stoppered bottles, and were rotated in a thermostat for 18-24 h. The bottles were then left upright until solids had settled, after which a sample was pipetted into a weighing bottle and weighed. This sample was then washed into a larger flask, and aliquots were analyzed by titration with *M*/10 $AgNO_3$.

SOURCE AND PURITY OF MATERIALS:

Not given.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Jones, H.C.; Getman, F.H.

Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1903, *46*, 244-86.

VARIABLES:

T/K = 261-271

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	concentration mol dm^{-3}	mass % (compiler[a])	solid phase
-1.760	0.5	2.859	ice
-3.550	1.0	5.603	"
-7.470	2.0	10.77	"
-12.225	3.0	15.56	"

COMMENTS: The compiler's calculations of mass % uses densities taken from the Critical Evaluation in this volume for solutions of NaCl saturated with ice.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The freezing-point method used a Beckmann thermometer and a stirred freezing-point tube immersed in a freezing mixture. A small correction was calculated to account for ice formed on supercooling, but the authors state that this correction is approximate only, and introduces some error.

SOURCE AND PURITY OF MATERIALS:

NaCl: made by ppt with HCl gas from a conc. sln. The salt was washed with water, then dried at 120°C.
Water: redistilled, conductivity 2.0×10^{-6} S cm^{-1}.

ESTIMATED ERROR:

Temperature: precision probably within ±0.1 K (compiler).
Solubility: estimated precision ±1 %.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Berkeley, Earl of

Phil. Trans. R. Soc. London A 1904, *203*, 189-214.

VARIABLES:

T/K = 273-380

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio NaCl/H_2O	mass % (compiler)	relative density	solid phase
0.35	35.75	26.34	1.2090	NaCl
15.20	35.84	26.38	1.2020	"
30.05	36.20	26.58	1.1956	"
45.40	36.60	26.79	1.1891	"
61.70	37.28	27.16	1.1823	"
75.65	37.82	27.44	1.1764	"
90.50	38.53	27.81	1.1701	"
107.0 [a]	39.65	28.39	1.1631	"

---

[a] boiling point

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The salt-water mixture was stirred at the appropriate temperature and the density followed by pycnometric measurement until its value remained constant. Solubilities were determined by evaporation to dryness of the saturated solution in platinum crucibles, except at the boiling point, where evaporations were done in Jena glass bulbs. Different temperature control systems were used.

SOURCE AND PURITY OF MATERIALS:

The purest NaCl from Merck was used and the purity controlled by chloride titration.

ESTIMATED ERROR:

Temperature: accuracy ±0.01 K referred to hydrogen scale
Solubility: precision at least 0.16 %

REFERENCES:

COMPONENTS: (1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Van't Hoff, J.H.; Sachs, H.; Biach, O. *Ber. Berl. Akad.* 1904, 576-86.
VARIABLES: $T/K = 356$	PREPARED BY: P. Vallée

EXPERIMENTAL VALUES:

$t/°C$	mass %	solid phase
83	27.68	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE Presumably the isothermal saturation method was used. No other information given.	SOURCE AND PURITY OF MATERIALS: No information given.
	ESTIMATED ERROR:
	REFERENCES:

COMPONENTS:

(1) Sodium Chloride; NaCl;
[7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Jahn, H.

Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1905, *50*, 129-68.

VARIABLES:

T/K: 272-273

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
- 0.0890	0.1472	ice
- 0.0900	0.1472	"
- 0.1345	0.2216	"
- 0.1355	0.2224	"
- 0.1757	0.2938	"
- 0.1765	0.2935	"
- 0.2646	0.4414	"
- 0.2650	0.4417	"
- 0.3475	0.5837	"
- 0.3492	0.5836	"
- 0.5165	0.8735	"
- 0.5172	0.8724	"
- 0.6883	1.1592	"
- 0.6906	1.1662	"
- 0.8598	1.4561	"
- 0.8626	1.4579	"
- 1.0207	1.7237	"
- 1.0209	1.7374	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Freezing points were determined by cryoscopy. The solution was undercooled to about 1.5K below the crystallization temperature and then seeded by a small piece of ice. The temperature became stable at less than a few thousands of a Kelvin for about 40 minutes.

SOURCE AND PURITY OF MATERIALS:

The salt was purified by different methods: recrystallization from hydrochloric solution, then evaporation under vacuum; washing with a mixture of water and alcohol, then evaporation to dryness.

ESTIMATED ERROR:

Temperature: ±0.001K

REFERENCES:

COMPONENTS:

(1) Sodium chloride, NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Matignon, C.

C. R. Hebd. Séances Acad. Sci. 1909, *9*, 550-3.

VARIABLES:

T/K = 252-267

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass ratio NaCl/H_2O	mass % (compiler)	solid phase
- 6.6	0.11	9.9	ice
- 9.25	0.15	13.0	"
-12.7	0.20	16.7	"
-16.67	0.25	20	"
-21.3	0.307	23.5	ice + $NaCl \cdot 2H_2O$
-12.25	0.329	24.8	$NaCl \cdot 2H_2O$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Saturation was obtained at a fixed temperature. A part of the clear solution was removed and analyzed. The temperature of the eutectic point was determined by thermal analysis.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Eutectic point:
Temperature: ±0.1 K
Composition: ±0.5 % in mass ratio

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Armstrong, H.E.; Eyre, J.V.

Proc. R. Soc. London, A 1910-11, *84*, 123-36.

VARIABLES:

T/K = 273, 298

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio $NaCl/H_2O$		mass % (compiler)		solid phase
	A	B	A	B	
0	35.775		26.35		NaCl
25	35.83	35.71	26.38	26.31	"
25	35.78	35.77	26.35	26.35	"

The values given in columns A and B represent results obtained with two samples. B was withdrawn one hour after A.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method was described in a previous communication (1). At 0°C the mixture was constantly stirred in a bath of crushed ice and water. the temperature was easily kept constant for several hours. For measurements at 25°C, see (1).

SOURCE AND PURITY OF MATERIALS:

"Pure" salt was recrystallized 2X.

ESTIMATED ERROR:

Mass ratio: precision about 0.2% (compiler)

REFERENCES:

1. Armstrong, H.E.; Eyre, J.V. *Proc. R. Soc. London, A* 1907, *79*, 564.

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Berkeley, Earl of; Appleby, M.P.

Proc. R. Soc. London, A 1911, *85*, 489-505.

VARIABLES:

T/K = 381, 382

p/kPa = 58, 100

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

pressure mmHg	t/°C (boiling point)	NaCl concentration mol dm^{-3}	mass % (compiler)^b	solid phase
745	108.096			NaCl
760	108.668^a	5.648	28.379	"

^{a} corrected to standard conditions ^{b} density from (1)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Described in previous paper (1).

REFERENCE:

1. Berkeley, Earl of; *Phil. Trans. R. Soc. London, A* 1904, *203*, 189.

SOURCE AND PURITY OF MATERIALS:

Kahlbaum's purest NaCl was used.

ESTIMATED ERROR:

Temperature: ±0.005 K

COMPONENTS:

(1) Sodium chloride, NaCl;
[7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Cohen, E.; Inouye, K.; Euwen, C.

Z. *Phys. Chem., Stoechiom. Verwandtschaftsl.* 1910, 75, 257-93.

VARIABLES:

T/K = 252-267
p/MPa = 0.1 - 150

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

$t/°C$	p/atm	mass ratio $NaCl/H_2O$	mass % (average; compiler)	solid phase
24.05	1	0.3590	26.42	NaCl
	1	0.3589		"
	250	0.3623	26.61	"
	250	0.3627		"
	500	0.3655	26.77	"
	500	0.3655		"
	1 000	0.3701	27.02	"
	1 000	0.3704		"
	1 500	0.3736	27.20	"
	1 500	0.3737		"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

A mixture of salt and water was confined in a steel bomb and stirred by a magnetic stirrer. The bomb was kept in a thermostat; see (1). Samples of saturated solution were analyzed after removal by evaporation to dryness, calcining at 300°C, and weighing.

SOURCE AND PURITY OF MATERIALS:

NaCl: Kahlbaum, purified by pptn from sln with HCl, recrystallized. Neutral to Congo Red indicator. The product was dried and calcined.

ESTIMATED ERROR:

Temperature: precision ±0.03 K.
Solubility: precision ±0.02 in mass ratio.

REFERENCES:

1. Cohen, E.; Sinnige, L.R. *Z. Phys. Chem., Stoechiom. Verwandtschaftsl.* 1909, 67, 513.

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Rivett, A.C.D.

K. Sven. vetenskapsakad. Medd., Nobel-inst. 1911, *2*(*9*), 1-32.

VARIABLES:

T/K = 269-273

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
-0.518	0.873	ice
-1.042	1.747	"
-1.584	2.650	"
-2.086	3.466	"
-2.618	4.319	"
-3.174	5.182	"
-3.708	5.984	"
-4.210	6.712	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The mixture was supercooled in a bath 4 K below the f.p. until a large amount of ice separated out, which was thawed until only a very small amount remained. The sln. was placed in an air jacket and stirred until the temp. was steady. Supercooling for 0.01 to 0.02 K was allowed and hand stirring continued until the temp. rose to a maximum.

SOURCE AND PURITY OF MATERIALS:

NaCl: Kemista Fabriken Ion.

ESTIMATED ERROR:

Temperature: ±0.003 K (mean of 5 readings)

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Bronsted, J.N.

Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1913, *82*, 632-40.

VARIABLES:

$T/K = 373$

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

$t/°C$	mass ratio $NaCl/H_2O$	mass % (compiler)	vapor pressure /mmHg	solid phase
100	0.3922	28.17	561.5	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Saturated solution was obtained by agitating an excess of salt with water. Solubility was calculated from the relation: $S = (S_1 - r_1)/w_1$, where S_1 = mass of salt, r_1 = mass of residue and w_1 = mass of water.

SOURCE AND PURITY OF MATERIALS:

Purest salt of Kahlbaum.

ESTIMATED ERROR:

Temperature: ±0.01 *K*

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Amadori, M.

Atti Ist. Veneto Sci., Lett. Arti 1919, *79*, 293-320.

VARIABLES:

$T/K = 298$

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

$t/°C$	100 x mass ratio $NaCl/H_2O$	mass %	solid phase
25	35.98	26.46	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solubility was determined by the isothermal method. A sample of clear solution was weighed and evaporated to dryness. The residue was analyzed.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Grünewald, W. *Zur Kenntnis der ozeanischen Salzablagerungen.* Inaugural-Dissertation. Erlangen. K.B. Hof- u. Universitäts-buchdruckerei v. Junge & Sohn. Erlangen. 1913.

VARIABLES:

T/K = 298, 356 K

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	equilibration time/h	analytical data		mass satd sln/g	mass % NaCl	source of salt
25	8	19.75 cm^3	(a)	0.44083	26.18	O
	14	0.8655 g	(b)	1.33456	26.45	O
	8	14.9 cm^3	(a)	0.32964	26.42	K
	12	6.1 cm^3	(a)	0.13454	26.50	K
	15	0.4297 g	(b)	0.65928	26.58	K
				Average:	26.43	
				Std dev.:	0.15	
83	6	6.62 cm^3	(a)	0.1400	27.64	K
	7	0.2907 g	(b)	0.4281	27.69	K
	7	0.1185 g	(c)	0.4281	27.68	K
				Average:	27.67	
				Std dev.:	0.03	

The solid phase is NaCl for all entries. Mass % NaCl calc. by compiler.

Analytical methods: (a) titration with 0.1 mol dm^{-3} $AgNO_3$

(b) gravimetric as AgCl

(c) gravimetric as NaCl

Source of salt: O - own preparation

K - Kahlbaum "NaCl zur Analyse mit Garantieschein"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The method of isothermal saturation was used. Water and salt were stirred in thermostatted, closed flasks. Samples were analyzed to show equilibrium had been reached. Weighed samples were obtained using prewarmed pipets fitted with cotton wool filters. Analyses: Cl by Volhard titration or gravimetric as AgCl; total salt by evaporation and weighing as NaCl.

SOURCE AND PURITY OF MATERIALS:

Recrystallized "relatively pure" sample, or Kahlbaum "NaCl zur Analyse mit Garantieschein". Found: Cl, 60.51; calc: 60.66.

ESTIMATED ERROR:

Temperature: not given.
Solubility: std dev. within 0.15 mass %, from data given above.

REFERENCES:

COMPONENTS:

(1) Sodium chloride, NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Leather, J.W.; Mukerji, J.N.

Mem. Dep. Agri. India, Chem. Ser. 1914, *3*(7), 177-204.

VARIABLES:

T/K = 293-364

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass ratio $NaCl/H_2O$	mass % NaCl (compiler)	density g cm^{-3}	solid phase (compiler)
20	35.63	26.27	1.193	NaCl
30	36.32	26.59	1.202	"
40	36.53	26.76	1.197	"
91	38.72	27.91	1.189	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The method has been described by Meyerhoffer and Saunders (1). Water and salt were weighed in a glass tube. The mixture was first heated to a temperature above that at which equilibrium was expected. It was then stirred at a fixed temperature for about 20 h. Samples of the clear solution were then withdrawn and analyzed.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: ±0.2 K

REFERENCES:

1. Meyerhoffer, W.; Saunders, A.P. *Z. Phys. Chem., Stoechiom. Verwandtschaftsl.* 1899, *28*, 451.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Sodium chloride, NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	Reinders, W. *Z. Anorg. Chem.* 1915, 93, 202-12.
VARIABLES:	PREPARED BY:
$T/K = 278-373$	J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio $NaCl/H_2O$	mass % (compiler)	solid phase
5	35.74	26.33	NaCl
25	36.04	26.49	"
50	36.72	26.86	"
100	39.2	28.2	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE	SOURCE AND PURITY OF MATERIALS:
Not given, but probably isothermal method with analysis of saturated solution (compiler).	Not stated.
	ESTIMATED ERROR:
	Not stated.
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Sodium chloride, NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	Sill, H.F. *J. Am. Chem. Soc.* 1916, *38*, 2632-43.
VARIABLES:	**PREPARED BY:**
T/K = 298 *p*/MPa = 0.1-75	J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	pressure kg cm^{-2}	mass % NaCl	solid phase
25	1	26.44	NaCl
	1	26.44	"
	250	26.58	"
	250	26.58	"
	500	26.76	"
	500	26.68	"
	750	26.82	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The pressure bomb was a U-tube, made from Shelby steel tubing. One branch was the "reaction chamber" and the second the "mercury chamber". Connections with a Cailletet pump and between the chambers were effected by means of capillary steel tubing. The bomb was supported in a thermostat and could be rotated freely through an angle of more than 90°. The calibration of the pressure gauge of the pump has already been described in (1). The thermal regulation and the stirring of the bath were connected in the manner described by Richards (2). Analysis of the saturated solution was made by evaporation to dryness and weighing.

SOURCE AND PURITY OF MATERIALS:

C.P. NaCl was reprecipitated from a saturated solution by HCl gas. The salt was washed several times, dried and heated for 1 h at 350°C.

ESTIMATED ERROR:

Temperature: ±0.003 K

REFERENCES:

1. Stähler, A. *Handbuch der Arbeitsmethoden in der Anorganischen Chemie*. Veit. Leipzig. 1913-4. vol. 3, p. 259.
2. Richards, T.W.; Stull, W.N.; Matthews, J.H.; Speyers, C.L. *J. Am. Chem. Soc.* 1912, *34*, 972.

COMPONENTS:

(1) Sodium chloride, NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Rodebush, W.H.

J. Am. Chem. Soc. 1918, *40*, 1204-13.

VARIABLES:

T/K = 252-270

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio NaCl/H_2O	mass % (compiler)	solid phases
- 3.48	6.11	5.76	ice
- 5.17	8.92	8.19	"
- 6.32	10.77	9.72	"
- 8.52	14.20	12.43	"
- 9.41	15.46	13.39	"
-11.04	17.87	15.16	"
-14.33	22.25	18.20	"
-14.77	22.99	18.69	"
-16.21	24.75	19.84	"
-18.73	27.70	21.69	"
-20.56	29.70	22.90	"
-21.12	30.4	23.3	ice + $NaCl\cdot 2H_2O$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Freezing point lowerings were measured directly by means of a Cu-constantan thermocouple connected to a potentiometer. The saturation point was taken as the point at which the temperature stopped falling and began to rise slowly. The composition of the saturated solution was determined by conductivity measurements. For the determination of the eutectic temperature, salt and ice were mixed, frozen to a solid mass, broken up into small pieces and placed in a Dewar. The mixture warmed up rapidly to a definite temperature and then remained constant within 0.01 K for 20 to 30 min.

SOURCE AND PURITY OF MATERIALS:

The salt was the purest commercially obtainable. It was recrystallized and its purity determined by Lewis' equation (1).

ESTIMATED ERROR:

Temperature: ±0.01 to 0.02 K
Solubility: ±0.1%

REFERENCES:

1. Lewis, G.N. *Proc. Am. Acad.* 1907, *43*, 284.

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Denecke, W.

Z. *Anorg. Allg. Chem.* 1919, *108*, 1-43.

VARIABLES:

$T/K = 238-248$
p/MPa: 57 - 255

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

$t/°C$	$p/kg\ cm^{-2}$	solid phases
-25.7	583	ice I + $NaCl\cdot 2H_2O$
-29.4	1037	"
-33.9	1617	"
-36.9	2110	"
-38.5	2248	ice III'+ $NaCl\cdot 2H_2O$
-35.5	2550	"
-35.0	2602	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Water and sodium salt were confined in a steel bomb with pentane for transmitting pressure. The bomb was immersed in an ethanol-carbonic acid bath. The temperature was increased at about 0.4 K/min, and solid-liquid equilibrium points were found from a plot of temperature against pressure.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: ±0.1 K.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Sodium Chloride, NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	Kurnakov, N.S.; Zhemchuzhnii, S.R. *Zh. Russ. Fiz.-Khim. O-va, Chast Khim.* 1920, 51, 1-59.
VARIABLES:	PREPARED BY:
T/K: 273, 298	J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	100 x mol ratio Na_2Cl/H_2O	mass % (compiler)	solid phase
0	54.9	26.3	NaCl
25	55.5	26.5	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Salt and water were stirred in glass vessels immersed in a thermostat. Equilibrium was reached in 1-2 days, after which the solid phase was allowed to settle, and a sample was removed via a pipet equipped with a filter tip. The sample was analyzed for Cl, presumably by gravimetric determination as AgCl (compiler).

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

Temperature: ±0.05-0.1K

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sborgi, U.; Franco, C.

Gazz. Chim. Ital. 1921, *51*, 33-8.

VARIABLES:

$T/K = 273 - 298$

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

$t/°C$	1000 mol ratio $NaCl/H_2O$	mass % (compiler)	solid phase
0	109.34	26.18	NaCl
10	109.99	26.30	"
25	110.64	26.41	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothermal method was used.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Sodium Chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	Takegami, S. *Mem. Fac. Sci., Univ. Kyoto* 1921, 4, 317-42.
VARIABLES:	**PREPARED BY:**
T/K: 298	J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase (compiler)
25.0	26.52	NaCl
	26.46	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Mixtures of salt and water were rotated in a thermostat for at least 24 h, after which the solid phase was allowed to settle. Samples were removed via a pipet fitted with a cotton filter into weighing bottles. Analysis was for Cl by titration with $AgNO_3$.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

Temperature: ±0.1K (compiler)
Solubility: precision within 0.1 mass % (from data)

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Mondain-Monval, P.

C. R. Hebd. Séances Acad. Sci. 1922, *175*, 162-4; 1922, *174*, 1014-7.

VARIABLES:

$T/K = 273-288$

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

$t/°C$	100 x mass ratio $NaCl/H_2O$	mass % (compiler)	solid phase	reference
0	35.6	26.25	NaCl	paper 1
15	35.7	26.3	"	paper 2

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Saturated solution was obtained by stirring the mixture of salt and water during about 4 h. A sample of saturated solution was removed and analyzed.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Toporescu, E.

C. R. Hebd. Séances Acad. Sci. 1922, *174*, 870-3; 1922, *175*, 268-70.

VARIABLES:

$T/K = 288-323$

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

$t/°C$	100 x mass ratio $NaCl/H_2O$	mass % (compiler)	solid phase	reference
15	35.7	26.3	NaCl	paper 1
35	36.18	26.57	"	paper 2
50	36.67	26.83	"	paper 2

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Salt water mixtures were stirred for 3 to 6 h in a thermostat. Samples of clear solution were weighed and analyzed.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: ±1 K

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Smits, A.; Elgersma, J.; Hardenburg, M.E.

Recl. Trav. Chim. Pays-Bas 1924, *43*, 671-6.

VARIABLES:

$T/K = 298$

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass % NaCl	solid phase (compiler)
25	26.4	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The authors investigated the ternary system LiCl-NaCl-H_2O at 25°C. Saturated solutions were prepared in an apparatus described by Meyer (1), filtered and, in the case of binary mixtures, analyzed by evaporation of water.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Meyer, G. *Recl. Trav. Chim. Pays-Bas* 1923, *42*, 301.

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Benrath, A.

Z. Anorg. Allg. Chem. 1927, *163*, 396-404.

VARIABLES:

$T/K = 371$

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mol ratio H_2O/NaCl	mass % (compiler)	solid phase
98	8.33	28.03	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Not stated; probably isothermal method.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	Deacon, G.E.R. *J. Chem. Soc.* 1927, 2063-5.
VARIABLES:	**PREPARED BY:**
$T/K = 298$	J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	35.96	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothermal saturation method was used. Chloride was determined gravimetrically as AgCl.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

Temperature: precision probably within ±0.1 K (compiler).
Solubility: No estimates possible.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Foote, H.W.

Am. J. Sci. 1927, *5*, 158-66.

VARIABLES:

T/K = 298

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass % NaCl	solid phase
25	26.50	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Saturated solutions were prepared by shaking the components in small glass-stoppered bottles in a thermostat. Samples were drawn off for analysis through a small filter of glass wool directly into a weighing bottle.

SOURCE AND PURITY OF MATERIALS:

NaCl was purified by "usual methods".

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Holluta, J.; Mautner, S.

Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1927, *127*, 455-75.

VARIABLES:

T/K = 292

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	conc. of NaCl g dm^{-3}	mass % (compiler)	relative density	solid phase (compiler)
18.5	316.30	26.31	1.2019	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The mixture of salt and water was heated at 60°C for 1 h, then stirred in a thermostat. Solid-liquid equilibrium was obtained after about 12 h. Samples of clear solution were removed and analyzed by evaporation and drying the solid to constant weight at 120°C.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Sodium Chloride, NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kupper, A.

Caliche 1927, *8*, 467-87.

VARIABLES:

T/K: 273-356

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	1000 x mol ratio Na_2Cl_2/H_2O	mass % (compiler)	solid phase
0	54.8	26.23	$NaCl\cdot 2H_2O$
5	54.87	26.26	NaCl
15.3	55.08	26.33	"
17.9	55.13	26.35	"
20.6	55.18	26.37	"
25	55.33	26.42	"
27	55.40	26.44	"
31	55.55	26.50	"
35.5	55.76	26.57	"
49	56.44	26.81	"
55	56.80	26.93	"
57	56.96	26.99	"
59	57.06	27.02	"
61	57.16	27.06	"
64	57.37	27.13	"
71	57.88	27.30	"
83	58.75	27.60	"

COMMENTS: The author's tabulated conversions of mole ratios to mass % are not consistent with any values of atomic weights in use between 1894 and 1925, but are consistently 0.03 mass % too high. The compiler's calculations use 1925 atomic weights.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Not given; presumably isothermal saturation was used.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

No estimates posible.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Palitzsch, S.

Z. Phys. Chem., Abt. A 1928, *138*, 379-98; *Studier over Oplösingers Overfladespaending.* Habilitation Thesis. Levin & Munksgaards Forlag. Copenhagen 1927.

VARIABLES:

$T/K = 298$

PREPARED BY:

R. Tenu; J.W. Lorimer

EXPERIMENTAL VALUES:

$t/°C$	molality mol kg^{-1}	mass %	relative density d_4^{25}	solid phase
25	6.12	26.32	1.19814	NaCl

COMMENTS AND ADDITIONAL DATA: Solubilities were measured in connection with studies of surface tensions. The experimental molalities and densities are given on pp. 386-95 of the paper. In the Thesis, the primary data are mass of solution and titer of 0.1 mol dm^{-3} $AgNO_3$. The compiler has calculated molalities and mass fractions from these data, which differ in the last figure from the values given by the author. The primary data follow.

mass of sln/g	titer/cm^3	molality/mol kg^{-1}	mass %
0.7702	34.69	6.128	26.32
0.7702	34.70	6.115	26.33

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solution and solid were rotated in sealed flasks in a thermostat. After saturation, which was continued up to 15 h, the mixture was filtered through cotton wool. Cl was determined by titration with $AgNO_3$. Densities were measured by pycnometer.

SOURCE AND PURITY OF MATERIALS:

NaCl (Kahlbaum or Merck) was recrystallized and checked by analysis. Chloride was determined volumetrically. Water was redistilled over alkaline permanganate.

ESTIMATED ERROR:

Temperature: precision to 0.02 K.
Solubility: precision within 0.05 mass %, from data in thesis.
Density: precision 1-10 x 10^{-5}.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Scott, A.F.; Frazier, W.R.

J. Phys. Chem. 1927, *31*, 459-63.

VARIABLES:

$T/K = 298$

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

$t = 25.000°C$ Solid phase: NaCl (compiler)

mass sln/g in vacuum	vol. sln /cm^3	density/H_2O /g cm^{-3}	mass sample in vacuum/g	mass AgCl in vacuum/g	solubility /mass % (compiler)
30.4406	25.4105	1.19795	7.9637	5.1567	26.404
29.4303	24.5669	1.19797	8.2454	5.3387	26.402
30.4395	25.4105	1.19791			
30.4416	25.4105	1.19799			
	averages	1.19796			26.403

COMMENTS: The primary data given above are the mass and volume of solutions, the mass of an aliquot of each solution, and the mass of AgCl from titration. The authors' solubility values are given erroneously as g salt/100 g water. The compilers' values have been calculated using 1975 atomic weights.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The isothermal method was used. About 80 cm^3 of mixture were prepared in a 250 cm^3 glass bottle. The bottle was placed in a rotating device in a thermostat and stirred for 1 h. It was then allowed to stand in the bath for 1 h. These operations were repeated several times. Saturated solution was transferred into a weighing flask. Solubility was obtained by titration for chloride.

SOURCE AND PURITY OF MATERIALS:

Preparation and purification of the materials were as described in (1).

ESTIMATED ERROR:

Temperature: ±0.01 K.

REFERENCES:

1. Baxter, G.P.; Wallace, C.C. *J. Am. Chem. Soc.* 1916, *38*, 70.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	Wright, R. *J. Chem. Soc.* 1927, *130*, 1334-7.
VARIABLES:	**PREPARED BY:**
$T/K = 293,373$	J.-J. Counioux

EXPERIMENTAL VALUES:

$t/°C$	100 x mass ratio $NaCl/H_2O$	mass % (compiler)	solid phase (compiler)
20	36.0	26.5	NaCl
100	39.1	28.1	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The composition of saturated solutions was determined at constant temperature by titration or evaporation to dryness.	Not stated.
	ESTIMATED ERROR: No estimates possible.
	REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Flottmann, F.

Z. *Anal. Chem.* 1928, 73, 1-39.

VARIABLES:

T/K = 288-298

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass %	density g cm^{-3}	solid phase	remarks
15	26.348	1.2024	NaCl	a
	26.348		"	b
	26.332		"	b
20	26.406	1.2001	"	a
	26.400		"	b
	26.404		"	b
25	26.484	1.1979	"	a
	26.450		"	a
	26.511		"	a
	26.475		"	b
	26.442		"	b

a - analysis by evaporation to dryness
b - analysis of solution by precipitation of AgCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The mixture was introduced into a Jena bottle and stirred for 10 h. A part of the clear solution was removed and analyzed. The composition of the saturated solution was determined by evaporation to dryness and weighing of the residue or by precipitation of chloride as silver chloride. AgCl was dried at 130°C and weighed (1).

SOURCE AND PURITY OF MATERIALS:

Distilled water and the purest Kahlbaum NaCl were used.

ESTIMATED ERROR:

Temperature: ±0.02 K
Density: ±0.0002 g cm^{-3}

REFERENCES:

1. Treadwell, F.P. *Kurzes Lehrbuch der analytischen Chemie.* 1923, *2*, 11.

COMPONENTS:

(1) Sodium chloride, NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Chrétien, A.

Ann. Chim. (Paris) 1929, *12*, 9-155.

VARIABLES:

T/K = 262-378

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass %	relative density	solid phases
- 10.6	13.8		ice
- 21.6	22.9		ice + $NaCl\cdot 2H_2O$
- 10.6	24.7		$NaCl\cdot 2H_2O$
0.2	26.29	1.209	$NaCl\cdot 2H_2O$ + NaCl
6.5	26.28		NaCl
10.2	26.3		"
15	26.36		"
17.5	26.4		"
20	26.4		"
25	26.6	1.198	"
35	26.6		"
50	26.9	1.185	"
75	27.4	1.175	"
100	28.6	1.164	"
105	28.3	1.162	"

COMMENTS: Tables of data are on pp. 129-45 of paper.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothermal method was used. A sample of clear solution was removed and analyzed for chloride by titration with silver nitrate. The temperatures of the eutectic and peritectic points were determined by thermal analysis.

SOURCE AND PURITY OF MATERIALS:

Pure salt was crystallized several times in distilled water.

ESTIMATED ERROR:

Temperature: precision within ±0.05 K between 0 and 35°C; < 0.1 K above 35°C.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Froelich, W.

Mitt. Kali-Forsch. Anst. 1929, 37-66.

VARIABLES:

T/K = 415 - 478
p/MPa = 0.2 - 4.2

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mass %	pressure /atm	stirring time/h	solid phase
142	29.7	2.1	2	NaCl
181	31.1	6.5	2	"
205	31.8	12	2	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Salt and water were stirred at 25 rev/min in an autoclave heated by an oil bath. The autoclave was fitted with thermometers and a manometer. Samples were removed via a sampling tube fitted with a linen filter. Dead space was at a minimum in the autoclave, so compressed air or CO_2 was used to force out samples, which were collected in a closed bomb and then cooled. Analyses were by the "usual methods used in the potash industry".

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

Temperature: precision ±1 K.
Solubility: precision within ±0.2 mass %, from data in table.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Sodium chloride, NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	Gerassimow, I. *Z. Anorg. Allg. Chem.* 1930, *187*, 321-33.
VARIABLES:	PREPARED BY:
T/K = 273 - 348	J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
0	26.00	NaCl
20	26.43	"
50	26.91	"
75	27.45	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The apparatus was described by Meyerhoffer and Saunders (1). Experiments were carried out in an ice thermostat at 0°C and in an Ostwald thermostat between 20 and 75°C. The mixtures were stirred for many hours. Sodium chloride was determined gravimetrically as AgCl. The thermometer was standardized.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Meyerhoffer, W.; Saunders, A.P. *Z. Phys. Chem., Stoechiom. Verwandtschaftsl.* 1899, *28*, 453.

COMPONENTS:

(1) Sodium chloride, NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Adams, L.H.; Hall, R.E.

J. Wash. Acad. Sci. 1931, *21*, 183-94.

VARIABLES:

$T/K = 303$
$p/MPa = 0.1-190$

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

$t/°C$	p/bar	mass %	solid phase
29.93	1	26.47	NaCl
	293	26.73	"
	307	26.73	"
	412	26.79	"
	812	26.98	"
	877	27.00	"
	1258	27.15	"
	1266	27.15	"
	1218	27.07	"
	1293	27.15	"
	1437	27.22	"
	1429	27.22	"
	1419	27.22	"
	1911	27.48	"
30.00	1	26.470[a]	"

---

[a] Saturated solution analyzed by evaporation to dryness.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Saturation was obtained by using a cell in which convection currents produced complete equilibrium between solid and liquid. The concentration was determined by measuring the electric resistance of the solution. The conductivity cell, surrounded by sulfur-free oil, was subjected to pressure in a steel bomb which was placed in a thermostat.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature and pressure: no estimates possible
Solubility: av. dev. at $p = 1$ atm is 0.004 mass %

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Il'inskii, V.P.; Sagaidachnuii, A.F.
Zh. Obshch. Khim. 1931, *1*, 584-8.

VARIABLES:

T/K = 258 - 273

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass %	solid phases
0	26.30	NaCl
-5	25.50	$NaCl\cdot 2H_2O$
-10	24.60	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothermal method was used.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Lannung, A.

Z. Phys. Chem., Abt. A. 1934, *170*, 134-44.

VARIABLES:

T/K = 291
p/kPa = 1.5

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	p/mmHg	molality, m_1/mol kg^{-1}	mass % (compiler)	solid phase
18	11.71	5.64	24.8	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The vapor pressure of the sln was plotted against concentration. The solubility was calculated from the discontinuity in this plot.

SOURCE AND PURITY OF MATERIALS:

NaCl: see (1).

ESTIMATED ERROR:

Temperature: ±0.003 K.
Pressure: ± 7 Pa.

REFERENCES:

1. Lannung, A. *Z. Phys. Chem., Abt. A* 1932, *161*, 255.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	Akhumov, E.; Vasiliev, B.V.; *Zh. Obshch. Khim.* 1932, *2*, 271-89; *Izv. Sekt. Fiz.-Khim. Anal., Inst. Obshch. Neorg. Khim., Akad. Nauk SSSR* 1936, 9, 295-315.
VARIABLES:	PREPARED BY:
T/K = 373-673	J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass ratio $NaCl/H_2O$	mass %	density g cm^{-3}	solid phase
100	0.396	28.37	1.167	NaCl
110	0.402	28.67		"
120	0.408	28.98		"
130	0.414	29.28	1.161	"
140	0.420	29.58		"
150	0.426	29.87	1.155	"
160	0.432	30.17		"
170	0.438	30.46	1.152	"
180	0.446	30.84		"
190	0.454	31.22		"
200	0.462	31.60	1.148	"
220	0.473	32.11		"
230	0.482	32.52		"
250	0.497	33.20		"
270	0.520	34.21		"
280	0.526	34.47		"
300	0.540	35.06		"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE	SOURCE AND PURITY OF MATERIALS:
Three methods were used: (1) Visual. The temperature at which the last crystal disappears was noted. (2) Isothermal. Water and salt were introduced into a U-tube which was sealed and placed in a thermostat. When equilibrium was attained, part of the saturated solution was separated from the mixture and collected in one side of the tube. After cooling, the tube was cut and the solution was analyzed. (3) Conductimetric. Conductivity was plotted against concentration, and a break was observed in the curve at the saturation composition.	Not stated. ESTIMATED ERROR: No estimates possible. REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Cornec, E.; Krombach, H.

Ann. Chim. (Paris) 1932, *18*, 5-31.

VARIABLES:

T/K = 252-463

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio $NaCl/H_2O$	mass %	relative density	solid phases
- 21.1	30.0	23.07		ice + $NaCl\cdot 2H_2O$
- 10.0	32.8	24.70		$NaCl\cdot 2H_2O$
0	35.6	26.25	1.209	NaCl
0.1	35.6	26.27		NaCl + $NaCl\cdot 2H_2O$
10	35.8	26.34	1.201	NaCl
40	36.3	26.64	1.192	"
60	37.0	27.03	1.184	"
100	38.9	28.00	1.166	"
108.7[a]	39.4	28.30	1.162	"
120	40.0	28.60		"
140	41.4	29.30		"
169.5	44.1	30.62		"
189.6	45.9	31.45		"

---

[a] boiling point

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Saturated solution was stirred at constant temperature for several h. A sample of clear solution was then removed and analyzed. When the temperature of saturation was higher than the boiling point at atmospheric pressure, saturated solutions were prepared in a bomb placed in a thermostated oil bath. After several h, the bomb was turned in order to separate clear solution, which was removed after cooling and analyzed.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: ±0.2 K

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Osokoreva, N.A.; Opikhtina, M.A.; Shioket, A.N.; Plaksina, E.F.; Zaslavskii, A.I.; with Kurnakov, N.S.; Manoev, D.P.

Tr. Gos. Inst. Prikl. Khim. 1932, *no. 16*, 24-47.

VARIABLES:

$T/K = 283 - 373$

PREPARED BY:

T. Mioduski

EXPERIMENTAL VALUES:

$t/°C$	Solubility of NaCl mass % $100w_1$	mole fraction[a] x_1	solid phase
10	26.33	0.09924	NaCl
20	26.37	0.09942	"
25	26.48	0.09993	"
40	26.76	0.1012	"
50	26.93	0.1020	"
60	27.02	0.1024	"
70	27.36	0.1040	"
100	28.29	0.1084	"

---

[a] Mole fractions calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothermal saturation method was used. Samples were agitated in a water thermostat below 333 K and in an oil thermostat at higher temperatures. Equilbrium was established in 1-2 d, or sooner at higher temperatures, as confirmed by constancy of density to 2-3 x 10^{-4} g cm^{-3}. Samoples were taken at the same temperature as the thermostat. Solid phases were not analyzed. Solutions were analyzed gravimetrically for Cl as AgCl.

SOURCE AND PURITY OF MATERIALS:

No information available.

ESTIMATED ERROR:

Temperature: precision within ±0.1 K.

REFERENCES:

COMPONENTS:

(1) Sodium Chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Scatchard, G.; Prentiss, S.S.

J. Am. Chem. Soc. 1933, *55*, 4355-62.

VARIABLES:

T/K: 269-273

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

j	t/°C	molality NaCl mol kg^{-1}	mass % (compiler)	solid phase
-0.0092	-0.0031	0.000819	0.00479	ice
0.0092	-0.0069	0.001866	0.01090	"
0.0192	-0.0187	0.005120	0.02991	"
0.0265	-0.0311	0.008605	0.05026	"
0.0334	-0.0486	0.013540	0.07907	"
0.0445	-0.0804	0.022648	0.13218	
0.0468	-0.1186	0.033489	0.19533	"
0.0553	-0.1928	0.054924	0.31996	"
0.0628	-0.2746	0.078838	0.45863	"
0.0668	-0.3596	0.10371	0.60245	"
0.0710	-0.4342	0.12579	0.72978	"
0.0743	-0.5423	0.15765	0.91293	"
0.0775	-0.6411	0.18703	1.0812	"
0.0803	-0.7627	0.22318	1.2875	"
0.0831	-0.9334	0.27394	1.5757	"
0.0863	-1.2051	0.35492	2.0321	"
0.0881	-1.40797	0.41547	2.3705	"
0.0884	-1.4692	0.43370	2.4720	"
0.0892	-1.6447	0.48597	2.7617	"
0.0899	-1.7947	0.53070	3.0082	"
0.0902	-2.0000	0.59159	3.3418	"
0.0908	-2.1912	0.64857	3.6520	"
0.0907	-2.4503	0.72518	4.0658	"
0.0907	-2.7072	0.80120	4.4729	"
0.0894	-3.0499	0.90133	5.0040	"
0.0884	-3.3825	0.99853	5.5138	"
0.0862	-3.9186	1.1540	6.3181	"
0.0845	-4.3457	1.2774	6.9468	"

COMMENTS: The Lewis and Randall function j is defined as: $j = 1 - (\Delta T/K)/3.716(m/\text{mol kg}^{-1})$, where ΔT is the freezing point depression and m the molality.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The freezing points were measured by the "equilibrium method" and the concentration was determined by conductance as described in previous papers (1) and (2), except that nitrogen was always passed through an ice-water mixture to cool it before it was bubbled through the solution.

SOURCE AND PURITY OF MATERIALS:

NaCl (C.P.) was dissolved in water, precipitated by HCl gas, washed, dried at 200°C and melted.
The water used was distilled from a new Kraus type still.

ESTIMATED ERROR:

For more dilute solutions than 0.01 mol kg^{-1}, average deviation corresponds to about 0.00003K.

REFERENCES:

1. Scatchard, G.; Jones, P.T.; Prentiss, S.S. *J. Am. Chem. Soc.* 1932, 54, 2690.
2. Scatchard, G.; Prentiss, S.S. *J. Am. Chem. Soc.* 1932, 54, 2696.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	Taylor, H.S.; Caley, E.R.; Eyring, H. *J. Am. Chem. Soc.* 1933, 55, 4334.
VARIABLES:	PREPARED BY:
T/K = 298	J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mass ratio $NaCl/H_2O$	mass % (compiler)	solid phase
25	0.359	26.4	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothermal saturation method was used. Analysis was by evaporation of a weighed sample to dryness.

SOURCE AND PURITY OF MATERIALS:

No information available.

ESTIMATED ERROR:

Temperature: precision probably within ±0.1 K (compiler).
Solubility: precision > 1 % (authors).

REFERENCES:

COMPONENTS:

(1) Sodium Chloride; NaCl; [7647-14-85]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Akhumov, E.I.; Golovkov, M.P.

Zh. Obshch. Khim. 1935, 5(4), 500-9.

VARIABLES:

T/K = 288

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass % NaCl	refractive index	solid phase
15	26.35	1.3826	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility was determined by the synthetic method. The refractive indexes of solutions were plotted vs concentration. A sample of saturated solution was also analyzed.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Akerlof, G.; Turck, H.E.

J. Amer. Chem. Soc. 1935, 57, 1746-50.

VARIABLES:

T/K = 298

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	molality mol/kg	mass %	solid phase
25	6.162[a]	26.477	NaCl

[a] mean of 2 determinations

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Water and salt were introduced into glass-stoppered Pyrex bottles and the mixture was stirred over a period of 20 h. Samples of saturated solution were weighed, evaporated to dryness and the residue of pure salt was weighed.

SOURCE AND PURITY OF MATERIALS:

The "analyzed" NaCl was recrystallized and dried.

ESTIMATED ERROR:

Temperature: ±0.01K

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Obukhov, A.P.; Mikhailova, M.N.

Zh. Prikl. Khim. 1935, *8*, 1148-51.

VARIABLES:

T/K = 298, 378

PREPARED BY:

R. Cohen-Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	26.40	NaCl
105	28.25	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method. Equilibrium was reached in 2-3 h at 25°C and in 30 min. at 105°C. At 105 C, samples were drawn into glass tubes and allowed to solidify. The tubes were then washed out and the contents analyzed for Cl by Volhard titration. Solid phases in the system Na_3PO_4-NaCl-H_2O were determined by the wet residue method.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Sodium chloride, NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Schroeder, W.C.; Gabriel, A.; Partridge, E.P.

J. Am. Chem. Soc. 1935, *57*, 1539-46.

VARIABLES:

T/K = 423-623

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass ratio NaCl/H_2O	mass % (compiler)	solid phase
150	0.420	29.6	NaCl
173	0.436	30.4	"
200	0.462	31.6	"
225	0.497	33.2	"
250	0.520	34.2	"
300	0.649[a]	39.4	"
300	0.609	37.8	"
350	0.724	42.0	"

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[a] value high (authors)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Solubility determinations were made in nickel bombs which were rotated end over end in an air thermostat. The bombs were of the type developed and used by Waldeck *et al.* (1). The bomb containing the mixture was placed in the thermostat and rotated at the desired temperature for 12 to 48 h. Before sampling the bomb was allowed to stand upright for at least 30 min to settle out the suspended solid. Chloride was determined by titration with silver nitrate using potassium chromate as indicator.

SOURCE AND PURITY OF MATERIALS:

NaCl: Baker C.P. Analyzed

ESTIMATED ERROR:

Temperature: precision within ±2 K

REFERENCES:

1. Waldeck, W.F.; Lynn, G.; Hill, A.E. *J. Am. Chem. Soc.* 1932, *54*, 928; 1934, *56*, 43.

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Yarluikov, M.M.

Zhur. Prikl. Khim. (Leningrad) 1935, 7, 902-5.

VARIABLES:

$T/K = 263-353$

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

$t/°C$	100 x mass ratio $NaCl/H_2O$	mass %	relative density	solid phase
-10	33.09	24.86	1.1898	$NaCl \cdot 2H_2O^a$
0	35.17	26.02	1.2020	NaCl
10	35.36	26.12	1.1994	"
20	35.50	26.20	1.201	"
35	36.16	26.56	1.1910	"
50	36.75	26.87	1.1900	"
65	37.03	27.02	1.1920	"
80	37.42	27.23	1.1926	"

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[a] compiler

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Benrath, A.; Gjedebo, F.; Schiffers, B.; Wunderlich, H.

Z. Anorg. Allg. Chem. 1937, *231*, 285-97.

VARIABLES:

$T/K = 558-728$

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
285	36.1	NaCl
301	37.3	"
334	40.6	"
356	42.6	"
364	43.3	"
384	45.1	"
388	45.6	"
409	47.5	"
430	49.1	"
455	51.3	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Salt and water were introduced into a small diameter glass tube which was stirred during heating. The temperature was read when the last crystal disappeared.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Restaino, S.

Int. Congr. Pure Appl. Chem. [Proc.], 10th 1938, *2*, 761-6.

VARIABLES:

$T/K = 298\text{-}373$

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	26.44	NaCl
50	26.90	"
100	28.23	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The method of Noyes (1) was used at 25 and 50°C, and the method of Meyerhoffer and Saunders (2) at 100°C.

Mixtures were introduced into Jena glass bottles and stirred in a thermostat for many days. Samples of saturated solution were removed and chloride was determined by Volhard's method.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

1. Noyes, A.A. *Z. Phys. Chem., Stoechiom. Verwandtschaftsl.* 1892, *10*, 603.
2. Meyerhoffer, W.; Saunders, A.P. *Z. Phys. Chem., Stoechiom. Verwandtschaftsl.* 1899, *28*, 451.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	Zaslavskii, A.I.; Sinani, S.S.; Sokolova, L.A. *Izv. Akad. Nauk SSSR, Otdel. Khim. Nauk* 1938, 47, 68.
VARIABLES:	PREPARED BY:
$T/K = 268$	J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
-5	17.83	$NaCl \cdot 2H_2O$
-5	24.60	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE	SOURCE AND PURITY OF MATERIALS:
	Not stated.
	ESTIMATED ERROR:
	No estimates possible.
	REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Eddy, R.D.; Menzies, A.W.C.

J. Phys. Chem. 1940, *44*, 207-35.

VARIABLES:

$T/K = 375, 442$

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

$t/°C$	molality $m_1/\text{mol kg}^{-1}$	mass % (compiler)	solid phase
101.9	6.69	28.1	NaCl
168.3	7.54	30.6	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The sybthetic method, in the form used by Menzies (1), was used. The apparatus consists of a sealed tube containing salt and water, with the water contained in a calibrated side-arm which can be sealed off from the rest of the apparatus by a trap containing a sealant which can be melted. Correction is made for the mass of solvent in the vapor phase.

SOURCE AND PURITY OF MATERIALS:

NaCl: made by ppt. with HCl (Grasselli reagent) from a sln of Na_2CO_3, then 2x recryst., dried by heating to incipient fusion for 20 min.
Water: redistilled, air-free, conductivity 5.3×10^{-6} S cm^{-1}.

ESTIMATED ERROR:

Temperature: precision probably within ±0.2 K (compiler).
Solubility: estimated precision ±1 %; similar accuracy claimed.

REFERENCES:

1. Menzies, A.W.C. *J. Am. Chem. Soc.* 1936, *58*, 934.

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Keevil, N.B.

J. Am. Chem. Soc. 1942, *64*, 841-50.

VARIABLES:

$T/K = 456-919$
$p/MPa = 0.7 - 37$

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	vapor pressure /atm	NaCl mol fraction	mass % (compiler)	method
183.0	7.27	0.120	30.7	h
205.1	11.76	0.124	31.5	c
230.2	19.29	0.130	32.6	h
246.7	25.08	0.135	33.6	c
254.6	27.51	0.138	34.2	h
299.3	56.03	0.155	37.3	h
327.3	78.50	0.169	39.7	c
344.4	96.29	0.178	41.3	h
354.3	106.4	0.183	42.1	c
385.7	145.0	0.205	45.6	c
410.0	178.9	0.217	47.3	h
442.5	230.1	0.238	50.3	c
467.5	269.0	0.251	52.1	h
485.5	294.4	0.270	54.5	c
514.2	335.1	0.285	56.4	h
550.5	370.1	0.335	62.0	h
600.0	388.7	0.411	69.4	h
646.2	368.5	0.505	76.8	h

c - temperature was reached by cooling
h - " " " " heating

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The experimental system was described by Benedict (1,2). Salt and water were confined in a steel bomb by means of mercury. Foreign gases were removed previously by boiling and pumping. Temperature was measured by means of a Pt:Pt-10% Rh thermocouple sealed in Pyrex glass. Pressure measurements were made with a dead-weight piston gauge of the Bridgman type (3) standardized against the vapor pressure of carbon dioxide at 0°C and 34.4009 atm. The procedure consisted of making a series of pressure-volume measurements at each of several temperatures. The volume of the salt-water system in the bomb was controlled by means of mercury and a screw-compressor. When the solid phase disappeared before the boiling point was reached, a discontinuity in slope was observed. This change at the disappearance of salt gave the solubility.

SOURCE AND PURITY OF MATERIALS:

Sodium chloride, Mallinckrodt analytical reagent, was dissolved in distilled water and precipitated with washed dry HCl. After filtering and pressing between filter paper, the crystals were dried for 24 h at 450°C.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Benedict, M. *J. Geol.* 1939, *47*, 252.
2. Benedict, M. *Rev. Sci. Inst.* 1937, *8*, 252.
3. Bridgman, P.W. *Proc. Am. Acad. Arts Sci.* 1909, *44*, 201.

COMPONENTS:

(1) Sodium Chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Gehlen, H.; Dieter, H.

Z. Phys. Chem. (Leipzig) 1950, *196*, 258-77.

VARIABLES:

p/MPa = 0-1000

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	*p*/atm	mass % a	mass % b	solid phase
25	1	26.42	26.42	NaCl
	1000	27.2	26.05	"
	2000	27.8	27.45	"
	3000	28.8	27.80	"
	4000	29.4	27.90	"
	5000	30.1	28.40	"
	6000	30.5	28.20	"
	7000	31.1	28.10	"
	8000	31.9	28.60	"
	9000	32.2	27.90	"
	10000	32.7	28.50	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Solubilities under pressure were calculated from density and vapor pressure data under atmospheric pressure using Tamman's assumption (1) on the coincidence pressure and the compressibility coefficient of solid chloride.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Tammann, G. *Uber die Beziehungen zwischen den inneren Kräften und Eigenschaften der Lösungen.* Leopold Voss. Hamburg, Leipzig. 1907.

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Olander, A.; Liander, H. *Acta Chim. Scand.* <u>1950</u>, *4*, 1437-45.

VARIABLES:

T/K = 623-748
p/bar = 170-400

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

Pressures (kg cm^{-2}) at which a phase exists containing the amount of salt (mass %, $100w_1$) shown in the first column. The critical pressures (p_C/kg cm^{-2}) are given on the second line, and the line through the table indicates the location of the critical states.

t/°C	350	360	370	380	390	400	410	420	430	440	450	460	475
p_C/kg cm^{-2}				240	262	286	313	343	373	405	436		
0	169	194	215										
0.005				149	154	159	163	166	169	171			
0.01				172	178	184	190	194	198	202	205	208	
0.02				193	199	206	213	220	226	231	236	241	
0.03				206	211	218	227	234	241	248	254	259	267
0.05				220	226	234	243	252	261	269	277	285	296
0.1				234	242	253	264	275	286	297	308	318	334
0.2				240	254	268	283[a]	297	311	325	338	352	372
0.5	167	189	213	240	260	280	301	321	341	361	379	396	
1.0	166	187	211	236	262	284	309	333	358	382			
2.0	163	184	208	234	262	286	313	340	368	396			
5.0	157	178	201	226	254	283	313	343	373	403			
10	148	169	192	216	244	284	305	338	371	405			
15	140	161	184	208	233	261	291	324	369	395			
20	133	154	176	199	222	248	277	309	341	376			
25	127	147	168	189	211	235	260	289	321	256			
satd	113	127	141	155	169	183	198	213	227	243	258	273	297

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[a] Authors give 233, which is clearly a typographical error (compiler).

COMMENTS AND ADDITIONAL DATA: The above data have been smoothed from the basic data for salt content of the upper phase as a function of pressure at a given temperature. Plots of these data also gave the critical curve (not given here). The compiler finds that $\ln(100w_1)$ is linear (higher temps.) or quadratic (lower temps.) in p for each temp., and the pressures of the satd. slns. from the table then give, with least-square fits, the compositions of the vapor (mass % NaCl, u_1) in the three-phase S-L-G system, as follows:

t/°C	380	390	400	410	420	430	440	450	460	475
$100u_1$	0.0060	0.0076	0.0098	0.013	0.017	0.021	0.027	0.033	0.039	0.051
p/bar	155	165	180	195	210	225	239	253	268	288

Similar calculations were made by Bischoff *et al.* (1), who, however, do not explain their method clearly, and give only graphical results.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

A copper-lined steel bomb, volume about 5 L, and electrically heated, was filled through a steel pump. The bomb was then heated, and appropriate amounts of liquid were removed. When thermal eqm was reached, samples were removed via copper capillaries located at top and bottom of the bomb. Analysis for Cl was by Mohr titration. The authors state that observed corrosion of the copper lining and steel valves did not affect the results. Temp. was measured with calibrated chromel-alumel thermocouples, pressure by a calibrated Bourdon manometer.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

Temperature: precision ± 1 K.
Pressure: ± 1 kg cm^{-2}.

REFERENCES:

1. Bischoff, J.L.; Rosenbauer, R.J.; Pitzer, K.S. *Geochim. Cosmochim. Acta* <u>1988</u>, *50*, 1437.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	Blidin, V.P. *Dokl. Akad. Nauk SSSR* 1953, *88*, 451-9.
VARIABLES:	PREPARED BY:
T/K = 313	M. Ferriol

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
40	26.65	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE	SOURCE AND PURITY OF MATERIALS:
Isothermal method. Saturation was obtained by adding weighed amounts of salt to unsaturated solution. A sample of clear solution was weighed and analyzed.	No information given.
	ESTIMATED ERROR:
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Sodium chloride; NaCl; [7647-14-85] (2) Water; H_2O; [7732-18-5]	Labash, J.A.; Lusby, G.R. *Can. J. Chem.* 1955, *33*, 774-86.
VARIABLES:	PREPARED BY:
T/K = 293, 333	J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
20	26.36	NaCl
60	27.03	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The isothermal method was used. Solutions were sampled by allowing salts to settle and then quickly drawing a sample into a pipet heated above room temperature. A short length of glass tubing containing a wad of absorbent cotton was attached by a rubber tube to the lower end of the pipet. Chloride was analyzed volumetrically using $AgNO_3$ in excess and back titrating. Na was determined by converting to the sulphate and heating to constant weight.

SOURCE AND PURITY OF MATERIALS:

NaCl: A.R. grade

ESTIMATED ERROR:

Temperature: ±0.1 K
Solubility: ±0.004 mass %

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	Blidin, W.P. *Zh. Obshch. Khim.* 1956, *26*, 1281-5; **J. Gen. Chem. USSR (Engl. Transl.)* 1956, *26*, 1449-52.
VARIABLES:	PREPARED BY:
T/K = 298	M.-T. Saugier

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	26.50	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The isothermal method was used. The solution with excess solid phase was placed in a reaction vessel with an oil seal and stirred until equilibrium had been achieved. Chloride ion was determined gravimetrically in saturated solution.

SOURCE AND PURITY OF MATERIALS:

C.P. grade salt, 2x recrystallized, was used.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Nallet, A.

Thesis. Lyon (France). no. 209 <u>1955</u>.

Nallet, A.; Pâris, R.A.

Bull. Soc. Chim. Fr. <u>1955</u>, *94*, 488-97.

VARIABLES:

T/K = 252-373

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass %	100 x mass ratio NaCl/H_2O	relative density	solid phases
-21.25	23.19	30.19	1.191	ice + NaCl·$2H_2O$[a]
-19.2	21.8	27.88	1.179	ice
-19.2	23.42	30.58	1.193	NaCl·$2H_2O$
- 9.8	13.73	15.92	1.1075	ice
- 9.8	24.86	33.08	1.2015	NaCl·$2H_2O$
0	26.26	35.6	1.209	NaCl + NaCl·$2H_2O$[b]
10	26.35	35.78	1.2047	NaCl
30	26.53	36.11	1.1957	"
50	26.84	36.69	1.187	"
70	27.28	37.51	1.178	"
100	28.13	39.14	1.168	"

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[a] eutectic point

[b] peritectic point

COMMENTS: Only graphical data are given in the paper in *Bull. Soc. Chim. Fr.*

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Solubility was measured at fixed temperatures. The salt was previously dissolved by heating the mixture. The mixtures were stirred in a thermostat for 36 h above 70°C and for 4 d at -20°C. A sample of clear solution was removed and analyzed for chloride by potentiometric titration with $AgNO_3$. Densities were measured with a pyknometer. Eutectic and peritectic temperatures were determined by thermal analysis.

SOURCE AND PURITY OF MATERIALS:

Na_2CO_3, 2x recrystallized, was neutralized by very pure HCl. The NaCl was precipitated from solution by means of HCl gas, then washed and dried at 120°C. Impurities were lower than 0.1%.

ESTIMATED ERROR:

Temperature: ±0.02 K in the range 10 to 40°C; ±0.05 K below 10°C or above 40°C

Cl^-: 0.2 to 0.3% (potentiometric titration)

K^+: 0.5 to 1% according to the method (chemical analysis or spectrophotometry)

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Akhumov, E.I.; Pylkova, E.V.

Ber. Akad. Wiss. USSR 1956, *108*, 857-60; *Freiberger Forsch.* 1959, *123(A)*, 251-6.

VARIABLES:

$T/K = 299-509$

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass % NaCl	solid phase
26	26.46	NaCl
48	26.75	"
73	27.35	"
100	28.20	"
106	28.39	"
121	28.88	"
132	29.23	"
145	29.65	"
149	29.78	"
163	30.27	"
179	30.85	"
208	32.01	"
218	33.39	"
236	33.17	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Synthetic method: a solution with an excess of salt was placed in a sealed tube. The temperature of disappearance of the last crystal on heating and of appearance on cooling (supersaturated solution) were observed.

SOURCE AND PURITY OF MATERIALS:

Chemically pure salt was recrystallized 3x and dried to constant weight.

ESTIMATED ERROR:

Temperature: ±0.5 to 1 K.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Sodium Chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	Magdin, W.M.; Swales, D.A. *J. Appl. Chem.* 1956, 6, 482-7.
VARIABLES:	PREPARED BY:
T/K: 298, 308	J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio $NaCl/H_2O$	mass % (compiler)	density g cm^{-3}	solid phase
25	35.96	26.45	1.1984	NaCl
35	36.02	26.48	1.1935	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Salt and water were rotated in sealed sample bottles in a thermostat. Equilibrium was reached, according to density measurements, within 60 hours. Samples of saturated solution were removed in calibrated pipets fitted with sintered glass filters. Analyses were for Cl by Mohr titration.

SOURCE AND PURITY OF MATERIALS:

NaCl: Analar grade

ESTIMATED ERROR:

Temperature: ±0.01K

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Makin, A.V.

Zh. Neorg. Khim. 1957, *2*, 2794-6; *J. Inorg. Chem., USSR (Engl. Transl.)* 1957, *2* [12], 182-6.

VARIABLES:

T/K = 298

PREPARED BY:

R. Cohen-Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	26.42	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method. Gravimetric analyses. No further information given.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Karnaukhov, A.S.

Izv. Vyssh. Uch. Zav. Khim. Khim. Tekhnol. 1958, *3*, 34-9.

VARIABLES:

T/K = 293

PREPARED BY:

R. Cohen-Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
20	26.50	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method. Equilibrium was reached in 2 d. Na was detd. by Mohr titration.

SOURCE AND PURITY OF MATERIALS:

NaCl: C.P. salt recryst. 2X; purity 99.4-99.6%.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Sodium Chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Plyushchev, V.E.; Tulinova, V.B.; Kuznetsova, G.P.; Korovin, S.S.; Shipetina, N.S.

Zh. Neorg. Khim. 1957, *2*, 2654-60; **Russ. J. Inorg. Chem.* (Engl. Transl.) 1957, *2*, 267-75.

VARIABLES:

T/K = 298 - 348

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass %	relative density
25	26.58	1.199
50	26.77	1.181
75	27.24	1.181

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothermal method was used. It was found that equilibrium was established at 25°C in 12 d, at 50°C in 7 d, and at 75°C in 5 d. Samples were removed by a pipet, the end of which was fitted with a cotton filter. The concentrations of salts in the solution were calculated from chemical analysis.

SOURCE AND PURITY OF MATERIALS:

Chemically pure, 2x crystallized NaCl was used.

ESTIMATED ERROR:

Temperature: ±0.1K

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	Lepeshkov, I.N.; Fradkina, Kh.B. *Zh. Neorg. Khim.* 1959, *4*, 2803-11; **Russ. J. Inorg. Chem. (Engl. Transl.)* 1959, *4*, 1297-1401.
VARIABLES:	**PREPARED BY:**
T/K = 308	J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
35	26.76	NaCl

ADDITIONAL DATA: By differential thermal analysis, the authors found the melting point of NaCl to be 801°C.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Samples were equilibrated in a thermostat. Equilibrium times were 25-35 d. Equilibrium liquids were sampled using a heated pipet fitted with a cotton wool filter tip. Cl was determined by Volhard titration of both the solution phase and the residue.
Compositions of solid phases were confirmed by optical methods and by differential thermal analysis.

SOURCE AND PURITY OF MATERIALS:

NaCl was recrystallized twice.

ESTIMATED ERROR:

Temperature: precision within ±0.05 K.

REFERENCES:

COMPONENTS:

(1) Sodium Chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Slovinskaya, W.M.; Mukimov, S.M.

Uzb. Khim. Zh. 1959, *2*, 12-20.

VARIABLES:

T/K = 298 - 348

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	100 mass ratio NaCl/H_2O	mass %	relative density	solid phase
0	34.23	26.25	1.2090	NaCl
25	35.30	26.60	1.2053	"
50	36.74	26.87	1.1928	"
75	37.93	27.50	1.1936	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method is described in (1,2).

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Mukimov, S.M.; Bodiaghina, V.M. *Uzb. Khim. Zh.* 1948, 3.
2. Slovinskaya, W.M.; Mukimov, S.M. *Uzb. Khim. Zh.* 1956, 11.

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Zhuravlev, E.F.; Bychkova, M.N.

Zh. *Neorg. Khim.* 1959, 4, 2367-75; **Russ. J. Inorg. Chem. (Engl. Transl.)* 1959, 4, 1082-7.

VARIABLES:

$T/K = 278-323$

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

$t/°C$	mass %	solid phase
5	26.2	NaCl
25	26.5	"
50	26.9	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Solubility was determined by use of the graphical method known as the isothermal method of sections and used in the investigation of individual phase equilibria (1,2). Its application to water-salt systems was demonstrated by Mertslin and Krupatkin (3).

SOURCE AND PURITY OF MATERIALS:

NaCl was recrystallized and dried over anhydrous $CaCl_2$.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Mertslin, R.V. *Izv. Nauch. Issled. Inst. Perm. Gos. Univ.* 1937, *11* (1,2), 1; *Uchen. Zap. Perm. Univ.* 1939, *3* (4), 37.
2. Mochalov, K.I. *Zh. Obshch. Khim.* 1939, 9, 1701.
3. Mertslin, R.V.; Krupatkin, I.L. *Zh. Obshch. Khim.* 1940, *10*, 22.

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Akhumov, E.I.; Pylkova, E.V.

Zh. Neorg. Khim. 1960, 5, 1819-27; *Russ. J. Inorg. Chem. (Engl. Transl.) 1960, 5, 882-6.

VARIABLES:

T/K = 323-373

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass % a	mass % b	solid phase
50	26.80	29.00	NaCl
75	27.45	29.80	"
100	28.20	30.70	"

---

[a] stable solution
[b] metastable solution

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Solutions containing particular ratios of components were heated or cooled in sealed glass tubes.

SOURCE AND PURITY OF MATERIALS:

NaCl: 3X recrystallized
H_2O: freshly distilled

ESTIMATED ERROR:

Temperature: precision within ±0.5-1 K

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sourirajan, S.; Kennedy, G.C.

Am. J. Science 1962, *260*, 115-41.

VARIABLES:

$T/K = 493-982$
$p/kPa = 22-392$

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

I. Vapor pressures of solutions saturated with solid NaCl

$t/°C$	vapor pressure p/bar	$t/°C$	vapor pressure p/bar	$t/°C$	vapor pressure p/bar
707.0	269.5	425.8	222.0	313.2	75.6
668.1	335.5	405.3	190.6	343.5	105.8
609.3	389.5	386.2	161.6	375.0	146.5
600.0	392.0	384.6	160.6	406.8	191.9
577.5	390.0	363.5	131.2	438.8	240.0
558.6	384.0	343.5	106.0	470.0	288.0
555.3	381.5	323.0	84.8	501.9	332.2
527.8	360.0	300.8	66.6	525.0	358.2
504.4	334.5	279.3	52.0	560.0	384.0
502.6	333.5	259.8	38.8	604.3	391.0
488.9	314.5	219.5	21.5	610.0	388.0
466.9	283.0	249.5	33.5	633.9	373.5
465.0	281.0	280.0	51.0	675.0	326.2
446.6	253.0	312.2	75.1	708.5	269.0
444.3	250.5				

II. Solubility of NaCl in the gas phase of the three-phase S-L-G system (From Tables 2 and 3 of the original paper; data on two-phase equilibria not compiled.)

$t/°C$	p/bar	mass % $100u_1$	$t/°C$	p/bar	mass % $100u_1$
350	114	0.0026	500	330	0.0243
360	127	0.0035	525	359	0.0292
370	140	0.0046	550	379	0.0343[a]
380	153	0.0056	575	389	0.0380
390	167	0.0068	600	392	0.0414
400	182	0.0080	625	379	0.0744
425	220	0.0115	650	356	0.1600
450	259	0.0157	675	326	0.3815
475	296	0.0200	700	287	0.9416

---

[a] from Table 2; Table 3 gives 0.0342.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

General: Equilibria were studied in a stellite bomb furnished with filling and sampling tubes and connected to a pressure system. Temperatures were measured with thermocouples calibrated to NBS standards, pressures with Bourdon gauges calibrated with free piston gauges. Compositions of samples withdrawn from the bomb were detd. by flame photometry or titration.

I. V.P. of solutions saturated with solid NaCl. Solid was placed in the bomb, then water was added in increments until further additions did not change the pressure, indicating 3-phase equilibrium. Eqm. times about 2 h, 6 h allowed, with at least 3 consistent readings at each T and p.

II. Solubility of NaCl in the 3-phase S-L-G system. As above, but a sample was withdrawn after flushing the sampling tube. The pressure drop during sampling was < 2 bar. At least two samples were taken.

SOURCE AND PURITY OF MATERIALS:

NaCl: analytical grade.
H_2O: conductivity grade.

ESTIMATED ERROR:

Temperature: precision ± 0.1 K.
Pressure: precision ± 2 bar
Composition: no estimates possible.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Belyaev, I.N.; Le T'yuk

Zh. Neorg. Khim. 1965, *10*, 2355-8; **Russ. J. Inorg. Chem. (Engl. Transl.)* 1965, *10*, 1279-81.

VARIABLES:

$T/K = 298$

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

$t/°C$	mass %	relative density	viscosity mPa s	conductivity S cm^{-1}	solid phase
25	26.49	1.196	1.5766	0.159	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Isothermal method. With continuous mixing, equilibrium between solid and liquid phases was established in 8-10 h. Chlorine in saturated solution was determined by Volhard's volumetric method.

SOURCE AND PURITY OF MATERIALS:

"Chemically pure" grade NaCl was recrystallized 2x from aqueous solution.

ESTIMATED ERROR:

Temperature: precision ±0.1 K

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Belyaev, I.N.; Lobas, L.M.

Zh. Neorg. Khim. 1965, *10*, 946-9; **Russ. J. Inorg. Chem. (Engl. Transl.)* 1965, *10*, 512-4.

VARIABLES:

$T/K = 298$

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

$t/°C$	mass %	relative density	viscosity /mPa s	electrical conductivity S cm^{-1}	solid phase
25	26.71	1.195	1.7099	0.133	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility was determined by the isothermal method. Equilibrium between the liquid and solid phases was reached by continuous stirring for 8-10 h. Total chlorine was determined volumetrically by Volhard's method. The electrical conductivity of saturated solution was measured with a bridge, the viscosity in an Ostwald viscometer, and the density in a 5 ml pycnometer.

SOURCE AND PURITY OF MATERIALS:

"Chemically pure" grade NaCl was recrystallized from aqueous solution.

ESTIMATED ERROR:

Temperature: precision within ±0.1K

REFERENCES:

COMPONENTS:

(1) Sodium Chloride, NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Zen, E-An

J. Petrol. 1965, *6*, 124-64.

VARIABLES:

T/K: 308, 323

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio NaCl/H_2O	mass % (compiler)	solid phase	method[a]
35	362.01	26.579	NaCl	u
	362.18	26.588	"	s
50	363.70	26.670	"	u
	365.00	26.740	"	s

---

[a] from undersaturation
[b] from supersaturation

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

(a) From supersaturation. Unsaturated solutions were allowed to evaporate while being stirred in a thermostat. Equilibrium times were at least 3 weeks at 50°C and 2-3 months at 35°C.

(b) From undersaturation. As above, but excess salt and water were stirred together.
Samples were removed by gentle suction through a fritted filter dish into a Pyrex crucible. Analyses were by evaporation and final heating at 400°C.

SOURCE AND PURITY OF MATERIALS:

NaCl: Baker Reagent Grade

ESTIMATED ERROR:

Temperature: ±0.5K; traceable to NBS standards.
Solubility: precision ±0.5% on mass ratio (authors).

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Karnaukhov, A.S.; Kudryakova, S.A.

Uch. Zap. Yarosl. Gos. Ped. Inst. 1966, *59*, 119-36.

VARIABLES:

$T/K = 298$

PREPARED BY:

R. Cohen-Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	26.45	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method. Equilibrium was reached in 20-70 h. Na was detd. gravimetrically as NaZn uranyl acetate, Cl mercurimetrically.

SOURCE AND PURITY OF MATERIALS:

NaCl: recryst. 2X; purity 95.6-99.8%

ESTIMATED ERROR:

Temperature: precision ± 0.1 K.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Karnaukhov, A.S.; Troitskii, E.N.

Uch. Zap. Yarosl. Gos. Ped. Inst. 1966, *59*, 8-21.

VARIABLES:

$T/K = 363$

PREPARED BY:

R. Cohen-Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
90	27.80	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method. Na was detd. gravimetrically as NaZn uranyl acetate, Cl mercurimetrically.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Sodium Chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Momicchioli, F.; Devoto, O.; Grandi, G.; Cocco, G.

Atti Soc. Nat. Mat. Modena 1968, *99*, 226-32; *Ber. Bunsen-Ges. Phys. Chem.* 1970, *74*, 59-66.

VARIABLES:

T/K: 262-273

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C (compiler)	molality m/mol kg^{-1}	($\Delta T/m$) /K kg mol^{-1}	mass % (compiler)	solid phase
-0.0652	0.0178_1	3.6_6	0.104	ice
-0.0872	0.0242_9	3.5_9	0.142	"
-0.1431	0.0405_5	3.5_3	0.236	"
-0.2048	0.0586_5	3.49_2	0.342	"
-0.3415	0.0980_3	3.48_4	0.570	"
-0.4508	0.1309_8	3.44_2	0.760	"
-0.6093	0.1772_7	3.43_7	1.025	"
-0.7812	0.2289_6	3.41_2	1.320	"
-1.1193	0.3294_1	3.39_8	1.889	"
-1.4549	0.4285_5	3.39_5	2.443	"
-1.7319	0.5121_2	3.381_8	2.906	"
-2.0506	0.6081_6	0.6081_6	3.432	"
-2.5638	0.7592_5	3.376_7	4.249	"
-3.2429	0.9584_7	3.383_4	5.304	"
-3.9058	1.1520_8	3.390_2	6.308	"
-5.0356	1.4743_9	3.415_4	7.933	"
-5.8682	1.7052_7	3.441_2	9.063	"
-7.0582	2.0290_4	3.478_6	10.601	"
-8.4987	2.4061_4	3.532_1	12.328	"
-10.1341	2.8154_2	3.599_5	14.129	"
-11.2064	3.0736_1	3.646_0	15.228	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

A precision apparatus for measuring freezing point depressions using the equilibrium method was set up as described in a previous paper (1). Temperatures were measured by a platinum resistance thermometer coupled with a Mueller bridge.
A pneumatic stirrer was used.
The concentration was determined by a Hilger-Rayleigh interferometer.

SOURCE AND PURITY OF MATERIALS:

Merck "Suprapur" reagent, Cat. No. 6406.

ESTIMATED ERROR:

Temperature: $\pm 3.10^{-4}$ K
Molality: the absolute error was almost independent of concentration and was about $4\text{-}5.10^{-5}$ mol kg^{-1}.

REFERENCES:

1. Chiorboli, P.; Momicchioli, F.; Grandi, G. *Boll. sci. Fac. Chim. ind. Bologna* 1966, *24*, 133.

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Urusova, M.A.; Ravich, M.I.

Zh. Neorg. Khim. 1971, *16*, 2881-3; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1971, *16*, 1534-5.

VARIABLES:

T/K = 623, 673

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	vapor pressure[a]		solubility of NaCl		solid phase
	p/kgf cm^{-2}	p/bar	mass % $100w_1$	mole fraction[b] x_1	
350	107.5	105.4	41.6	0.180	NaCl
400	176	173	46.5	0.211	NaCl

---

[a] 1 kgf cm^{-2} = 0.980665 bar

[b] Mole fractions calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Vapor pressures were measured in an autoclave with mercury seal by the method of P-V curves (1,2). Corrections were made for the salt dissolved in the vapor phase. The solubility was found from the break in the temperature-composition curve, where measurements extended into the three-phase region.

SOURCE AND PURITY OF MATERIALS:

No information available.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Urusova, M.A.; Ravich, M.I. *Zh. Neorg. Khim.* 1964, *9*, 952; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1964, *9*, 353.
2. Ravich, M.I.; Borovaya, F.E.; Smirnova, E.G. *Zh. Neorg. Khim.* 1968, *19*, *Russ. J. Inorg. Chem. (Engl. Transl.)* 1968, *19*, 1000.

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Liu, C.; Lindsay, Jr., W.T.

J. Solution Chem. 1972, *1*, 45-69.

VARIABLES:

$T/K = 398 - 573$

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	molality m_1/mol kg^{-1}	mole fraction[a] x_1	mass % $100w_1$	vapor pressure of water[c] p^*/mmHg	lowering of v. p. (p^*-p)/mmHg	osmotic coefficient φ	activity coefficient γ
75	6.460[b]	-	-	289.10	74.50	1.771	0.996
100	6.680[b]	-	-	760.00	-	1.236	0.935
108.81	-	-	-	1 032.33	270.73	-	-
125	6.935	0.1111	28.84	1 740.96	460.88	1.202	0.835
150	7.198	0.1148	29.61	3 570.68	960.94	1.163	0.721
175	7.573	0.1202	30.68	6 695.13	1 837.1	1.106	0.610
200	7.973	0.1256	31.79	11 664.93	3 276.6	1.048	0.501
225	8.435	0.1319	33.02	19 129.53	5 506.1	0.985	0.398
250	8.989	0.1394	34.44	29 832.76	8 855.3	0.915	0.303
275	9.649	0.1481	36.06	44 615.23	13 728	0.839	0.218
300	10.413	0.1580	37.83	64 432.36	20 713	0.761	0.144

[a] Mole fraction, mass % calculated by compiler; [b] ref. (1); [c] refs.(2, 3).

COMMENTS AND ADDITIONAL DATA

Osmotic coefficients φ were calculated from the vapor pressure data and the equation

$$\varphi = \left\{\ln(p^*/p) - \int_p^{p^*}(1/p - V_2^*(g)/RT)\,dp - V_2\Delta p/RT\right\}/2m_1M_2$$

where M_2 is the molar mass of water, R the gas constant, T the thermodynamic temperature, $\Delta p = p^* - p$, V_2^* is the molar volume of pure water, calculated from (3, 4), and V_2 is the partial molar volume of water in the salt solution, which was taken as the molar volume of pure water, calculated from (3, 5), except at the highest temperatures and molalities, where it was estimated from the density equation given in (6).

To find the solubility, φ and the constant value φm_1 for a given temperature were plotted together as functions of $m_1^{1/3}$. The intersection of the two curves gave both γ and m_1 at the particular temperature.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The lowering of the vapor pressure of salt solutions was measured using the apparatus and techniques described in (3, 4). Solubilities were calculated from the data by the method given above.

SOURCE AND PURITY OF MATERIALS:

No information available.

ESTIMATED ERROR:

Temperature: precision within ±0.002 K.

Solubility: no estimates possible.

REFERENCES:

1. Keevil, N.B. *J. Am. Chem. Soc.* 1942, *64*, 841.
2. Smith, L.B.; Keyes, F.G.; Gerry, H.T. *Proc. Am. Acad Arts Sci.* 1934, *69*, 137.
3. Keenan, J.F.; Keyes, F.G. *Thermodynamic Properties of Steam.* Wiley, New York. 1936.
4. Keyes, F.G.; Smith, L.B.; Gerry, H.T. *Proc. Am. Acad. Arts Sci.* 1936, *70*, 319.
5. Smith, L.B.; Keyes, F.G. *Proc. Am. Acad. Arts Sci.* 1934, *69*, 285.
6. Haas, Jr., J.L. *Am. J. Sci.* 1970, *269*, 490.

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Ennan, A.A.; Lapshin, V.A.

Zh. Strukt. Khim. 1973, *14*, 21-9; **J. Chem. Struct.* (*Engl. Transl.*) 1973, *14*, 16-25.

VARIABLES:

$T/K = 252$

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

$t/°C$	molality $m_1/mol\ kg^{-1}$	mass % (compiler)	solid phase
-21.2	3.93	22.97	eutectic: $NaCl \cdot 2H_2O$ + ice

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The method is described in (1). Expts. were carried out in a cryostat designed to prevent supercooling and to permit visual observation of the formation of the first crystals. After preliminary heating and cooling, final cooling was carried out, using dry ice-heptane as coolant. Freezing points were detd. using totally-immersed Hg and alcohol thermometers.

SOURCE AND PURITY OF MATERIALS:

NaCl: c.p. grade.
Water: doubly-distilled.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

(1) Ennan, A.A.; Lapshin, V.A. *Zh. Strukt. Khim.* 1972, *13*, 596.

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Balarev, Kh.; Ketenev, D.H.

Dokl. Bolg. Akad. Nauk 1975, *28*, 221-3.

VARIABLES:

$T/K = 298$

PREPARED BY:

M. Ferriol

EXPERIMENTAL VALUES:

$t/°C$	mass %	solid phase
25	26.47	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The Khlopin method (isothermal decrease of supersaturation) was used. a series of almost-satd. slns. was prepared at a temp. higher than 25°C. These were placed in a thermostat and stirred at 25°C. Equilibrium was reached in 12-15 d. The liquid phase was analyzed for Cl by Mohr titration.

SOURCE AND PURITY OF MATERIALS:

NaCl: A.R. reagent.

ESTIMATED ERROR:

Temperature: precision ± 0.1 K.

REFERENCES:

COMPONENTS:

(1) Sodium chloride, NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Gibbard, Jr., H.F.; Gossmann, A.F.

J. Solution Chem. 1974, *3*, 385-93.

VARIABLES:

$T/K = 273-287$

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

Solid phase: ice

$t/°C$	molality $m/mol\ kg^{-1}$	mass % NaCl
-0.4728[a]	0.1368	0.7932
-0.6770[a]	0.1979	1.143
-0.7998	0.2352	1.356
-0.9026[a]	0.2646	1.523
-1.1301[a]	0.3325	1.906
-1.3759	0.4060	2.318
-1.6095[a]	0.4744	2.698
-1.9736[a]	0.5828	3.294
-2.3088[a]	0.6826	3.836
-2.7018[a]	0.7985	4.459
-3.1983	0.9459	5.239
-3.3149	0.9788	5.411
-3.6984[a]	1.0907	5.992
-3.8040	1.12085	6.147
-4.3827	1.2893	7.007
-4.4409[a]	1.3034	7.078
-4.7496	1.3926	7.526
-5.1824[a]	1.5137	8.127
-5.2239	1.5254	8.185
-5.9709	1.7329	9.196
-6.0733[a]	1.7592	9.323
-6.4249	1.8566	9.788
-6.7494[a]	1.9445	10.205
-8.281	2.3490	12.071
-8.791	2.4797	12.658
-9.692	2.7058	13.654
-9.715	2.7117	13.680
-10.186	2.8232	14.163
-10.204	2.8325	14.203
-11.273	3.0858	15.279
-12.189	3.2993	16.165
-13.633	3.6265	17.488

---

[a] Results of Gibbard and Fong (1).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Freezing point depressions were measured directly by measuring the difference in temperature between two identical containers, one filled with water and finely-divided ice, the other with solution and finely-divided ice. The solution was circulated over the ice by means of a lift pump. The difference in temperature was measured by a quartz differential thermometer. Solutions were analyzed for chloride gravimetrically. Data of Gibbard and Fong (1) used a Pt resistance thermometer and resistance bridge.

SOURCE AND PURITY OF MATERIALS:

NaCl: analytical reagent, dried at 393 K.

H_2O: distilled, doubly deionized.

ESTIMATED ERROR:

Temperature: precision ±0.0002 K.

Composition: precision ±0.05 %.

REFERENCES:

1. Gibbard, H.F.; Fong, S.L. *Freezing Points of Aqueous Two-salt Mixtures of Sodium, Magnesium, Calcium and Barium Chlorides.* 163rd National Meeting, ACS. Boston. 1972.

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Urusova, M.A.

Zh. Neorg. Khim. 1974, *19*, 828-33; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1974, *19*, 450-4.

VARIABLES:

T/K = 623, 673

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

$t/°C$	vapor pressure[a] $p/\mathrm{kgf\ cm^{-2}}$	vapor pressure[a] p/bar	solubility of NaCl mass % $100w_1$	solubility of NaCl mole fraction[b] x_1	solid phase
450	251	246	52.0	0.250	NaCl
500	332	326	59.5	0.312	"
550	388	380	65.2	0.366	"

---

[a] Average values calculated by compiler; av. dev. 0.5 - 1 kg $\mathrm{cm^{-2}}$. 1 kgf $\mathrm{cm^{-2}}$ = 0.990665 bar.

[b] Mole fractions calc. by compiler; author's values incorrect.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Vapor pressures were measured in an autoclave with mercury seal by the method of *P-v* curves (1,2). Corrections were made for the salt dissolved in the vapor phase. The solubility was found from the break in the temperature-composition curve, where measurements extended into the three-phase region.

SOURCE AND PURITY OF MATERIALS:

No information available.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Urusova, M.A.; Ravich, M.I. *Zh. Neorg. Khim.* 1964, *9*, 952; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1964, *9*, 353.
2. Ravich, M.I.; Borovaya, F.E.; Smirnova, E.G. *Zh. Neorg. Khim.* 1968, *19*, *Russ. J. Inorg. Chem. (Engl. Transl.)* 1968, *19*, 1000.

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Potter II, R.W.; Babcock, R.S.; Brown, D.L.

EOS Trans. Am. Geophys. Union 1975, *56*, 12.

VARIABLES:

$T/K = 273 - 473$

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

$t/°C$	molality $m_1/\text{mol kg}^{-1}$	mass % (compiler)	solid phase (compiler)
0.0	6.096	26.268	NaCl
10.0	6.111	26.316	
20.0	6.128	26.370	"
30.0	6.166	26.490	"
40.0	6.216	26.647	"
50.0	6.274	26.829	"
60.0	6.342	27.041	"
70.0	6.417	27.274	"
80.0	6.501	27.533	"
90.0	6.590	27.805	"
100.0	6.680	28.078	"
110.0	6.670	28.618	"
120.0	6.860	28.618	"
130.0	6.970	28.944	"
140.0	7.090	29.296	"
150.0	7.200	29.616	"
160.0	7.350	30.048	"
170.0	7.495	30.460	"
180.0	7.668	30.946	"
190.0	7.836	31.411	"
200.0	8.013	31.984	"

COMMENTS: The authors give the fitting equation:
$100w_1 = 26.218 + 0.0072\ T/K + 0.000106\ (T/K)^2$, range 100-300°C.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Solutions of known composition were heated in Pt-lined bombs until the solid dissolved completely, as shown by a discontinuity in $(\partial p/\partial T)_{x,V}$.
The authors remark that many older data are in error because of some or all of: corrosion of the stainless steel pressure vessel; chemical reaction between solution and mercury pressure media; re-equilibration during quenching.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

Equation fits data with an uncertainty of ±0.5 mass %.
Other errors presumably as in (1).

REFERENCES:

1. Potter II, R.W.; Babcock, R.S.; Brown, D.L. *J. Res. U.S. Geol. Surv.* 1977, *5*, 389.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Sodium chloride, NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	Bouchacourt, M.; Saugier, M.-T.; Cohen-Adad, R. *Bull. Soc. Chim. Fr.* <u>1977</u>, *9-10*, 842.
VARIABLES:	PREPARED BY:
T/K: 300	J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass %	mol ratio $H_2O/NaCl$	solid phase
27	26.52	17.98	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

At constant temperature, small quantities of water were added to the anhydrous salt. The conductivity of the solution was plotted against the volume of water introduced. A break was observed in the curve when the saturation point was reached.

SOURCE AND PURITY OF MATERIALS:

NaCl was Merck's "for analysis" or Prolabo RP. Water was 2x distilled.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	Potter II, R.W.; Babcock, R.S.; Brown, D.L. *J. Res. U.S. Geol. Surv.* <u>1977</u>, 5, 389-95.
VARIABLES:	**PREPARED BY:**
$T/K = 442-698$	J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase (compiler)
148.7	29.62	NaCl
148.6	29.62	"
148.2	29.62	"
149.0	29.62	"
148.4	29.62	"
148.8	29.62	"
149.2	29.62	"
161.0	30.08	"
172.4	30.61	"
202.3	32.05	"
214.5	32.66	"
272.9	36.01	"
329.4	40.07	"
424.8	48.42	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Salt, saturated solution and vapor were heated in a Pt-lined stainless steel bomb. The curve of pressure vs temperature was measured, and showed a break (located by least-squares analysis of the data) at the temperature at which the last crystal of salt disappeared. The same values were obtained for heating rates between 0.17 and 0.44 K/min.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

Temperature: ±0.1 K accuracy, traceable to NBS standards.

Pressure: ±10 kPa

Solubility: fits quadratic eqn to $\pm 2s = 0.05$ mass %

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Potter II, R.W.; Clynne, M.A.; Brown, D.L.

Econ. Geol. 1978, *73*, 284-5.

VARIABLES:

$T/K = 242\text{-}270$

PREPARED BY:

M.-T. Saugier; J.W. Lorimer

EXPERIMENTAL VALUES:

$t/°C$	mass %	solid phase
-3.05	5	ice
-6.60	10	"
-10.97	15	"
-16.48	20	"
-20.81	23.225	ice + $NaCl\cdot 2H_2O$ (eutectic)

COMMENTS AND ADDITIONAL DATA:

No direct experimental data are given. The data given above were calculated from the authors' fitting equation:

$$100\ w_1 = 0.00 + 1.76958(\theta/K) - 4.2384 \times 10^2(\theta/K)^2 + 5.2778 \times 10^4(\theta/K)^3,\quad \text{uncertainty} = \pm 0.028 \text{ mass \%}$$

where w_1 is the mass fraction of NaCl and θ is the depression of the freezing point.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Solution (15-20 g) was placed in a Pyrex tube, which was sealed with a rubber stopper holding a stirrer and a Pt resistance thermometer. The solution was frozen, then warmed in an insulated container while being stirred vigorously. The temperature at which the last ice crystal melted was observed visually.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

Temperature of melting of last ice crystal reproducible to ±0.03 K.

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Potter II, R.W.; Clynne, M.A.

J. Res. U.S. Geol. Surv. 1978, 6, 701-5.

VARIABLES:

$T/K = 291-373$

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase (compiler)
17.62	26.18	NaCl
28.64	26.34	"
28.64	26.36	"
28.77	26.40	"
28.86	26.40	"
35.09	26.48	"
39.90	26.59	"
53.00	26.79	"
59.78	27.01	"
72.33	27.24	"
80.87	27.49	"
99.99	28.00	"

COMMENTS AND ADDITIONAL DATA:

Special equilibration experiments at 26.48 mass % NaCl showed that the data of Berkeley (1) appear to be too high, possibly because either: (a) fluid inclusions remained in the solids after analysis by evaporating to dryness; (b) small crystals were present after the vigorous stirring used to overcome density stratification.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The visual method was used. Weighed amounts of salt and water were placed in a tube fitted with a stirrer and sealed with a layer of silicone oil. The tube was heated slowly and incrementally in a thermostat until the last crystal of salt had dissolved. It was found that 1 mg of salt could be seen easily, using a 20 g-sample of salt.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

Temperature: accuracy ±0.01 K (Pt resistance thermometer); repeatability of dissolution temp. ±0.05 to ±0.15 K.

Solubility: est. precision 0.03-0.05 mass %.

REFERENCES:

1. Berkeley, Earl of *Philos. Trans. R. Soc. London, A* 1904, *203*, 189.

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Girich, T.E.; Gulyamov, Yu. M.; Ganz, S.N.

Vopr. Khim. Khim. Tekhnol. 1979, 57, 58-61.

VARIABLES:

T/K = 298, 323

PREPARED BY:

R. Cohen-Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	26.23	NaCl
50	26.99	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method. Equilibrium was reached in 20-70 h. Na was detd. gravimetrically as NaZn uranyl acetate, Cl mercurimetrically.

SOURCE AND PURITY OF MATERIALS:

NaCl: recryst. 2X; purity 95.6-99.8%

ESTIMATED ERROR:

Temperature: precision ±0.1 K.

REFERENCES:

COMPONENTS:

(1) Sodium chloride, NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Rard, J.A.; Miller, D.G.

J. Chem. Eng. Data 1981, *26*, 38-43.

VARIABLES:

T/K: 298

PREPARED BY:

J.-J. Counioux; R. Cohen-Adad

EXPERIMENTAL VALUES:

t/°C	molality mol kg^{-1}	mass % (compiler)	solid phase
25.00	6.1580 ± 0.0050[a]	26.47 ± 0.02	NaCl
25.00	6.1589 ± 0.0041[b]	26.47 ± 0.02	"

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[a] mean of three measurements obtained with 4-7 days equilibration for samples from Stock 1.

[b] 5 and 6 day equilibration of Stock 2 samples.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isopiestic method. Experimental details were described elsewhere (1). Two NaCl solutions (Stock 1 and 2) were prepared by mass from separate lots of reagent.

SOURCE AND PURITY OF MATERIALS:

Mallinckrodt analytical reagent. Water was first deionized and then distilled. Analysis was performed in triplicate by dehydration and in quadruplicate by mass titration using $AgNO_3$ (dichlorofluorescein end point indicator, dextrin colloid stabilizer).

ESTIMATED ERROR:

Temperature: ±0.005 K (IPTS - 68)
Mass %: ±0.02

REFERENCES:

1. Spedding, F.H.; Weber, H.O.; Saeger, V.W.; Petheram, H.H.; Rard, J.A.; Habenschuss, A. *J. Chem. Eng. Data* 1977, *21*, 341.

COMPONENTS:

(1) Sodium chloride, NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Langer, H.; Offermann, H.

J. Cryst. Growth 1982, *60*, 389-92.

VARIABLES:

T/K = 293-346

PREPARED BY:

J. J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass ratio NaCl/H_2O	mass % (compiler)	solid phase
20.0	0.3591	26.42	NaCl
24.0	0.3593	26.43	"
34.0	0.3616	26.56	"
41.5	0.3643	26.70	"
44.5	0.3656	26.77	"
48.1	0.3661	26.80	"
53.25	0.3673	26.86	"
55.5	0.3686	26.93	"
57.0	0.3695	26.98	"
67.6	0.3730	27.17	"
68.0	0.3750	27.27	"
73.25	0.3771	27.38	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

A device for the measurement of rates of crystal growth of freely suspended crystals was used (1,2). The saturation temperatures were defined as the points at which neither growth nor dissolution occurred. The NaCl concentration of each solution was calculated from chemical analyses of different solution samples.

SOURCE AND PURITY OF MATERIALS:

NaCl used was a PA reagent (Merck) which had a purity of about 99.4%.

ESTIMATED ERROR:

Maximum error in concentration is estimated to be ±0.07 g NaCl/ 100 g H_2O.

REFERENCES:

1. Offermann, H.; Ulrich, J. *Ger. Chem Eng.* 1980, *3*, 139.
2. Offermann, H.; Langer, H. *Industrial Crystallization 81*. Eds. E.J. de Jong, S.J. Jančic. North-Holland, Amsterdam, 1982, 297-8.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water; H_2O; [7732-18-5]	Gunter, W.D.; Chou, I.-M.; Girsperger, S. *Geochim. Cosmochim. Acta* 1983, *47*, 863-73; Chou, I.-M. *Geochim. Cosmochim. Acta* 1987, *51*, 1965-75.
VARIABLES:	PREPARED BY:
$T/K = 720-984$	J.W. Lorimer

EXPERIMENTAL VALUES:

$t/°C$	mass % $100w_1$	mole fraction x_1 (compiler)	solid phase
447	53.54	0.2621	NaCl
507	62.44	0.3388	"
604	76.17	0.4963	"
604	76.56	0.5017	"
619	78.29	0.5264	"
646	82.26	0.5884	"
677	86.47	0.6633	"
711	90.47	0.7453	"

COMMENTS AND ADDITIONAL DATA: Chou, in the second paper listed, analyzed the data from the first paper. Anomalous splitting of DTA peaks and a sharp change in slope of the *p-T* curves near the three-phase region were attributed to initial (precooling) separation of the fluid into NaCl-poor gas and NaCl-rich liquid that did not become homogeneous during a DTA experiment. Solubilities were found by extrapolation of the linear portions of the *p-T* curves to intersect the known three-phase *p-T* curve.

Previous work (1) was shown to be unreliable because of temperature gradients in the vertical furnace used.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Differential thermal analysis was performed in two ways: (1) the signal between two thermocouples was used (DTA mode); (2) one thermocouple was used (TA mode). A sample of NaCl and water was placed in a gold tube along with an inconel-sheathed chromel-alumel thermocouple. The tube was welded shut, sealed in a pressure vessel, pressurized under Ar, and placed in a horizontal tube furnace. Cooling rates (2-10 k/min) and heating rates (10 K/min) were computer controlled. Thermocouples were calibrated against standard thermocouples. Pressures were measured by transducer, calibrated by a Bourdon tube gauge. Sample temperatures were recorded 25 times per K. Temp. gradients were < 5 K over a 10-cm sample.

DTA scans were analyzed by computer. No sharp peak was observed on heating. Nucleation occurred on cooling, giving a sharp peak whose position was measured at different cooling rates, and extrapolated to zero rate.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

Temperature: ± 3 K (cooling expts.); ± 5 K (heating); ± 6 K (overall).

Pressure: ± 5 bar.
Composition: ± 0.1 mass %.

REFERENCES:

1. Chou, I.-M.; Eugster, H.P. *EOS, Trans., Am. Geophys. Union* (abstract) 1981, *62*, 410.
2. Chou, I.-M. *Geochim. Cosmochim. Acta* 1982, *46*, 1957.

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Bischoff, J.L.; Rosenbauer, R.J.; Pitzer, K.S.
Geochim. Cosmochim. Acta 1986, *50*, 1437-44.

VARIABLES:

T/K = 576-777
p/bar = 58-328

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

Temperatures, pressures and vapor compositions for three-phase S-L-G equilibria.

t/°C	p/bar	vapor composition mass % $100u_1$	10^4 x mole fraction 10^4y_1 (compiler)	solid phase
300.3	57.6	-	-	NaCl
323.7	78.8	0.0071	0.22	"
348.5	105.3	0.0014	0.043	"
375.1	137.4	0.0032	0.099	"
375.5	138.4	0.0026	0.080	"
400.2	172.7	0.0065	0.20	"
427.0	214.1	0.013	0.40	"
450.5	251.5	0.027	0.83	"
451.8	253.5	0.031	0.96	"
475.9	288.8	0.046	1.42	"
477.0	291.9	0.049	1.51	"
502.5	327.2	0.070	2.16	"
503.4	328.0	0.075	2.31	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The titanium pressure vessel, vol. 26 mL, was held vertically in a fluidized bed furnace. Openings at top and bottom were connected via capillary tubes to sampling valve blocks and pressure transducers (calibrated at 11 points by a dead weight gauge). Temperature was measured with calibrated type K chromel-alumel thermocouples. The vessel was filled about 2/3 full with saturated sln. and excess solid, and heated to the desired temp., which stabilized in about 2 h, after which 3 samples (0.3 g each) were taken from the top opening. Three phases were present if the pressure remained constant during sampling. This procedure was then repeated at intervals of 25 K up to 500°C. Analysis for Cl was by ion chromatography with a conductivity detector. The pH of all samples was neutral.

SOURCE AND PURITY OF MATERIALS:

NaCl: reagent-grade
H_2O: deionized

ESTIMATED ERROR:

Temperature: ± 0.5 K.
Pressure: ± 0.7 bar

REFERENCES:

1. Bischoff, J.L.; Rosenbauer, R.J. *Earth Plan. Sci. Lett.* 1989, *68*, 172.

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Hall, D.L.; Sterner, S.M.; Bodnar, R.J.

Econ. Geol. 1988, *83*, 197-202.

VARIABLES:

$T/K = 252$ to 273

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

mass %	mole fraction (compiler)	freezing point $t/°C$	solid phase
0.00	0.0000	0.00	ice
3.00	0.0095	-1.72	"
4.19	0.0137	-2.50	"
4.95	0.0164	-3.01	"
6.41	0.0215	-4.00	"
7.84	0.0264	-5.00	"
9.21	0.0311	-6.00	"
10.50	0.0356	-7.00	"
11.72	0.0400	-8.00	"
12.86	0.0442	-9.00	"
14.00	0.0484	-10.03	"
14.98	0.0522	-11.00	"
15.96	0.0561	-12.00	"
16.93	0.0600	-13.05	"
17.77	0.0635	-14.00	"
18.62	0.0671	-15.00	"
20.22	0.0741	-17.01	"
21.17	0.0782	-18.24	"
21.68	0.0807	-19.00	"
22.37	0.0839	-20.00	"
23.04	0.0871	-21.00	"
23.20	0.0878	-21.21	"

COMMENTS: The fitting equation given in this paper has also been given in a published abstract (1), but without the experimental data.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

A 20 mass % sln. of salt was diluted to 3 mass % and placed in a 1-L Erlenmeyer flask fitted with ports for sampling and thermocouple (type K, measured with potentiometer, calibrated at f.p. of water and Hg). Sln. was initially undercooled ≈ 1 K below f.p., then was nucleated with a seed crystal and cooled slowly at 3-4 K/h. Samples of equilibrated brine were removed by pipet, then were weighed, dried at 110°C, then dried at 350°C.

SOURCE AND PURITY OF MATERIALS:

NaCl: reagent grade.

H_2O: distilled and deionized.

ESTIMATED ERROR:

Temperature: ±0.05 K (from potentiometer precision).

Composition: ±0.02 mass % (from known samples).

REFERENCES:

1. Hall, D.L.; Sterner, S.M.; Bodnar, R.J. *EOS, Trans., Am. Geophys. Union* 1987, *68*, 450.

COMPONENTS:

(1) Sodium chloride; $NaCl$; [7647-14-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sterner, S.M.; Hall, D.L.; Bodnar, R.J.

Geochim. Cosmochim. Acta 1988, *52*, 989-1005.

VARIABLES:

$T/K = 572 - 987$

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

mass %	mole fraction	dissolution temp. t/°C				std. dev. in		solid
$100w_1$	x_1 (compiler)	average	range	std. dev.	no. of detns.	$100w_1$	$100x_1$	phase
37.8	0.158	298.6	279-300	0.83	8	0.072	0.041	NaCl
46.9	0.214	393.3	390-397	2.30	15	0.29	0.20	"
57.0	0.290	481.2	478-484	1.88	13	0.30	0.26	"
62.4	0.338	518.1	514-521	2.49	10	0.43	0.41	"
62.4	0.338	518.0	487-526	5.99	25	1.03	0.98	"
80.0	0.552	644.1	632-651	4.99	17	0.82	1.2	"
90.0	0.735	713.9	709-719	2.68	15	0.32	0.69	"

Std. devs. in w_1 and x_1 which correspond to std. dev. in temp. calc. by compiler from $s(w_1) = (dw_1/d\theta)s(T)$ and $s(x_1) = (M_1/M_2)(x_1/w_1)^2 s(w_1)$, and the authors' fitting eqn (compiler's notation) with $\theta = T/K - 273.15$ and range of validity 0.1 to 801°C:

$$100w_1 = 26.242 + 0.4928\theta + 1.42 \times 10^{-4}\theta^2 - 2.23 \times 10^{-7}\theta^3 + 4.129 \times 10^{-10}\theta^4 + 6.295 \times 10^{-13}\theta^5 - 1.967 \times 10^{-15}\theta^6 + 1.112 \times 10^{-18}\theta^7$$

A similar equation (but with different coefficients), valid for the range 300 to 801°C, is given in a published abstract of this paper (3). No experimental data are given in the abstract.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Fluid inclusions were synthesized in presence of $NaCl-H_2O$ slns. of known composition by healing fractures in Brazilian quartz at elevated temp. and pressure (1, 2). Solubilities were determined by measuring the dissolution temps. of NaCl daughter crystals within inclusions, using a microscope with heating stage. Quartz, fractured by heating to 350 °C then quenching in dist. H_2O at room temp., was dried, loaded into Pt capsules with NaCl slns., welded shut, loaded into pressure vessels in a horizontal pre-heated furnace, and pressurized to 6 kbar. Fractures were reopened by pressure cycling, which also avoided inclusions before the salt had dissolved completely. After 5 d, the pressure vessel was let cool, opened, and the quartz cylinders cut into 1 mm thick disks and polished. The actual T, p were chosen to lie on an isochore which passes through the intersection of the liquidus isopleth for the bulk sln. and the vapor-satd. solubility surface.

SOURCE AND PURITY OF MATERIALS:

NaCl, water: not stated.
Quartz: from Brazil.

ESTIMATED ERROR:

Temperature: E-type thermocouple calibrated using known fluid inclusions. Thermal gradients: < 0.1 K at -56.6, 0°C, < 5 K at 374°C. Accuracy: ±0.1 K at < 50°C, ±2.5 K near 375°C, ±3 K near 575°C.

REFERENCES:

1. Sterner, S.M.; Bodnar, R.J. *Geochim. Cosmochim. Acta* 1984, *48*, 2659.
2. Bodnar, R.J.; Sterner, S.M. In *Hydrothermal Experimental Techniques*. Ulmer, G.C.; Barnes, H.L.; eds. Wiley, New York. 1987, p. 423.
3. Hall, D.L.; Sterner, S.M.; Bodnar, R.J. *EOS, Trans., Am. Geophys. Union* 1987, *68*, 450.

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I) 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. August, 1990

CRITICAL EVALUATION

Solubility data for the binary system $KCl-H_2O$ have been presented in more than 116 publications. The solid phase in equilibrium with the saturated solution is, according to the range of concentration, ice or anhydrous salt.

Some authors (75, 90, 130, 153) have indicated the existence of two polymorphic forms of KCl; others (143, 146, 153) mention a hydrate $KCl{\cdot}nH_2O$, with $n = 1$ or 1.5, which makes itself evident through the existence of a eutectic with ice and a peritectic. However, there is no proof for the existence of these particular forms.

EXPERIMENTAL METHODS

The solubility has been measured using analytical methods (1, 2, 7, 8, 11, 13, 17, 19, 20, 32, 37, 57, 60, 68, 80, 84, 85, 88, 89, 94, 95, 96, 99, 107, 109, 110, 111, 113, 118, 128, 136, 142, 144, 147, 149, 154, 159, 160, 162, 163, 167, 175, 177, 182) or synthetic methods (6, 9, 12, 23, 29, 34, 55, 67, 69, 103, 105, 110, 115, 116, 117, 124, 126, 127, 130, 133, 134, 143, 146, 148, 153, 161, 165, 167, 168, 176, 178, 179, 180). One modern variant of the synthetic method is measurement of the dissolution temperatures of crystals in fluid inclusions in healed fratures in quartz (183). Most other determinations have been carried out isothermally .

ANALYSIS OF SOLUTIONS

The composition of the saturated solution was determined either by evaporation to dryness and weighing (1, 2, 7, 8, 17, 18, 20, 32, 37, 57, 68, 85, 88, 95, 109, 118, 125, 154, 167, 175) or by chemical analysis: for chloride (23, 34, 57, 84, 89, 94, 96, 99, 107, 113, 128, 136, 142, 144, 147, 149, 154, 162, 163, 169, 177), or for potassium (57, 149, 169).

CHEMICALS USED

Most frequently KCl was a pure reagent, sometimes recrystallized twice or more (6, 17, 19, 34, 41, 45, 57, 67, 84, 85, 89, 103, 115, 118, 129, 142, 143, 144, 148, 153, 161, 162, 163, 172, 176, 183) and dried by heating to 100°C (373 K) (2), to 250°C (523 K) (167), or by heating to a dull red (103). Kernot (41) prepared KCl from potassium and hydrochloric acid, and recrystallized the salt several times. Andreae (17) decomposed recrystallized and dried potassium chlorate slowly; the chloride obtained was melted, recrystallized, and dried. Grunewald (57) recrystallized potassium tartrate; this salt was decomposed to the carbonate, then converted into the chloride, which was then recrystallized five times,

(continued)

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I) 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. August, 1990

CRITICAL EVALUATION (continued)

dried and melted. The purity of the sample was checked, in two instances, by Lewis' method (67), and in three others by analysis for chloride (32, 57, 99). Water used in the preparation of solutions was usually distilled twice.

CRITICAL EVALUATION OF RESULTS

1. *Temperature and enthalpy of fusion of KCl*

Numerous measurements have been carried out (13, 16, 18, 22, 25, 31, 33, 36, 40, 43, 44, 47, 48, 49, 51, 52, 53, 56, 58, 59, 61, 63, 65, 66, 72, 73, 74, 75, 76, 79, 81, 82, 100, 101, 104, 114, 123, 151, 157, 158, 164). Data from before 1912 were compiled by Haigh (52) who proposed T_f = 775°C = 1048 K. However, more recent measurements (151, 158) lead to the lower values 1043 and 1045 K, respectively.

Finally, we have kept, in calculating the solubility curve, the values obtained from JANAF (164):

melting temperature: 1044 K
enthalpy of fusion: 6.28 kcal mol^{-1} = 26.28 kJ mol^{-1}
ΔC_p at the melting temperature: 6.62 J K^{-1} mol^{-1}

2. *Polymorphism of KCl; hydrates of the salt*

For solubility measurements carried out using visual methods, the following points can be noted.

(a) Polosin and Shakhparonov (130) remarked that the liquidus curve for KCl shows a change of curvature at 22.2°C (295.4 K) and interpreted this phenomenon as indicating a transition between two allotropic forms of KCl (α at the lower and β at the higher temperature).

(b) Bergman (132) indicated the existence of a homeomorphic transformation of KCl at 27°C (300 K).

(c) Shul'gina *et al.* (146) affirmed the existence of a hydrate $KCl \cdot nH_2O$ with n = 1 or 1.5 which exhibits a peritectic of -6.6°C (266.6 K)

$$KCl \cdot nH_2O \rightarrow KCl + liq$$

and a eutectic of -10.6°C (262.6 K), whereas the metastable eutectic ice-KCl is situated at -10.8°C (262.4 K) (fig. 1).

(d) Bergman and Kuznetsova (153) found that the hydrate $KCl \cdot nH_2O$ melted incongruently at -5.8°C (267.4 K) to give β-KCl; the eutectic liq → ice + hydrate was located at -10.7°C (262.5 K).

(e) By direct and differential thermal analysis, Fialkov and Tchernogorenko (143) confirmed the existence of a hydrate to which they attributed the formula $KCl \cdot H_2O$, and located the metastable eutectic point (ice, KCl) at -10.76°C (262.39 K) and the stable eutectic (ice,

(continued)

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I) 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. August, 1990

CRITICAL EVALUATION (continued)

monohydrate) at -9.80°C (263.35 K).

The systematic measurements of Said (170, 173), arrived at by reheating at different temperatures and by thermal analysis were not successful in reproducing these transformations. It does not therefore seem possible, at this time, to draw a definite conclusion on the actual existence of the polymorphic forms of KCl or of its hydrates, and the critical analysis of the solubility curve of KCl has been caried out without taking into consideration these characteristics of the system.

3. *Eutectic ice-KCl*

Sixteen values for the eutectic temperature are given in the literature (12, 19, 27, 28, 67, 78, 103, 106, 111, 130, 143, 144, 145, 146, 172, 183) but three of them depart notably from the others (more than 0.5 K) and have been rejected (28, 143). The average of the 13 remaining measurements is -10.65°C (262.50 K). The most reliable figure is that of Redlich and Løffler (106), who measured the eutectic temperature with the help of a platinum resistance thermometer by the differential method of Kohlrausch-Jaeger. The KCl used was a "Kahlbaum, for analysis" reagent with a certificate of warranty, recrystallized twice from conductivity water. The value obtained, an average of four measurements, was $-10.645_5 \pm 0.0025$°C (262.505 K).

As well, 13 values for the composition are given, but five of them depart from the average by more than 1% (27, 103, 130, 146, 172), and have been rejected. The value retained is: 19.59 ± 0.15 mass%.

4. *Fitting Equations*

All the data from the compilation sheets have been analyzed according to the procedure outlined in the Preface to this volume. The solubility curve of KCl is represented by an equation of the form:

$$Y = A/T + B\ln T + CT + D + JT^2$$

with $Y(x_1) = 2\ln\,[2x_1/(1 + x_1)]$

while requiring that the curve pass through the eutectic point ice-KCl and through the fusion point of the salt (T = 1044 K).

The coefficients A, B, C, D, J have been adjusted by the least squares method, taking into account the constraints imposed on the curve.

The equation for the solubility curve of ice is expressed according to the procedure given on in the Preface by the relation:

$$\ln\,\{(1 - x_1)/(1 + x_1)\} = A(1/T - 1/T_0) + B\ln(T/T_0) - \ln f_2$$

(continued)

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I) 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. August, 1990

CRITICAL EVALUATION (continued)

where T_0 = 273.15 K is the melting temperature of ice at atmospheric pressure. A and B have been calculated from the molar enthalpy and molar heat capacity of fusion of ice:

$$A = -(\Delta H_0 - T_0\Delta C_0)/R \qquad B = \Delta C_0/R$$

The quantities ΔH_0 and ΔC_0 are given in tables of thermodynamic data:

$$\Delta H_0 = 6009 \text{ J mol}^{-1} \qquad \Delta C_0 = 37.7 \text{ J K}^{-1}\text{ mol}^{-1}$$

The experimental value of $\ln f_2$ along the solubility curve was evaluated from the difference:

$$\ln f_2 = A(1/T - 1/T_0) + B\ln(T/T_0) - \ln\{(1 - x_1)/(1 + x_1)\}$$

The logarithm of the activity of the water is written as the series:

$$\ln f_2 = \{x_1/(1 + x_1)\}^{3/2}(E + FZ + GZ^2 + HZ^3)/T$$

where $Z = \ln\{(x_1/(1 + x_1)\}$, and the coefficients E, F, G, H have been adjusted by the least squares from the curve expressing the function $T\{x_1/(1 + x_1)\}^{-3/2} \ln f_2$ as a function of Z.

Three iterations were sufficient to obtain stationary values for the coefficients.

5. *Critical Evaluation of the Data*

5.1 Solubility Curve of KCl

The data of Ravitsch (155), given in graphical form between 300°C and and the melting point, have not been taken into consideration in the critical analysis. The data of Bathrick (26) are obviously in error, and have not been compiled. Four hundred and four solubility data are available from the literature, to which may be added the analytical expressions proposed by different authors (1, 15, 16, 23, 176, 178).

The critical analysis has been carried out using a fitting equation with five coefficients. The experimental points utilised correspond to relative ranges:

$$|[x_1(\text{exp}) - x_1(\text{calc})]/x_1(\text{calc})| < 0.025 \text{ when } t < 500°\text{C}.$$

Above this temperature, no constraint has been imposed on the range, taking into account the fact that measurements at high temperature under pressure are imprecise.

In all, 346 experimental points have been retained for the calculations, and three iterations were necessary to obtain a set of stationary coefficients. The values of the coefficients are given in Table 1, and the results of the analysis are summarized in Table 2.

(continued)

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I) 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. August, 1990

CRITICAL EVALUATION (continued)

Table 1

Coefficients of fitting equations for solubility

Solid phase	Coefficients	Conditions introduced in calculation	Range/K
KCl	$A = -7262.7$ K	melting point	262 - 1044
	$B = -36.0456$	eutectic point ice + KCl	
	$C = 0.06294$ K^{-1}	$\lvert\Delta x_1/x_1(\text{calc})\rvert < 0.025$ if t < 500°C	
	$D = 208.489$		
	$J = -1.53201 \times 10^{-5}$ K^{-2}		
Ice	$A = 514.778$ K	melting point of ice	258 - 273
		eutectic point ice + KCl + liq	
	$B = 4.532$	heat of fusion of ice	
	$C = -27.307$	heat capacity of fusion	
	$E = -1008.231$ K	$A = -(\Delta H_0 - T_0\Delta C_0)/R$	
	$F = -542.807$ K	$B = \Delta C_0/R$	
	$G = -59.9937$ K	$C = A/T_0 - B\ln(T_0/K)$	
	$H = -3.55519$ K	$\lvert\Delta x_1/x_1(\text{calc})\rvert < 0.01$	

Table 2

Solubility of KCl in aqueous solutions (solid phase KCl)

T/K-273.15	mass % $100w_1$ exp	mass % $100w_1$ calc	mole fraction x_1 exp	mole fraction x_1 calc	status	ref
-11.1	19.74	19.559	0.0561	0.0555	t	28
-11.0	19.64	19.579	0.0558	0.0556	r	13
-11.0	19.66	19.579	0.0558	"	r	13
-10.8	19.95	19.620	0.0558	0.0557	r	27
-10.8	19.87	19.620	0.0565	"	t	146
-10.75	19.48	19.630	0.0552	0.0557	r	144
-10.7	19.54	19.640	0.0554	0.0558	r	111
-10.7	19.80	19.640	0.0563	"	r	153
-10.66	19.74	19.648	0.0561	0.0558	r	67
-10.64	19.58	19.652	0.0556	0.0558	r	19
-10.64	19.58	19.652	0.0556	0.0558	r	78
-10.6	19.70	19.660	0.0560	"	r	146
-10.4	19.80	19.701	0.0563	0.0560	r	130
-10.31	19.02	19.719	0.0537	0.0560	a	103
-10.3	20.00	19.721	0.0570	0.0560	t	153
-10.2	19.75	19.741	0.0561	0.0561	r	167
-10	20.2	19.782	0.0576	0.0562	t	133
-10	21.6	19.782	0.0624	"	a	127
-9.8	19.77	19.822	0.0562	0.0564	r	144
-9.8	19.8	19.822	0.0563	"	r	167

(continued)

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I) 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. August, 1990

CRITICAL EVALUATION (continued)

Table 2 (continued)

Solubility of KCl in aqueous solutions (solid phase KCl)

T/K-273.15	mass % $100w_1$ exp	mass % $100w_1$ calc	mole fraction x_1 exp	mole fraction x_1 calc	status	ref
-9.7	20.43	19.84	0.0584	0.0564	a	153
-9.5	19.99	19.88	0.0569	0.0566	r	146
-9.1	20.3	19.96	0.0580	0.0568	t	153
-9	19.9	19.98	0.0569	0.0569	r	172
-9.0	20.0	19.98	0.0570	"	r	184
-9.0	20.05	19.98	0.0571	0.0569	r	146
-8.9	19.89	20.00	0.0566	0.0570	r	167
-8.6	20.06	20.06	0.0572	0.0572	r	167
-8.2	20.10	20.14	0.0573	0.0575	r	146
-8.0	20.20	20.19	0.0576	0.0576	r	146
-8.0	20.62	20.19	0.0591	0.0576	a	153
-7.6	20.29	20.26	0.0579	0.0579	r	146
-7.2	20.44	20.35	0.0585	0.0581	r	146
-7.0	20.46	20.39	0.0585	0.0583	r	167
-7.0	20.50	"	0.0587	"	r	146
-7.0	20.84	20.39	0.0598	0.0583	t	153
-6.9	20.60	20.40	0.0590	0.0583	t	146
-6.6	20.68	20.46	0.0593	0.0585	t	146
-6.4	20.50	20.50	0.0587	0.0587	r	13
-6.0	20.80	20.58	0.0597	0.0589	a	146
-5.8	21.13	20.62	0.0608	0.0591	a	153
-5.4	20.98	20.70	0.0603	0.0593	t	146
-5.2	20.80	20.74	0.0597	0.0595	r	167
-5	20.8	20.78	0.0597	0.0596	r	133
-5	20.96	20.77	0.0602	"	t	128
-4.7	21.54	20.84	0.0622	0.0598	a	153
-4.5	20.6	20.88	0.0590	0.0599	t	35
-2.9	21.25	21.20	0.0612	0.0610	r	167
-2.8	21.30	21.21	0.0614	0.0611	r	146
-1	21.4	21.56	0.0617	0.0623	r	35
-1.0	21.70	21.56	0.0628	0.0623	r	146
0	20.32	21.75	0.0580	0.0629	r	125
0	21.4	"	0.0617	"	t	172
0	21.5	"	0.0621	"	t	161
0	21.6	"	0.0624	"	r	35
0	21.60	21.75	0.0624	0.0629	r	97, 98
0	21.65	"	0.0626	"	r	130
0.0	21.78	"	0.0630	"	r	13
0	21.8	"	0.0631	"	r	133
0	21.83	"	0.0632	"	r	85
0.0	21.84	21.75	0.0632	0.0629	r	13
0.00	21.866	"	0.0633	"	r	17
0	21.92	"	0.0635	"	r	111
0	21.93	"	0.0636	"	r	154
0	21.94	"	0.0636	"	r	119
0	22.10	21.75	0.0642	0.0629	t	153
0	22.2	"	0.0645	"	t	7

(continued)

COMPONENTS

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

EVALUATOR:

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August, 1990

CRITICAL EVALUATION (continued)

Table 2 (continued)

Solubility of KCl in aqueous solutions (solid phase KCl)

T/K-273.15	mass % $100w_1$ exp	calc	mole fraction x_1 exp	calc	status	ref
0	22.29	21.75	0.0648	0.0629	t	156
0	22.6	"	0.0659	"	a	3
0.00	22.61	"	0.0659	"	a	1
0.05	21.868	21.77	0.0633	0.0630	r	17
0.70	22.05	21.89	0.0640	0.0634	r	32
2.4	22.35	22.22	0.0650	0.0646	r	146
2.5	22.2	22.24	0.0645	0.0646	r	35
3.9	22.70	22.50	0.0663	0.0656	r	13
4.25	22.8	22.56	0.0666	0.0658	r	7
4.9	22.70	22.69	0.0663	0.0662	r	146
5	22.6	22.71	0.0659	0.0663	r	133
5	22.84	"	0.0668	"	r	109
5	22.93	"	0.0671	"	t	62
5.52	22.989	22.81	0.0673	0.0666	r	17
7.00	23.262	23.08	0.0682	0.0676	r	17
7.5	23.0	23.17	0.0673	0.0679	r	35
7.5	23.32	"	0.0685	"	r	126
7.6	23.20	23.19	0.0680	0.0680	r	146
9.4	23.57	23.52	0.0693	0.0692	r	13
9.6	23.50	23.56	0.0691	0.0693	r	146
10	23.2	23.63	0.0680	0.0693	r	172
10	23.4	"	0.0687	"	t	133
10	23.5	"	0.0691	"	r	35
10	23.50	23.63	0.0691	0.0693	r	130
10.0	23.70	"	0.0698	"	r	153
10	23.7	"	0.0696	"	r	161
10	23.8	"	0.0702	"	r	144
10	23.84	"	0.0703	"	a	113
10	25.57	23.63	0.0766	0.0693	r	111
10.2	23.7	23.67	0.0698	0.0695	r	84
10.50	23.900	23.72	0.0705	0.0699	r	17
10.62	23.928	23.74	0.0706	0.0700	t	17
10.9	24.9	23.81	0.0741	0.0702	a	84
11.4	24.35	23.89	0.0722	0.0705	r	13
11.5	23.8	23.90	0.0705	0.0706	r	35
12.0	23.97	23.99	0.0708	0.0709	r	146
13	25.1	24.17	0.0749	0.0715	a	8
14.2	24.50	24.39	0.0727	0.0723	r	153
14.25	24.555	24.40	0.0729	0.0723	r	17
14.95	24.62	24.52	0.0731	0.0728	r	13
15	24.2	24.56	0.0716	0.0728	t	133
15	24.714	"	0.0735	"	r	96
15	24.720	"	0.0735	"	r	96
15	24.747	24.56	0.0736	0.0728	t	96
15	24.76	"	0.0737	"	t	117
15	26.15	"	0.0788	"	a	2
15.6	24.60	24.63	0.0731	0.0732	r	146
15.6	24.74	"	0.0736	"	r	11

(continued)

COMPONENTS

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

EVALUATOR:

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August, 1990

CRITICAL EVALUATION (continued)

Table 2 (continued)
Solubility of KCl in aqueous solutions (solid phase KCl)

T/K-273.15	mass % $100w_1$ exp	calc	mole fraction x_1 exp	calc	status	ref
15.6	24.84	24.63	0.0740	0.0732	t	11
16.13	24.73	24.73	0.0735	0.0735	r	176
16.5	25.2	24.78	0.0753	0.0737	t	7
17.5	24.8	24.97	0.0738	0.0744	r	5
17.5	25.06	"	0.0748	"	r	20
18	25.25	25.04	0.0755	0.0747	r	116
18.2	25.37	25.09	0.0759	0.0749	t	126
18.5	25.0	25.14	0.0745	0.0751	r	35
18.5	25.43	"	0.0761	"	t	88
18.6	25.05	25.16	0.0747	0.0751	r	146
19.0	25.55	25.23	0.0766	0.0754	t	13
19.35	25.67	25.29	0.0770	0.0756	t	1
19.55	25.58	25.32	0.0767	0.0757	t	32
20	25.0	25.40	0.0745	0.0760	t	127,133
20	25.3	"	0.0756	"	r	161
20	25.5	25.40	0.0764	0.0760	r	95
20	25.577	"	0.0674	"	r	96
20	25.59	"	0.0767	"	r	137
20	25.598	"	0.0768	"	r	96
20	25.68	"	0.0771	"	t	113
20	25.71	25.40	0.0772	0.0760	t	60
20	25.8	"	0.0775	"	t	3
21.2	25.70	25.60	0.0771	0.0768	r	126
21.97	25.80	25.73	0.0775	0.0773	r	176
22.0	25.65	25.74	0.0769	0.0773	r	146
22	26.390	25.73	0.0797	0.0772	a	180
22.2	26.20	25.77	0.0790	0.0774	t	130
23.4	26.21	25.99	0.0790	0.0782	t	37
23.50	26.02	25.99	0.0783	0.0782	r	176
23.6	26.00	26.01	0.0783	0.0783	r	146
24.6	26.00	26.17	0.0783	0.0783	r	153
25	21.70	26.23	0.0628	0.0792	a	138
25	21.90	"	0.0635	"	a	138
25	24.75	"	0.0736	"	a	86
25	24.75	"	0.0791	"	a	160
25	25.95	26.23	0.0781	0.0792	t	154
25	26	"	0.0782	"	t	80
25	26.02	"	0.0783	"	t	98
25	26.07	"	0.0785	"	r	119
25	26.28	"	0.0793	"	r	163
25	26.3	26.23	0.0794	0.0792	t	140
25	26.31	"	0.0774	"	r	91
25	26.36	"	0.0796	"	r	109
25	26.37	"	0.0797	"	r	94
25	26.46	"	0.0798	"	r	7
25	26.42	26.23	0.0798	0.0792	r	142
25	26.43	"	0.0799	"	r	85
25	26.450	"	0.0799	"	r	96

(continued)

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I) 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. August, 1990

CRITICAL EVALUATION (continued)

Table 2 (continued)
Solubility of KCl in aqueous solutions (solid phase KCl)

T/K-273.15	mass % $100w_1$ exp	calc	mole fraction x_1 exp	calc	status	ref
25	26.453	26.23	0.0800	0.0792	t	96
25	26.46	"	0.0800	"	t	62
25	26.46	26.23	0.0800	0.0792	t	87
25	26.46	"	0.0800	"	t	99
25	26.46	"	0.0800	"	t	118
25	26.469	"	0.0800	"	t	96
25	26.47	"	0.0800	"	t	68
25	26.48	26.23	0.0801	0.0792	t	149
25	26.50	"	0.0801	"	t	160
25	26.50	"	0.0801	"	t	130
25	26.5	"	0.0801	"	t	161
25	26.52	"	0.0801	"	t	113
25	26.52	26.23	0.0802	0.0792	t	159
25	26.6	"	0.0805	"	t	182
25	26.63	"	0.0806	"	t	135
25	26.63	"	0.0806	"	t	169
25	26.66	"	0.0807	"	t	57
25	26.67	26.23	0.0808	0.0792	t	45
25	26.69	"	0.0809	"	t	45
25	26.70	"	0.0809	"	t	45
25	26.71	"	0.0809	"	t	45
25.00	26.72	"	0.0810	"	t	177
25	26.72	26.23	0.0810	0.0792	t	156
25	26.80	"	0.0813	"	t	162
25	26.99	"	0.0820	"	a	147
25.22	26.41	26.28	0.0798	0.0793	r	103
25.42	26.40	26.31	0.0798	0.0794	r	179
25.7	26.52	26.36	0.0802	0.0796	r	13
26.32	26.36	26.46	0.0796	0.0800	r	176
27	26.27	26.57	0.0793	0.0804	t	167
28.5	26.91	26.81	0.0817	0.0813	r	126
29.25	27.17	26.93	0.0827	0.0818	r	13
29.75	27.3	27.00	0.0832	0.0820	t	7
29.78	26.96	27.02	0.0819	0.0821	r	179
29.79	26.96	27.02	0.0819	0.0821	r	179
29.88	26.99	27.04	0.0820	0.0822	r	179
30	26.6	27.04	0.0805	0.0822	t	133
30	26.78	27.04	0.0812	0.0822	t	181
30	26.8	"	0.0813	"	t	127
30	27.16	"	0.0827	"	r	175
30	27.18	"	0.0827	"	r	144,145
30	27.2	27.04	0.0828	0.0822	r	77
30	27.30	"	0.0832	"	t	175
30	27.32	"	0.0833	"	t	60
30	27.4	"	0.0836	"	t	8
30	27.53	"	0.0841	"	t	137
30.06	27.03	27.06	0.0822	0.0823	r	179
30.1	27.20	27.07	0.0828	0.0823	r	153

(continued)

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I) 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. August, 1990

CRITICAL EVALUATION (continued)

Table 2 (continued)

Solubility of KCl in aqueous solutions (solid phase KCl)

T/K-273.15	mass % $100w_1$ exp	mass % $100w_1$ calc	mole fraction x_1 exp	mole fraction x_1 calc	status	ref
30.80	27.23	27.18	0.0829	0.0827	r	176
31.59	27.57	27.31	0.0840	0.0832	r	176
32.80	27.70	27.50	0.0840	0.0832	r	32
34	27.8	27.69	0.0851	0.0847	r	70
34.42	27.811	27.75	0.0852	0.0849	r	17
35	27.70	27.84	0.0847	0.0853	r	130
35	27.80	"	0.0851	"	r	98
35	28.09	"	0.0863	"	t	139
37.62	28.17	28.25	0.0866	0.0869	r	176
38	27.9	28.30	0.0855	0.0871	t	167
38.0	28.42	"	0.0875	"	r	13
38.0	29.06	"	0.0901	"	a	153
39.94	25.50	28.59	0.0764	0.0882	a	179
40	28.06	28.59	0.0861	0.0883	a	97
40	28.6	"	0.0882	"	r	3
40	28.6	"	0.0882	"	r	8
40	28.60	"	0.0882	"	r	97
40	28.65	"	0.0884	"	r	111
40	28.67	28.59	0.0885	0.0883	r	181
40	28.80	"	0.0890	"	r	113
40	28.88	"	0.0894	"	t	60
40.98	28.61	28.75	0.0883	0.0888	r	179
41.00	28.73	28.76	0.0888	0.0889	r	176
41.45	28.91	28.82	0.0895	0.0891	r	13
45	29.5	29.33	0.0918	0.0911	r	7
45	29.14	"	0.0904	"	r	119
46.15	29.75	29.51	0.0928	0.0919	r	13
48.12	29.82	29.79	0.0931	0.0930	r	176
48.8	30.00	29.87	0.0938	0.0934	r	13
50	29.96	30.04	0.0937	0.0940	r	41
50	29.97	"	0.0937	"	r	62
50	30.00	"	0.0938	"	r	160
50	30.0	"	0.0938	"	r	167
50	30.06	30.04	0.0941	0.0940	r	113
50	30.03	"	0.0940	"	r	154
50	30.03	"	0.0940	"	r	109
50	30.05	"	0.0940	"	r	156
50	30.06	"	0.0941	"	r	144
50	30.07	30.04	0.0941	0.0940	r	85
50.21	30.0	30.09	0.0938	0.0942	r	107
50.49	30.00	30.12	0.0938	0.0943	r	179
52.39	30.36	30.39	0.0953	0.0954	r	1
53.27	30.42	30.51	0.0955	0.0959	r	176
53.82	30.52	30.58	0.0960	0.0962	r	176
55.1	30.80	30.76	0.0971	0.0969	r	13
56	30.4	30.88	0.0955	0.0974	t	70
56	30.90	30.66	0.0975	0.0974	r	148
57	31.0	31.01	0.0979	0.0980	r	8

(continued)

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I) 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. August, 1990

CRITICAL EVALUATION (continued)

Table 2 (continued)

Solubility of KCl in aqueous solutions (solid phase KCl)

T/K-273.15	mass % $100w_1$ exp	calc	mole fraction x_1 exp	calc	status	ref
58.6	31.05	31.23	0.0981	0.0989	r	126
59.17	31.160	31.30	0.0986	0.0992	r	17
59.85	31.43	31.39	0.0997	0.0996	r	32
59.92	31.26	31.26	0.0990	0.0997	r	17
60	31.29	31.40	0.0991	0.0996	r	111
60	31.3	31.40	0.0992	0.0996	r	3
60	31.30	"	0.0992	"	r	91, 98
60	31.3	"	0.0992	"	r	167
60	31.37	"	0.0995	"	r	113
60.55	31.46	31.48	0.0998	0.0999	r	13
61.28	31.40	31.58	0.0996	0.1003	r	179
62.7	31.54	31.76	0.1002	0.1011	r	126
62.88	31.49	31.79	0.1000	0.1012	t	176
64.95	32.05	32.05	0.1023	0.1023	r	13
65	31.91	32.06	0.1017	0.1023	r	119
66.23	32.03	32.21	0.1022	0.1030	r	176
67.91	32.2	32.42	0.1029	0.1039	r	107
69.12	32.36	32.57	0.1036	0.1045	r	176
70	32.51	32.67	0.1043	0.1049	r	144,145
70	32.52	"	0.1043	"	r	113
71.65	32.32	32.88	0.10343	0.1058	t	13
72.44	32.71	33.00	0.1051	0.1063	t	179
74.25	33.01	33.20	0.1064	0.1072	r	13
74.80	33.15	33.26	0.1070	0.1075	r	32
75	32.99	33.29	0.1063	0.1073	r	154
75	33.16	33.29	0.1070	0.1073	r	85
77	33.45	33.53	0.1083	0.1086	r	148
77.07	33.26	33.53	0.1075	0.1087	t	176
79	33.70	33.76	0.1094	0.1096	r	148
79.58	33.74	33.63	0.1096	0.1099	r	1
80	33.59	33.88	0.1089	0.1102	t	111
80	33.6	"	0.1090	"	t	70
80	33.8	"	0.1098	"	r	3
80	33.80	"	0.1098	"	r	97
80.75	33.88	33.96	0.1102	0.1105	r	13
83.18	33.91	34.24	0.1103	0.1118	t	179
85.26	34.15	34.48	0.1114	0.1128	t	176
86.6	34.44	34.63	0.1126	0.1135	r	13
89.45	34.80	34.94	0.1142	0.1149	r	32
90	34.42	35.00	0.1125	0.1151	t	119
91	34.89	35.11	0.1146	0.1156	r	60
91.4	34.85	35.15	0.1145	0.1158	t	13
92.23	34.9	35.24	0.1146	0.1162	t	107
93.40	34.99	35.37	0.1151	0.1168	t	179
94	35.30	35.43	0.1165	0.1171	r	148
96.0	35.31	35.65	0.1165	0.1180	t	126
99	35.80	35.96	0.1187	0.1195	r	148

(continued)

COMPONENTS

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

EVALUATOR:

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August, 1990

CRITICAL EVALUATION (continued)

Table 2 (continued)
Solubility of KCl in aqueous solutions (solid phase KCl)

T/K-273.15	mass % $100w_1$ exp	mass % $100w_1$ calc	mole fraction x_1 exp	mole fraction x_1 calc	status	ref
100	35.69	36.07	0.1182	0.1200	r	111
100	35.70	"	0.1183	"	t	85
100	35.72	"	0.1184	"	t	144,145
100	35.9	36.07	0.1192	0.1200	r	62
100	35.90	"	0.1192	"	r	110
100	35.9	"	0.1192	"	r	95
100	35.92	"	0.1193	"	r	54
100	36.03	"	0.1198	"	r	113
100	36.1	36.07	0.1201	0.11200	r	3
100	36.1	"	0.1201	"	r	95
100	36.2	"	0.1206	"	r	70
101	35.96	36.17	0.1195	0.1204	r	148
107.65	36.9	36.82	0.1238	0.1235	r	7
108.0	36.75	36.88	0.1231	0.1237	r	32
108.5	36.50	36.93	0.1220	0.1239	t	111
108.599	36.82	36.94	0.1234	0.1240	r	46
108.7	38.01	36.95	0.1290	0.1240	a	108
109.60	37.21	37.04	0.1253	0.1245	r	1
110	36.4	37.08	0.1215	0.1246	t	124
110	36.71	"	0.1229	"	t	110
112	37.10	37.27	0.1247	0.1256	r	148
118.3	37.7	37.86	0.1276	0.1284	r	184
119	37.79	37.95	0.1280	0.1288	r	148
120	37.65	38.05	0.1273	0.1292	t	111
120	37.66	"	0.1274	"	t	110
125	36.3	38.51	0.1210	0.1315	a	18
125	38.30	"	0.1304	"	r	148
127.1	38.54	38.71	0.1316	0.1324	r	126
129	38.2	38.88	0.1299	0.1332	t	124
130	38.3	38.97	0.1504	0.1337	a	102
130	38.4	"	0.1309	"	t	102
130	38.61	"	0.1319	"	t	110
131	40.2	39.06	0.1397	0.1341	a	102
133	40.8	39.24	0.1428	0.1350	a	102
133	40.9	39.24	0.1433	0.1350	a	18
140	39.60	39.87	0.1368	0.1381	r	111
140	39.69	"	0.1372	"	r	110
141	39.3	39.96	0.1353	0.1385	t	124
142	38.6	40.05	0.1319	"	a	23
142	39.95	"	0.1385	"	r	148
144	41.5	40.22	0.1464	0.1398	a	18
147.2	40.58	40.50	0.1416	0.1413	r	126
148	40.45	40.57	0.1410	0.1416	r	148
148.6	40.24	40.62	0.1399	0.1419	t	178
150	38.8	40.74	0.1328	0.1425	a	23
150	40.48	"	0.1411	"	r	110
150	41.1	"	0.1439	"	r	102
153.4	40.77	41.04	0.1448	0.1440	r	178

(continued)

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I) 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. August, 1990

CRITICAL EVALUATION (continued)

Table 2 (continued)

Solubility of KCl in aqueous solutions (solid phase KCl)

T/K-273.15	mass % $100w_1$ exp	calc	mole fraction x_1 exp	calc	status	ref
160	41.38	41.56	0.1457	0.1468	r	110
161	41.2	41.68	0.1448	0.1473	t	124
162.8	41.43	41.83	0.1460	0.1470	r	178
168	42.35	42.27	0.1507	0.1503	r	148
169.5	42.42	42.39	0.1511	0.1510	r	111
170	42.33	42.43	0.1506	0.1512	r	110
173.1	42.49	42.69	0.1515	0.1525	r	178
175	41.2	42.82	0.1448	0.1532	a	23
175	42.9	"	0.1536	"	r	18
175.6	43.00	42.89	0.1542	0.1536	r	126
177	43.12	43.01	0.1548	0.15423	r	148
178	43.2	43.09	0.1552	0.1546	r	102
180	41.8	43.26	0.1479	0.1555	a	23
180	43.05	"	0.1544	"	r	110
180	43.3	"	0.1558	"	r	102
180	43.7	43.26	0.1579	0.1555	t	18
189.6	44.34	44.04	0.1614	0.1598	r	111
190	43.2	44.07	0.1552	0.1600	a	23
190	43.95	"	0.1593	0.1600	r	110
190	44.08	"	0.1600	"	r	134
192.3	44.02	44.26	0.1597	0.1610	r	178
193	44.45	44.32	0.1620	0.1613	r	148
195	44.72	44.48	0.1635	0.1622	r	148
199	44.7	44.80	0.1634	0.1640	r	124
200	42.9	44.88	0.1536	0.1644	a	23
200	44.87	44.88	0.1633	0.1644	r	110
210	45.41	45.69	0.1674	0.1690	r	110
213	45.52	45.94	0.1680	0.1703	t	134
213.5	46.00	45.98	0.1707	0.1706	r	178
216	46.50	46.18	0.1736	0.1717	t	148
219	46.79	46.42	0.1752	0.1731	t	148
220	46.52	46.51	0.1737	0.1736	r	110
230	47.31	47.32	0.1783	0.1783	r	110
230	47.5	"	0.1794	"	r	124
237.2	47.60	47.91	0.1800	0.1818	r	134
237.6	47.60	47.94	0.1800	0.1820	t	134
240	48.02	48.14	0.1825	0.1831	r	110
242	47.6	48.31	0.1800	0.1842	t	23
250	48.44	48.95	0.1850	0.1882	t	134
250	48.80	"	0.1872	"	r	110
250	49.3	48.95	0.1903	0.1882	t	129
250	49.55	"	0.1918	"	t	148
251	49.5	49.05	0.1915	0.1887	t	124
256.1	50.00	49.48	0.1946	0.1914	t	178
260	49.49	49.81	0.1914	0.1934	t	110
268.1	51.9	50.46	0.207	0.1975	e	184
269.2	50.54	50.58	0.1980	0.1983	r	134
270	50.20	50.65	0.1959	0.1987	t	110

(continued)

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I) 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. August, 1990

CRITICAL EVALUATION (continued)

Table 2 (continued)

Solubility of KCl in aqueous solutions (solid phase KCl)

T/K-273.15	mass % $100w_1$ exp	calc	mole fraction x_1 exp	calc	status	ref
273	51.5	50.91	0.2042	0.2004	t	124
278.0	52.00	51.34	0.2075	0.2031	t	178
280	50.88	51.51	0.2002	0.2042	t	110
290	51.55	52.38	0.2045	0.2100	t	110
295	53.5	52.82	0.2175	0.2129	t	124
298	53.28	53.08	0.2160	0.2147	r	134
298.1	53.28	53.09	0.2160	0.2147	r	134
300	52.24	53.26	0.2090	0.2159	a	110
300	53.42	"	0.2170	"	r	134
300	54.0	53.26	0.2210	0.2159	a	129
328	56.7	55.80	0.2404	0.2337	a	124
330	56.38	55.98	0.2380	0.2351	t	134
342.2	57.58	57.12	0.2470	0.2435	t	134
349.4	58.23	57.81	0.2520	0.2487	t	134
350	58.23	57.86	0.2520	0.2491	r	134
350	58.7	"	0.2556	"	t	129
362	60.0	59.02	0.2660	0.2581	t	124
367.7	61.9	59.54	0.282	0.2623	a	184
371.0	50.98	59.90	0.2008	0.2652	a	178
371	60.48	"	0.2700	"	t	134
372.5	60.73	60.04	0.2720	0.2664	t	134
375	60.97	60.29	0.2740	0.2684	t	134
375	60.97	"	0.2740	"	t	134
388	62.49	61.58	0.2870	0.2792	t	134
391	62.6	61.89	0.2880	0.2818	t	124
397.3	63.17	62.52	0.2930	0.2873	t	134
400	63.39	62.80	0.2950	0.2897	t	134
400	63.4	"	0.2951	"	t	129
409	64.4	64.72	0.3042	0.2978	t	124
427.2	66.28	65.60	0.3220	0.3155	t	134
428.6	66.38	67.75	0.3230	0.3169	t	134
439.5	67.58	66.90	0.3350	0.3281	t	134
443.1	70.1	67.24	0.362	0.3315	e	184
450	68.2	68.01	0.3413	0.3394	r	129
450	68.74	"	0.3470	"	t	134
454	69.0	68.44	0.3497	0.3438	t	124
457.2	69.40	68.78	0.3540	0.3474	t	134
472	70.85	70.37	0.3700	0.3646	t	134
480.4	71.46	71.86	0.3810	0.3816	r	134
485.8	71.81	71.86	0.3819	0.3816	r	134
493.8	72.82	72.73	0.3930	0.3919	r	134
497.2	72.99	73.10	0.3950	0.3963	r	134
500	73.0	73.40	0.3952	0.4001	t	129
500	73.23	"	0.3980	"	r	134
516.1	74.67	75.16	0.4160	0.4223	a	134
526.4	75.51	76.28	0.4269	0.4373	t	134
529.7	75.89	76.64	0.4320	0.4422	t	134
538.9	76.77	77.64	0.4440	0.4563	t	134

(continued)

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I) 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. August, 1990

CRITICAL EVALUATION (continued)

Table 2 (continued)

Solubility of KCl in aqueous solutions (solid phase KCl)

T/K-273.15	mass % $100w_1$ exp	mass % $100w_1$ calc	mole fraction x_1 exp	mole fraction x_1 calc	status	ref
550.5	80.2	78.86	0.495	0.4742	a	184
548.7	77.76	78.71	0.4579	0.4718	t	134
550	77.9	78.85	0.4600	0.4739	t	129
550	77.97	"	0.4610	"	t	134
584.5	81.10	82.57	0.5090	0.5337	t	134
600	82.64	84.41	0.5349	0.5631	t	134
600	82.9	84.21	0.5395	0.5631	t	129
645	87.30	88.85	0.6242	0.6581	t	134
651.2	89.9	89.42	0.683	0.6713	t	184

$$e = 100|x_1(exp) - x_1(calc)|/x_1(calc)$$

For $t < 500$°C: values are recommended if $e \leqslant 1$
tentative if $1 < e \leqslant 2.5$
aberrant if $2.5 < e$

For $t > 500$°C: all values may be considered as tentative.

5.2 Solubility of Ice [7732-18-5]

The data of Jones (21), Jones and Getman (30), Dernby (64), Klein and Svanberg (71) and Lange (122), given in mol L^{-1}, have not been compiled. Two hundred and nine experimental points are given in the bibliography, of which 154 have been kept for the calculations after elimination of the most aberrant data by graphical selection or by iterative calculations, rejecting points for which the relative range $|\Delta x_1/x_1(\text{calc})| > 0.01$. Three iterations were necessary to obtain stationary values for E, F, G and H, the final numerical values of which are given in Table 1.

The results of the solubility measurements, the calculated values and the logarithm of the activity of water in the saturated solution are given in Table 3. The recommended values correspond to a relative range $|\Delta x_1/x_1| < 0.01$; they are considered as aberrant if this range is > 0.03.

Table 3

Solubility of ice in aqueous solutions of KCl

T/K -273.15	mass % $100w_1$ exp	mass % $100w_1$ calc	mole fraction x_1 exp	mole fraction x_1 calc	status	ref
-0.0051	0.01035	0.0104	0.0000	0.0000	r	115
-0.0102	0.02136	0.0212	0.0001	0.0001	r	115
-0.0234	0.04806	0.0483	0.0001	0.0001	r	115
-0.0399	0.08296	0.0830	0.0002	0.0002	r	115
-0.0509	0.1079	0.1072	0.0003	0.0003	r	29

(continued)

COMPONENTS

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

EVALUATOR:

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August, 1990

CRITICAL EVALUATION (continued)

Table 3 (continued)

Solubility of ice in aqueous solutions of KCl

T/K -273.15	mass % $100w_1$ exp	calc	mole fraction x_1 exp	calc	status	ref
-0.0580	0.12076	0.1210	0.0003	0.0003	r	115
-0.0592	0.1227	0.1234	0.0003	0.0003	r	165
-0.0900	0.1884	0.1889	0.0005	0.0005	r	34
-0.0905	0.1900	0.1902	0.0005	0.0005	r	34
-0.0913	0.1910	0.1915	0.0005	0.0005	r	165
-0.0957	0.20089	0.2012	0.0005	0.0005	r	115
-0.1031	0.2166	0.2170	0.0005	0.0005	r	29
-0.10775	0.222	0.2245	0.0005	0.0005	t	105
-0.1340	0.2807	0.2821	0.0007	0.0007	r	34
-0.1340	0.2813	0.2824	0.0007	0.0007	r	34
-0.1342	0.28379	0.2839	0.0007	0.0007	r	115
-0.1493	0.3119	0.3141	0.0008	0.0008	r	165
-0.16149	0.334	0.3381	0.0008	0.0008	t	105
-0.169	0.3526	0.3555	0.0009	0.0009	r	55
-0.1760	0.3744	0.3742	0.0009	0.0009	r	34
-0.1770	0.3752	0.3757	0.0009	0.0009	r	34
-0.1912	0.4065	0.4070	0.0010	0.0010	r	165
-0.1966	0.41754	0.4180	0.0010	0.0010	r	115
-0.201	0.448	0.4388	0.0011	0.0011	t	12
-0.2026	0.434	0.4329	0.0011	0.0010	r	29
-0.21	0.47	0.4597	0.0011	0.0011	t	143
-0.260	0.5485	0.5520	0.0013	0.0013	r	55
-0.2640	0.5614	0.5629	0.0014	0.0014	r	34
-0.2640	0.5625	0.5635	0.0014	0.0014	r	34
-0.2659	0.56887	0.5689	0.0014	0.0014	r	115
-0.3060	0.6621	0.6593	0.0016	0.0016	r	165
-0.3229	0.686	0.6892	0.0017	0.0017	r	105
-0.340	0.7312	0.7308	0.0018	0.0018	r	89
-0.3465	0.7421	0.7444	0.0018	0.0018	r	34
-0.3478	0.7423	0.7473	0.0018	0.0018	r	34
-0.3663	0.78746	0.7877	0.0019	0.0019	r	115
-0.3830	0.8325	0.8242	0.0020	0.0020	r	165
-0.3836	0.825	0.8255	0.0020	0.0020	r	105
-0.384	0.829	0.8264	0.0020	0.0020	r	24
-0.39	0.85	0.8395	0.0021	0.0021	t	143
-0.4007	0.867	0.8651	0.0021	0.0021	r	29
-0.4040	0.8735	0.8722	0.0021	0.0021	r	165
-0.412	0.8904	0.8876	0.0022	0.0022	r	89
-0.425	0.9204	0.9160	0.0022	0.0022	r	89
-0.4333	0.9413	0.9342	0.0023	0.0023	r	165
-0.45	0.99	0.9707	0.0024	0.0024	t	6
-0.454	0.9773	0.9795	0.0024	0.0024	r	55
-0.4638	1.0007	1.0009	0.0024	0.0024	r	115
-0.4776	1.032	1.0312	0.0025	0.0025	r	105
-0.482	1.057	1.0497	0.0026	0.0026	r	50
-0.5017	1.0912	1.0878	0.0027	0.0027	r	165
-0.5130	1.1088	1.1088	0.0027	0.0027	r	34
-0.5145	1.1114	1.1117	0.0027	0.0027	r	34
-0.5413	1.1792	1.1753	0.0029	0.0029	r	165

(continued)

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I) 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. August, 1990

CRITICAL EVALUATION (continued)

Table 3 (continued)

Solubility of ice in aqueous solutions of KCl

T/K -273.15	mass % $100w_1$ exp	mass % $100w_1$ calc	mole fraction x_1 exp	mole fraction x_1 calc	status	ref
-0.5754	1.2462	1.2459	0.0030	0.0030	r	115
-0.616	1.3359	1.3353	0.0033	0.0033	r	89
-0.6795	1.4766	1.4749	0.0036	0.0036	r	34
-0.6800	1.4749	1.4754	0.0036	0.0036	r	34
-0.6865	1.4892	1.4877	0.0036	0.0036	r	115
-0.7164	1.559	1.5571	0.0038	0.0038	r	105
-0.7360	1.6025	1.6001	0.0039	0.0039	r	165
-0.7805	1.6960	1.6960	0.0042	0.0042	r	115
-0.7814	1.7065	1.7022	0.0042	0.0042	r	165
-0.7992	1.735	1.7356	0.0042	0.0042	r	29
-0.803	1.7442	1.7444	0.0043	0.0043	r	89
-0.8055	1.7577	1.7545	0.0043	0.0043	r	165
-0.81	1.76	1.7600	0.0043	0.0043	r	143
-0.8126	1.7671	1.7665	0.0043	0.0043	r	165
-0.827	1.778	1.7970	0.0044	0.0044	t	24
-0.8709	1.8927	1.8931	0.0046	0.0046	r	34
-0.8711	1.8924	1.8931	0.0046	0.0046	r	34
-0.892	1.9241	1.9384	0.0047	0.0047	r	55
-0.9	1.96	1.9588	0.0048	0.0048	r	6
-0.913	1.9805	1.9858	0.0049	0.0049	r	89
-0.9603	2.0895	2.0893	0.0051	0.0051	r	115
-0.9743	2.131	2.1199	0.0052	0.0052	r	105
-1.004	2.210	2.1849	0.0054	0.0054	t	50
-1.007	2.1863	2.1914	0.0054	0.0054	r	89
-1.0741	2.3353	2.3380	0.0057	0.0058	r	165
-1.1292	2.4575	2.4583	0.0061	0.0061	r	34
-1.1320	2.4704	2.4644	0.0061	0.0061	r	34
-1.1721	2.5509	2.5513	0.0063	0.0063	r	115
-1.2592	2.7359	2.7384	0.0068	0.0068	r	165
-1.3137	2.8536	2.8566	0.0070	0.0071	r	165
-1.347	2.9254	2.9320	0.00720	0.0072	r	89
-1.3498	2.9343	2.9381	0.0073	0.0073	r	115
-1.389	2.992	3.0231	0.0074	0.0075	t	24
-1.3978	3.050	3.0421	0.0075	0.0075	r	105
-1.409	2.992	3.0664	0.0074	0.0076	r	24
-1.46	3.18	3.18	0.0079	0.0079	r	183
-1.474	3.217	3.2071	0.0080	0.0079	r	50
-1.4754	3.2096	3.2101	0.0079	0.0080	r	165
-1.511	3.2803	3.2870	0.0081	0.0081	r	89
-1.60	3.49	3.4788	0.0087	0.0086	r	143
-1.6012	3.466	3.4814	0.0086	0.0086	r	29
-1.6101	3.4939	3.5006	0.0087	0.0087	r	115
-1.6238	3.5231	3.5300	0.0087	0.0088	r	165
-1.649	3.599	3.5842	0.0089	0.0089	r	105
-1.6928	3.6702	3.6783	0.0091	0.0091	r	115
-1.723	3.7350	3.7431	0.0093	0.0093	r	89

(continued)

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I) 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. August, 1990

CRITICAL EVALUATION (continued)

Table 3 (continued)

Solubility of ice in aqueous solutions of KCl

T/K -273.15	mass % $100w_1$ exp	calc	mole fraction x_1 exp	calc	status	ref
-1.760	3.9226	3.8223	0.0098	0.0095	t	55
-1.8	3.85	3.9079	0.0096	0.0097	t	6
-1.8532	4.0115	4.0215	0.0100	0.0100	r	115
-1.9406	4.2005	4.2078	0.0105	0.0105	r	165
-1.972	4.271	4.2745	0.0107	0.0107	r	50
-1.992	4.3140	4.3170	0.0108	0.0108	r	89
-2.00	4.28	4.33	0.0106	0.0108	t	183
-2.0667	4.4621	4.4754	0.0112	0.0112	r	115
-2.24	4.95	4.8410	0.0124	0.0121	t	103
-2.2515	4.8531	4.8651	0.0122	0.0122	r	115
-2.2587	4.8550	4.8803	0.0122	0.0122	r	165
-2.3	5.02	4.9670	0.0126	0.0125	t	146
-2.303	4.9689	4.9733	0.0125	0.0125	r	89
-2.475	5.328	5.3328	0.0134	0.0134	r	50
-2.5289	5.4310	5.4450	0.0137	0.0137	r	165
-2.5545	5.4858	5.4981	0.0138	0.0139	r	115
-2.5547	5.4948	5.4966	0.0139	0.0139	r	165
-2.577	5.5331	5.5383	0.0140	0.0140	r	89
-2.65	5.66	5.6960	0.0143	0.0144	r	6
-2.719	5.8296	5.8384	0.0147	0.0148	r	89
-2.721	5.779	5.8426	0.0146	0.0148	t	24
-2.8347	6.0710	6.0764	0.0154	0.0154	r	165
-2.85	5.99	6.1077	0.0152	0.0152	t	9
-2.8692	6.1353	6.1471	0.0155	0.0156	r	115
-2.9	5.99	6.2101	0.0152	0.0157	a	9
-2.955	6.336	6.3225	0.0161	0.0160	r	50
-3.00	6.43	6.41	0.0163	0.0163	r	183
-3.001	6.4072	6.4163	0.0163	0.0163	r	89
-3.07	6.62	6.5916	0.0168	0.0168	r	67
-3.2055	6.8220	6.8308	0.0174	0.0174	r	115
-3.2329	6.8892	6.8861	0.0176	0.0176	r	165
-3.2864	6.942	6.9938	0.0177	0.0178	r	29
-3.30	6.52	7.0211	0.0166	0.0179	a	143
-3.30	6.52	7.0211	0.0166	0.0179	a	143
-3.328	7.0674	7.0773	0.0181	0.0181	r	89
-3.40	7.13	7.2216	0.0182	0.0185	t	143
-3.40	7.13	7.2216	0.0812	0.0185	t	143
-3.437	7.243	7.2956	0.0185	0.0187	r	24
-3.461	7.358	7.3435	0.0188	0.0188	r	50
-3.4683	7.3567	7.3580	0.0188	0.0188	r	165
-3.5	6.5	7.4212	0.0165	0.0190	a	167
-3.55	7.41	7.5207	0.0190	0.0193	t	6
-3.618	7.6560	7.6556	0.0196	0.0196	r	89
-3.7532	7.9782	7.9200	0.0204	0.0204	r	165
-3.7817	7.9751	7.9797	0.0205	0.0205	r	115
-3.960	8.3376	8.3331	0.0215	0.0215	r	89
-3.9801	8.3984	8.3984	0.0217	0.0216	r	165
-4.00	8.38	8.40	0.0216	0.0217	r	183

(continued)

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I) 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. August, 1990

CRITICAL EVALUATION (continued)

Table 3 (continued)

Solubility of ice in aqueous solutions of KCl

T/K -273.15	mass % $100w_1$ exp	calc	mole fraction x_1 exp	calc	status	ref
-4.0223	8.4531	8.4490	0.0218	0.0218	r	165
-4.0479	8.4968	8.4987	0.0219	0.0220	r	115
-4.230	8.8608	8.8509	0.0230	0.0229	r	89
-4.2441	8.8760	8.8780	0.0230	0.0230	r	165
-4.2755	8.9433	8.9384	0.0232	0.0232	r	165
-4.4	9.09	9.1769	0.0236	0.0238	r	6
-4.5043	9.3830	9.3797	0.0244	0.0244	r	165
-4.528	9.4331	9.4274	0.0245	0.0245	r	89
-4.60	9.48	9.5154	0.0247	0.0248	r	103
-4.6239	9.6172	9.6103	0.0251	0.0250	r	165
-4.66	9.72	9.6707	0.0254	0.0252	r	67
-4.696	9.70	9.7386	0.0253	0.0254	r	24
-4.7479	9.8421	9.8362	0.0257	0.0257	r	165
-4.7691	9.9085	9.8761	0.0259	0.0258	r	165
-4.8	9.58	9.9341	0.0250	0.0260	r	9
-4.8	10.04	9.9341	0.0263	0.0260	r	146
-4.804	9.9620	9.9416	0.0260	0.0260	r	89
-4.835	9.70	9.9996	0.0253	0.0261	a	24
-4.8455	10.0390	10.0193	0.0263	0.0262	r	165
-4.8727	10.0659	10.0702	0.0263	0.0263	r	165
-4.8961	10.1136	10.1043	0.0265	0.0264	r	165
-4.9212	10.1515	10.1560	0.0266	0.0266	r	165
-5.00	10.30	10.30	0.0270	0.0270	r	183
-5	10.39	10.3519	0.0273	0.0271	r	128
-5	12	"	0.0319	"	a	133
-5.0641	10.4383	10.4326	0.0274	0.0274	r	165
-5.1719	10.6387	10.6327	0.0280	0.0279	r	165
-5.208	10.705	10.6919	0.0282	0.0281	r	89
-5.223	10.747	10.7195	0.0283	0.0282	r	89
-5.3101	11.2401	10.8793	0.0297	0.0287	a	165
-5.35	10.71	10.9523	0.0282	0.0289	t	6
-5.50	11.11	11.2255	0.0293	0.0296	t	143
-5.50	11.11	11.2255	0.0293	0.0296	t	143
-5.50	11.11	11.2255	0.0293	0.0296	t	143
-5.5	12.5	11.2255	0.0334	0.0296	a	35
-5.519	11.272	11.2600	0.0298	0.0297	r	89
-5.5603	11.3500	11.3348	0.0300	0.0300	r	165
-5.757	11.705	11.68892	0.0310	0.0310	r	89
-5.7814	11.7417	11.7329	0.0311	0.0311	r	165
-5.8	11.4	11.7662	0.0302	0.0312	a	167
-5.85	11.30	11.8556	0.0299	0.0315	a	9
-5.882	11.937	11.9127	0.0317	0.0316	r	89
-5.9701	12.0759	12.0695	0.0321	0.0321	r	165
-6.00	12.14	12.12	0.0323	0.0323	r	183
-6	13.6	12.1226	0.0366	0.0323	a	35
-6.37	12.69	12.7732	0.0339	0.0342	r	24
-6.60	13.25	13.1721	0.0356	0.0354	r	143

(continued)

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I) 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. August, 1990

CRITICAL EVALUATION (continued)

Table 3 (continued)

Solubility of ice in aqueous solutions of KCl

T/K -273.15	mass % $100w_1$ exp	calc	mole fraction x_1 exp	calc	status	ref
-6.68	13.25	13.2785	0.0356	0.0357	r	143
-6.7910	13.5075	13.5038	0.0364	0.0364	r	165
-6.88	13.70	13.6771	0.0369	0.0369	r	103
-7.00	13.81	13.85	0.0373	0.0374	r	183
-7	14.9	13.8521	0.0406	0.0374	a	35
-7.3	14.80	14.3472	0.0403	0.0389	a	146
-7.34	14.41	14.4275	0.0391	0.0391	r	24
-7.51	14.81	14.7076	0.0403	0.0400	r	67
-7.75	14.49	14.7877	0.0303	0.0402	t	9
-7.8188	15.226	15.2177	0.0416	0.0416	r	168
-7.85	15.25	15.2686	0.0417	0.0417	r	143
-8.00	15.48	15.51	0.0424	0.0425	r	183
-8	16.7	15.5124	0.0462	0.0425	a	35
-8.1401	15.744	15.7386	0.0432	0.0432	r	168
-8.5	17.7	16.3134	0.0494	0.045	a	35
-8.66	16.62	16.5660	0.0460	0.0458	r	24
-8.7269	16.660	16.6712	0.0461	0.0461	r	168
-8.88	17.03	16.9106	0.0473	0.0469	r	143
-8.91	16.62	16.9573	0.0460	0.0470	t	24
-9.00	17.06	17.09	0.0474	0.0475	r	183
-9	19.3	17.0971	0.0546	0.0475	a	35
-9.0	19.9	17.0971	0.0566	0.0475	a	172
-9.20	17.03	17.4059	0.0473	0.0485	t	143
-9.48	17.85	17.8337	0.0499	0.0498	r	103
-9.5	18.0	17.8641	0.0504	0.0499	r	127
-9.6	18.00	18.0155	0.0504	0.0504	r	146
-9.7	17.51	18.1663	0.0488	0.0509	a	9
-9.7	17.51	18.1663	0.0488	0.0509	a	9
-9.77	18.30	18.2715	0.0513	0.0513	r	143
-9.8	18.23	18.3165	0.0511	0.0514	r	144
-9.8	18.30	18.3165	0.0513	0.0514	r	143
-9.8	18.55	18.3165	0.0520	0.0514	t	167
-9.80	18.94	18.3165	0.0534	0.0514	a	143
-9.800	20.00	18.3165	0.0570	0.0514	a	143
-9.84	18.49	18.3764	0.0520	0.0515	r	67
-9.8658	18.398	18.4149	0.0517	0.0517	r	168
-10.00	18.59	18.61	0.0523	0.0524	r	183
-10	19.0	18.6149	0.0536	0.0524	t	133
-10.04	18.86	18.6743	0.0532	0.0526	t	24
-10.17	18.94	18.8666	0.0534	0.0532	r	143
-10.2	18.90	18.9108	0.0533	0.0533	r	146
-10.34	19.22	19.1165	0.0544	0.0540	r	67
-10.31	19.49	19.1458	0.0553	0.0541	t	103
-10.4	19.80	19.2043	0.0563	0.0543	a	130
-10.46	19.45	19.2919	0.0551	0.0546	r	24
-10.50	19.29	19.35	0.0546	0.0548	r	183
-10.6	19.60	19.4954	0.0556	0.0553	r	153

(continued)

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I) 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. August, 1990

CRITICAL EVALUATION (continued)

Table 3 (continued)

Solubility of ice in aqueous solutions of KCl

T/K -273.15	mass % $100w_1$ exp	mass % $100w_1$ calc	mole fraction x_1 exp	mole fraction x_1 calc	status	ref
-10.6	19.70	19.4954	0.0560	0.0553	t	146
-10.6	20.09	"	0.0573	"	a	130
-10.64	19.58	19.5553	0.0556	0.0555	r	19
-10.64	19.58	19.5553	0.0556	0.0555	r	78
-10.66	19.74	19.5822	0.0561	0.0556	r	67
-10.69	19.55	19.62	0.0555	0.0557	r	183
-10.7	19.54	19.6400	0.0554	0.0558	r	111
-10.7	19.80	19.6400	0.0563	0.0558	r	153
-10.75	19.48	19.7180	0.0552	0.0560	t	144
-10.75	19.76	19.7209	0.0561	0.0560	r	24
-10.8	19.65	19.7840	0.0558	0.0562	r	167
-10.8	19.87	19.7840	0.0565	0.0562	r	146
-10.8	19.95	19.7840	0.0568	0.0565	r	27
-11.1	19.74	19.2126	0.0561	0.0577	t	28
-11.5	20.31	20.7760	0.0580	0.0596	t	9

$$e = 100|x_1(exp) - x_1(calc)|/x_1(calc)$$

Values are: recommended if $e \leq 1$
tentative if $1 < e \leq 3$
aberrant if $3 < e$

5.3 Vapor Pressures of Saturated Solutions

Measurements are less numerous at atmospheric pressure or below. Foote *et al.* (112) proposed a relation applicable between 0 and 30°C:

$$\log(p/\text{mmHg}) = -\ 2995.5\ \text{K}/T - 6.680\log(T/\text{K}) + 0.001024\ T/\text{K} + 27.500$$

Leopold and Johnston (90) measured the vapor pressure of the saturated solution between 21, 42 and 44.03°C. Brønsted (54) gives $p = 567.8$ mmHg at 100°C. Limited data are given in the vicinity of atmospheric pressure (12, 32, 102). Above atmospheric pressure, three series of measurements have been carried out. The three-phase (S-L-G) pressures at 374, 400, 500, 600 and 700°C have been determined by Morey and Chen (150) and by Ravitsch (155), and at 11 temperatures by Hovey *et al.* (185).

The vapor pressures of saturated solutions were calculated within the whole range of crystallization of KCl from the formula in the Preface:

$$\ln(p/\text{atm}) = \ln[(1 - x_1)/(1 + x_1)] + a/T + b\ln T + cT + d$$

where x_1 and T are the calculated coordinates of a point on the solubility curve; the adjustable coefficients a, b, c and d were calculated by the least squares methods, imposing three constraints on the curve $p = f(T)$:

(continued)

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I) 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. August, 1990

CRITICAL EVALUATION (continued)

1. that it pass through the points: p = 1 atm, t = 108.599°C (46) and p = 0.0214 atm, t = 21.42°C (90).
2. that the vapor pressure is negligible at the melting point of the pure salt.

The coefficients have the following values:

$a = -6065.708$ K, $b = -2.800623$, $c = -0.000398713$ K^{-1}, $d = 32.93983$.

The critical evaluation of the data of the bibliography is given in Table 4. The results are expressed in atmospheres in order to permit a comparison with the units used by most authors. The pressure for rounded values of temperature (Table 7) is, however, expressed in bars. Note that the measurements of Froelich (102) are systematically aberrant.

Table 4

Vapor pressure of saturated solutions of KCl

T/K -273.15	100w_1 (calc)	x_1 (calc)	pressure p/atm obs	pressure p/atm calc	status	ref
21.42	25.64	0.0769	0.0214	0.0214	r	90
25.62	25.68	0.0771	0.0273	0.0274	r	90
27.56	26.65	0.0807	0.0306	0.0304	r	90
33.64	27.64	0.0846	0.0427	0.0424	r	90
39.31	28.50	0.0878	0.0517	0.0572	a	90
44.03	29.20	0.0906	0.0732	0.0726	r	90
100	36.10	0.1201	0.7471	0.7475	r	54
108.599	36.94	0.1240	1.00	1.00	r	46
130	38.97	0.1337	1.0	1.94	a	102
130	38.97	0.1337	1.2	1.94	a	102
131	39.06	0.1341	1.3	2.00	a	102
133	39.24	0.1350	1.3	2.11	a	102
150	40.74	0.1424	1.7	3.36	a	102
178	43.09	0.1547	6.9	6.59	a	102
180	43.25	0.1555	7.2	6.89	a	102
190	44.07	0.1599	8.58	8.55	r	134
213	45.93	0.1703	14.5	13.45	a	134
237.2	47.91	0.1818	19.45	20.51	a	134
237.6	47.94	0.1820	19.81	20.65	a	134
250	48.97	0.1882	24.42	25.13	t	129
250	48.97	0.1882	24.42	25.13	t	134
269.2	50.58	0.1983	32.33	33.28	t	134
298	53.08	0.2147	47.8	48.35	t	134
298.1	53.08	0.2147	48.26	48.41	r	134
300	53.25	0.2159	48.65	49.52	t	129
330	55.98	0.2350	68.4	68.96	r	134
347.5	57.59	0.2471	81.0	81.81	r	185
349.4	57.80	0.2487	82.8	83.22	r	134
350	57.86	0.2491	83.07	83.68	r	129
350	57.86	0.2491	82.96	83.68	r	129

(continued)

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I) 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. August, 1990

CRITICAL EVALUATION (continued)

Table 4 (continued)

Vapor pressure of saturated solutions of KCl

T/K -273.15	$100w_1$ (calc)	x_1 (calc)	pressure p/atm obs	calc	status	ref
371	59.89	0.2652	100.5	100.36	r	134
372.5	60.04	0.2664	101.8	101.59	r	134
375	60.29	0.2684	102.2	103.65	t	134
377.5	60.50	0.2702	105.7	105.79	r	185
397.3	62.52	0.2873	121.8	122.46	r	134
398.5	62.61	0.2881	123.9	123.56	r	185
398.8	62.64	0.2883	124.1	123.82	r	185
399.7	62.73	0.2891	124.8	124.59	r	185
400	62.79	0.2897	125.59	124.77	r	129
419.1	64.72	0.3072	142.0	141.28	t	185
427.2	65.60	0.3155	151	148.11	t	134
428.6	65.74	0.3169	150.7	149.30	r	134
439.4	66.85	0.3276	159.6	158.51	r	185
439.5	66.89	0.3281	160.4	158.47	t	134
450	68.00	0.3394	168.84	167.11	t	129
457.2	68.77	0.3473	187	172.87	a	134
458.3	68.86	0.3482	175.2	173.89	r	185
459.8	69.02	0.3499	176.1	175.07	r	185
472	70.37	0.3645	185	184.19	r	134
480.1	71.20	0.3740	190.9	190.21	r	185
480.4	71.27	0.3748	190.7	190.23	r	134
485.8	71.86	0.3616	194.0	193.96	r	134
493.8	72.72	0.3919	200.1	199.19	r	134
497.2	73.10	0.3963	202	201.30	r	134
498.7	73.22	0.3979	202.4	202.44	r	185
500	73.40	0.4001	204.86	203.00	r	129
516.1	75.15	0.4223	214	211.78	t	134
526.4	75.28	0.4373	218.5	216.35	r	134
529.7	76.64	0.4422	217.1	217.78	r	134
538.9	77.64	0.4563	218	221.02	t	134
548.7	78.71	0.4718	218	218.67	t	134
550	78.85	0.4733	223.74	227.27	t	129
550	78.85	0.4733	223.75	227.27	t	129
584.5	82.57	0.5337	220	225.56	t	134
600	84.21	0.5337	220	222.25	t	129
645	88.85	0.6581	197	196.68	r	134

$e = |p(\text{exp}) - p(\text{calc})|/p(\text{calc})$ r = recommended value $e < 0.01$

t = tentative value $0.01 < e < 0.03$ a = aberrant value $0.03 < e$

5.4 Composition of the Vapor in Three-Phase S-L-G Equilibria

Only one paper (185) gives data for the composition of the vapor in equilibrium with saturated KCl solutions, and these compositions are given at only three temperatures. The details can be found on the compilation sheet.

(continued)

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I) 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. August, 1990

CRITICAL EVALUATION (continued)

5.5 Influence of Pressure on the Solubility of Ice

The measurements of Denecke (69) show that above 2800 kg/cm^2 (2746 bar) one can observe ice III' in equilibrium with KCl.

5.6 Density of Saturated Solutions

In the bibliography are found eight numerical values for the solubility curve of the ice: $d = a_1 + b_1x_1 + c_1x_1^2 + d_1x_1^3$, and 74 for the liquidus of KCl up to 600°C. The densities are expressed, following the authors' usage, as relative densities or as absolute densities, but the units employed are not always clearly defined. We have therefore systematically given the absolute densities g cm^{-3}. No appreciable error results from this in the precision of the results.

The critical evaluation of the densities has been carried out using a polynomial regression. The values of Akhumov and Vassiliev, manifestly erroneous, have not been included in the calculations, for they differ by more than 10% from the average values.

The constants a_1, b_1, c_1 and d_1 and the calculated densities are given in Tables 5 and 6.

Table 5

Coefficients of fitting equations for density of saturated solutions

a_1	b_1	c_1	d_1	solid phases	range/°C
1	2.616686	-1.989976	0	ice	273-258
1.08274	1.52079	-4.26983	4.13685	KCl	258-873

Table 6

Densities of saturated solutions
Binary system KCl-H_2O

T/K -273.5	x_1(calc)	density, d/g cm^{-3} exp	calc	status	ref
-0.384	0.0020	1.007	1.00523	r	24
-0.827	0.0044	1.011	1.01147	r	24
-1.389	0.0075	1.019	1.01951	r	24
-1.409	0.0076	1.019	1.01977	r	24
-2.721	0.0148	1.038	1.03829	r	24
-3.437	0.0187	1.048	1.04824	r	24
-4.696	0.0254	1.066	1.06518	r	24
-4.835	0.0261	1.065	1.06694	r	24
-6.37	0.0342	1.088	1.08716	r	24
-7.34	0.0391	1.100	1.09927	r	24

(continued)

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I) 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. August, 1990

CRITICAL EVALUATION (continued)

Table 6 (continued)

Densities of saturated solutions
Binary system $KCl-H_2O$

T/K -273.5	x_1(calc)	density, d/g cm^{-3} exp	calc	status	ref
-8.66	0.0458	1.118	1.11567	r	24
-8.91	0.0470	1.118	1.11859	r	24
-9.8	0.0513	1.128	1.290	r	145
-10.04	0.0526	1.136	1.13213	r	24
-10.04	0.0526	1.134	1.13213	r	24
-10.46	0.0546	1.141	1.13694	r	24
-10.75	0.0560	1.135	1.14029	r	145
-10.75	0.0560	1.143	1.14029	r	24
-9.8	0.0564	1.1405	1.1557	t	145
0	0.0630	1.1528	1.1626	r	156
0	0.0630	1.154	1.1626	r	111
0	0.0630	1.1642	1.1626	r	119
0.70	0.0634	1.1540	1.1630	r	32
5	0.0663	1.155	1.1660	r	109
10	0.0696	1.1646	1.1693	r	145
10	0.0696	1.174	1.1693	r	111
15	0.0728	1.0055	1.1724	a	96
15	0.0728	1.180949	1.1724	r	2
15	0.0663	1.20433	1.1660	t	4
15.6	0.0732	1.17172	1.1728	r	11
15.6	0.0732	1.17145	1.1728	r	11
15.6	0.0732	1.17194	1.1728	r	11
15.6	0.0732	1.17171	1.1728	r	11
17.5	0.0744	1.1729	1.1740	r	5
17.5	0.0744	1.1730	1.1740	r	20
18.5	0.0751	1.1738	1.1746	r	88
19.55	0.0757	1.1738	1.1752	r	32
20	0.0760	1.176	1.1755	r	60
20	0.0760	1.0045	1.1755	a	96
20	0.0760	1.1735	1.1755	r	137
23.4	0.0782	1.1798	1.1775	r	37
25	0.0792	1.179	1.1785	r	85
25	0.0792	1.1786	1.1785	r	94
25	0.0792	1.17813	1.1785	r	99
25	0.0792	1.0033	1.1785	a	96
25	0.0792	1.179	1.1785	r	85
25	"	1.179	"	r	109
25	"	1.1775	1.1785	r	119
25	"	1.1803	1.1785	r	156
25	"	1.1775	1.1785	r	162
25	0.0792	1.192	1.1785	t	163
30	0.0822	1.1815	1.1812	r	145
30	"	1.186	1.1812	r	60
30	"	1.1821	1.1812	r	137
32.80	0.0840	1.1839	1.1828	r	32

(continued)

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I) 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. August, 1990

CRITICAL EVALUATION (continued)

Table 6 (continued)

Densities of saturated solutions
Binary system $KCl-H_2O$

T/K -273.5	x_1(calc)	density, d/g cm^{-3} exp	calc	status	ref
40	0.0883	1.189	1.1866	r	111
40	"	1.194	1.1866	r	60
45	0.0912	1.1956	1.1891	r	119
50	0.0940	1.193	1.1914	r	145
50	"	1.1920	1.1914	r	156
50	0.0940	1.194	"	r	85
50.21	0.0941	1.1930	1.1915	r	107
56	0.0974	1.196	1.1942	r	70
59.85	0.0996	1.1980	1.1959	r	32
60	0.0996	1.199	1.1959	r	111
65	0.1023	1.209	1.1981	r	119
67.91	0.1038	1.2006	1.1992	r	107
70	0.1050	1.201	1.2001	r	145
74.80	0.1075	1.2032	1.2020	r	32
75	0.1076	1.203	1.2021	r	85
80	0.1102	1.194	1.2040	r	70
80	"	1.205	1.2040	r	111
89.45	0.1149	1.2069	1.2074	r	32
90	0.1151	1.2184	1.2075	r	119
91	0.1156	1.222	1.2079	t	60
92.23	0.1162	1.2076	1.2083	r	107
100	0.1200	1.211	1.2109	r	85
100	"	1.211	1.2109	r	145
100	"	1.215	1.2109	r	110
100	"	1.209	1.2109	r	111
108.0	0.1232	1.2118	1.2130	r	32
108.5	0.1239	1.209	1.2135	r	111
130	0.1337	1.235	1.2196	t	110
150	0.1425	1.254	1.2247	a	110
170	0.1512	1.276	1.2294	a	110
200	0.1644	1.317	1.2357	a	110
250	0.1882	1.224	1.2453	t	129
300	0.2159	1.230	1.2537	t	129
350	0.2491	1.242	1.2606	t	129
400	0.2897	1.255	1.2655	r	129
450	0.3394	1.272	1.2688	r	129
500	0.4001	1.295	1.2727	t	129
550	0.4734	1.319	1.2847	a	129

$e = |d(\mathrm{exp}) - d(\mathrm{calc})|/d(\mathrm{calc})$ r = recommended value $e \leq 0.01$

t = tentative value $0.01 < e \leq 0.02$ a = aberrant value $0.02 < e$

SOLUBILITY, VAPOR PRESSURE, DENSITY, and ACTIVITY COEFFICIENT OF WATER FOR ROUNDED VALUES OF TEMPERATURE

These values are given in Table 7, and in the Figures.

(continued)

COMPONENTS

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

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CRITICAL EVALUATION (continued)

Table 7

Solubility, Density, Vapor Pressure and Activity of Water in Saturated Solutions for Rounded Values of Temperature for the System $KCl-H_2O$

T/K -273.15	$100w_1$	x_1	$\ln f_2$	$d/g\ cm^{-3}$	p/bar	solid phase
-0.5	1.08	0.0026	0.00042	1.0069		ice
-1	2.18	0.0053	0.00100	1.0139		"
-1.5	3.26	0.0081	0.00162	1.0212		"
-2	4.33	0.0108	0.00225	1.0281		"
-2.5	5.38	0.0136	0.00287	1.0351		"
-3	6.41	0.0163	0.00347	1.0421		"
-3.5	7.42	0.0190	0.00403	1.0490		"
-4	8.41	0.0217	0.00455	1.0558		"
-4.5	9.37	0.0244	0.00503	1.0626		ice
-5	10.31	0.0270	0.00547	1.0692		"
-6	12.12	0.0323	0.00621	1.0823		"
-7	13.86	0.0374	0.00678	1.0951		"
-8	15.51	0.0424	0.00717	1.1076		"
-9	17.10	0.0475	0.00739	1.1197		"
-10	18.61	0.0524	0.00744	1.1316		"
-10	19.77	0.0562		1.1555	0.0027	KCl
0	21.75	0.0629		1.1626	0.0055	"
10	23.62	0.0695		1.1692	0.0107	"
20	25.39	0.0760		1.1754	0.0199	"
30	27.04	0.0822		1.1812	0.0353	"
40	28.59	0.0882		1.1865	0.0600	"
50	30.04	0.0940		1.1914	0.0985	"
60	31.40	0.0996		1.1959	0.1565	"
70	32.67	0.1049		1.2001	0.2413	"
80	33.86	0.1101		1.2039	0.3621	"
90	34.98	0.1151		1.2075	0.5299	"
100	36.05	0.1199		1.2108	0.758	"
120	38.03	0.1291		1.2168	1.457	"
140	39.85	0.1380		1.2222	2.608	"
160	41.56	0.1467		1.2270	4.385	"
180	43.23	0.1554		1.2315	6.987	"
200	44.86	0.1643		1.2357	10.62	"
220	46.48	0.1735		1.2397	15.48	"
240	48.12	0.1831		1.2434	21.76	"
260	49.78	0.1932		1.2470	29.58	"
280	51.48	0.2041		1.2504	39.06	"
300	53.23	0.2157		1.2536	50.19	"
350	57.83	0.2489		1.2605	84.8	"
400	62.76	0.2894		1.2655	126.5	"
450	67.97	0.3390		1.2688	169.5	"
500	73.36	0.3996		1.2726	205.9	"
550	78.81	0.4733		1.2847	227.3	"
600	84.17	0.5624		1.3234	225.7	"
650	89.30	0.6685		1.4271	195.6	"
700	94.06	0.7928		1.6661	134.8	"
750	98.33	0.9343		2.1504	45.8	"

(continued)

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I) 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. August, 1990

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(continued)

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I) 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. August, 1990

CRITICAL EVALUATION (continued)

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(continued)

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I) 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. August, 1990

CRITICAL EVALUATION (continued)

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(continued)

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I) 69622 Villeurbanne, France. J.W. Lorimer The University of Western Ontario, London, Ontario N6A 5B7, Canada. August, 1990

CRITICAL EVALUATION (continued)

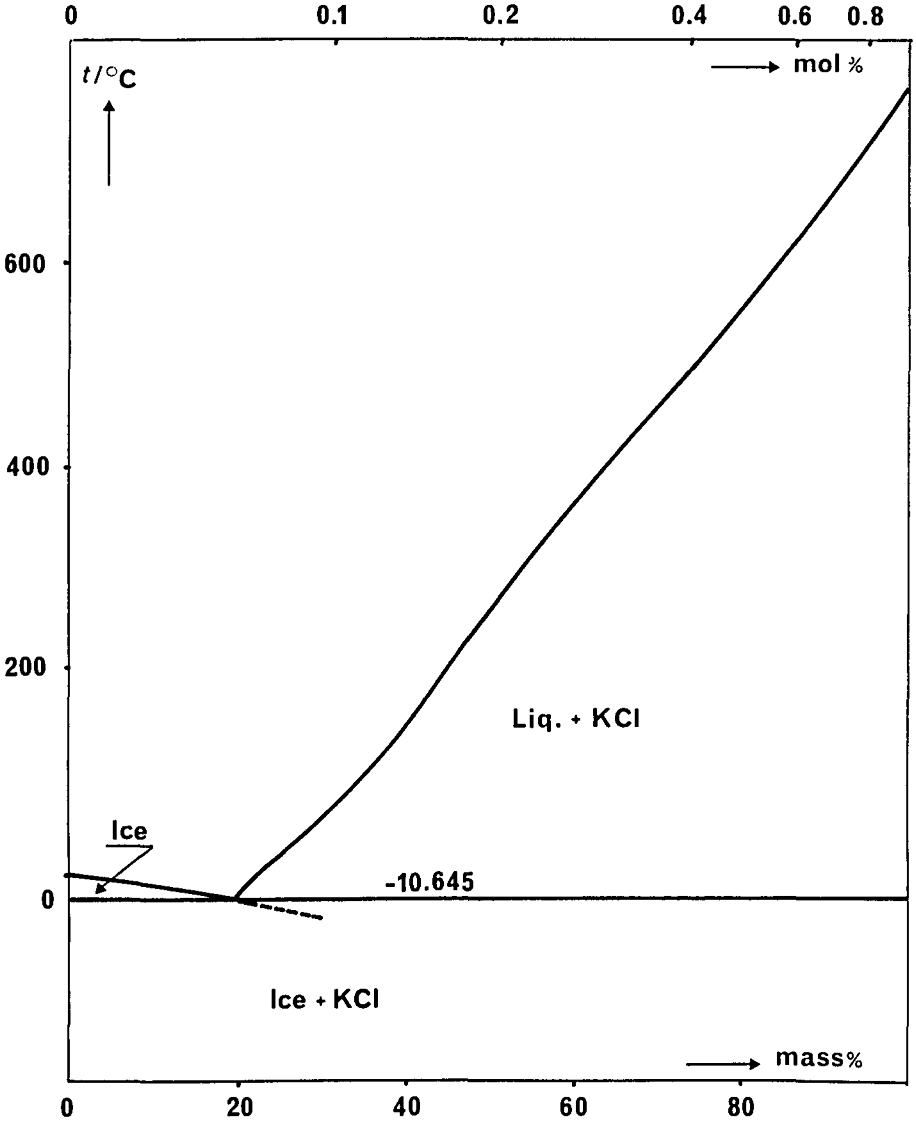

Fig. 1. Temperature-composition phase diagram for the binary system $KCl-H_2O$ under the vapor pressure of the saturated solution.

(continued)

COMPONENTS

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

EVALUATOR:

R. Cohen-Adad; P. Vallée
Université Claude Bernard (Lyon I)
69622 Villeurbanne, France.
J.W. Lorimer
The University of Western Ontario,
London, Ontario N6A 5B7, Canada.

August, 1990

CRITICAL EVALUATION (continued)

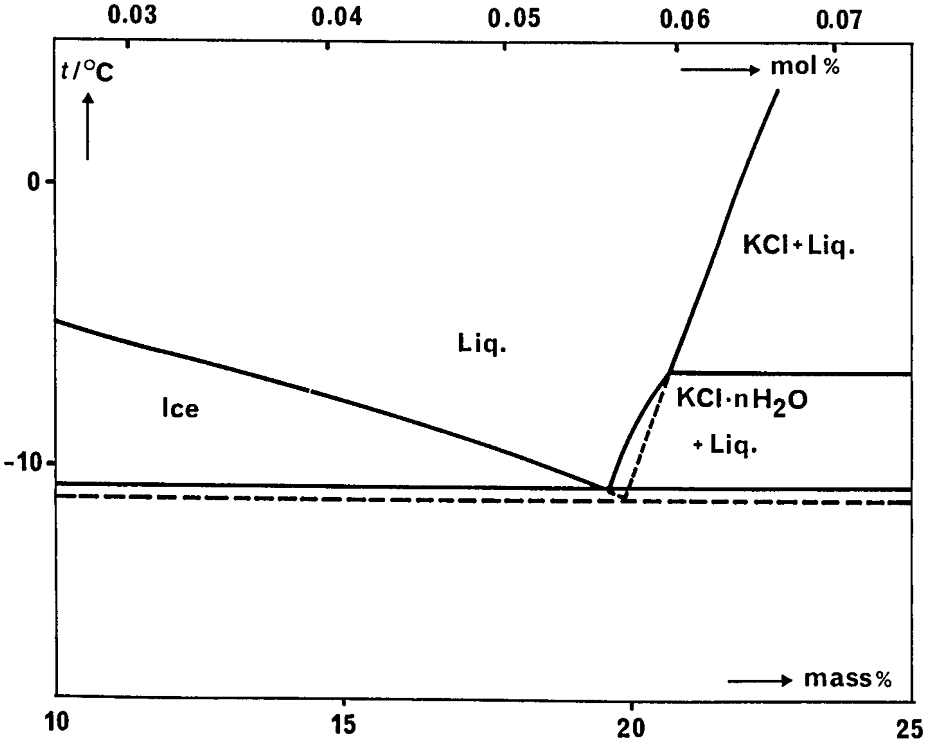

Fig. 2. Temperature-composition phase diagram for the binary system $KCl-H_2O$ at p = 1 bar in the vicinity of the eutectic.

(continued)

COMPONENTS

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

EVALUATOR:

R. Cohen-Adad; P. Vallée
Université Claude Bernard (Lyon I)
69622 Villeurbanne, France.
J.W. Lorimer
The University of Western Ontario,
London, Ontario N6A 5B7, Canada.

August, 1990

CRITICAL EVALUATION (continued)

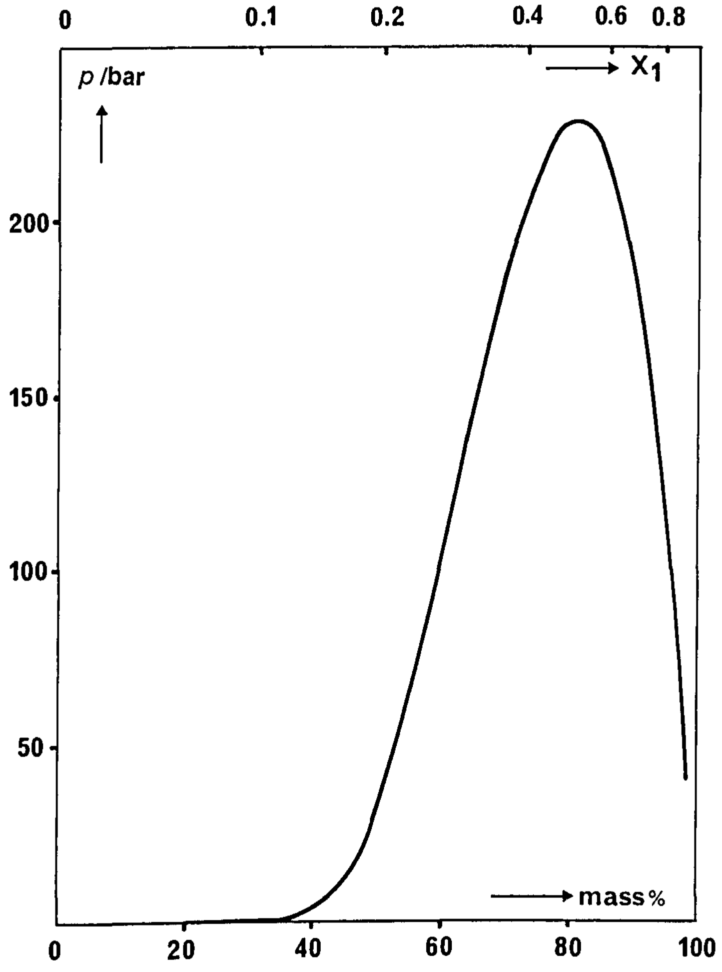

Fig. 3. Vapor pressure-temperature curve for three-phase solid-liquid-vapor equilibria in the binary system KCl-H_2O.

(continued)

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Gay-Lussac, M.

Ann. Chim. Phys. 1819, *11*, 296-315.

VARIABLES:

$T/K = 273-383$

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

$t/°C$	100 x mass ratio KCl/H_2O	mass % (compiler)	solid phase
0.00	29.21	22.61	KCl
19.35	34.53	25.67	"
52.39	43.59	30.36	"
79.58	50.93	33.74	"
109.60	59.26	37.21	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method. A sample of saturated solution was analyzed to dryness.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Michel, A.; Krafft, L.

Ann. Chim. Phys. [3] 1854, *41*, 471-83.

VARIABLES:

T/K = 288

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	concentration g dm^{-3}	mass %	relative density at 15°C	solid phase
15	308.794	26.15	1.180949	KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Mixtures of water and salt in excess were maintained for 1 month in the range 14-16°C and stirred often. After 1 day at 15°C, samples of solution were drawn off and analyzed by evaporation to dryness and weighing.

SOURCE AND PURITY OF MATERIALS:

The pure salt was previously dried at 100°C.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Schiff, H.

Justus Liebigs Ann. Chem. 1859, *109*, 325-32.

VARIABLES:

T/K = 291

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass % KCl	100 x mass ratio KCl/H_2O	relative density	solid phase
17.5	24.8	33.0	1.1729	KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The variation of volume during the dissolution of salt was calculated. The method is described in (1).

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Schiff, H. *Justus Liebigs Ann. Chem.* 1858, *108*, 326.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	Kremers, P. *Ann. Phys. Chem.* 1856, *99*, 25-63.
VARIABLES:	**PREPARED BY:**
$T/K = 273-383$	M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	100 mass H_2O/mol KCl[a]	mass % (compiler)	solid phase
0	2.56	22.6	KCl
20	2.15	25.8	"
40	1.86	28.6	"
60	1.64	31.3	"
80	1.46	33.8	"
100	1.32	36.1	"
110[b]			"

---

[a] Atomic weights K = 39.2, Cl = 35.5 according to the author.

[b] Boiling point of saturated solution

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

After complete dissolution at higher temperature, the mixture was stirred for 1 hour at the desired temperature. Then the saturated solution was drawn off but not filtered because of its viscosity. At 95, 140 and 160°C, the composition was determined by evaporation and weighing.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	Gerlach, Th. G. *Spezifische Gewichte der Gebrauchlichsten Salzlosungen bei verschidenen Concentrationsgraden.* J.G. Engelhardt. Freiberg. 1859. pp. 9-10.
VARIABLES:	**PREPARED BY:**
$T/K = 288$	J.W. Lorimer

EXPERIMENTAL VALUES:

$t = 15°C$

mass %	relative density, $d_r = d(15°C)/d(H_2O, 15°C)$	solid phase
5	1.03250	
10	1.06580	
15	1.10036	
20	1.13608	
satd sln	1.20433	KCl

COMMENTS AND ADDITIONAL DATA:

The author found the solubility from graphical interpolation. The compiler found that the density could be represented by the equation $(d_r - 1)/100w_1 = A_1 + A_2(100w_1) + A_2(100w_1)^2$ where w_1 is the mass fraction of the salt, with least-square coefficients:

$A_1 = 6.43 \times 10^{-3}$ $s(A_1) = 1.8 \times 10^{-5}$
$A_2 = 1.22 \times 10^{-5}$ $s(A_2) = 3.3 \times 10^{-6}$
$A_3 = 3.30 \times 10^{-7}$ $s(A_3) = 1.3 \times 10^{-7}$

and standard error of estimate 6.5×10^{-6}. Solution of this equation gave the solubility as: 24.85 mass %.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE	SOURCE AND PURITY OF MATERIALS:
Solutions were made up by mass, using calibrated weights and vacuum corrections. Densities were measured by hydrostatic weighing, using a glass sinker attached to a balance. The method of saturation is not given.	KCl: pure, decrepitated salt.
	ESTIMATED ERROR:
	Temperature: precision ±0.1 K Solubility: no estimates possible.
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	Rüdorff, F. *Ann. Phys. Chem.* 1861, *114*, 63-81.
VARIABLES:	PREPARED BY:
T/K = 268-273	M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass ratio KCl/H_2O	mass %	solid phase
-0.45	0.01	0.99	ice
-0.9	0.02	1.96	"
-1.8	0.04	3.85	"
-2.65	0.06	5.66	"
-3.55	0.08	7.41	"
-4.4	0.10	9.09	"
-5.35	0.12	10.71	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE	SOURCE AND PURITY OF MATERIALS:
The freezing points of solutions of known composition were measured.	Pure salt wass recrystallized several times.
	ESTIMATED ERROR:
	Temperature: 0.1 K
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	Mulder, G.J. *Scheikundige Verhandelingen en Onderzoeken. Part 3, vol. 3. Bijdragen tot de Geschiedenis van het Scheikundig Gebonden Water.* H.A. Kramers. Rotterdam. 1864. pp. 51-6.
VARIABLES:	PREPARED BY:
$T/K = 273\text{-}318$	J.W. Lorimer

EXPERIMENTAL VALUES:

$t/°C$	100x mass ratio KCl/H_2O	mass %	solid phase
0	28.5 28.5	22.2	KCl
4.25	29.5	22.8	"
16.5	33.7	25.2	"
25	35.9	26.4	"
29.75	37.5	27.3	"
45	41.8	29.5	"
107.65	58.5 (boiling point)	36.9	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The method of isothermal saturation was used. Ice baths, cool cellars and heated water baths were used to control temperature. mixtures of salt and water were shaken for at least 7 d. The saturated solution was weighed and evaporated, and the residue was dried at 160°C, then weighed.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

Temperature: ±0.1 K at 0°C, ±1 K at other temperatures.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Gerardin, A.

Ann. Chim. Phys. 1865, 5, 129-60.

VARIABLES:

$T/K = 286-330$

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass ratio KCl/H_2O	mass % (compiler)	solid phase
13	0.336	25.1	KCl
30	0.378	27.4	"
40	0.401	28.6	"
57	0.450	31.0	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method. A sample of saturated solution was analyzed for salt by evaporation to dryness.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

de Coppet, L.C.

Ann. Chim. Phys. [4] 1872, *25*, 502-27; *Bull. Soc. Vaudoise Sci. Nat.* 1871, *11*, 7-126.

VARIABLES:

T/K = 262-270

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio KCl/H_2O	mass % (compiler)	solid phase
- 2.85	6.37	5.99	ice
- 2.9	6.37	5.99	"
- 4.8	10.6	9.58	"
- 5.85	12.74	11.30	"
- 7.75	16.94	14.49	"
- 9.7	21.23	17.51	"
- 9.7	21.23	17.51	"
-11.5[a]	25.48	20.31	"

---

[a] metastable equilibrium

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The method was described in a previous paper (1). A sample of known composition was cooled in a mixture of ice and NaCl (or $CaCl_2$) maintained at a few kelvins below the freezing point. A small piece of ice was added to the sample when its temperature was lower than the freezing point by some tenths of a degree.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

1. de Coppet, L.C. *Ann. Chim. Phys.* 1871, *23*, 366.

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Page, D.; Keightley, A.D.

J. Chem. Soc. 1872, *25*, 566-70.

VARIABLES:

T/K = 289

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio KCl/H_2O	mass %	density	method	solid phase
15.6	32.88	24.74	1.17172, 1.17145	a	KCl
15.6	33.06	24.84	1.17194, 1.17171	b	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Isothermal method. Solutions were prepared in 2 different ways: (a) digestion of the salt in distilled water at a constantly maintained temperature of 15.6°C; (b) saturation of distilled water with the salt at 100°C and subsequent cooling to 15.6°C.

SOURCE AND PURITY OF MATERIALS:

Chemically pure salt was used.

ESTIMATED ERROR:

Temperature: precision within ±0.1 K.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Raoult, F.M.

C. R. Hebd. Séances Acad. Sc. 1878, *87*, 167-9.

VARIABLES:

T/K = 273

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass ratio	mass % (compiler)	solid phase
-0.201	0.0045	0.448	ice

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Cryoscopic method.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

de Coppet, L.C.

Ann. Chim. Phys. 1883, *30*, 411-29.

VARIABLES:

T/K = 262-365

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio KCl/H_2O	mass % (compiler)	solid phase
-11.0[a]	24.48	19.66	KCl
-11.0[a]	24.44	19.64	"
-6.4[b]	25.78	20.50	"
0.0	27.94	21.84	"
0.0	27.85	21.78	"
3.9	29.37	22.70	"
9.4	30.84	23.57	"
11.4	32.12	24.35	"
14.95[b]	32.66	24.62	"
19.0 [b]	34.32	25.55	"
25.7	36.10	26.52	"
29.25	37.31	27.17	"
38.0	39.71	28.42	"
41.45	40.67	28.91	"
46.15	42.34	29.75	"
48.8	42.86	30.00	"
55.1	44.51	30.80	"
60.55	45.90	31.46	"
64.95	47.17	32.05	"
71.65	48.76	32.32	"
74.25	49.27	33.01	"
80.75	51.24	33.88	"
86.6	52.53	34.44	"
91.4	53.49	34.85	"

---

[a] freezing point of saturated solution

[b] mean of 2 observations

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Salt and water were introduced into glass test tubes. Low temperatures were obtained using different eutectic mixtures. In the other cases, the tube was placed in a thermostat. Samples were removed from the saturated solution and analyzed.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Andreae, J.L.

J. Prakt. Chem. 1884, *29*, 456-77.

VARIABLES:

T/K = 273-333

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	100 x mass % KCl/H_2O	mass %	method
0.00	27.986	21.866	b
0.05	27.988	21.868	a
5.52	29.851	22.989	b
7.00	30.314	23.262	a
10.50	31.406	23.900	a
10.62	31.454	23.928	b
14.25	32.547	24.555	b
34.42	38.525	27.811	b
59.17	45.264	31.160	a
59.92	45.473	31.259	b

a = heating

b = cooling

Solid phase: KCl throughout

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Two methods were used: (1) Heating method: the mixture of salt and water was stirred at constant temperature for 1-1.5 hours.
(2) Cooling method: the mixture was previously heated above the temperature of equilibrium. A sample of saturated solution was analyzed by evaporation to dryness and weighing.

SOURCE AND PURITY OF MATERIALS:

Commercial $KClO_3$ was recrystallized, dried and slowly decomposed in a platinum crucible. The resulting KCl was melted, recrystallized and dried.

ESTIMATED ERROR:

Temperature: ±0.1 K
Mass ratio: ±0.0003

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Tilden, W.A.; Shenstone, W.A.

Philos. Trans. R. Soc. London 1884, 175, 23-36.

VARIABLES:

T/K = 398-1007

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio KCl/H_2O	mass %	solid phase
125	59.6	36.3	KCl
133	69.3	40.9	"
144	70.8	41.5	"
175	75.2	42.9	"
180	77.5	43.7	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Water and salt were placed at one end of a tube. One type of tube consisted of two parts made of gun metal electroplated with silver. The two parts screwed together, were separated by a disk of Pt gauze, and could be turned around the longitudinal axis. The other type was of glass, either bent in the middle to an angle of 130-140°, or straight and divided in the middle by a Pt gauze strainer. After heating in a paraffin bath at a steady temperature for 5 hours, the end containing the sample was raised and the other depressed. The tube was cooled and opened. Then the saturated solution was weighed, evaporated to dryness, and weighed again. The part of the tube not occupied by solution was filled by water vapor which condensed on cooling. By ascertaining the volume of this vapor, approximate corrections to the results were made with the aid of tables of vapor pressures os salt solutions (1).

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Wüllner, A. *Ann. Phys. Chem.* 1860, *110*, 564.

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Ponsot, A.

C. R. Hebd. Séances Acad. Sci. 1889, *129*, 98-100.

VARIABLES:

T/K = 263

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
-10.64	19.58	ice + KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Saturated solution was prepared at room temperature and cooled slowly. The depression of the freezing point was measured. The temperature became constant to within 0.003 K when the eutectic was reached. The saturated solution was analyzed.

SOURCE AND PURITY OF MATERIALS:

KCl was purified by several recrystallizations.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Bodländer, G.

Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1891, 7, 358-61.

VARIABLES:

T/K = 291

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	conc. g dm^{-3}	mass % (compiler)	relative density	solid phase
17.5	293.9	25.06	1.1730	KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The mixture of water and finely powdered salt was stirred at constant temperature for at least 24 hours. A sample of saturated solution was anlyzed by evaporation to dryness and weighing.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	Etard, A. *Ann. Chim Phys.* [7] 1894, *2*, 503-74.
VARIABLES:	**PREPARED BY:**
$T/K = 415\text{-}1005$	M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase (compiler)
142	38.6	KCl
150	38.8	"
175	41.2	"
180	41.8	"
190	43.2	"
200	42.9	"
242	47.6	"
732	100	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Salt and water were placed in one end of an inverted U-tube, and the tube was sealed. After equilibration (time or method not stated) some saturated solution was transferred to the other end of the tube. The tube was cooled and opened. The temperature at which the last crystal of KCl disappeared was also observed. Analyses were for Cl by titration with $AgNO_3$ solution.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: no estimates possible.
Solubility: precision within ±0.01 mass %.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Roloff, M.

Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1895, *18*, 578-84.

VARIABLES:

T/K = 262-272

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	concentration c_1/mol dm^{-3}	mass %	density *d*/g cm^{-3}	solid phase
-0.384	0.141	0.829	1.007	ice
-0.827	0.241	1.778	1.011	"
-1.389	0.409	2.992	1.019	"
-1.409[a]	0.409	2.992	1.019	"
-2.721	0.804	5.779	1.038	"
-3.437	1.018	7.243	1.048	"
-3.437[a]	1.018	7.243	1.050	"
-4.696	1.387	9.70	1.066	"
-4.835[a]	1.387	9.70	1.065	"
-6.37	1.851	12.69	1.088	"
-7.34	2.126	14.41	1.100	"
-8.66	2.490	16.62	1.118	"
-8.91[a]	2.490	16.62	1.118	"
-10.04	2.872	18.86	1.136	"
-10.04	2.872	18.86	1.134	"
-10.46	2.975	19.45	1.141	"
-10.75[a]	3.026	19.76	1.143	"

---

[a] Individual observations; remaining values are averages of 4-5 measurements.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Solutions in stoppered flasks were vigorously shaken at constant temperatures achieved by baths containing eutectic mixtures of various salts and water. Calibrated thermometers were used. Samples were removed via a cooled calibrated pipet, weighed, and analyzed. Equilibrium was confirmed by analysis. Method of analysis not given.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature:
over 267 K: ≈ 0.01 K
under 267 K: ≈ 0.1 K

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Bruni, G.

Gazz. Chim. Ital. 1897, *27*, 537-61.

VARIABLES:

$T/K = 262$

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass ratio KCl/H_2O	mass %	solid phase
-10.8	24.9	19.95	ice + KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Cryoscopic method. To prevent supersaturation the eutectic temperature was measured on heating. A slightly hypereutectic solution maintained at the eutectic temperature was then seeded with ice and KCl, and the composition of the saturated solution was determined by analysis. Baudin's thermometers were used.

SOURCE AND PURITY OF MATERIALS:

KCl: Merck reagent (puriss. grade for analysis)

ESTIMATED ERROR:

Temperature: ±0.03 K

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

de Coppet, L.C.

Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1897, *22*, 239-40.

VARIABLES:

$T/K = 262$

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio KCl/H_2O	mass % (compiler)	solid phase
-11.1	24.6	19.74	KCl + ice

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Previously described (1).

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. de Coppet, L.C. *Bull. Soc. Vaudoise Sci. Nat.* 1871, *11*, 1.

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Raoult, F.M.

Ann. Chim. Phys. [7] 1899, *16*, 162-220.

VARIABLES:

T/K = 270-273

PREPARED BY:

J.-J. Counioux

EXPERIMENTAL VALUES:

t/°C	mass ratio KCl/H_2O	mass % (compiler)	solid phase
-0.0509	0.001080	0.1079	ice
-0.1031	0.002171	0.2166	"
-0.2026	0.00436	0.434	"
-0.4007	0.00875	0.867	"
-0.7992	0.01766	1.735	"
-1.6012	0.03590	3.466	"
-3.2864	0.07460	6.942	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Cryoscopic method. The mixture of salt and water (125 mL) was stirred slowly and cooled to 0.5 K below the freezing point. Then the temperature of the thermostat was increased to 0.1 K below the estimated freezing point. A small crystal of ice was added to the sample, and the temperature was read every 2 or 3 min. Equilibrium was reached when the temperature variations were smaller than 0.002-0.003 K over 15 min.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: precision within ± 0.001 K.

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Jones, H.C.; Getman, F.H.

Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1903, *46*, 244-86.

VARIABLES:

$T/K = 262-273$

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	concentration mol dm^{-3}	mass % (compiler[a])	solid phase
-0.685	0.2	0.0148	ice
-1.692[a]	0.5	0.0365	"
-3.400	1.0	0.0713	"
-6.944	2.0	0.1365	"
-11.062	3.0	0.1964	"

---

[a] Given erroneously as -0.692 by the authors.

COMMENTS: The compiler's calculations of mass % uses densities taken from the Critical Evaluation in this volume for solutions of KCl saturated with ice.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The freezing-point method used a Beckmann thermometer and a stirred freezing-point tube immersed in a freezing mixture. A small correction was calculated to account for ice formed on supercooling, but the authors state that this correction is approximate only, and introduces some error.

SOURCE AND PURITY OF MATERIALS:

KCl: a "fairly pure" sample was recrystallized repeatedly, then dried at 110°C for several d and stored over $CaCl_2$.
Water: redistilled, conductivity 2.0×10^{-6} S cm^{-1}.

ESTIMATED ERROR:

Temperature: precision probably within ±0.1 K (compiler).
Solubility: estimated precision ±1 %.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	Berkeley (Earl of) *Phil. Trans. R. Soc. London, A* <u>1904</u>, *203*, 189-214.
VARIABLES:	**PREPARED BY:**
$T/K = 274\text{-}381$	M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio KCl/H_2O	mass % (compiler)	relative density	solid phase
0.70	28.29	22.05	1.1540	KCl
19.55	34.37	25.58	1.1738	"
32.80	38.32	27.70	1.1839	"
59.85	45.84	31.43	1.1980	"
74.80	49.58	33.15	1.2032	"
89.45	53.38	34.80	1.2069	"
108.0 [a]	58.11	36.75	1.2118	"

---

[a] boiling point

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The salt-water mixture was stirred at the appropriate temperature and the density followed by pycnometric measurement until its value remained constant. Solubilities were determined by evaporation to dryness of the saturated solution in platinum crucibles, except at the boiling point, where evaporations were done in Jena glass bulbs. Different temperature control systems were used.

SOURCE AND PURITY OF MATERIALS:

KCl: Merck's purest grade; purity checked by chloride titration.

ESTIMATED ERROR:

Temperature: accuracy ±0.01 K referred to hydrogen scale.
Solubility: precision at least 0.16%

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Jahn, H.Z.

Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1905, *50*, 129-68.

VARIABLES:

T/K = 272-273

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase (compiler)
-0.0900	0.1884	ice
-0.0905	0.1900	"
-0.1340	0.2807	"
-0.1340	0.2813	"
-0.1760	0.3744	"
-0.1770	0.3752	"
-0.2640	0.5614	"
-0.2640	0.5625	"
-0.3465	0.7421	"
-0.3478	0.7423	"
-0.5130	1.1088	"
-0.5145	1.1114	"
-0.6795	1.4766	"
-0.6800	1.4749	"
-0.8709	1.8927	"
-0.8711	1.8924	"
-1.1292	2.4575	"
-1.1330	2.4704	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Cryoscopic method. The solution was cooled to about 1.5 K under the crystallization temperature, then seeded by a small piece of ice. Temperature was stable at less than some thousandths K for about 40 min. Solutions were analyzed for Cl by the Volhard method.

SOURCE AND PURITY OF MATERIALS:

The salt was purified from KBr by dissolution in hydrochloric acid after addition of Cl_2, followed by several recrystallizations.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Meusser, A.

Z. Anorg. Allg. Chem. 1905, 44, 79-80.

VARIABLES:

T/K = 268-292

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio KCl/H_2O	mass %	solid phase (compiler)
18.5	33.3	25.0	KCl
11.5	31.2	23.8	"
10	30.8	23.5	"
7.5	29.8	23.0	"
2.5	28.4	22.2	"
0	27.5	21.6	"
- 1	27.2	21.4	"
- 4.5	25.9	20.6	"
- 9	23.9	19.3	ice
- 8.5	21.5	17.7	"
- 8	20.0	16.7	"
- 7	17.5	14.9	"
- 6	15.7	13.6	"
- 5.5	14.3	12.5	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Thermometric method.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Buchanan, J.Y.

Am. J. Sci. 1906, *21*, 25-40.

VARIABLES:

$T/K = 297$

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	molality mol kg^{-1}	mass % a	relative density	solid phase
23.4	4.7619	26.21	1.1798	KCl

---

[a] KCl molar mass = 74.6 g mol^{-1}, according to the author.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

25 g of distilled water were weighed into a suitable vessel and the salt was gradually added until a small quantity remained undissolved. This quantity was such that a further rise in temperature of 1 K caused all salt to disappear. The salt content was determined by titration with $AgNO_3$.

SOURCE AND PURITY OF MATERIALS:

KCl: Merck's purest reagent..

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kernot, G.; D'Agostino, E.; Pellegrino, M.

Gazz. Chim. Ital. 1906, *38*, 532-54.

VARIABLES:

$T/K = 323$

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
50	42.7800	KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method. KCl in saturated solution was determined by evaporation to dryness at 150°C.

SOURCE AND PURITY OF MATERIALS:

KCl: from neutralization of KOH by a solution of HCl (puriss. grade); product recrystallized several times. Distilled water prepared by method of Hulett.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Armstrong, H.E.; Eyre, J.V.

Proc. R. Soc. London, A 1910-11, *84*, 123-36.

VARIABLES:

T/K = 273, 298

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio KCl/H_2O		mass % (compiler)		solid phase
	A	B	A	B	
0	28.355		22.09		KCl
25	36.43	36.40	26.70	26.69	"
25	36.44	36.37	26.71	26.67	"

The values given in columns A and B represent results obtained with two samples. B was withdrawn one hour after A.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method was described in a previous communication (1). At 0°C the mixture was constantly stirred in a bath of crushed ice and water. The temperature was easily kept constant for several hours. For measurements at 25°C, see (1).

SOURCE AND PURITY OF MATERIALS:

"Pure" salt was recrystallized 2X.

ESTIMATED ERROR:

Mass ratio: precision about 0.1% (compiler)

REFERENCES:

1. Armstrong, H.E.; Eyre, J.V. *Proc. R. Soc. London, A* 1907, *79*, 564.

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Berkeley (Earl of); Appleby, M.P.

Proc. R. Soc. London, A 1911, *85*, 489-505.

VARIABLES:

p/mmHg: 750 - 760

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

pressure mmHg	t/°C (boiling point)	KCl concentration mol dm^{-3}	mass % (compiler)^b	solid phase
750	108.205			KCl
760	108.599^a	5.985	36.82	"

---

^{a} corrected to standard conditions ^{b} density from (1)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Described in previous paper (1).

REFERENCE:

1. Berkeley, (Earl of); *Phil. Trans. R. Soc. London, A* 1904, *203*, 189.

SOURCE AND PURITY OF MATERIALS:

Merck's "guaranteed" salt was used.

ESTIMATED ERROR:

Temperature: precision within ±0.005 K

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Rivett, A.C.D.

K. Sven. Vetenskapsakad. Medd., Nobel-inst. 1911, *2*(9), 1-32.

VARIABLES:

$T/K = 270\text{-}273$

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
-0.482	1.057	ice
-1.004	2.210	"
-1.474	3.217	"
-1.972	4.271	"
-2.475	5.328	"
-2.955	6.336	"
-3.461	7.358	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The mixture was supercooled in a bath 4 K below the freezing point until a large quantity of ice separated out, which was thawed until only a very small amount remained. The solution was placed in an air jacket and stirred until the temperature was stationary. Supercooling for 1 or 2 hundredths K was allowed and hand stirring continued until the temperature rose to its maximum.

SOURCE AND PURITY OF MATERIALS:

Salt from Kemista Fabriken Ion.

ESTIMATED ERROR:

Temperature (mean of 5 readings): ±0.003 K

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	Brönsted, J.N. *Z. Phys. Chem., Stoechiom. Verwandtschaftsl.* 1913, *82*, 632-40.
VARIABLES:	**PREPARED BY:**
$T/K = 373$	M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

$t/°C$	mass ratio KCl/H_2O	mass % (compiler)	vapor pressure /mm Hg	solid phase
100	0.5605	35.92	567.8	KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Saturated solution was obtained by agitating an excess of salt with water. Solubility was calculated from the relation:

$$r = (m_1 - r_1)m_2$$

r = mole ratio
m_1 = mass of salt
r_1 = mass of residue
m_2 = mass of water

SOURCE AND PURITY OF MATERIALS:

Purest salt of Kahlbaum.

ESTIMATED ERROR:

Temperature: ±0.01 K

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Cornec, E.

Ann. Chim. Phys. 1913, *29*, 491-529.

VARIABLES:

T/K = 271-273

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass ratio KCl/H_2O	mass %	solid phase
-0.169	0.003538	0.3526	ice
-0.260	0.005515	0.5485	"
-0.454	0.009869	0.9773	"
-0.892	0.019618	1.9241	"
-1.760	0.039603	3.9226	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Raoult's cryoscopic method (1). The test tube containing about 100 cm^3 of the sample was cooled in a bath of carbon disulfide maintained at 2 or 3 K below the freezing point. The temperature was read on Baudin thermometers graduated in 0.02 K or Beckmann thermometers (0.01 K). The supercooling observed was about 0.3 to 0.4 K.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: about ±0.005 K

REFERENCES:

1. Raoult, F.M. *Ann. Chim. Phys.* 1899, *16*, 162.

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Grünewald, W.

Zur Kenntnis der ozeanischen Salzablagerungen. Inaugural-Dissertation. Erlangen. Junge & Sohn. Erlangen. 1913.

VARIABLES:

T/K = 298

PREPARED BY:

J. W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mass sln /g	vol 0.1 mol dm^{-3} $AgNO_3/cm^3$	mass AgCl/g	mass % KCl (compiler)	stirring time/h	source of salt
25	0.3427	12.24	-	26.63	8	a
	0.1268	4.53	-	26.66	8	a
	0.11195	4.0	-	26.64	8	a
	0.84732	30.28	-	26.64	8	a
	0.84732	-	0.4335	26.61	8	a
	0.84732	30.30	-	26.66	8	a
	0.84732	30.29	-	26.65	8	a
	0.84732	-	0.2259[a]	26.66	8	a
	0.84732	-	0.2650[b]	26.76	8	a
	0.4500	16.12	-	26.71	14	b
			average	26.66	s = 0.04	

---

[a] mass KCl on drying; [b] mass $\frac{1}{2}$ K_2SO_4 after evaporating with H_2SO_4.

Solid phase: KCl throughout

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Salt and water were stirred in a flask in a thermostat. The stirrer shaft passed through a seal to minimize evaporation. Samples were removed through a cotton wool filter into a pipet warmed to the temperature of the solution, and transferred to weighing flasks. KCl was determined by titration with $AgNO_3$, gravimetrically as AgCl, by evaporation, or by evaporating with H_2SO_4 and weighing as K_2SO_4.

SOURCE AND PURITY OF MATERIALS:

a - 5x recrystallized KCl precipitated as tartrate, decomposed to carbonate, converted to chloride, 5x recrystallized, dried at 150°C, fused. Contained 47.54, 47.62 % Cl (theor. 47.56 %).

b - Kahlbaum "zur Analyse mit Garantieschein"

ESTIMATED ERROR:

Temperature: ±0.1 K (compiler)

Solubility: s = 0.04 mass %, from data.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Leather, J.W.; Mukerji, J.N.

Mem. Dep. Agri. India, Chem. Ser. 1914, *3(7)*, 177-204.

VARIABLES:

T/K = 293-364

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio KCl/H_2O	mass %	relative density
20	34.61	25.71	1.176
30	37.58	27.32	1.186
40	40.60	28.88	1.194
91	53.58	34.89	1.222

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The method has been described by Meyerhofer and Saunders (1). Water and salt were weighed in a glass tube. The mixture was first heated to a temperature above that at which equilibrium was expected. It was then stirred at a fixed temperature for about 20 hours. Samples of the clear solution were then withdrawn and analyzed.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: up to 40°C, ±0.2 K.
Relative density: at 91°C, ±0.005.

REFERENCES:

1. Meyerhofer, W.; Saunders, A.P. *Z. Phys. Chem., Stoechiom. Verwandtschaftsl.* 1899, *28*, 451.

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Reinders, W.

Z. Anorg. Allg. Chem. 1915, *93*, 202-12.

VARIABLES:

T/K = 278-373

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio KCl/H_2O	mass % (compiler)	solid phase
5	29.76	22.93	KCl
25	35.98	26.46	"
50	42.80	29.97	"
100	56.0	35.9	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Not given, but probably isothermal method with analysis of saturated solution (compiler).

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	Rodebush, W.H. *J. Am. Chem. Soc.* 1918, 40, 1204-13.
VARIABLES:	**PREPARED BY:**
T/K = 262-270	M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio KCl/H_2O	mass % (compiler)	solid phase
- 3.07	7.09	6.62	ice
- 4.66	10.77	9.72	"
- 7.51	17.38	14.81	"
- 9.84	22.69	18.49	"
-10.34	23.80	19.22	"
-10.66	24.60	19.74	ice + KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Freezing point lowerings were measured directly by means of a Cu-constantan thermocouple connected to a potentiometer. The saturation point was taken as the point at which the temperature stopped falling and began to rise slowly. The composition of the saturated solution was determined by conductivity measurements. For the determination of the eutectic temperature, salt and ice were mixed, frozen to a solid mass, broken into small pieces and placed in a Dewar. The mixture warmed up rapidly to a definite temperature and then remained constant within 0.01 K for 20-30 monutes.

SOURCE AND PURITY OF MATERIALS:

The salt was the purest commercially obtainable. It was recrystallized and its purity was determined by Lewis' equation (1).

ESTIMATED ERROR:

Temperature: ±0.01 to 0.02 K
Solubility: ±0.1%

REFERENCES:

1. Lewis, G.N. *Proc. Am. Acad.* 1907, 43, 284.

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Amadori, M.

Atti Ist. Veneto Sci., Lett. Arti 1919, *79*, 293-320.

VARIABLES:

T/K = 298

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio KCl/H_2O	mass %	solid phase
25	36.00	26.47	KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Solubilities were determined by the isothermal method. A sample of clear solution was weighed and evaporated to dryness. The residue was analyzed.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	Denecke, W. Z. *Anorg. Allg. Chem.* 1919, *108*, 1-43.
VARIABLES:	**PREPARED BY:**
T/K = 243-250 *p*/MPa: 133-302	M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	p/kg cm^{-2}	solid phases
-23.7	11326	ice I + KCl
-31.6	1948	"
-31.7	2815	ice III' + KCl
-30.7	3007	"
-30.6	3015	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Water and KCl were confined in a steel bomb with pentane for transmitting pressure. The bomb was immersed in an ethanol-carbonic acid bath. The temperature was increased at about 0.4 K/min, and solid-liquid equilibrium points were found from a plot of temperature against pressure.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: ±0.01 K

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Tourneux, C.

Ann. Chim. 1919, *11*, 230-65.

VARIABLES:

$T/K = 307-373$

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass %	density g cm^{-3}	solid phase
34	27.8	-	KCl
56	30.4	1.196	"
80	33.6	1.194	"
100	36.2	-	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method. Crystals were separated from saturated solution by centrifugation. The solution was analyzed by a gravimetric method.

SOURCE AND PURITY OF MATERIALS:

KCl: pure grade reagent

ESTIMATED ERROR:

Temperature: ±0.2 K
Mass %: ±0.01

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	Barbaudy, J. *Recl. Trav. Chim. Pays-Bas* 1923, 42, 638-42.
VARIABLES:	PREPARED BY:
T/K = 303	M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
30	27.2	KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Isothermal method.	Not stated.
	ESTIMATED ERROR:
	No estimates possible.
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	Mondain-Monval, P. *C. R. Hebd. Séances Acad. Sci.* 1923, *176*, 1313-7.
VARIABLES:	PREPARED BY:
T/K = 263	M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio KCl/H_2O	mass % (compiler)	solid phases	remark
-10.64	24.34	19.58	ice + KCl	eutectic point

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The method was described in a previous paper (1).	Not stated.
	ESTIMATED ERROR:
	No estimates possible.
	REFERENCES:
	1. Mondain-Monval, P. *C. R. Hebd. Séances Acad. Sci.* 1923, *176*, 889.

COMPONENTS: (1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	**ORIGINAL MEASUREMENTS:** Valeton, J.J.P.; Frömel, W. *Z. Anorg. Allg. Chem.* 1924, *137*, 91-100.
VARIABLES: *T*/K = 298	**PREPARED BY:** M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mol %	mass % (compiler)	solid phase
25	8.0	26	KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: Isothermal method. A saturated solution was prepared. When equilibrium was obtained, a sample of solution was analyzed.	**SOURCE AND PURITY OF MATERIALS:** Not stated. **ESTIMATED ERROR:** No estimates possible. **REFERENCES:**

COMPONENTS: (1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	**ORIGINAL MEASUREMENTS:** Zeitlin, S.M. *Z. Phys. Chem., Stoechiom. Verwandtschaftsl.* 1926, *121*, 39-44.
VARIABLES: *T*/K = 283, 293	**PREPARED BY:** M.-T. Saugier

EXPERIMENTAL VALUES:

t/°C	solubility mol dm^{-3}	mass % (compiler)	solid phase (compiler)
10.2	3.712	23.70	KCl
10.9	3.903	24.90	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: The solubility was studied by isothermal saturation. The compositions of saturated solutions were deduced from chloride titration by Mohr's method.	**SOURCE AND PURITY OF MATERIALS:** KCl was recrystallized several times. **ESTIMATED ERROR:** Temperature: ±0.1 K **REFERENCES:**

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Cornec, E.; Hering, H.

Caliche, 1926-7, *8*, 52-9;

Hering, H.

Thèse, Université Strasbourg 1926; *Ann. Chim.* 1936, *5*, 483-586.

VARIABLES:

$T/K = 273-373$

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

$t/°C$	100 x mass ratio KCl/H_2O	mass %	density g cm^{-3}	solid phase
0	27.92	21.83	-	KCl
25	35.93	26.43	1.179	"
50	43.00	30.07	1.194	"
75	49.63	33.16	1.203	"
100	55.52	35.70	1.211	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method. Saturated solution was analyzed by evaporation to dryness.

SOURCE AND PURITY OF MATERIALS:

Commercial KCl was recrystallized.

ESTIMATED ERROR:

Temperature: ±0.05 K
Density: ±0.001 g cm^{-3}

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Benrath, A.

Z. Anorg. Allg. Chem. 1927, *163*, 396-404.

VARIABLES:

T/K = 298

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mol ratio H_2O/KCl	mass % (compiler)	solid phase
25	12.58	24.75	KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Not stated; probably isothermal method.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Foote, H.W.

Am. J. Sci. 1927, 158-66.

VARIABLES:

T/K = 298

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	26.46	KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Saturated solutions were prepared by shaking the components in small glass-stoppered bottles in a thermostat. Samples were drawn off for analysis through a small filter of glass wool directly into a weighing bottle.

SOURCE AND PURITY OF MATERIALS:

KCl was purified by "usual methods".

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Holluta, J.; Mautner, S.

Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1927, *127*, 455-75.

VARIABLES:

T/K = 292

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	KCl g dm^{-3}	mass % (compiler)	density	solid phase
18.5	298.50	25.43	1.1738	KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

A mixture of salt and water was heated at 60°C for 1 hour, then placed in a thermostat and stirred. Solid-liquid equilibrium was obtained after about 12 hours. Samples of clear solution were removed and analyzed by evaporating the solution and drying the residue at 120°C to constant weight.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Jones, E.R.; Bury, C.R.

Philos. Mag. 1927, *3*, 1032-7.

VARIABLES:

T/K = 271-273

PREPARED BY:

M. Ferriol

EXPERIMENTAL VALUES:

t/°C	molality mol/kg	mass % (compiler)	solid phase
-0.340	0.0988	0.7312	ice
-0.412	0.1205	0.8904	"
-0.425	0.1246	0.9204	"
-0.616	0.1816	1.3359	"
-0.803	0.2381	1.7442	"
-0.913	0.2710	1.9805	"
-1.007	0.2998	2.1863	"
-1.347	0.4042	2.9254	"
-1.511	0.4549	3.2803	"
-1.723	0.5204	3.7350	"
-1.992	0.6047	4.3140	"
-2.303	0.7013	4.9689	"
-2.577	0.7856	5.5331	"
-2.719	0.8303	5.8296	"
-3.001	0.9182	6.4072	"
-3.328	1.020	7.0674	"
-3.618	1.112	7.6560	"
-3.960	1.220	8.3376	"
-4.230	1.304	8.8608	"
-4.528	1.397	9.4331	"
-4.804	1.484	9.9620	"
-5.208	1.608	10.705	"
-5.223	1.615	10.747	"
-5.519	1.704	11.272	"
-5.757	1.778	11.705	"
-5.882	1.818	11.937	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The apparatus consisted of a Dewar flask of 400 cm^3 capacity closed by a rubber stopper through which passed a thermometer, a stirrer and a closed tube holding a pipet. The flask was placed in a vigorously stirred brine bath, the temperature of which was kept within 0.1°C of that inside the flask. Temperatures were measured by Beckmann thermometers standardized to 0.005 K. Saturated solution was analysed by titration for Cl^-.

SOURCE AND PURITY OF MATERIALS:

KCl was srecrystallized 4 times.

ESTIMATED ERROR:

Temperature: ±0.005 K.
Molality: ±0.001 mol kg^{-1}

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	Malquori, G. *Atti. Accad. Naz. Lincei, Cl. Sci. Fis., Mat. Nat., Rend.* [5] <u>1927</u>, *5*, 510-11; <u>1928</u>, *7*, 749-50; <u>1928</u>, *8*, 738-9; *Gazz. Chim Ital.* 19<u>28</u>, *58*, 891-8.

VARIABLES:	PREPARED BY:
T/K = 273-353	M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase	reference
0	21.60	KCl	1928 papers 1, 3
25	26.31	"	1927 paper
25	26.02	"	1928 paper 3
35	27.80	"	" " 3
40	28.06	"	" " 2
40	28.60	"	" " 1
60	31.30	"	1927; 1928 papers 1, 2
80	33.80	"	1928 paper 2

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isoothermal method.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Palitzsch, S.

Z. Phys. Chem., Abt. A 1928, *138*, 379-98; *Studier over Opløsingers Overfladespaending*. Habilitation Thesis. Levin & Munksgaards Forlag. Copenhagen 1927.

VARIABLES:

T/K = 298

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	molality mol kg^{-1}	mass %	relative density d_4^t	solid phase
25	4.828	26.46	1.17813	KCl

COMMENTS AND ADDITIONAL DATA: Solubilities were measured in connection with studies of surface tensions. The experimental molalities and densities are given on pp. 386-95 of the paper. In the Thesis, the primary data are mass of solution and titer of 0.1 mol dm^{-3} $AgNO_3$. The compiler has calculated molalities and mass fractions from these data, which differ in the last figure from the values given by the author. The primary data follow.

mass of sln/g	titer/cm^3	molality/mol kg^{-1}	mass %
1.1962	42.40	4.818	26.42
1.0069	35.80	4.838	26.51

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solution and solid were rotated in sealed flasks in a thermostat. After saturation, which was continued up to 15 h, the mixture was filtered through cotton wool. Cl was determined by titration with $AgNO_3$. Densities were measured by pycnometer.

SOURCE AND PURITY OF MATERIALS:

KCl (Kahlbaum or Merck) was recrystallized and checked by analysis. Chloride was determined volumetrically. Water was redistilled over alkaline permanganate.

ESTIMATED ERROR:

Temperature: precision to 0.02 K.
Solubility: precision within 0.05 mass %, from data in thesis.
Density: precision 1-10 x 10^{-5}.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Scott, A.F.; Frazier, W.R.

J. Phys. Chem. 1927, *31*, 459-63.

VARIABLES:

$T/K = 298$

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass sln/g	vol. sln. /cm^3	density g cm^{-3}	mass sample/g	mass AgCl/g	mass salt salt/g	mass % (compiler)
25	29.9301	25.4105	1.17786	7.7042	3.9070	2.0322	26.375
	28.9362	24.5669	1.17785	6.4209	3.2547	1.6929	26.365
				7.5590	3.8351	1.9948	26.389
			1.17786				26.376
							s = 0.012

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothermal method was used. About 80 cm^3 of mixture were prepared in a 250 cm^3 glass bottle. The bottle was placed in a rotating device in a thermostat and stirred for 1 hour. It was then allowed to stand in the bath for 1 hour. These operations were repeated several times. Saturated solution was transferred into a weighing flask. Solubility was obtained by titration for chloride. All masses given above have been corrected to vacuum.

SOURCE AND PURITY OF MATERIALS:

Preparation and purification of the materials were described elsewhere (1).

ESTIMATED ERROR:

Temperature: ±0.01 K

REFERENCES:

1. Baxter, G.P.; Wallace, C.C. *J. Am. Chem. Soc.* 1916, *38*, 70.

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Wright, R.

J. Chem. Soc. 1927, 1334-7.

VARIABLES:

$T/K = 293, 373$

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio	mass %	solid phase
20	34.3	25.5	KCl
	34.3	25.5	"
100	56.5	36.1	"
	56.0	35.9	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Solid and solution were mixed in a container in a thermostat at 20°C. At 100°C, solid and solution were mixed in a sealed tube furnished with a sidearm. After rocking the tube for 4 h, the crystals were transferred into the sidearm, and the solution was cooled and analyzed by titration or evaporation to dryness.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Flöttmann, F.

Z. Anal. Chem. 1928, *73*, 1-39.

VARIABLES:

$T/K = 288-298$

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass %	density g cm^{-3}	refractive index	solid phase	remarks
15	24.720	1.0055	1.33478	KCl	b
	24.747			"	b
	24.714			"	a
20	25.576	1.0045	1.33439	"	b
	25.578			"	b
	25.598			"	b
25	26.450	1.0033	1.33385	"	b
	26.453			"	b
	26.450			"	a
	26.469			"	a

---

a analysis by evaporation to dryness

b analysis by precipitation of AgCl.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The mixture was introduced into a Jena bottle and stirred for 10 h. A part of the clear solution was removed and analyzed by evaporation to dryness and weighing of the residue or by precipitation of chloride as AgCl.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: ±0.02 K

Density: ±0.0002 g cm^{-3}

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Froelich, W.

Mitt. Kali-Forsch. Anst. 1929, 37-66.

VARIABLES:

T/K = 415-478

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mass %	pressure /atm	stirring time/h	solid phase
130	38.3	1.0	1	KCl
130	38.4	1.2	2	"
131	40.2	1.3	1½	"
133	40.8	1.3	2½	"
150	41.1	1.7	1½	"
178	43.2	6.9	1½	"
180	43.3	7.2	1	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Salt and water were stirred at 25 rev/min in an autoclave heated by an oil bath. The autoclave was fitted with thermometers and a manometer. Samples were removed via a sampling tube fitted with a linen filter. Dead space was at a minimum in the autoclave, so compressed air or CO_2 was used to force out samples, which were collected in a closed bomb and then cooled. Analyses were by the "usual methods used in the potash industry".

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

Temperature: precision ±1 K.
Solubility: precision within ±0.2 mass %, from data in table.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	Askenazy, P.; Nessler, F. *Z. Anorg. Allg. Chem.* 1930, *189*, 305-28.
VARIABLES:	PREPARED BY:
$T/K = 273$	T. Mioduski

EXPERIMENTAL VALUES:

$t/°C$	mole ratio H_2O/KCl	mass % (compiler)	solid phase
0	14.40	20.32	KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

No experimental details given, but presumably isothermal saturation method was used. The saturated solution was analyzed for chloride and for KCl by evaporation.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Barnes, W.H.; Maass, O.

Can. J. Res. 1930, *2*, 218-29.

VARIABLES:

T/K = 263-298

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C (mean)	t_c/°C	t_w/°C	mass %	solid phase
- 2.24	- 2.34	- 2.13	4.95	ice
- 4.60	- 4.84	- 4.35	9.48	"
- 6.88	- 7.11	- 6.65	13.70	"
- 9.48	- 9.87	- 9.09	17.85	"
		- 9.78	18.94	"
-10.31	-10.68	- 9.93	19.02	ice + KCl
		-10.36	19.49	" "
25.22			26.41	KCl

t_c = appearance of first crystal on cooling
t_w = disappearance of last crystal on warming

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The solubility was determined by the visual method (appearance of first crystal on cooling; disappearance on warming). The temperature of solutions was allowed to fall at a rate of less than 1 K per minute and to rise at a rate of about 1 K per 5 minutes.

SOURCE AND PURITY OF MATERIALS:

Kahlbaum's KCl was recrystallized several times and was finally kept at dull red heat in a Pt crucible for 2-3 hours.

ESTIMATED ERROR:

Temperature: ±0.1 K below 25°C.
Mass %: ±0.1% over a range including eutectic.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Karagunis, B.; Hawkinson, A.; Damköhler, G.

Z. Phys. Chem., Abt. A 1930, *151*, 433-66.

VARIABLES:

T/K = 272-273

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	molality mol kg^{-1}	mass % (compiler)	solid phase
-0.1077_5	0.0298	0.222	ice
-0.1614_9	0.0450	0.334	"
-0.3229	0.0926	0.686	"
-0.3836	0.1116	0.825	"
-0.4776	0.1398	1.032	"
-0.7164	0.2124	1.559	"
-0.974_3	0.2920	2.131	"
-1.397_8	0.422_1	3.050	"
-1.649	0.500_8	3.599	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Cryoscopic method. The difference between the melting points of ice and solution was measured with a thermocouple. Concentrations of solution were determined using a Haber-Lowe interferometer.

SOURCE AND PURITY OF MATERIALS:

Guaranteed pure grade de Haen reagent was used.

ESTIMATED ERROR:

$\Delta(t/m)$ = 0.2%

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Scott, A.F.; Durham, E.J.

J. Phys. Chem. 1930, *34*, 1424-38.

VARIABLES:

T/K = 323-365

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	density g cm^{-3}	molality mol kg^{-1}	mass % (compiler)	solid phase
50.21	1.1930	5.74	30.0	KCl
67.91	1.2006	6.38	32.2	"
92.23	1.2076	7.20	34.9	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Saturation was carried out by stirring salt and water in closed tubes. After saturation, the stirrer and stopper were replaced with a stopper carrying two holders with the calibrated solubility and density flasks, which were pre-warmed to 50 K above the temp. of the satd solution. The flasks were equilibrated in the space above the sln, then immersed in it and filled by inserting a capillary. The flasks were removed, dried and weighed. The contents of the solubility flask were analyzed by gravimetric determination of Cl as AgCl.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: ±0.01 K at 50°C; ±0.04 K at 92°C. Thermometers calibrated by NBS.

Density: av. dev. 9×10^{-5} g cm^{-3} at 50°C; 13×10^{-5} g cm^{-3} at 92°C.

Solubility: no estimates possible.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Aronova, S.I.; Lunskaya, S.N.

Zh. Khim. Prom-sti 1931, *8*, 23-7.

VARIABLES:

$T/K = 382$

PREPARED BY:

M.-T. Saugier-Cohen Adad;
A.M. Szafranski

EXPERIMENTAL VALUES:

$t/°C$	mass %	pressure p/mmHg	solid phase
108.7	38.01	756.0	KCl[a]

---

[a] boiling point of saturated solution

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The boiling point was measured in an open vessel thermostatted in an oil bath. The sample was stirred and Hg thermometers reading to 1 K were used. Saturation was checked by sampling and analyzing the liquid phase.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Hill, A.E.; Ricci, J.E.

J. Am. Chem. Soc. 1931, *53*, 4305-15.

VARIABLES:

$T/K = 278\text{-}323$

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

$t/°C$	mass %	density $d/g\ cm^{-3}$	solid phase
5	22.84	1.155	KCl
25	26.36	1.179	"
50	30.03	-	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method. Sampling showed that equilibrium was attained in 2-3 days (higher temperatures, compiler) or in 2 weeks. Saturated solutions were analyzed by evaporation to dryness for water content.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Akhumov, E.I.; Vasiliev, B.V.

Zh. Obshch. Khim. 1932, *2*, 271-89; *Izv. Sekt. Fiz.-Khim. Anal., Inst. Obshch. Neorg. Khim., Akad. Nauk SSSR* 1936, *9*, 295-315.

VARIABLES:

$T/K = 383\text{-}573$

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio KCl/H_2O	mass % (compiler)	density g cm^{-3}
100	56.0	35.90	1.215
110	58.0	36.71	
120	60.4	37.66	
130	62.9	38.61	1.235
140	65.8	39.69	
150	68.0	40.48	1.254
160	70.6	41.38	
170	73.4	42.33	1.276
180	75.6	43.05	
190	78.4	43.95	
200	81.4	44.87	1.317
210	83.2	45.41	
220	87.0	46.52	
230	89.8	47.31	
240	92.4	48.02	
250	95.3	48.80	
260	98.0	49.49	
270	100.8	50.20	
280	103.6	50.88	
290	106.4	51.55	
300	109.4	52.24	

Solid phase: KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Three methods were used. (1) Visual: the temperature at which the last crystal disappeared was noted. (2) Isothermal: water and salt were introduced into a sealed U-tube which was placed in a thermostat. When equilibrium was obtained, a part of the saturated solution was separated from the mixture and collected in one side of the tube. After cooling the tube was cut and the solution was analyzed. (3) Conductimetric: conductivity was plotted vs concentration. At the saturation point, a break was observed in the curve.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Cornec, E.; Krombach, N.

Ann. Chim. (Paris) 1932, *18*, 5-31.

VARIABLES:

T/K = 263-463

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio KCl/H_2O	mass %	density	solid phases
- 10.7	24.3	19.54	-	ice + KCl
0	28.1	21.92	1.154	KCl
10	34.3	25.57	1.174	"
40	40.2	28.65	1.189	"
60	45.5	31.29	1.199	"
80	50.6	33.59	1.205	"
100	55.5	35.69	1.209	"
108.5[a]	57.6	36.50	1.209	"
120	60.4	37.65	-	"
140	65.6	39.60	-	"
169.5	73.7	42.42	-	"
189.6	79.7	44.34	-	"

[a] boiling point

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Saturated solution was stirred at constant temperature for several hours. A sample of clear solution was then removed and analyzed. When the temperature of saturation was higher than the boiling point at atmospheric pressure, saturated solutions were prepared in a bomb placed in a thermostatted oil bath. After several hours, the bomb was turned in order to separate clear solution, which was removed after cooling and analyzed.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: ±0.2 K

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Osokoreva, N.A.; Opikhtina, M.A.; Shioket, A.N.; Plaksina, E.F.; Zaslavskii, A.I.; with Kurnakov, N.S.; Manoev, D.P.

Tr. Gos. Inst. Prikl. Khim. 1932, *no. 16*, 24-47.

VARIABLES:

T/K = 283 - 373

PREPARED BY:

T. Mioduski

EXPERIMENTAL VALUES:

	Solubility of KCl		
t/°C	mass % $100w_1$	mole fraction[a] x_1	solid phase
10	23.84	0.07032	KCl
20	25.68	0.07706	"
25	26.52	0.08022	"
40	28.80	0.08904	"
50	30.06	0.09409	"
60	31.37	0.09947	"
70	32.52	0.1043	"
100	36.03	0.1198	"

---

[a] Mole fractions calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothermal saturation method was used. Samples were agitated in a water thermostat below 333 K and in an oil thermostat at higher temperatures. Equilbrium was established in 1-2 d, or sooner at higher temperatures, as confirmed by constancy of density to 2-3 x 10^{-5} g cm^{-3}. Samples were taken at the same temperature as the thermostat. Solid phases were not analyzed. Solutions were analyzed gravimetrically for Cl as AgCl.

SOURCE AND PURITY OF MATERIALS:

No information available.

ESTIMATED ERROR:

Temperature: precision within ±0.1 K.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Scatchard, G.; Prentiss, S.S.

J. Am. Chem. Soc. <u>1933</u>, *55*, 4355-62.

VARIABLES:

T/K = 269-273

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	molality /mol kg^{-1}	mass %	solid phase
-0.0051	0.001389	0.01035	ice
-0.0102	0.002865	0.02136	ice
-0.0234	0.006449	0.04806	ice
-0.0399	0.011136	0.08296	ice
-0.0580	0.016217	0.12076	ice
-0.0957	0.027000	0.20089	ice
-0.1342	0.038173	0.28379	ice
-0.1966	0.056239	0.41754	ice
-0.2659	0.076739	0.56887	ice
-0.3663	0.10646	0.78746	ice
-0.4638	0.13558	1.0007	ice
-0.5754	0.16926	1.2462	ice
-0.6865	0.20277	1.4892	ice
-0.7805	0.23141	1.6960	ice
-0.9603	0.28624	2.0895	ice
-1.1721	0.35110	2.5509	ice
-1.3498	0.40548	2.93443	ice
-1.6101	0.48560	3.4939	ice
-1.6928	0.51103	3.67015	ice
-1.8532	0.56055	4.0115	ice
-2.0667	0.62645	4.4621	ice
-2.2515	0.68415	4.8531	ice
-2.5545	0.77852	5.4858	ice
-2.8692	0.87671	6.1353	ice
-3.2055	0.98203	6.8220	ice
-3.7817	1.1624	7.9751	ice
-4.0479	1.2455	8.4968	ice

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Freezing points were measured by "equilibrium method" and concs. were determined by conductivity, as in (1,2). Nitrogen was precooled and saturated in an ice-water mixture, then bubbled through the solution to stir it.

SOURCE AND PURITY OF MATERIALS:

A C.P. poduct was twice recrystallized from conductivity water and dried for 10 hours at 250°C. The stock solution was made up by weighing this salt.

REFERENCES:

1. Scatchard, G.; Jones, P.T.; Prentiss, S.S. *J. Am. Chem. Soc.* <u>1932</u>, *54*, 2696.
2. Scatchard, G.; Prentiss, S.S. *J. Am. Chem. Soc.* <u>1932</u>, *54*, 2696.

ESTIMATED ERROR:

Temperature: precision ±3 x 10^{-5} K for solutions more dilute than 0.01 mol dm^{-3}.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Potassium chloride; KCl; [7447-40-5] (2) Water; H_2O; [7732-18-5]	Lannung, A. *Z. Phys. Chem., Abt. A* 1934, *170*, 134-44.
VARIABLES:	PREPARED BY:
$T/K = 255$ $p/kPa = 1.4$	R. Cohen-Adad

EXPERIMENTAL VALUES:

$t/°C$	p/mmHg	molality mol kg^{-1}	mass % (compiler)	solid phase
18	13.2	4.53	0.253	KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The vapor pressure of the solution was plotted against the concentration. The solubility was found from the discontinuity in this curve.

SOURCE AND PURITY OF MATERIALS:

The purity of the salt has been described in a previous paper (1).

ESTIMATED ERROR:

Temperature: precision ±0.003 K
Pressure: ±7 Pa

REFERENCES:

1. Lannung, A. *Z. Phys. Chem., Abt. A* 1932, *161*, 255.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	Akhumov, E.I.; Golovkov, M.P. *Zh. Obshch. Khim.* 1935, 5, 500-9.
VARIABLES:	PREPARED BY:
$T/K = 288$	M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass %	refractive index	solid phase
15	24.76	1.3706	KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The solubility was determined by a synthetic method where refractive indices of solutions were plotted vs concentration. A sample of saturated solution was also analyzed.	Not stated.
	ESTIMATED ERROR:
	No estimates possible.
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	Akerlöf, G.; Turck, H.E. *J. Am. Chem. Soc.* 1935, 57, 1746-50.
VARIABLES:	PREPARED BY:
$T/K = 298$	M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	molality mol/kg	mass % (compiler)	solid phase
25	4.826	26.46	KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Water and salt were introduced into glass-stoppered Pyrex bottles and the mixture was stirred over a period of about 20 hours. Samples of saturated solution were analyzed by evaporation to dryness.	The "analyzed" salt was recrystallized and dried.
	ESTIMATED ERROR:
	Temperature: ±0.01 K
	REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Yarluikov, M.M.

Zh. Prikl. Khim. (Leningrad) <u>1935</u>, *7*, 902.

VARIABLES:

$T/K = 273-363$

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

$t/°C$	100 x mass ratio KCl/H_2O	mass % (compiler)	density $g\ cm^{-3}$	solid phase
0	28.10	21.94	1.1642	KCl
25	35.26	26.07	1.1775	"
45	41.13	29.14	1.1956	"
65	46.87	31.91	1.209	"
90	52.49	34.42	1.2184	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Benrath, A.; Gjedebo, F.; Schiffers, B.; Wunderlich, H.

Z. Anorg. Allg. Chem. 1937, *231*, 285-97.

VARIABLES:

T/K = 383-1041

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
110	36.4	KCl
129	38.2	"
141	39.3	"
161	41.2	"
199	44.7	"
230	47.5	"
251	49.5	"
273	51.5	"
295	53.5	"
328	56.7	"
362	60.0	"
391	62.6	"
409	64.4	"
454	69.0	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Salt and water were introduced into a small diameter glass tube which was stirred while being heated. The temperature was read when the last crystal disappeared.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Shearman, R.W.; Menzies, A.W.C.

J. Am. Chem. Soc. 1937, *59*, 185-6.

VARIABLES:

T/K = 281-449

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	molality /mol kg^{-1}	mass % (compiler)	solid phase
7.5	4.08	23.32	KCl
18.2	4.56	25.37	"
21.2	4.64	25.70	"
28.5	4.94	26.91	"
58.6	6.04	31.05	"
62.7	6.18	31.54	"
96.0	7.32	35.31	"
127.1	8.41	38.54	"
147.2	9.16	40.58	"
175.6	10.12	43.00	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

One form of the synthetic method of solubility measurement was used. Known weights of solvent and solute were sealed in a glass tube. This was slowly heated until the last crystal disappeared. Details of the experimental technique are given in (1).

SOURCE AND PURITY OF MATERIALS:

KCl was of highest purity. The authors estimated that the impurity other than water was less than 0.05 %.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Menzies, A.W.C. *J. Am. Chem. Soc.* 1936, *58*, 934.

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Bergman, A.G.

Izv. Akad. Nauk SSSR, Otd. Mat. Estest. Nauk 1938, 1, 203-16.

VARIABLES:

T/K = 264-303

PREPARED BY:

B. Russer

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase	method
- 9.5	18.0	ice	a
-10	21.6	KCl	b
10	23.4	"	b
20	25	"	b
30	26.8	"	b

a polythermal method

b isothermal method

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Method a: polythermal method, in which the temperatures of appearance and disappearance of crystals were noted (compiler; no details given). Method b: isothermal saturation method, with no details given.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: precision ±0.5 K for appearance of crystals; ±0.2 K for appearance of ice crystals.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl;
[7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Zaslavskij, A.I.; Sinani, S.S.;
Sokolova, L.A.

Izv. Akad. Nauk. SSSR, Otd. Mat. Estest. Nauk, Ser. Khim. 1938, (1), 203-16.

VARIABLES:

$T/K = 268$

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
- 5	10.39	ice
- 5	20.96	KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothermal method was used. The solubility was determined through chloride titration.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl;
[7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Benedict, M.

J. Geol. 1939, *47*, 252-76.

VARIABLES:

$T/K = 523-1043$
$p/MPa = 2.5-22$

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass %	p/atm	specific volume $cm^3\ g^{-1}$	density $g\ cm^{-3}$ (compiler)	solid phase
250	49.3	24.42	0.817	1.224	KCl
300	54.0	48.65	0.813	1.230	"
350	58.7	82.96	0.805	1.242	"
		83.07			"
400	63.4	125.59	0.797	1.255	"
450	68.2	168.84	0.786	1.272	"
500	73.0	204.86	0.772	1.295	"
550	77.9	223.74	0.758	1.319	"
		223.75			"
600	82.9	220			"
					"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Weighed amounts of salt and water were confined over mercury in a stainless steel bomb. The temperature of the bomb was maintained constant by a thermostatted copper block. Pressure was measured by means of a dead weight piston gauge.

SOURCE AND PURITY OF MATERIALS:

C.p. salt was recrystallized 3X from conductivity water, then dried and fused.
Distilled water was deaerated, then distilled under vacuum into the bomb.

ESTIMATED ERROR:

Temperature: ±0.5 K below 450°C,
± 1 K above 450°C.
Pressure: <2 %
Specific vol.: 1-2- %

REFERENCES:

COMPONENTS: (1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Polosin, V.A.; Shakhparonov, M.I. *Zh. Fiz. Khim.* 1939, *13*, 541-6.
VARIABLES: $T/K = 263-308$	PREPARED BY: M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phases
-10.6	20.09	ice
-10.4	19.80	ice + KCl
0	21.65	α-KCl
10	23.50	"
22.2	26.20	α-KCl + β-KCl
25	26.50	β-KCl
35	27.70	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The temperature when the first crystal appeared on cooling, or when the last crystal disappeared on heating was noted. A sample of eutectic solution was analyzed.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	Bergman, A.G.; Vlasov, N.A. *Dokl. Akad. Nauk. SSSR* 1942, *36*, 64-8.
VARIABLES:	PREPARED BY:
T/K = 263-303	M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase (compiler)
- 5	12	ice
-10	19.0	"
-10	20.2	KCl
- 5	20.8	"
0	21.8	"
5	22.6	"
10	23.4	"
15	24.2	"
20	25.0	"
30	26.6	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The temperature was noted at which the last crystal disappeared on heating, or at which the first crystal appeared on cooling.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Keevil, N.B.

J. Am. Chem. Soc. 1942, *64*, 841-50.

VARIABLES:

T/K = 463-918

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	vapor pressure *p*/atm	mole fraction KCl	mass % KCl (compiler)	method	solid phases
190	8.58	0.160	44.08	h	NaCl
213	14.5	0.168	44.52	h	"
237.2	19.45	0.180	47.60	c	"
237.6	19.81	0.180	47.60	h	"
269.2	32.33	0.198	50.54	h	"
298	47.8	0.216	53.28	h	"
298.1	48.26	0.216	53.28	c	"
330	68.40	0.238	56.38	h	"
342.2	unsaturated	0.247	57.58	c	"
349.4	82.80	0.252	58.23	h	"
371	100.5	0.270	60.48	h	"
372.5	101.8	0.272	60.73	h	"
375	unsaturated	0.274	60.97	c	"
375	102.2	0.274	60.97	h	"
388	unsaturated	0.287	62.49	c	"
397.3	121.8	0.293	63.17	h	"
400	unsaturated	0.295	63.39	c	"
427.2	151	0.322	66.28	h	"
428.6	150.7	0.323	66.38	c	"
439.5	160.4	0.335	67.58	h	"
457.2	187	0.354	69.40	h	"
472	185.0	0.370	70.85	h	"
480.4	190.7	0.377	71.46	h	"
485.8	194.0	0.381	71.81	c	"
493.8	200.1	0.393	72.82	h	"
497.2	202.0	0.395	72.99	c	"
516.1	214±1	0.416	74.67	c	"
526.4	218.5±1	0.427	75.51	c	"
529.7	217.1±1	0.432	75.89	h	"
538.9	218±3	0.444	76.77	h	"
548.7	218±5	0.458	77.76	h	"
584.5	220±5	0.509	81.10	h	"
645	197±5	0.624	87.30	h	"

c: temperature reached by cooling h: temperature reached by heating

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Salt and water were confined in a steel bomb by means of mercury, as described in (1), after removal of foreign gases by boiling and pumping. Temp. was measured by a Pt to Pt-10% Rh thermocouple sealed in Pyrex. Pressure was measured with a dead-weight Bridgman gauge (2) standardized against the v.p. of CO_2 at 0°C and 34.400 g atm. A series of p-V measurements were made at each of several temps. The vol. of the salt-water mixture in the bomb was controlled by mercury and a screw compressor. When the solid phase disappeared before the b.p. was reached, a discontinuity in the p-V slope gave an approx. solubility.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Benedict, M. *J. Geol.* 1939, *47*, 252; *Rev. Sci. Inst.* 1937, *8*, 252.
2. Bridgman, P.W. *Proc. Am. Acad. Arts Sci.* 1909, *64*, 201 .

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	Flatt, R.; Burkhardt, G. *Helv. Chim. Acta* 1944, *27*, 1605-10.
VARIABLES:	PREPARED BY:
T/K = 298	M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mol ratio H_2O/KCl	mass % (compiler)	solid phase
25	11.40	26.63	KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Described in previous paper (1).

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Burkhardt, G. *Untersuchungen über ternäre Mischkristallbildung; Das System NH_4^+-Cl^--Br^--H_2O bei 25°.* Dissertation. Bern 1942.

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Dolique, R.; Pauc, M.

Trav. Soc. Pharm. Montpellier 1946-7, *6*, 86-9; 1948, *8*, 30-1.

VARIABLES:

$T/K = 293, 303$

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio KCl/H_2O	mass % (compiler)	density g cm^{-3}	solid phase	paper (year)
20	34.39	25.59	1.173_5	KCl	1946-7
30	38.10	27.53	1.182_1	"	1948

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method. The operative technique was described in an earlier publication (1). Chloride was analyzed by titration using the Charpentier-Volhard method.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: ±0.05 K

REFERENCES:

1. Dolique, R. *Trav. Soc. Pharm. Montpellier* 1944, *3*, 55-62.

COMPONENTS: (1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Chang, T.-L.; Hsieh, Y.-Y. *J. Chinese Chem. Soc. (Peking)* 1949, *16*, 10-13.
VARIABLES: $T/K = 298$	PREPARED BY: J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	molality mol kg^{-1}	mass % (compiler)	method (see METHOD)	solid phase
25	4.741	21.90	(a)	KCl
	4.797	21.70	(b)	KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Presumably the method of isothermal saturation was used. The authors give results for: (a) initial heating at 60°C for 1 h, final heating at 25°C for 5 h; (b) initial heating at 80°C for 1 h, final heating at 25°C for 3 h.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	Lepeshkov, I.N.; Bodaleva, N.V. *Izv. Sekt. Fiz.-Khim. Anal., Inst. Obshch. Neorg. Khim., Akad. Nauk SSSR* 1949, *17*, 338-45.
VARIABLES:	PREPARED BY:
$T/K = 308$	J.W. Lorimer

EXPERIMENTAL VALUES:

$t/°C$	mass %	solid phase (compiler)
35	28.09	KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE	SOURCE AND PURITY OF MATERIALS:
Salt and water were stirred together in a thermostat. No other details are given.	Not stated.
	ESTIMATED ERROR:
	No estimates possible.
	REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Gehlen, H.; Dieter, H.

Z. Phys. Chem. (Leipzig) 1950, *196*, 258-77.

VARIABLES:

p/MPa = 0-100

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	p/atm	mass % a	mass % b	solid phase
25	0	26.3	26.3	KCl
	1000	27.6	27.4	"
	2000	28.7	28.5	"
	3000	29.7	29.6	"
	4000	30.6	30.6	"
	5000	31.5	31.2	"
	6000	32.4	32.2	"
	7000	33.2	33.2	"
	8000	33.8	33.7	"
	9000	34.5	35.7	"
	10000	35.1	37.2	"

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^{a}- first approximation; ^{b}- second approximation; see Method.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Solubilities under pressure were calculated from density and vapor pressure data under atmospheric pressure using Tammann's assumption (1) concerning the coincidence pressure and the compressibility of solid KCl.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Tammann, G. *Über die Beziehungen zwischen den inneren Kräften und Eigenschaften der Lösungen.* Leopold Voss. Hamburg und Leipzig. 1907.

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Dejak, C.

Gazz. Chim. Ital. 1951, *81*, 295-304.

VARIABLES:

T/K = 269-273

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	molality mol kg^{-1}	mass % (compiler)	solid phase
-0.26591	0.076739	0.56887	ice
-0.36625	0.10646	0.78746	"
-0.46376	0.13558	1.0007	"
-0.57544	0.16926	1.2462	"
-0.68650	0.20277	1.4892	"
-0.78054	0.23141	1.6960	"
-0.96027	0.28624	2.0895	"
-1.17212	0.35110	2.5509	"
-1.34975	0.40548	2.9343	"
-1.61013	0.48560	3.4939	"
-1.69275	0.51103	3.6702	"
-1.85324	0.56055	4.0115	"
-2.06669	0.62645	4.4621	"
-2.25146	0.68415	4.8531	"
-2.55450	0.77852	5.4858	"
-2.86918	0.87671	6.1353	"
-3.19489	0.98203	6.8220	"
-3.78169	1.1624	7.9751	"
-4.04788	1.2455	8.4968	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Cryoscopy.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Blidin, V.P.

Dokl. Akad. Nauk SSSR, Ser. Khim. 1953, *88*, 457-9.

VARIABLES:

T/K = 303-313

PREPARED BY:

M. Ferriol; R. Cohen-Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
30	26.78	KCl
40	28.67	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method. Saturation was obtained by addition of small quantities of salt. A sample of clear solution was weighed and analyzed. The remaining salt was weighed.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Durham, G.S.; Rock, E.J.; Frayn, J.S.

J. Am. Chem. Soc. 1953, 75, 5792-4.

VARIABLES:

$T/K = 298$

PREPARED BY:

J. W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mass %	mole fraction (compiler)	solid phase
25	26.42	0.07984	KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothemal saturation method was used, starting from both over- and undersaturation. For the ternary systems investigated, equilibrium was reached in 3-4 weeks. The solubility tubes were ratated in a thermostat, and samples were removed through filter pipets. Analysis was by titration for chloride.

SOURCE AND PURITY OF MATERIALS:

KCl: met ACS purity standards. Recrystallized, centrifuged, dried to const. wt. at 190°C; 99.8% pure by chloride analysis.

ESTIMATED ERROR:

Temperature: precision within ±0.02 K.
Solubility: precision within ±0.1 mass % (compiler).

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Campbell, A.N.; Kartzmark, E.M.

Can. J. Chem. 1956, 34, 672-78.

VARIABLES:

$T/K = 298$

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mass %	mole fraction (compiler)	solid phase
25	26.99	0.08201	KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothermal saturation method was used, with samples in sealed flasks in a thermostat. Equilibrium was reached in 5 h, then shaking was continued for another 5 h. Samples filtered at the temperature of the thermostat were analyzed for Cl by Mohr titration.

SOURCE AND PURITY OF MATERIALS:

KCl: Merck "reagent" or BDH "Analar", with no further purification.

ESTIMATED ERROR:

Temperature: precision ±0.05 K.
Solubility: No estimates possible.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Fialkov, G.A.; Tchernogorenko, V.B.

Dokl. Akad. Nauk. SSSR 1955, *102*, 759-62.

VARIABLES:

T/K = 263-273

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C freezing point	t/°C eutectic point b	c	100 x mass ratio KCl/H_2O	mass % (compiler)
- 0.21	-10.76		0.47	0.47
- 0.39	-10.76		0.86	0.85
- 0.81	-10.76		1.79	1.76
- 1.60	-10.76		3.62	3.49
- 3.30	-10.76		7.40	6.52
- 3.30[a]	-10.76	- 9.80	7.40	"
- 3.40	-10.76		7.68	7.13
- 3.40[a]		- 9.80	7.68	"
- 5.50	-10.76		12.50	11.11
- 5.50[a]	-10.76	- 9.80	12.50	"
- 5.50[a]	-10.76	-10	12.50	"
- 6.60[a]	-10.76	- 9.80	15.28	13.25
- 6.68	-10.76		15.28	"
- 7.85	-10.76		18.0	15.25
- 7.85[a]	-10.76	- 9.80	18.0	"
- 8.88	-10.76		20.52	17.03
- 9.20[a]	-10.76	- 9.80	20.52	"
- 9.77	-10.76		22.40	18.30
- 9.80[a]	-10.76	-10.20	22.40	"
-10.17	-10.76		23.37	18.94
- 9.80		- 9.80	23.37	"
- 9.80	-10.76	- 9.80	25	20.00

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[a] solution was frozen at a low cooling rate (0.5 K/min)

[b] eutectic: ice + KCl

[c] eutectic: ice + KCl·H_2O

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Direct and differential thermal analysis was used. The solutions were frozen, then the temperature was followed as a function of time at a heating rate of 0.5 K/min.

SOURCE AND PURITY OF MATERIALS:

Pure KCl was recrystallized twice.

ESTIMATED ERROR:

Temperature: ±0.01 K in the range 0 to -11°C.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	Nallet, A. *Thesis. Lyon (France). no. 209* <u>1955</u>. Nallet, A.; Pâris, R.A. *Bull. Soc. Chim. Fr.* <u>1955</u>, *94*, 488-97.
VARIABLES:	PREPARED BY:
T/K = 252-373	M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass %	100 x mass ratio NaCl/H_2O	relative density	solid phases
-10.75	19.48	24.19	1.135	ice + KCl
-9.8	18.23	22.29	1.128	ice
-9.8	19.77	24.64	1.1405	KCl
10	23.8	31.23	1.1646	"
30	27.18	37.32	1.1815	"
50	30.06	42.98	1.193	"
70	32.51	48.17	1.201	"
100	35.72	55.57	1.211	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Solubility was measured at fixed temperatures. The salt was previously dissolved by heating the mixture. The mixtures were stirred in a thermostat for 36 h above 70°C and for 4 h at -20°C. A sample of clear solution was removed and analyzed for chloride by potentiometric titration with $AgNO_3$. Densities were measured with a pycnometer.

SOURCE AND PURITY OF MATERIALS:

Twice recrystallized KCl, purity > 99.9 %, was used.

ESTIMATED ERROR:

Temperature: ±0.02 K in the range 10 to 40°C; ±0.05 K below 10°C or above 40°C

Cl^-: 0.2 to 0.3% (potentiometric titration)

K^+: 0.5 to 1% according to the method (chemical analysis or spectrophotometry)

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Shul'gina, M.P.; Kharchuck, O.S.; Yanat'eva, G.K.

Izv. Sekt. Fiz. Khim. Anal., Inst. Obshch. Neorg. Khim., Akad. Nauk SSSR 1955, *26*, 198-210.

VARIABLES:

$T/K = 266-271$

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

$t/°C$	mass %	solid phases	$t/°C$	mass %	solid phases
- 2.3	5.02	ice	- 6.6	20.68	$KCl\cdot nH_2O$ + KCl
- 4.8	10.04	"	- 6.0	20.80	KCl
- 7.3	14.80	"	- 5.4	20.98	"
- 9.6	18.00	"	- 2.8	21.30	"
-10.2	18.90	"	- 1.0	21.70	"
-10.6	19.70	ice + $KCl\cdot nH_2O$[a]	2.4	22.35	"
-10.8	19.87	ice + KCl	4.9	22.70	"
- 9.5	19.99	$KCl\cdot nH_2O$[a]	7.6	23.20	"
- 9.0	20.05	"	9.6	23.50	"
- 8.2	20.10	"	12.0	23.97	"
- 8.0	20.20	"	15.6	24.60	"
- 7.6	20.29	"	18.6	25.05	"
- 7.2	20.44	"	22.0	25.65	"
- 7.0	20.50	"	23.6	26.00	"
- 6.9	20.60	"			

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[a] value of n = 1 or 1.5

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Temperature was noted when the last crystal disappeared on heating or when the first crystal appeared on cooling.

SOURCE AND PURITY OF MATERIALS:

Salt was recrystallized twice.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Akhumov, E.I.; Pylkova, E.V.

Dokl. Akad. Nauk SSSR 1956, *108*, 857-60; *Freiberg. Forschungsh. A* 1959, *123*, 251-6.

VARIABLES:

T/K = 329-523

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
56	30.90	KCl
77	33.45	"
79	33.70	"
94	35.30	"
99	35.80	"
101	35.96	"
112	37.10	"
119	37.79	"
125	38.30	"
142	39.95	"
148	40.45	"
168	42.35	"
177	43.12	"
193	44.45	"
195	44.72	"
216	46.50	"
219	46.79	"
250	49.55	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Visual method: solution with an excess of salt was placed in a sealed tube. Temperatures of disappearance of last crystal on heating and of appearance on cooling (supersaturated solution) were observed.

SOURCE AND PURITY OF MATERIALS:

Chemically pure salt was recrystallized 3x and dried to constant weight.

ESTIMATED ERROR:

Temperature: ±0.5 to 1 K

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	Blidin, W.P. *Zh. Obshch. Khim.* 1956, *26*, 1281-5; *J. Gen. Chem. USSR (Engl. Transl.)* 1956, *26*, 1449-52.
VARIABLES:	**PREPARED BY:**
T/K = 298	M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	26.48	KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method. The solution with excess solid phase was placed in a reaction vessel with an oil seal and stirred until equilibrium had been achieved. The chloride ion was determined in saturated solution gravimetrically. K was determined as the cobaltinitrite.

SOURCE AND PURITY OF MATERIALS:

C.P. grade salt was recrystallized twice.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Bergman, A.G.; Kuznetsova, A.I.

Zh. Neorg. Khim. 1959, 4, 194-204; **Russ. J. Inorg. Chem.* (*Engl. Transl.*) 1959, *4*, 80-4.

VARIABLES:

T/K = 263-311

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phases
-10.6	19.60	ice
-10.7	19.80	ice + $KCl \cdot nH_2O$
-10.3	20.00	$KCl \cdot nH_2O$
- 9.1	20.3	"
- 9.7	20.43	"
- 8.0	20.62	"
- 7.0	20.84	"
- 5.8	21.13	$KCl \cdot nH_2O$ + KCl
- 4.7	21.54	β-KCl
0	22.10	"
10.0	23.70	"
14.2	24.50	"
24.6	26.00	"
30.1	27.20	α-KCl
38.0	29.06	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Polythermic visual method was used.

SOURCE AND PURITY OF MATERIALS:

KCl, commercially pure, was recrystallized.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	Plyushchev, V.E.; Kuznetsova, G.P.; Stepina, S.B. *Zh. Neorg. Khim.* 1959, 4, 1449-53; **Russ. J. Inorg. Chem. (Engl. Transl.)* 1959, 4, 652-4.
VARIABLES:	PREPARED BY:
T/K = 273-348	M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
0	21.93	KCl
25	25.95	"
50	30.03	"
75	32.99	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method. Cl^- in saturated solution was determined as AgCl, KCl by evaporation to dryness.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Slovinskaya, W.M.; Mukimov, S.M.

Uzb. Khim. Zh. 1959, *2*, 12-20.

VARIABLES:

T/K = 273-323

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio KCl/H_2O	mass %	density	solid phase
0	28.68	22.29	1.1528	KCl
25	36.46	26.72	1.1803	"
50	42.96	30.05	1.1920	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The method was described in two previous papers (1,2).

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Mukimov, S.M.; Bodliaghina, V.M. *Uzb. Khim. Zh.* 1948, *3*,
2. Slovinskaia, W.M.; Mukimov, S.M. *Uzb. Khim. Zh.* 1956, *11*,

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Shevtsova, Z.N.; Zhizhina, L.I; El'Tsberg, L.E.

Izv. Vyssh. Uchebn. Zaved., Khim. Khim. Tekhnol. 1961, 4, 176-8.

VARIABLES:

$T/k = 298$

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

$t/°C$	mass %	solid phase
25	26.52	KCl
25	26.50	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method. Phase equilibrium was obtained after 3-4 days. The methods of analysis are not given.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Shevtsova, Z.N.; Kulichkina, L.I.; El'Tsberg, L.E.

Izv. Vyssh. Uchebn. Zaved., Khim. Khim. Tekhnol. 1961, 4, 178-9.

VARIABLES:

$T/K = 298, 323$

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

$t/°C$	mass %	solid phase
25	24.75	KCl
50	30.00	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method. Phase equilibrium was obtained after 2-3 days stirring. The methods of analysis are not given.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Akopov, E.K.

Zh. Neorg. Khim. 1962, 7, 385;
**Russ. J. Inorg. Chem. (Engl. Transl.)* 1962, 7, 195-8.

VARIABLES:

T/K = 273-298

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
0	21.5	KCl
10	23.7	"
20	25.3	"
25	26.5	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Solubility was determined by visual observation of the temperature at which the first crystals appeared on cooling (or the last crystals disappeared on heating). A test tube provided with a glass stirrer and a thermometer was used. The temperature difference between appearance of the first and disappearance of the last crystals was 0.2-0.3. The observation was repeated until the interval between these temperatures was a minimum and then the mean of the 2 values was taken.

SOURCE AND PURITY OF MATERIALS:

"Chemically pure" grade KCl was twice recrystallized and dehydrated by evaporating a solution to dryness in a flow of HCl. Doubly-distilled water was used.

ESTIMATED ERROR:

The temperature difference between appearance of the first crystal and disappearance of the last one was 0.2-0.3 K.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Belyaev, I.N.; Lobas, L.M.

Zh. Neorg. Khim. 1965, *10*, 1279-81; **Russ. J. Inorg. Chem. (Engl. Transl.)* 1965, *10*, 512-14.

VARIABLES:

T/K = 298

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass %	density g cm^{-3}	viscosity mPa s	electrical cond. S cm^{-1}	solid phase
25	26.80[a]	1.1775	0.9901	0.163	KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Isothermal. Equilibrium between liquid and solid phases at a given temperature was reached by continuous stirring for 8-10 hours. The total Cl was determined volumetrically by Volhards' method. The electrical conductivity was measured with an A.C. bridge, the viscosity in an Ostwald viscosimeter and the density in a 5 mL pycnometer.

SOURCE AND PURITY OF MATERIALS:

"Chemically pure" grade KCl was recrystallized from aqueous soln.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Belyaev, I.N.; Le T'yuk

Zh. Neorg. Khim. 1965, *10*, 2355-8; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1965, *10*, 1279-81.

VARIABLES:

T/K = 298

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass %	density	solid phase
25	26.28[a]	1.192	KCl

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[a] Authors give 126.28, evidently in error.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Isothermal method. With continuous mixing, equilibrium between solid and liquid phases was established in 8-10 hours. Chlorine in the saturated solution was determined by Volhard's volumetric method.

SOURCE AND PURITY OF MATERIALS:

"Chemically pure" grade KCl doubly recrystallized from aqueous soln.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Chiorboli, P.; Momicchioli, F.; Grandi, G.

Boll. Sci. Fac. Chim. Ind. Bologna 1966, *24*, 133-53.

VARIABLES:

$T/K = 266-273$

PREPARED BY:

P. Vallée

EXPERIMENTAL VALUES:

$t/°C$	molality mol kg^{-1}	mass %	solid phases (compiler)
-0.0592	0.01648	0.1227	ice
-0.0913	0.02567	0.1910	"
-0.1493	0.04196	0.3119	"
-0.1912	0.05475	0.4065	"
-0.3060	0.08940	0.6621	"
-0.3830	0.11260	0.8325	"
-0.4040	0.11820	0.8735	"
-0.4333	0.12745	0.9413	"
-0.5017	0.14797	1.0912	"
-0.5413	0.16005	1.1792	"
-0.7360	0.21844	1.6025	"
-0.7814	0.23286	1.7065	"
-0.8055	0.23997	1.7577	"
-0.8126	0.24128	1.7671	"
-1.0741	0.32072	2.3353	"
-1.2592	0.37728	2.7359	"
-1.3137	0.39399	2.8536	"
-1.4754	0.44478	3.2096	"
-1.6238	0.48980	3.5231	"
-1.9406	0.58811	4.2005	"
-2.2587	0.68443	4.8550	"
-2.5289	0.77029	5.4310	"
-2.5547	0.77986	5.4948	"
-2.8347	0.86693	6.0710	"
-3.2329	0.99241	6.8892	"
-3.4683	1.06510	7.3567	"
-3.7532	1.15339	7.9782	"
-3.9801	1.22975	8.3984	"
-4.0223	1.23850	8.4531	"
-4.2441	1.30650	8.8760	"
-4.2755	1.31738	8.9433	"
-4.5043	1.38885	9.3830	"
-4.6239	1.42720	9.6172	"
-4.7479	1.46423	9.8421	"
-4.7691	1.47519	9.9085	"
-4.8455	1.49679	10.0390	"
-4.8727	1.50124	10.0659	"
-4.8961	1.50916	10.1136	"
-4.9212	1.51546	10.1515	"
-5.0641	1.56326	10.4383	"
-5.1719	1.59684	10.6387	"
-5.3101	1.69855	11.2401	"
-5.5603	1.71728	11.3500	"
-5.7814	1.78443	11.7417	"
-5.9701	1.84226	12.0759	"
-6.7910	2.09469	13.5075	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Cryoscopy using a plastic thermostat regulated by an automatic cryostat was used. Temperature was measured with a Pt resistance thermometer calibrated at fixed primary points. Solution concentrations were measured with a Hilger-Rayleigh Interferometer M154.

SOURCE AND PURITY OF MATERIALS:

Water was distilled from $KMnO_4$.

ESTIMATED ERROR:

Temperature: $\pm 3 \times 10^{-4}$ K

Molality: $\pm 0.35 \times 10^{-4}$ to $\pm 0.5 \times 10^{-4}$ mol kg^{-1}

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	Cohen-Adad, R.; Said, J. *Bull. Soc. Chim. Fr.* 1967, 564-9; Said, J. *Thesis* no. 585, Lyon (France) 1969.
VARIABLES:	PREPARED BY:
T/K = 262-333	M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass %	method (see below)	solid phase
- 3.5	6.5	a	ice
- 5.8	11.4	a	"
- 9.8	18.55	b	"
-10.8	19.65	a	"
-10.2	19.75	b	KCl
- 8.9	19.89	b	"
- 8.6	20.06	b	"
- 7.0	20.46	b	"
- 5.2	20.80	b	"
- 2.9	21.25	b	"
- 9.8	19.8	b	"
27	26.27	b	"
38	27.9	b	"
50	30.0	b	"
60	31.3	b	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Two experimental methods were used:
a: thermal analysis
b: isothermal method.
A mixture of salt in excess and solution was stirred at constant temperature until equilibrium was reached. Then, a sample of saturated solution was analyzed by evaporation to dryness.

SOURCE AND PURITY OF MATERIALS:

R.P. Prolabo reagent dried at 250°C for 24 hours.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Momicchioli, F.; Devoto, O.; Grandi, G.; Cocco, G.

Atti Soc. Nat. Modena 1968, 99, 226-32; *Ber. Bunsen-Ges. Phys. Chem.* 1970, 74, 59-66.

VARIABLES:

$T/K = 279-283$

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

$t/°C$ (compiler)	molality /mol kg^{-1}	$\Delta T/m$ /K kg mol^{-1}	mass % (compiler)	solid phase
-7.8188	2.40896	3.245_7	15.226	ice
-8.1401	2.50627	3.247_9	15.744	ice
-8.7269	2.68123	3.2548	16.660	ice
-9.8658	3.02410	3.2624	18.398	ice

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

A precision apparatus for measuring freezing point depressions by the equilibrium method was used, as described in (1). Temperatures were measured by a Pt resistance thermometer and Mueller bridge. Efficient stirring was accomplished by a high-quality air-driven stirrer. Concentrations were determined by a Hilger-Rayleigh interferometer.

SOURCE AND PURITY OF MATERIALS:

Merck "Suprapur" reagent, Cat. No. 6406.

ESTIMATED ERROR:

Temperature: precision $\pm 3 \times 10^{-4}$ K.

Composition: absolute error almost independent of molality, and about $4-5 \times 10^{-5}$ mol kg^{-1}.

REFERENCES:

(1) Chiorboli, P.; Momicchioli, F.; Grandi, G. *Boll. Sci. Fac. Chim. Ind. Bologna* 1966, 24, 133.

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kirgintsev, A.N.; Trushnikova, L.N.

Zh. Neorg. Khim. 1968, *13*, 2843-7; **Russ. J. Inorg. Chem. (Engl. Transl.)* 1968, *13*, 1462-6.

VARIABLES:

T/K = 298

PREPARED BY:

R. Tenu; R. Cohen-Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	26.6	KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Solubility was determined by the isothermal relief of supersaturation. Equilibration time was 7-8 h. Samples of the liquid and solid phases were then withdrawn, transferred quantitatively to measuring flasks and analyzed.

SOURCE AND PURITY OF MATERIALS:

KCl: "chemically pure" and "analytical reagent" grade salts were recryst. from dist. water.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Merbach, A.; Gonella, J.

Helv. Chim. Acta 1969, *52*, 69-76.

VARIABLES:

T/K = 298

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mole ratio H_2O/KCl	mass % (compiler)	solid phase
25	11.40	26.63	KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The Brunisholz saturation method was used (1). Chloride was determined potentiometrically and potassium by atomic absorption.

SOURCE AND PURITY OF MATERIALS:

KCl: Merck "Analytical Reagent" grade was used.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

1. Brunisholz, G.; Quinche, J.P. Kalo, A.M. *Helv. Chim. Acta* 1964, *47*, 14.

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Babenko, A.M.; Kaganskii, I.M.

Zh. Prikl. Khim. (Leningrad) 1971, *44*, 1941-3; *J. Appl. Chem. USSR (Engl. Transl.)* 1971, *44*, 1974-6.

VARIABLES:

T/K = 264-284

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase (compiler)
- 9.0	19.9	ice + KCl
0	21.4	KCl
10	23.2	KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Solubilities were determined by the method of isothermal saturation (compiler). The apparatus is described in (1).

SOURCE AND PURITY OF MATERIALS:

Potassium chloride: twice recrystallized C.P. or analytical grade reagent.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Eraizer, L.N.; Kaganskii, I.M. *Zavod. Lab.* 1967, *33*, 119.

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Bakhoda, B.

Thesis. Pars College. 1975.

VARIABLES:

$T/K = 303$

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

$t/°C$	molality mol kg^{-1}	mass % (compiler)	solid phase
30	5.001 [a]	27.16	KCl
	5.036 [b]	27.30	"

---

[a] from undersaturation; [b] from supersaturation

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method. Equilibrium was obtained from under- and supersaturation. In the first case, the salt was dissolved in water at 32-33°C. The mixture was stirred for about 30 minutes and cooled to 30°C. Stirring was maintained for 4 days. The solution was filtered and the solid phase transferred to filter paper and wrapped completely. The moist salt was weighed; it was then dried at 95 to 100°C for 6 hours and weighed again. Composition of the saturated solution was deduced from the mass of moist and dry salt.

SOURCE AND PURITY OF MATERIALS:

KCl (Merck's reagent) was dried above 100°C for 5 hours.

ESTIMATED ERROR:

Temperature: ±1 K

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sunier, A.A.; Baumbach, J.

J. Chem. Eng. Data 1976, *21*, 335-6.

VARIABLES:

$T/K = 188-257$

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	molality mol kg^{-1}	mass %	solid phase
16.13	4.407	24.73	KCl
21.97	4.668	25.80	"
23.50	4.716	26.02	"
26.32	4.803	26.36	"
30.80	5.018	27.23	"
31.59	5.050	27.57	"
37.62	5.264	28.17	"
41.00	5.406	28.73	"
48.12	5.698	29.82	"
53.27	5.903	30.42	"
53.82	5.891	30.52	"
62.88	6.164	31.49	"
66.23	6.322	32.03	"
69.12	6.418	32.36	"
77.07	6.684	33.26	"
85.26	6.955	34.15	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The sealed tube method was used which involved introducing weighed quantities of solute and solvent into a tube and sealing. Then the tube was heated slowly with shaking to determine the temperature at which the last small crystal remained. Mercury in glass thermometers were employed.

SOURCE AND PURITY OF MATERIALS:

KCl: best grade of J.T. Baker, twice recrystallized from deionized water and fused.

ESTIMATED ERROR:

Temperature: ±0.01 K

REFERENCES:

COMPONENTS: (1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Kartzmark, E.M. *Can. J. Chem.* <u>1977</u>, 55, 2792-8.
VARIABLES: *T*/K = 298	PREPARED BY: J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25.00	26.72	KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The isothermal method was used. The mixture was equilibrated by stirring at 25.00°C for 2 or 3 days. The phases were separated by filtration through sintered glass and were analyzed for chloride by precipitation as AgCl.

SOURCE AND PURITY OF MATERIALS:

KCl: reagent grade was used without further purification.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	Potter II, R.W.; Babcock, R.S.; Brown, D.L. *J. Res. U.S. Geol. Surv.* 1977, 5, 389-95.
VARIABLES:	**PREPARED BY:**
T/K = 442-644	J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase (compiler)
148.6	40.24	KCl
153.4	40.77	"
162.8	41.43	"
173.1	42.49	"
192.3	44.02	"
213.5	46.00	"
256.1	50.00	"
278.0	52.00	"
371.0	50.98	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Salt, saturated solution and vapor were heated in a Pt-lined stainless steel bomb. The curve of pressure vs temperature was measured, and showed a break (located by least-squares analysis of the data) at the temperature at which the last crystal of salt disappeared. The same values were obtained for heating rates between 0.17 and 0.44 K/min.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

Temperature: ±0.1 K accuracy, traceable to NBS standards.

Pressure: ±10 kPa

Solubility: fits quadratic eqn to ±2s = 0.10 mass %

REFERENCES:

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Potter II, R.W.; Clynne, M.A.

J. Res. U.S. Geol. Surv. 1978, *6*, 701-5.

VARIABLES:

$T/K = 299\text{-}367$

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase (compiler)
25.42	26.40	KCl
29.78	26.96	"
29.79	26.96	"
29.88	26.99	"
30.06	27.03	"
39.94	25.50	"
40.98	28.61	"
50.49	30.00	"
61.28	31.40	"
72.44	32.71	"
83.18	33.91	"
93.40	34.99	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The visual method was used. Weighed amounts of salt and water were placed in a tube fitted with a stirrer and sealed with a layer of silicone oil. The tube was heated slowly and incrementally in a thermostat until the last crystal of salt had dissolved. It was found that 1 mg of salt could be seen easily, using a 20 g-sample of salt.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

Temperature: accuracy ±0.01 K (Pt resistance thermometer); repeatability of dissolution temp. ±0.05 to ±0.15 K.

Solubility: est. precision 0.03-0.05 mass %.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water; H_2O; [7732-18-5]	Rard, J.A.; Miller, D.G. *J. Chem. Eng. Data* 1981, *26*, 38-43.
VARIABLES:	**PREPARED BY:**
$T/K = 298$	M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

$t/°C$	molality m/mol kg^{-1}	mass % (compiler)	solid phase
22	4.8088 ± 0.0022	26.390	KCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isopiestic method. Experimental details are described elsewhere (1). 12-14 days equilibration were used.

SOURCE AND PURITY OF MATERIALS:

The preparation and analysis of KCl, H_2SO_4, and isopiestic standards have been described in (2).

ESTIMATED ERROR:

Temperature: ± 0.005/K

REFERENCES:

1. Spedding, F.H.; Weber, H.O.; Saeger, V.W.; Peterham, H.H.; Rard, J.A.; Habenschuss, A. *J. Chem. Eng. Data* 1977, *22*, 56.
2. Scott, A.F.; Frazier, W.R. *J. Phys. Chem.* 1927, *31*, 459.

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Hall, D.L.; Sterner, S.M.; Bodnar, R.J.

Econ. Geol. 1988, *83*, 197-202.

VARIABLES:

T/K = 273-262

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

mass %	mole fraction (compiler)	freezing point t/°C	solid phase
0.00	0.0000	0.00	ice
3.18	0.0079	-1.46	"
4.28	0.0106	-2.00	"
6.43	0.0163	-3.00	"
8.38	0.0216	-4.00	"
10.30	0.0270	-5.00	"
12.14	0.0323	-6.00	"
13.81	0.0373	-7.00	"
15.48	0.0424	-8.00	"
17.06	0.0474	-9.00	"
18.59	0.0523	-10.00	"
19.29	0.0546	-10.50	"
19.55	0.0555	-10.69	"

COMMENTS: The fitting equation given in this paper has also been given in a published abstract (1), but without the experimental data.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

A 20 mass % sln. of salt was diluted to 3 mass % and placed in a 1-L Erlenmeyer flask fitted with ports for sampling and thermocouple (type K, measured with potentiometer, calibrated at f.p. of water and Hg). Sln. was initially undercooled ≈ 1 K below f.p., then was nucleated with a seed crystal and cooled slowly at 3-4 K/h. Samples of equilibrated brine were removed by pipet, then were weighed, dried at 110°C, then dried at 350°C.

SOURCE AND PURITY OF MATERIALS:

KCl: reagent grade.
H_2O: distilled and deionized.

ESTIMATED ERROR:

Temperature: ±0.05 K (from potentiometer precision).

Composition: ±0.02 mass % (from known samples).

REFERENCES:

1. Hall, D.L.; Sterner, S.M.; Bodnar, R.J. *EOS, Trans., Am. Geophys. Union* 1987, *68*, 450.

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sterner, S.M.; Hall, D.L.; Bodnar, R.J.

Geochim. Cosmochim. Acta 1988, *52*, 989-1005.

VARIABLES:

$T/K = 264 - 924$

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

mass % $100w_1$	mole fraction x_1 (compiler)	dissolution temp. t/°C average	range	std. dev.	no. of detns.	std. dev. in $100w_1$	std. dev. in $100x_1$	solid phase
20.0	0.0570	-9.0	-9.0 to -9.1	0.05	6	0.011	0.004	KCl
37.7	0.1276	118.3	116-119	0.89	15	0.090	0.042	"
51.9	0.207	268.1	266-269	1.19	12	0.16	0.11	"
61.9	0.282	367.7	366-369	1.11	13	0.22	0.19	"
70.1	0.362	443.1	421-455	10.01	20	2.7	2.9	"
80.2	0.495	550.5	548-553	1.47	12	0.61	0.97	"
89.9	0.683	651.2	648-683	1.92	5	1.2	2.9	"

Std. devs. in w_1 and x_1 which correspond to std. dev. in temp. calc. by compiler from $s(w_1) = (dw_1/d\theta)s(T)$ and $s(x_1) = (M_1/M_2)(x_1/w_1)^2 s(w_1)$, and the authors' fitting eqn (compiler's notation) with $\theta = T/K - 273.15$ and range of validity -10.7 to 770°C:

$$100w_1 = 21.886 + 0.2028\theta - 9.603 \times 10^{-4}\theta^2 + 4.078 \times 10^{-6}\theta^3 - 8.724 \times 10^{-9}\theta^4 + 9.174 \times 10^{-12}\theta^5 - 3.776 \times 10^{-15}\theta^6$$

A similar equation (but with different coefficients), valid for the range 100 to 770°C, is given in a published abstract of this paper (3). No experimental data are given in the abstract.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Fluid inclusions were synthesized in presence of KCl-H_2O slns of known composition by healing fractures in Brazilian quartz at elevated temp. and pressure (1, 2). Solubilities were determined by measuring the dissolution temps. of KCl daughter crystals within inclusions, using a microscope with heating stage. Quartz, fractured by heating to 350 °C then quenching in dist. H_2O at room temp., was dried, loaded into Pt capsules with KCl slns., welded shut, loaded into pressure vessels in a horizontal pre-heated furnace, and pressurized to 6 kbar. Fractures were reopened by pressure cycling, which also avoided inclusions before the salt had dissolved completely. After 5 d, the pressure vessel was let cool, opened, and the quartz cylinders cut into 1 mm thick disks and polished. The actual T, p were chosen to lie on an isochore which passes through the intersection of the liquidus isopleth for the bulk sln. and the vapor-satd. solubility surface.

SOURCE AND PURITY OF MATERIALS:

KCl, water: not stated.

Quartz: from Brazil.

ESTIMATED ERROR:

Temperature: E-type thermocouple calibrated using known fluid inclusions. Thermal gradients: < 0.1 K at -56.6, 0°C, < 5 K at 374°C. Accuracy: ±0.1 K at < 50°C, ±2.5 K near 375°C, ±3 K near 575°C.

REFERENCES:

1. Sterner, S.M.; Bodnar, R.J. *Geochim. Cosmochim. Acta* 1984, *48*, 2659.
2. Bodnar, R.J.; Sterner, S.M. In *Hydrothermal Experimental Techniques*. Ulmer, G.C., Barnes, H.L., eds. Wiley, New York. 1987. p. 423.
3. Hall, D.L.; Sterner, S.M.; Bodnar, R.J. *EOS, Trans., Am. Geophys. Union* 1987, *68*, 450.

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Hovey, J.K.; Pitzer, K.S.; Tanger IV, J.C.; Bischoff, J.I.; Rosenbauer, R.J.

J. Phys. Chem. 1990, *94*, 1175-9.

VARIABLES:

T/K = 621-772

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

Temperature, pressure and vapor composition along the three-phase S-L-V line.

t/°C	p/bar	mass % KCl in vapor, u_1	solid phase
347.5	82.1	-	KCl
377.5	107.1	-	"
398.5	125.5	-	"
398.8 ± 0.2	125.7 ± 0.1	0.0013 ± 0.0005	"
399.7	126.5	-	"
419.1	143.9	-	"
439.4	161.7	-	"
458.3 ± 0.2	177.5 ± 0.2	0.0053 ± 0.0002	"
459.8	178.4	-	"
480.1	193.4	-	"
498.7 ± 0.2	205.1 ± 0.1	0.0128 ± 0.0020	"

COMMENTS AND ADDITIONAL DATA:

The large errors in vapor compositions are attributed to slow kinetics of liquid-vapor equilibration. The authors also give pressure-liquid composition-vapor composition data for two temperatures, 380.1 ± 0.3 and 410.2 ± 0.2 °C. The vapor composition along the three-phase line could be represented by (compiler)

$$\ln(100u_1) = a + b(T/\mathrm{K}-273.15)$$

with $a = -15.8$, $b = 0.0229$.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Similar to that used in (1, 2): a 26.5 mL pressure vessel (René 41) was suspended vertically in a two-zone Marshall resistance furnace, which was controlled electronically. Openings at top and bottom of the pressure vessel were connected to samplimg valve blocks and pressure transducers via Ti and stainless steel capillaries, with 0.2 mL dead volume in each pressure line.
A mass of solution sufficient to fill the pressure vessel and to generate, by expansion, a pressure above the critical pressure was placed in the apparatus. Excess fluid was withdrawn to give other pressures. Thermal eqm. was reached reached in 3 h. Samples (0.35 mL) were removed from top and bottom, weighed and analyzed for K by atomic absorption, Cl by automatic chloride titration. The final pressure was also measured. Pressure was measured using transducers calibrated to 0.01 % at 11 points with a dead-weight gauge. Temperature was measured by Pt resistance thermometers calibrated calibrated to NBS standards.

SOURCE AND PURITY OF MATERIALS:

KCl: reagent grade.
H_2O: deionized.

ESTIMATED ERROR:

Temperature: total error ±0.02 K
variation during expt. ±0.05 K
variation between expts. ±0.3 K
Pressure: ±0.5 bar
Composition: K, Cl: precision 1 % above 0.5 mass %

REFERENCES:

1. Rosenbauer, R.J.; Bischoff, J.L. *Geochim. Cosmochim. Acta* 1987, *51*, 2349.
2. Bischoff, J.L.; Rosenbauer, R.J. *Earth Planet. Sci. Lett.* 1984, *68*, 172.

COMPONENTS	EVALUATOR:
(1) Rubidium chloride; RbCl; [7791-11-9] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987

CRITICAL EVALUATION

Solubility data for the system RbCl-H_2O have been presented in 29 publications. The solid phase in equilibrium with the liquid is either anhydrous RbCl or ice, depending on the particular region of concentration of interest.

EXPERIMENTAL METHODS

The solubility of RbCl in water has been measured using analytical methods where a sample of the saturated solution, prepared under isothermal conditions, has been taken and analyzed. In two cases, the solubility has been determined from isopiestic measurements (20a, 37), and in another from measurements of the vapor pressure as a function of concentration (14). The solubility of ice has been determined by cryoscopy (12,27).

ANALYSIS OF SOLUTIONS

The composition of the sample or of the saturated solution was determined, in most cases, by evaporation to dryness and weighing (2, 3, 8, 29, 33, 37), by interferometry (12, 27), by determination of chloride (2, 6, 14, 22, 24, 34-36), or by analysis for rubidium (33).

PRODUCTS USED

Most often RbCl was a pure reagent, sometimes recrystallized once, twice or three times. Belyaev (22) prepared RbCl from pure carbonate.

MELTING POINT

There are only a few rather disperse experimental values given in the literature: 710 (4, 21), 712-713 (5), 714 (9), 722 (20), 726°C (7). In their compilations, Perel'man (21) indicated 710 and 726°C, while Bahrin, Knacke and Kubaschewski (30) gave 988 K (= 715°C). We have adopted this latter value in the calculations.

CRITICAL EVALUATION OF THE RESULTS

1. *Fitting equations for the Solubility Curves*

All the data on the compilation sheets have been analyzed according to the procedure given in the Preface to this volume. The curves can be represented by equations of the form:

$$Y(x_1) - Y(x_0) = A(1/T - 1/T_0) + B\ln(T/T_0) + C(T - T_0)$$

Solubility of RbCl:

$$Y = 2\ln[2x_1/(1 + x_1)]$$

Solubility of ice:

A good representation of the experimental results was obtained from a series expansion of the activity coefficient of water, according to an equation of the form:

(continued)

COMPONENTS	EVALUATOR:
(1) Rubidium chloride; RbCl; [7791-11-9] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987

CRITICAL EVALUATION (continued)

$$\ln f_2 = [x_1/(1 + x_1)]^{3/2}(E + Fz + Gz^2 + Hz^3)/T$$

where

$$z = \ln[x_1/(1 + x_1)]$$

The coefficients E, F, G and H have been adjusted by cubic regression.

Table 1

System RbCl-H_2O

Coefficients of fitting equations of solubility

	Solid Phase RbCl	Solid Phase ice
A	-3243.86	
B	-11.7572	
C	1.3816×10^{-2}	
D	70.7070	
E		730.96
F		613.93
G		201.73
H		15.79
Range/K	255-988	273-255

2. *Critical Evaluation of the Data*

2.1 Solubility of RbCl

The calculation of the solubility curve has been carried out using 41 numerical values over a range of temperature from 0°C (273.15 K) to 114.9°C (388.1 K). In addition, one supplementary condition has been imposed: the melting point ($x_0 = 1$, $T_0 = 988$ K) is a point on the solubility curve.

The whole of the experimental results and calculations are given in Table 2. The data from the literature are very coherent among themselves and equally very coherent with the calculated values. With the exception of the results of Benrath (10), which show a deviation of almost 3 %, and those of Gehlen and Dieter (15), all the numerical values can be recommended, particularly those of the Earl of Berkeley (3, 8).

Table 2

Solubility of RbCl in Aqueous Solutions

T/K - 273.15	mass % $100w_1$ exp.	mass % $100w_1$ calc.	mole fraction x_1 exp.	mole fraction x_1 calc.	density exp.	density calc.	status a	status b	ref.
0	43.48	43.57	0.1028	0.1032			r		24
0.4	43.61	43.65	0.1033	0.1035			r		2
0.55	43.61	43.69	0.1033	0.1036	1.4409	1.4410	r	r	3

(continued)

COMPONENTS	EVALUATOR:
(1) Rubidium chloride; RbCl; [7791-11-9] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987

CRITICAL EVALUATION (continued)

Table 2 (continued)

Solubility of RbCl in Aqueous Solutions

T/K - 273.15	mass % 100w_1		mole fraction x_1		density		status		ref.
	exp.	calc.	exp.	calc.	exp.	calc.	a	b	
1	43.30	43.78	0.1021	0.1040			t		1
7	45.32	45.03	0.1099	0.108			t		1
15.5	46.56	46.70	0.1149	0.1154			r		2
18	47.07	47.16	0.1170	0.1174			r		14
18	46.2	47.16	0.1134	0.1174			a		15
18.70	47.46	47.29	0.1186	0.1179	1.4865	1.4869	r	r	3
20	47.7	47.53	0.1196	0.1189			r		23
22.9	48.45	48.05	0.1228	0.1211	1.4971	1.4959	t	r	6
25.00	47.92	48.42	0.1206	0.1227			t		35
25	48.12	"	0.1214	"			t		17,19
25	48.21	"	0.1218	"			r		32
25	48.29	"	0.1221	"			r		26
25	48.47	"	0.1229	"			r		20a
25	48.48	"	0.1230	"			r		18
25	48.484	"	0.1230	"			r		37
25	48.50	"	0.1230	"	1.455	1.5000	r	a	22
25	48.50	"	0.1230	"	1.487	"	r		25
25.00	48.51	"	0.1231	"			r		34
25	48.54	"	0.1232	"			r		29
25	48.57	"	0.1233	"			r		11
25	48.58	"	0.1234	"			r		33
25	48.60	"	0.1235	"			r		24
25	48.67	"	0.1238	"			r		28
25	48.74	"	0.1242	"			t		36
25	49.71	"	0.1284	"			a		10
25	52	"	0.1394	"			a		13
31.5	49.65	49.41	0.1281	0.1275	1.5118	1.5125	r	r	3
40	49.85	50.86	0.1290	0.1336			a		17
44.70	51.51	51.57	0.1366	0.1369	1.5348	1.5346	r	r	3
50	51.2	52.33	0.1352	0.1405			a		31
50	52.2	"	0.1399	"			r		23
50	52.30	"	0.1404	"			r		24
50	52.5	"	0.1414	"			r		31
57.3	53.71	53.33	0.1474	0.1454			t		2
60.25	53.62	53.71	0.1469	0.1474	1.5558	1.5565	r	r	3
75.15	55.46	55.53	0.1565	0.1569	1.5746	1.5745	r	r	3
89.35	57.03	57.08	0.1651	0.1654	1.5905	1.5900	r	r	3
113.710	59.62	59.41	0.1803	0.1790			r		bp 8
114.0	59.46	59.44	0.1793	0.1792	1.6148	1.6150	r	r	bp 3
114.9	59.48	59.52	0.1794	0.1797			r		2

(a) status of solubility   (b) status of density

$e = |x_1(\text{obs}) - x_1(\text{calc})|/x_1(\text{calc})$ r = recommended value $e \leq 0.01$
t = tentative value $0.01 < e \leq 0.02$ a = aberrant value $e > 0.02$
bp = boiling point of saturated solution

2.2 Solubility of Ice

Calculations were made using 43 numerical values. The results of Dejak (16) reproduce the values of Karagunis (12), and have not been taken

(continued)

COMPONENTS	EVALUATOR:
(1) Rubidium chloride; RbCl; [7791-11-9] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987

CRITICAL EVALUATION (continued)

into account. The whole of the experimental data and calculations is given in Table 3. The concordance among the measurements and the calculations is excellent, and all values can be recommended.

2.3 Eutectic Point

No numerical value is given in the literature. The coordinates of the eutectic point have been determined by extrapolation of the solubility curves for ice and for salt, and are:

x_1(eutectic) = 0.0896; T(eutectic)/K - 273.15 = -16.4

These results must be considered as *tentative* values.

Table 3

Solubility of Ice in Aqueous Solutions of RbCl

T/K - 273.15	mass % $100w_1$ exp.	calc.	mole fraction x_1 exp.	calc.	$\ln f_2$	status	ref.
-0.0473	0.155	0.155	0.000231	0.000232	0.00001	r	27
-0.06510	0.214	0.215	0.000321	0.000322	0.00001	r	12
-0.0771	0.259	0.256	0.000387	0.000383	0.00002	r	27
-0.0949	0.319	0.317	0.000477	0.000474	0.00003	r	27
-0.1423	0.488	0.481	0.000730	0.000721	0.00006	r	27
-0.15115	0.506	0.511	0.000758	0.000766	0.00007	r	12
-0.1935	0.663	0.660	0.000993	0.000989	0.00010	r	27
-0.2147	0.739	0.735	0.001108	0.001102	0.00012	r	27
-0.21900	0.746	0.749	0.001119	0.001124	0.00013	r	12
-0.2708	0.937	0.933	0.001407	0.001401	0.00018	r	27
-0.2774	0.932	0.955	0.001400	0.001436	0.00018	r	12
-0.2738	0.937	0.942	0.001407	0.001416	0.00018	r	12
-0.4152	1.451	1.446	0.002189	0.002182	0.00034	r	27
-0.4165	1.448	1.450	0.002184	0.002187	0.00034	r	12
-0.5352	1.876	1.873	0.002840	0.002837	0.00049	r	12
-0.5504	1.925	1.927	0.002916	0.002920	0.00051	r	27
-0.6296	2.215	2.210	0.003363	0.003357	0.00061	r	12
-0.6713	2.358	2.358	0.003585	0.003586	0.00067	r	27
-0.7872	2.784	2.770	0.004248	0.004228	0.00083	r	12
-0.8102	2.846	2.851	0.004345	0.004354	0.00086	r	27
-0.8211	2.898	2.891	0.004427	0.004417	0.00087	r	12
-1.0067	3.537	3.545	0.005433	0.005447	0.00114	r	27
-1.1690	4.102	4.113	0.006332	0.006351	0.00137	r	27
-1.194	4.208	4.202	0.006502	0.006492	0.00141	r	12
-1.4139	4.943	4.961	0.007687	0.007718	0.00173	r	27
-1.9758	6.851	6.860	0.010838	0.010857	0.00256	r	27
-1.988	6.927	6.901	0.010966	0.010924	0.00257	r	12
-2.7314	9.312	9.309	0.015067	0.015067	0.00364	r	27
-3.244	11.000	10.902	0.018080	0.017913	0.00434	r	12
-3.4660	11.591	11.576	0.019158	0.019142	0.00464	r	27
-3.789	12.660	12.540	0.021138	0.020927	0.00507	r	12
-4.0967	13.462	13.440	0.022650	0.022624	0.00547	r	27
-4.128	13.580	13.531	0.022875	0.022796	0.00551	r	12
-4.947	15.940	15.840	0.027474	0.027296	0.00654	r	12

(continued)

COMPONENTS	EVALUATOR:
(1) Rubidium chloride; RbCl; [7791-11-9] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987

CRITICAL EVALUATION (continued)

Table 3 (continued)

Solubility of Ice in Aqueous Solutions of RbCl

T/K - 273.15	mass % $100w_1$ exp.	calc.	mole fraction x_1 exp.	calc.	$\ln f_2$	status	ref.
-5.0217	16.079	16.045	0.027752	0.027706	0.00663	r	27
-5.606	17.660	17.618	0.030963	0.030902	0.00733	r	12
-6.2937	19.402	19.403	0.034621	0.034652	0.00813	r	27
-6.388	19.640	19.642	0.035131	0.035165	0.00824	r	12
-6.977	21.020	21.110	0.038138	0.038367	0.00891	r	12
-7.645	22.600	22.719	0.041687	0.041986	0.00965	r	12
-7.6634	22.676	22.763	0.041861	0.042086	0.00967	r	27
-8.672	25.090	24.087	0.047527	0.047544	0.01077	r	12
-10.4356	28.550	28.882	0.056184	0.057063	0.01266	r	27

$e = |x_1(\text{obs}) - x_1(\text{calc})|/x_1(\text{calc})$ r = recommended value $e < 0.015$

2.4 Boiling Point at Atmospheric Pressure

Rimbach (2) indicated $x_1 = 0.1795$, $T/\text{K} - 273.15 = 114.9$. The Earl of Berkeley indicated $x_1 = 0.1793$, 114.0°C (3) and, subsequently, 113.71°C (8). This latter value is the most precise.

2.5 Influence of Pressure on the Solubility

This has been calculated at 18°C by Gehlen and Dieter (15), whose results must be considered as *tentative* values.

2.6 Densities of Saturated Solutions

These have been measured, between $T/\text{K} - 273.15 = 0.55$ to 114, by Berkeley (3). One adds to these results the values of Buchanan (6) and of Belyaev (22, 25) at a few other temperatures. The experimental values can be represented correctly by the formula:

$$d = a_1 + b_1x_1 + c_1x_1^2$$

a_1, b_1 and c_1, calculated by least squares, have the values:

$a_1 = 0.9934$ $b_1 = 5.5759$ $c_1 = -11.8176$

with a correlation coefficient equal to 1. The recommended values are those of Berkeley.

SOLUBILITY AND DENSITY FOR ROUNDED VALUES OF TEMPERATURE

Values of solubility and density are given in Table 4 and figures 1 and 2. The calculated values can be recommended between $T/\text{K} - 273.15 = 0$ and -12 for the solubility curve of ice, and between -10 and 130 for the solubility curve of the salt. In other regions, the results of the calculations must be considered as *tentative*.

(continued)

COMPONENTS	EVALUATOR:
(1) Rubidium chloride; RbCl; [7791-11-9] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987

CRITICAL EVALUATION (continued)

Table 4

Solubility for Rounded Values of Temperature

$t/°C$	mass % $100w_1$	mole fraction x_1	molality m_1 $/\mathrm{mol\ kg^{-1}}$	density	$10^3 \ln f_2$	solid phase
0	0	0	0			ice
-1	3.52	0.00541	0.302		1.13	"
-2	6.94	0.01099	0.617		2.59	"
-3	10.15	0.01655	0.934		4.01	"
-4	13.16	0.02208	1.253		5.34	"
-5	15.99	0.02757	1.574		6.60	"
-6	18.65	0.03303	1.896		7.79	"
-7	21.17	0.03846	2.220		8.94	"
-8	23.55	0.04388	2.548		10.04	"
-9	25.82	0.04929	2.878		11.12	"
-10	27.97	0.05470	3.212		12.19	"
-11	30.03	0.06010	3.550		13.26	"
-12	32.00	0.06551	3.891		14.32	"
-13	33.88	0.07092	4.237		15.41	"
-14	35.68	0.07634	4.588		16.51	"
-15	37.41	0.08178	4.944		17.63	"
-16	39.08	0.08723	5.305		18.79	"
-17	40.68	0.09269	5.671		19.98 m	"
-18	42.44	0.09817	6.043		21.21 m	"
-19	43.71	0.10368	6.421		22.49 m	"
-20	45.14	0.10920	6.805		23.82 m	"
-30	36.23	0.0780	4.699		m	RbCl
-25	37.58	0.0823	4.979		m	"
-20	38.88	0.0866	5.260	1.3715	m	"
-15	40.12	0.0908	5.542			"
-10	41.32	0.0949	5.823	1.4079		"
-5	42.47	0.0991	6.105			"
0	43.57	0.1032	6.385	1.4396		"
2	44.00	0.1048	6.497	1.4396		"
4	44.42	0.1064	6.608			"
6	44.83	0.1080	6.720			"
8	45.24	0.1096	6.831			"
10	45.63	0.1112	6.942	1.4665		"
12	46.03	0.1127	7.052			"
14	46.41	0.1143	7.162			"
16	46.79	0.1158	7.272			"
18	47.16	0.1174	7.382			"
20	47.53	0.1189	7.491	1.4897		"
22	47.89	0.1204	7.600			"
24	48.24	0.1219	7.708			"
26	48.59	0.1234	7.816			"
28	48.93	0.1249	7.924			"
30	49.27	0.1264	8.031	1.5097		"
32	49.60	0.1279	8.138			"
34	49.92	0.1293	8.244			"
36	50.24	0.1308	8.350			"
38	50.55	0.1322	8.455			"
40	50.86	0.1336	8.560	1.5271		"
42	51.17	0.1350	8.665			"
44	51.46	0.1364	8.769			"

(continued)

COMPONENTS	EVALUATOR:
(1) Rubidium chloride; RbCl; [7791-11-9] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987

CRITICAL EVALUATION (continued)

Table 4 (continued)

Solubility for Rounded Values of Temperature

t/°C	mass % $100w_1$	mole fraction x_1	molality m_1 /mol kg^{-1}	density	$10^3\ln f_2$	solid phase
46	51.76	0.1378	8.872			RbCl
48	52.05	0.1392	8.975			"
50	52.33	0.1406	9.078	1.5426		"
52	52.61	0.1419	9.180			"
54	52.88	0.1433	9.282			"
56	53.15	0.1446	9.383			"
58	53.42	0.1459	9.483			"
60	53.68	0.1472	9.584	1.5561		"
62	53.94	0.1485	9.683			"
64	54.19	0.1498	9.783			"
66	54.44	0.1511	9.881			"
68	54.68	0.1524	9.980			"
70	54.93	0.1536	10.077	1.5686		"
72	55.16	0.1549	10.175			"
74	55.40	0.1561	10.272			"
76	55.63	0.1574	10.368			"
78	55.86	0.1586	10.464			"
80	56.08	0.1598	10.559	1.5800		"
82	56.30	0.1610	10.654			"
84	56.52	0.1622	10.749			"
86	56.73	0.1634	10.843			"
88	56.94	0.1646	10.937			"
90	57.15	0.1658	11.030	1.5907		"
92	57.36	0.1669	11.123			"
94	57.56	0.1681	11.215			"
96	57.76	0.1692	11.307			"
98	57.95	0.1704	11.399			"
100	58.15	0.1715	11.490	1.6010		"
102	58.34	0.1726	11.581			"
104	58.53	0.1737	11.672			"
106	58.72	0.1748	11.762			"
108	58.90	0.1759	11.852			"
110	59.08	0.1770	11.941	1.6110		"
112	59.26	0.1781	12.030			"
114	59.44	0.1792	12.119			"
116	59.61	0.1803	12.207			"
118	59.79	0.1813	12.295			"
120	59.96	0.1824	12.383	1.6211		"
125	60.38	0.1850	12.602			"
130	60.79	0.1876	12.819			"
135	61.18	0.1902	13.034			"
140	61.57	0.1927	13.248			"
145	61.94	0.1952	13.461			"
150	62.31	0.1976	13.673			"
200	65.62	0.2214	15.784	1.7159		"
250	68.55	0.2451	18.023			"
300	71.37	0.2708	20.614			"
350	74.24	0.3004	23.837			"
400	77.26	0.3360	28.094			"
450	80.45	0.3801	34.039			"

(continued)

COMPONENTS	EVALUATOR:
(1) Rubidium chloride; RbCl; [7791-11-9] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987

CRITICAL EVALUATION (continued)

Table 4 (continued)

Solubility for Rounded Values of Temperature

t/°C	mass % $100w_1$	mole fraction x_1	molality m_1 /mol kg^{-1}	density	$10^3 \ln f_2$	solid phase
500	83.84	0.4360	42.907			RbCl
550	87.41	0.5084	57.399			"
600	91.12	0.6047	84.901			"
650	94.95	0.7370	155.545			"
700	98.84	0.9270	705.392			"
714.85	100	1.0000	∞			"

m = metastable point

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(continued)

COMPONENTS	EVALUATOR:
(1) Rubidium chloride; RbCl; [7791-11-9] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987

CRITICAL EVALUATION (continued)

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COMPONENTS	EVALUATOR:
(1) Rubidium chloride; RbCl; [7791-11-9] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987

CRITICAL EVALUATION (continued)

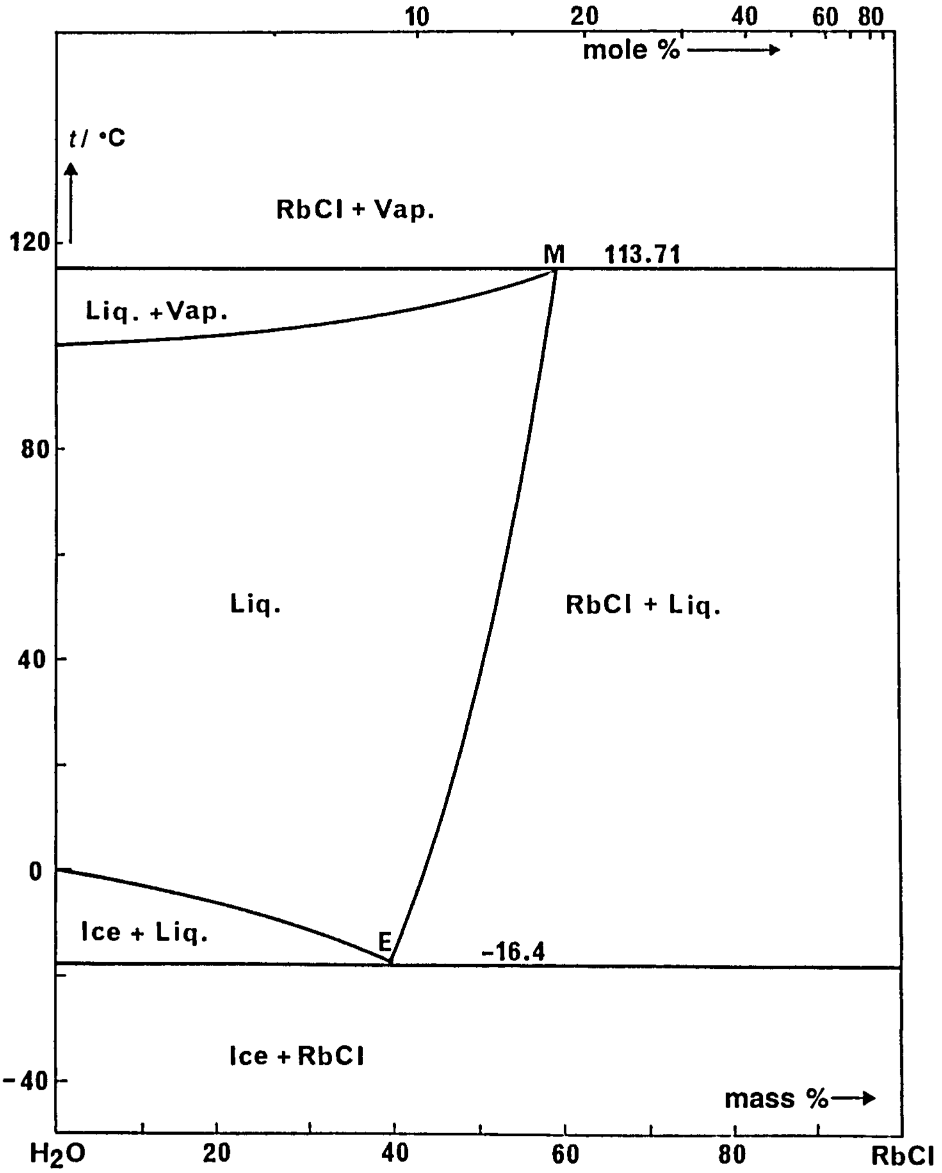

Fig. 1. Temperature-composition phase diagram for the system $RbCl-H_2O$ at a pressure of 1 bar.

(continued)

COMPONENTS	EVALUATOR:
(1) Rubidium chloride; RbCl; [7791-11-9] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987

CRITICAL EVALUATION (continued)

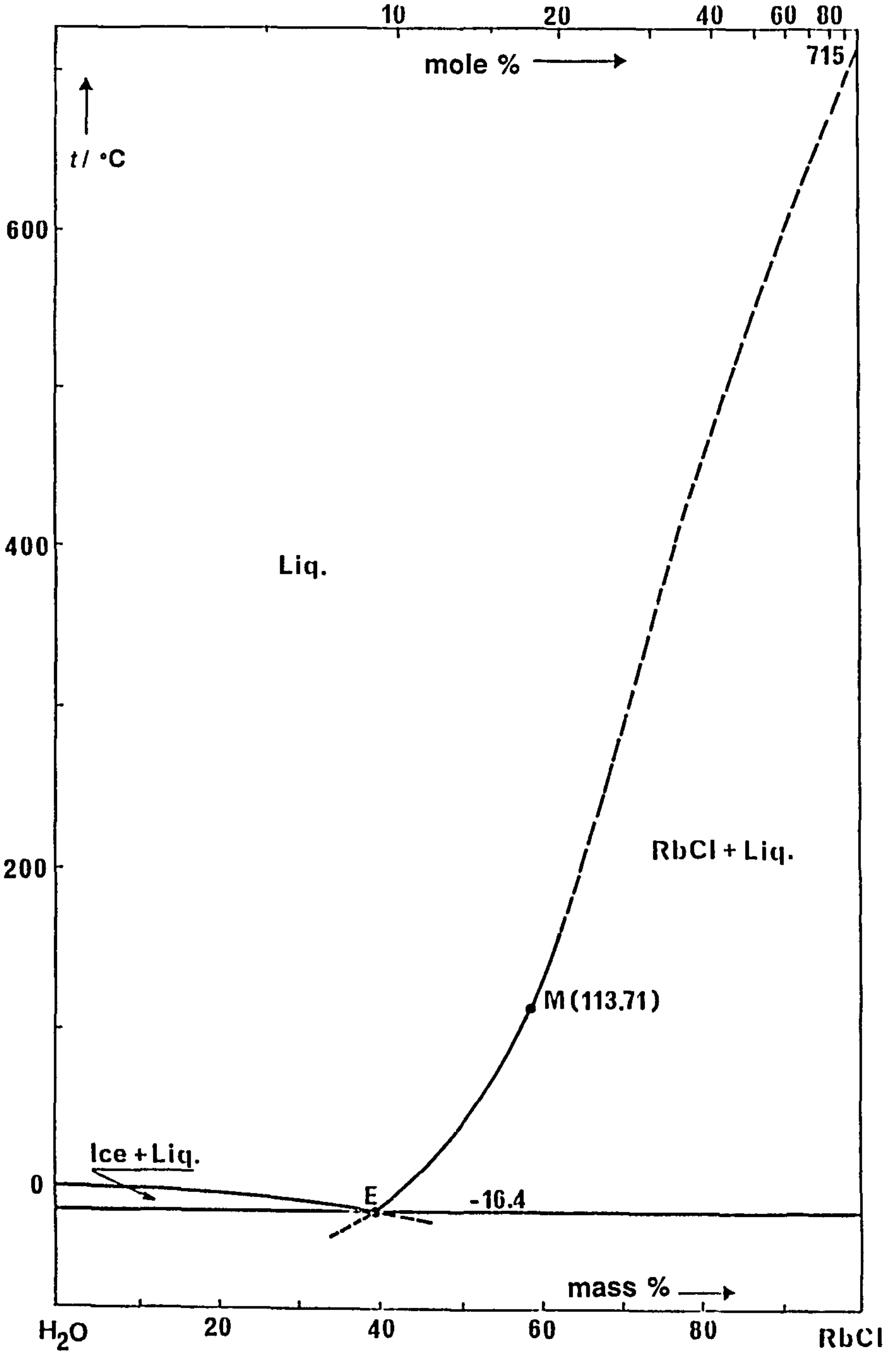

Fig. 2. Temperature-composition phase diagram for the system RbCl-H_2O under the vapor pressure of the saturated solution.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Rubidium chloride; RbCl; [7791-18-5] (2) Water; H_2O; [7732-18-5]	Kirchhoff, G.; Bunsen, R. *Ann. Phys. Chem.* [4] 1861, *113*, 337-81.
VARIABLES:	**PREPARED BY:**
$T/K = 274, 280$	J.W. Lorimer

EXPERIMENTAL VALUES:

$t/°C$	mass ratio $RbCl/H_2O$	mass % (compiler)	solid phase
1	0.7638	43.30	RbCl
7	0.8289	45.32	RbCl

COMMENTS:

These data are found on p. 352 of this paper, and were obtained in connection with the discovery and isolation of rubidium and caesium by the authors; the names of the elements are proposed in the paper, and the derivations of the names are also given. The preparation of RbCl appears to have been very pure; the analytical data given (0.9740 g RbCl gave 1.1541 g AgCl on precipitation) correspond to $x = 1.0010$ in $RbCl_x$, or 29.31 % Cl (theory 29.32), when 1984 atomic weights are used (compiler).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE	SOURCE AND PURITY OF MATERIALS:
No details are given; presumably the isothermal saturation method was used.	RbCl was extracted from lepidolite from Saxony. A large sample was freed from lithia and "earths", leaving a residue of about 150 kg. Extraction made use of the lower solubility of $RbPtCl_2$, compared to the chloroplatinates of Na and K. The purity of the product was checked by the emission spectrum.
	ESTIMATED ERROR:
	REFERENCES:

COMPONENTS:

(1) Rubidium chloride; RbCl; [7791-11-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Rimbach, E.

Ber. Dtsch. Chem Ges. 1902, 35, 1298-1309.

VARIABLES:

T/K = 274-388

PREPARED BY:

M. Ferriol

EXPERIMENTAL VALUES:

t/°C	mass % from Cl content	mass % from dry residue	mass % average	solid phase
0.4	43.59	43.63	43.61	RbCl
15.5	46.75	46.37	46.56	"
57.3	53.52	53.90	53.71	"
114.9	59.60	59.35	59.48	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The mixture was stirred for 5 or 6 h in a liquid thermostat. The saturated solution was drawn off by means of a pipet and its components determined by using chloride titration and evaporation to dryness at 105°C and weighing.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

Temperature: ±0.1 K
Solubility: precision range about 0.2 mass %

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Rubidium chloride; RbCl; [7791-11-9] (2) Water; H_2O; [7732-18-5]	Berkeley, Earl of *Phil. Trans. R. Soc. London, Ser. A* 1904, *203*, 189-214.
VARIABLES:	**PREPARED BY:**
T/K = 274-387	M. Ferriol

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio RbCl/H_2O	mass %	density g cm^{-3}	solid phase
0.55	77.34	43.61	1.4409	RbCl
18.70	90.32	47.46	1.4865	"
31.50	98.61	49.65	1.5118	"
44.70	106.24	51.51	1.5348	"
60.25	115.63	53.62	1.5558	"
75.15	124.52	55.46	1.5746	"
89.35	132.73	57.03	1.5905	"
114.0 [a]	146.65	59.46	1.6148	"

---

[a] boiling point

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The salt-water mixture was stirred at the appropriate temperature and the density followed by pycnometric measurement until its value remained constant. The solubilities were determined by evaporation to dryness of the saturated solution in platinum crucibles, except at the boiling point where Jena glass bulbs were used. According to the range, different temperature control systems were used. Temperatures were corrected to the hydrogen scale.

SOURCE AND PURITY OF MATERIALS:

Purest product from Merck, checked by chloride titration. The RbCl was tested spectroscopically for the presence of potassium and caesium.

ESTIMATED ERROR:

Temperature: ±0.01 K
Solubility: within ±0.16 mass %

REFERENCES:

COMPONENTS: (1) Rubidium chloride; RbCl; [7791-11-9] (2) Water; H_2O; [7732-18-5]	**ORIGINAL MEASUREMENTS:** Buchanan, J.Y. *Am. J. Sci.* 1906, *21*, 25-40.
VARIABLES: T/K = 296	**PREPARED BY:** M. Ferriol

EXPERIMENTAL VALUES:

t/°C	molality, mol kg^{-1}	mass % a	density g cm^{-3}	solid phase
22.9	7.7670	48.45	1.4971	RbCl

[a] RbCl molar mass: 121.0 g mol^{-1}, according to the author.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

25 g of distilled water were weighed into a suitable vessel and the salt was gradually added until a small quantity remained undissolved. This quantity was such that a further increase in temperature of 1 K caused all salt to disappear. The salt content was determined by titration with 0.1 M $AgNO_3$.

SOURCE AND PURITY OF MATERIALS:

RbCl: Schuchardt's purest reagent.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

COMPONENTS:

(1) Rubidium chloride; RbCl;
[7791-11-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Berkeley, Earl of; Appleby, M.P.

Proc. R. Soc. London, A
1911, 85, 489-505.

VARIABLES:

p/mmHg = 750, 760

PREPARED BY:

R. Cohen-Adad

EXPERIMENTAL VALUES:

pressure mm Hg	t/°C (boiling point)	concentration mol dm^{-3}	mass % (compiler)[b]	solid phase
750	113.318			RbCl
760	113.710[a]	7.948	59.618	

[a] corrected to standard conditions
[b] density is recorded in previous paper (1)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Described in previous paper (1).

SOURCE AND PURITY OF MATERIALS:

Merck's salt recrystallized 3x.

ESTIMATED ERROR:

Temperature: precision within ±0.005 K

REFERENCES:

1. Berkeley, Earl of *Phil. Trans. R. Soc. London, A* 1904, *203*, 189-214.

COMPONENTS: (1) Rubidium chloride; RbCl; [7791-11-9] (2) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Benrath, A. *Z. Anorg. Allg. Chem.* 1927, *163*, 396-404.
VARIABLES: T/K = 298	PREPARED BY: M. Ferriol

EXPERIMENTAL VALUES:

t/°C	mol ratio $H_2O/RbCl$	mass % (compiler)	solid phase
25	6.87	49.71	RbCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: Not stated; probably isothermal method.	SOURCE AND PURITY OF MATERIALS: Not stated. ESTIMATED ERROR: No estimates possible. REFERENCES:

COMPONENTS: (1) Rubidium chloride; RbCl; [7791-11-9] (2) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Foote, H.W. *Am. J. Sci.* 1927, [5], *13*, 158-66.
VARIABLES: T/K = 298	PREPARED BY: M. Ferriol

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	48.57	RbCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: Saturated solutions were prepared by shaking the components in small glass-stoppered bottles in a thermostat. They were drawn off for analysis through a small filter of glass wool directly into a weighing bottle.	SOURCE AND PURITY OF MATERIALS: RbCl was recrystallized. ESTIMATED ERROR: No estimates possible. REFERENCES:

COMPONENTS:

(1) Rubidium chloride; RbCl; [7791-11-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Karagunis, G.; Hawkinson, A.; *Damkohler*, G.

Z. *Phys. Chem.*, Abt. A 1930, *151*, 433-66.

VARIABLES:

T/K: 264-273

PREPARED BY:

M. Ferriol

EXPERIMENTAL VALUES:

t/°C	molality mol kg^{-1}	mass % (compiler)	solid phase
-0.0651_0	0.0178_0	0.2148	ice
-0.1511_5	0.0421	0.5065	"
-0.2190_0	0.0622	0.7465	"
-0.2774	0.0778_0	0.9320	"
-0.2738	0.0782_6	0.9374	"
-0.4165	0.1215	1.448	"
-0.5352	0.1581	1.876	"
-0.6296	0.1873	2.215	"
-0.7872	0.2368	2.784	"
-0.8211	0.2468	2.898	"
-1.194	0.3633	4.208	"
-1.988	0.615_5	6.927	"
-3.244	1.022	11.00	"
-3.789	1.199	12.66	"
-4.128	1.300	13.68	"
-4.947	1.568	15.94	"
-5.606	1.774	17.66	"
-6.388	2.021	19.64	"
-6.977	2.201	21.02	"
-7.645	2.415	22.60	"
-8.672	2.770	25.09	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Cryoscopic method: the difference between melting points of ice and solution was measured with a thermocouple. The concentration of solutions was determined with a Haber-Lowe interferometer.

SOURCE AND PURITY OF MATERIALS:

The purity of RbCl was checked by potentiometric titration of Cl.

ESTIMATED ERROR:

$\Delta(t/m) = 0.2\%$

REFERENCES:

COMPONENTS:

(1) Rubidium chloride; RbCl; [7791-11-9]

(2) Water; H_2O; [7732-185]

ORIGINAL MEASUREMENTS:

Fajans, K.; Karagunis, G. *quoted by* Meyer, K.H.; Dunkel, M.

Z. Phys. Chem., Bodenstein-Festband 1931, 553-573.

VARIABLES:

$T/K = 298$

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	molality mol kg^{-1}	mass % (compiler)	mol%	solid phase
25	7.8	52	13.9	RbCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

No details given.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Rubidium chloride; RbCl; [7791-11-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Lannung, A.

Z. Phys. Chem., Abt. A 1934, *170*, 134-44.

VARIABLES:

$T/K = 291$
$p/kPa = 1.6$

PREPARED BY:

J.J. Counioux

EXPERIMENTAL VALUES:

t/°C	*p*/mmHg	molality	mass %	solid phase
18	11.86	7.10	47.07	RbCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The vapor pressure of the solution was plotted against the concentration. The solubility was deduced from the break in this curve.

SOURCE AND PURITY OF MATERIALS:

The purity of the salt has been described in a previous paper (1).

ESTIMATED ERROR:

Temperature: precision ±0.003 K
Pressure: ±7 Pa

REFERENCES:

(1) Lannung, A. *Z. Phys. Chem., Abt. A.* 1932, *161*, 255.

COMPONENTS:

(1) Rubidium chloride; RbCl; [7791-11-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Gehlen, H.; Dieter, H.

Z. *Phys. Chem.* (*Leipzig*) 1950, *196*, 258-77.

VARIABLES:

p/atm = 0-10^4

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	p/atm	mass % RbCl		solid phase
		a	b	
18	0	46.2	46.2	RbCl
	1000	48.0	48.0	"
	2000	49.5	49.5	"
	3000	50.7	51.2	"
	4000	52.0	52.9	"
	5000	53.4	54.7	"
	6000	54.3	56.2	"
	7000	55.2	57.5	"
	8000	56.1	58.9	"
	9000	56.9	59.8	"
	10000	57.9	60.8	"

a: first approximation
b: second approximation

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Solubilities under pressure were calculated from density and vapor pressure data at atmospheric pressure using Tammann's assumption (1) concerning the coincidence pressure and the compressibility of solid RbCl.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Tammann, G. *Uber die Beziehungen zwischen den inneren Kraften und Eigenschaften der Losungen*. Leopold Voss. Hamburg und Leipzig. 1907.

COMPONENTS:

(1) Rubidium chloride; RbCl; [7791-11-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Blidin, V.P.

Izv. Akad. Nauk. SSSR 1953, *5*, 814-19; *Zh. Obshch. Khim.* 1956, *26*, 1281-5; **J. Gen. Chem. USSR (Engl. Transl.)* 1956, *26*, 1449-52.

VARIABLES:

T/K = 298, 313

PREPARED BY:

M.-T. Saugier-Cohen Adad

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	48.12[a]	RbCl
40	49.85	"

[a] Given in both 1953 and 1956 papers. Result at 40°C in 1956 paper only.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Isothermal method: saturation was obtained by addition of small quantities of salt. A sample of clear solution was weighed and analyzed. The remaining salt was weighed.

SOURCE AND PURITY OF MATERIALS:

Pure salt twice recrystallized.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

COMPONENTS:

(1) Rubidium chloride; RbCl; [7791-11-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Durham, G.S.; Rock, E.J.; Frayn, J.S.

J. Am. Chem. Soc. 1953, *75*, 5792-4.

VARIABLES:

T/K = 298

PREPARED BY:

J. W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	48.48	RbCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothermal saturation method was used, starting from both over- and undersaturation. For the ternary systems investigated, equilibrium was reached in 3-4 weeks. The solubility tubes were rotated in a thermostat, and samples were removed through filter pipets. Analysis was by titration for chloride.

SOURCE AND PURITY OF MATERIALS:

RbCl: A.D. Mackay, c.p. grade, dried to const. wt. at 190°C; gave no test for Br, but contained 0.6% KCl.

ESTIMATED ERROR:

Temperature: precision within ±0.02 K.
Solubility: precision within ±0.1 mass % (compiler).

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Rubidium chloride; RbCl; [7791-11-9] (2) Water; H_2O; [7732-18-5]	Makarov, L.L.; Evstrop'ev, K.K.; Vlasov, Yu. G. *Zh. Fiz. Khim.* <u>1957</u>, *31*, 1621.
VARIABLES:	PREPARED BY:
T/K = 298	P. Vallée

EXPERIMENTAL VALUES:

t/°C	molality m_1/mol kg^{-1}	mass %	solid phase
25	7.78	48.47	RbCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE	SOURCE AND PURITY OF MATERIALS:
Isopiestic method (compiler).	No information given.
	ESTIMATED ERROR:
	No estimates possible.
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Rubidium chloride; RbCl; [7791-11-9] (2) Water; H_2O; [7732-18-5]	Belyaev, I.N.; Le T'yuk *Zh. Neorg. Khim.* 1966, *11*, 1919-25; **Russ. J. Inorg. Chem. (Engl. Transl.)* 1966, *11*, 1025-8.
VARIABLES:	PREPARED BY:
$T/K = 298$	M. Ferriol

EXPERIMENTAL VALUES:

t/°C	mass %	viscosity mPa s	density g cm^{-3}	electrical conductivity S cm^{-1}	solid phase
25	48.50	1.0870	1.455	0.212	RbCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The method was described in earlier publications (1,2). The solubility was determined by the isothermal method in vessels with a stirrer and hydrostatic seal. Equilibrium was reached by continuous stirring for 8-10 h. Samples of liquid phase were analyzed for Cl. Electrical conductivity, viscosity and density were also measured.

SOURCE AND PURITY OF MATERIALS:

RbCl was made from "pure" grade carbonate.

ESTIMATED ERROR:

Temperature: ±0.1 K.

REFERENCES:

1. Belyaev, I.N.; Le T'yuk. *Zh. Neorg. Khim.* 1965, *10*, 1229; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1965, *10*, 664.
2. Belyaev, I.N.; Le T'yuk, *Zh. Neorg. Khim.* 1965, *10*, 235; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1965, *10*, 1279.

COMPONENTS:

(1) Rubidium chloride; RbCl; [7791-11-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sheveleva, A.D.

Uch. Zap. Permsk. Gos. Univ. im. A.M. Gor'kogo 1966, No. 159, 3-14.

VARIABLES:

T/K = 293, 323

PREPARED BY:

T. Mioduski

EXPERIMENTAL VALUES:

t/°C	mass%	molality mol kg^{-1}	solid phase
20	47.7	7.54	RbCl
50	52.2	9.03	RbCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The isothermal saturation method was used, with refractometric analysis (1). Known amounts of solid and water were equilibrated until their refractive indices became constant. The compositions of saturated solutions were found from discontinuities in the refractive index-composition plots. The refractometer was thermostated at 50°C.

SOURCE AND PURITY OF MATERIALS:

RbCl: Analytical grade was presumably used as received.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Zhuravlev, E.F.; Sheveleva, A.D.; *Zh. Neorg. Khim.* 1960, 5, 2630; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1960, 5, 1270.

COMPONENTS:

(1) Rubidium chloride; RbCl; [7791-11-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sheveleva, A.D.; Mochalov, K.I.; Khurtorski, E.N.; Torgashina, N.A.

Uch. Zap. Permsk. Gos. Univ. im. A.M. Gor'kogo 1973, No. 289, 3-8.

VARIABLES:

T/K = 323

PREPARED BY:

T. Mioduski

EXPERIMENTAL VALUES:

t/°C	mass%	molality mol kg^{-1}	solid phase
50	51.2	8.68	RbCl
50	52.5	9.14	RbCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The isothermal saturation method was used, with refractometric analysis (1). Known amounts of solid and water were equilibrated until their refractive indices became constant. The compositions of saturated solutions were found from discontinuities in the refractive index-composition plots. The refractometer was thermostated at 50°C.

SOURCE AND PURITY OF MATERIALS:

RbCl: Analytical grade was presumably used as received.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Zhuravlev, E.F.; Sheveleva, A.D.; *Zh. Neorg. Khim.* 1960, 5, 2630; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1960, 5, 1270.

COMPONENTS:

(1) Rubidium chloride; RbCl; [7791-11-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Arkhipov, S.M.; Kashina, N.I.; Rezvina, T.V.

Zh. Neorg. Khim. 1968, *13*, 587-8; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1968, *13*, 304.

VARIABLES:

T/K = 273, 298, 323

PREPARED BY:

P. Vallée

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
0	43.48	RbCl
25	48.60	RbCl
50	52.30	RbCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothermal saturation method was used with prolonged stirring of the solid phase and solution. At 0°C, glass vessels with oil seals were immersed in melting ice; at 25 and 50°C, test tubes were placed in a thermostat and stirred. Equilibrium was reached in 10 h. The composition of the saturated solution was found by titration with $AgNO_3$ and K_2CrO_4 indicator.

SOURCE AND PURITY OF MATERIALS:

RbCl: purity 99.9%.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Rubidium chloride; RbCl; [7791-11-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Bykova, I.N.; Kuznetzova, G.P.; Kolotilova, V.Ya.; Stepin, B.D.

Zh. Neorg. Khim. 1968, *13*, 540-4; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1968, *13*, 282-4.

VARIABLES:

T/K = 298

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	48.29	RbCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothermal saturation method was used with prolonged stirring of the solid phase and solution. Equilibrium was rached within 15 d. Analysis: gravimetric, with Rb as the tetraphenylborate, Cl as AgCl.

SOURCE AND PURITY OF MATERIALS:

RbCl: "pure" grade, heated to 400 °C to remove organic impurities, then recryst. from water, dried at 120°C.

ESTIMATED ERROR:

Temperature: precision within ±0.1 K.

REFERENCES:

COMPONENTS:

(1) Rubidium chloride; RbCl; [7791-11-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Belyaev, I.N.; Lobas, L.M.

Zh. Neorg. Khim. 1968, *13*, 1149-55; **Russ. J. Inorg. Chem. (Engl. Transl.)* 1968, *13*, 601-4.

VARIABLES:

$T/K = 298$

PREPARED BY:

M. Ferriol

EXPERIMENTAL VALUES:

$t/°C$	mass %	density g cm^{-3}	viscosity mPa s	conductivity S cm^{-1}	solid phase
25	48.50	1.487	1.0741	0.165	RbCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The isothermal method was used. Viscosity, electrical conductivity and density were measured.

SOURCE AND PURITY OF MATERIALS:

RbCl: recrystallized "chemically pure" grade reagent.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Rubidium chloride; RbCl; [7791-11-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Merbach, A.; Gonella, J.

Helv. Chim. Acta 1969, *52*, 69-76.

VARIABLES:

$T/K = 298$

PREPARED BY:

M. Ferriol

EXPERIMENTAL VALUES:

$t/°C$	100 x mole ratio H_2O/RbCl	mass % (compiler)	solid phase
25	708	48.67	RbCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The Brunisholz' saturation method was used (1). Chloride was determined potentiometrically.

SOURCE AND PURITY OF MATERIALS:

RbCl: Merck "analytical reagent" grade was used.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

1. Brunisholz, G.; Quinche, J.P.; Kalo, A.M. *Helv. Chim. Acta* 1964, *47*, 14.

COMPONENTS:

(1) Rubidium chloride; RbCl; [7791-18-5]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Momicchioli, F.; Devoto, O.; Grandi, G.; Cocco, G.

Atti Soc. Nat. Modena 1968, *99*, 226; *Ber. Bunsen-Ges. Phys. Chem.* 1970, 74, 59-65.

VARIABLES:

$T/K = 264\text{-}273$

PREPARED BY:

R. Cohen-Adad

EXPERIMENTAL VALUES:

t/°C (compiler)	molality /mol kg^{-1}	$\Delta T/m$ /K kg mol^{-1}	mass % (compiler)	solid phase
-0.0473	0.01286	3.6_7	0.155	ice
-0.0771	0.02145	3.5_9	0.259	ice
-0.0949	0.02650	3.5_8	0.319	ice
-0.1423	0.04055	3.50_9	0.488	ice
-0.1935	0.05522	3.50_4	0.663	ice
-0.2147	0.06160	3.48_5	0.739	ice
-0.2708	0.07826	3.46_0	0.937	ice
-0.4152	0.12177	3.41_0	1.451	ice
-0.5504	0.16232	3.39_1	1.925	ice
-0.6713	0.19974	3.36_1	2.358	ice
-0.8102	0.24222	3.34_5	2.846	ice
-1.0067	0.30323	3.32_0	3.537	ice
-1.1690	0.35372	3.30_5	4.102	ice
-1.4139	0.43005	3.287_8	4.943	ice
-1.9758	0.60827	3.248_2	6.851	ice
-2.7314	0.84910	3.216_8	9.312	ice
-3.4660	1.08422	3.196_8	11.591	ice
-4.0967	1.28646	3.184_5	13.462	ice
-5.0217	1.58444	3.169_4	16.079	ice
-6.2937	1.99072	3.161_5	19.402	ice
-7.6634	2.42520	3.159_9	22.676	ice
-10.4356	3.30440	3.158_1	28.550	ice

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

A precision apparatus for measuring freezing point depressions by the equilibrium method was used, as described in (1). Temperatures were measured by a Pt resistance thermometer and Mueller bridge. Efficient stirring was accomplished by a high-quality air-driven stirrer. Concentrations were determined by a Hilger-Rayleigh interferometer.

SOURCE AND PURITY OF MATERIALS:

Merck "Suprapur" reagent, Cat. No. 7622.

ESTIMATED ERROR:

Temperature: precision $\pm 3 \times 10^{-4}$ K. Composition: Absolute error almost independent of molality, and about $4\text{-}5 \times 10^{-5}$ mol kg^{-1}.

REFERENCES:

(1) Chiorboli, P.; Momicchioli, F.; Grandi, G. *Boll. Sci. Fac. Chim. Ind. Bologna* 1966, *24*, 133.

COMPONENTS:

(1) Rubidium chloride; RbCl; [7791-11-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Fedorova, O.N.; Serebrennikova, G.M.; Stepin, B.D.
Zh. Neorg. Khim. 1971, *16*, 2808-13;
**Russ. J. Inorg. Chem. (Engl. Transl.)* 1971, *16*, 1495-7.

VARIABLES:

$T/K = 298$

PREPARED BY:

M. Ferriol

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	48.54	RbCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The isothermal saturation method was used. Equilibrium was reached in 14 d. Samples of the liquid phase were analyzed for Cl by a gravimetric method.

SOURCE AND PURITY OF MATERIALS:

RbCl: Chemically pure grade was used.

ESTIMATED ERROR:

Temperature: precision ±0.1 K.

REFERENCES:

COMPONENTS:

(1) Rubidium chloride; RbCl; [7791-11-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Arkhipov, S.M.; Kashina, N.I.; Kuzina, V.A.
Zh. Neorg. Khim. 1974, *19*, 2858-62;
**Russ. J. Inorg. Chem. (Engl. Transl.)* 1974, *19*, 1562-4.

VARIABLES:

$T/K = 298$

PREPARED BY:

P. Vallée

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	48.21	RbCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The isothermal method was used. Equilibrium was reached within 30-36 h. The liquid phase was analyzed for Rb by precipitation with Na tetraphenylborate (1), and for Cl by titration with $AgNO_3$.

SOURCE AND PURITY OF MATERIALS:

RbCl: purity greater than 99.5%.

ESTIMATED ERROR:

Temperature: precision ±0.1 K.

REFERENCES:

1. Yanson, E.Yu.; Ievinysh, A.F. *Usp. Khim.* 1959, *28*, 980.

COMPONENTS:

(1) Rubidium chloride; RbCl; [7791-11-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Filippov, V.K.; Agafonova, K.A.; Yakimov, M.A.
Zh. Neorg. Khim. 1974, *19*, 3150-2;
**Russ. J. Inorg. Chem. (Engl. Transl.)* 1974, *19*, 1723-4.

VARIABLES:

T/K = 298

PREPARED BY:

P. Vallée

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	48.58	RbCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The isothermal saturation method was used (1). Analysis was by evaporation of a sample of solution followed by heating to constant mass between 240 and 260°C.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Shchukarev, S.A.; Yakimov, M.A.; Mishin, V.Ya. *Zh. Neorg. Khim.* 1958, *3*, 1661.

COMPONENTS:

(1) Rubidium chloride; RbCl; [7791-11-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Balarev, Kh.; Ketenev, D.N.;
Dokl. Bolg. Akad. Nauk 1975, *28*, 221-3.

VARIABLES:

T/K = 298

PREPARED BY:

M. Ferriol

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	48.51	RbCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The Khlopin method (isothermal decrease of supersaturation) was used. A series of almost saturated solutions was prepared at a temperature higher than 25°C. These were then placed in a thermostat at 25°C with stirring. Equilibrium was reached within 12-15 d. The liquid phase was analyzed for Cl by the Mohr method.

SOURCE AND PURITY OF MATERIALS:

RbCl: A.R. reagent was used.

ESTIMATED ERROR:

Temperature: precision ±0.1 K.

REFERENCES:

COMPONENTS:

(1) Rubidium chloride; RbCl; [7791-11-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kartzmark, E.M.

Can. J. Chem. 1977, *55*, 2792-8.

VARIABLES:

T/K = 298

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25.00	47.92	RbCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The isothermal method was used. The mixture was equilibrated by stirring at 25.00°C for 2 or 3 days. The phases were separated by filtration through sintered glass and were analyzed for chloride by precipitation as AgCl.

SOURCE AND PURITY OF MATERIALS:

RbCl: reagent grade was used without further purification.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Rubidium chloride; RbCl; [7791-11-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Shirai, Yu.V.; Shevchuk, V.G.

Zh. Neorg. Khim. 1981, *26*, 1940-3; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1981, *26*, 2046-8.

VARIABLES:

T/K = 298

PREPARED BY:

T. Mioduski

EXPERIMENTAL VALUES:

t/°C	mass %	molality mol kg^{-1}	refractive index	solid phase
25	48.74	3.881	1.3854	RbCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The isothermal method was used. The mixture was equilibrated by stirring in a thermostat, and equilibrium was reached within several days. Analysis was for Cl by the Volhard method.

SOURCE AND PURITY OF MATERIALS:

RbCl: C.P. grade was probably used as received.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Rubidium chloride; RbCl; [7791-11-9] (2) Water; H_2O; [7732-18-5]	Rard, J.A. *J. Chem. Eng. Data* <u>1984</u>, *29*, 443-50.
VARIABLES:	PREPARED BY:
T/K = 298	J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	molality mol kg^{-1}	mass % (compiler)	solid phase
25	7.7832 ± 0.0071	48.484 ± 0.044	RbCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Isopiestic equilibrations were made at 25.00 ± 0.005°C (IPTS-68) with aqueous NaCl and $CaCl_2$ solns as reference slns. Equilibration times were 4 d or longer. All weights were corrected to vacuum. Inert cups of Ta metal were used as containers. The standard slns have been described elsewhere (1), and were analyzed carefully. The RbCl stock conc. was detd. by both mass titration with $AgNO_3$ and by dehydration. The titration results and the water content from dehydration were used to obtain a stock conc. that was independent of any assumptions about impurities. Corrections were made for impurities by estimates of their effect on the osmotic coefficient, plus measurements of osmotic coefficients in presence of added KCl.

SOURCE AND PURITY OF MATERIALS:

RbCl: Alfa "99.9 %" was found to contain 0.577 mol % KCl, 0.053 mol % NaCl, 0.059 mol % CsCl.

ESTIMATED ERROR:

Temperature: accuracy ± 0.005 K.
Solubility: precision ± 0.0071 mol kg^{-1}.

REFERENCES:

1. Rard, J.A.; Miller, D.G. *Chem. Eng. Data* <u>1981</u>, *26*, 38.

COMPONENTS	EVALUATOR:
(1) Caesium chloride; CsCl; [7647-17-8] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987

CRITICAL EVALUATION

Solubility data for the system $CsCl-H_2O$ have been presented in 30 publications. The solid phase in equilibrium with the saturated solution is the anhydrous salt which is found in two polymorphic forms: the lower temperature form is simple cubic (sc), while the higher temperature form is face-centred cubic (fcc).

EXPERIMENTAL METHODS

The solubility of CsCl in water has been measured using analytical methods (3-5, 9, 20, 35, 42, 45, 50-52, 54, 55, 57, 59, 64-66) or synthetic methods (6, 7, 22, 40a, 61, 66, 67), or, in one case (27), from vapor pressure as a function of concentration at a fixed temperature. The greater part of the determinations were made under isothermal conditions.

ANALYSIS OF SOLUTIONS

The composition of the sample or of the saturated solution was determined by evaporation to dryness and weighing (4, 5, 64, 66) or else by chemical analysis for chloride (7, 45, 55, 56, 65, 66) or cesium (55).

PRODUCTS USED

Usually CsCl was a pure reagent, sometimes recrystallized once or twice. Foote (3) obtained the salt by thermal decomposition of cesium dichloride iodide ($CsCl_2I$) prepared by Professor Wells.

POLYMORPHISM

The transition temperatures reported in the bibliography range between 718 and 752 K (28, 31, 34, 36, 43, 44, 46, 62). The recent measurements of A.M. Vernay (62) indicate a temperature of 745 or 731 K, depending on whether it is taken during heating or cooling. The temperature used in our calculations is that of JANAF (60): 743 K.

MELTING POINT

Numerous measurements of the melting point of CsCl have been made: (1, 8, 10-19, 23, 26, 28, 29, 37, 40, 47, 48). We have accepted 918 K for calculating the solubility curve at high temperature (fcc variety), with an enthalpy of fusion of 16 kJ mol^{-1} (3.8 kcal mol^{-1}) (tentative value) (60).

CRITICAL EVALUATION OF THE RESULTS

1. *Fitting equations*

All the data on the compilation sheets have been analyzed according to the procedure given in the Preface to this volume. The curves can be represented by equations of the form:

(continued)

COMPONENTS	EVALUATOR:
(1) Caesium chloride; CsCl; [7647-17-8] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987

CRITICAL EVALUATION (continued)

$$Y(x_1) - Y(x_0) = A(1/T - 1/T_0) + B\ln(T/T_0) + C(T - T_0)$$

where x_0, T_0 are the coordinates of a specified point on the solubility curve.

1.1 Solubility of CsCl

Assuming that cesium chloride is completely dissociated into ions, Y is expressed by the relation:

$$Y = 2\ln[2x_1/(1 + x_1)]$$

Two branches of the solubility curve are observed:

a. At high temperature (fcc polymorph)

No experimental data exist. However, it is possible to deduce the approximate course of the solubility curve from thermochemical data for the salt (41,47,60,63):

- melting point: T_0 = 918 K, x_0 = 1
- enthalpy of fusion: 16 kJ mol^{-1} (3.8 kcal mol^{-1})
- variation in heat capacity change ΔCp = 13.72 J K^{-1} mol^{-1} (3.280 cal K^{-1} mol^{-1} at 800 K and 13.23 J K^{-1} mol^{-1} (3.162 cal K^{-1} mol^{-1}) to 900 K.

b. Transition point (50)

The composition is calculated from the equation of the liquidus of CsCl (fcc). The coordinates are:

T = 743 K x_1 = 0.6636

c. At low temperature (simple cubic polymorph)

Experimental data are limited to the range between 0.3 and 119.9°C. The coefficients A, B, C of the equation $Y = f(T)$ are evaluated by a least squares method which requires that the curve pass through the transition point calculated from the high temperature data.

1.2. Solubility of ice

Several fitting equations have been tried and compared. All represent correctly the experimental results, but the majority do not permit a correct extrapolation of the solubility curves.

The best representation was obtained by supposing that the Cs^+ ion is minimally solvated in solution, and that the logarithm of the activity coefficient of water ($\ln f_2$) can be developed in a series of the form:

$$\ln f_2 = \{x_1(1 + x_1)\}^{3/2}(E + Fz + Gz^2 + Hz^3)/T$$

with $z = \ln\{x_1/(1 + x_1)\}$.

The coefficients F, G, H are adjusted by a least squares method. E is calculated by requiring the curve to pass through the eutectic point.

1.3. Coefficients of the fitting equations: see Table 1.

(continued)

COMPONENTS	EVALUATOR:
(1) Caesium chloride; CsCl; [7647-17-8] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987

CRITICAL EVALUATION (continued)

Table 1

System $CsCl-H_2O$

Coefficients of fitting equations for solubility

Coefficient	Solid Phase fcc	 cubic	 ice
A	-211.266	-2892.72	
B	2.1268	12.013	
C	$-\ 2.97 \times 10^{-4}$	0.016136	
E			-350.368
F			-47.709
G			73.031
H			6.801
Range/K	745-918	250.8-745	250.8-273.15

2. *Solubility Data*

2.1 CsCl (cubic)

The calculation was carried out using 40 numerical values. The whole of the experimental results and calculations are presented in Table 2. The data from the literature are very coherent among themselves with the exception of those of Buchanan (7) which have not been taken into account in the calculations. The results of Meyer and Dunkel (24) are relatively distant from the other experimental values. The best values appear to be those of the Earl of Berkeley (4,9).

Extrapolation of the solubility curve permits calculation of the metastable melting point of cubic CsCl:

tp = 552.5°C (825.5 K)

2.2 Eutectic Point

No experimental value is given in the literature. The coordinates of the eutectic point have therefore been determined in our laboratory by Merrachi (68) with the goal of extending the low temperature measurements and of verifying the validity of the fitting equations in the course of the extrapolation. Measurements were carried out by thermal analysis and the setting up of a Tammann diagram. The coordinates of the eutectic are:

$t = -22.3°C\ (T = 250.9\ K)$ $w_1 = 0.542$ $x_1 = 0.1124$

In Table 1, $e = |x_1(\text{calc}) - x_1(\text{obs})|/x_1(\text{calc})$.

(continued)

COMPONENTS	EVALUATOR:
(1) Caesium chloride; CsCl; [7647-17-8] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987

CRITICAL EVALUATION (continued)

Table 2

Solubility of CsCl in Aqueous Solutions

T/K − 273.15	mass % $100w_1$		mole fraction x_1		density d/g cm^{-3}		status	ref.
	exp.	calc .	exp.	calc.	exp.	calc.		
0.3	61.9	61.89	0.1481	0.1480			r	5
0.7	61.87	61.95	0.1479	0.1484	1.8458	1.8435	r	4
10	63.5	63.48	0.1569	0.1568			r	5
15	64.750	64.24	0.1643	0.1612			r	20
15	64.25	"	0.1613	"			r	2
16.20	64.57	64.41	0.1632	0.1623	1.8984	1.8936	r	4
18	65.25	64.67	0.1673	0.1638			r	32
18	65.24	"	0.1673	"			r	27
20	64.9	64.96	0.1652	0.1655			r	5
20	65.0	"	0.1658	"			r	49
23.1	67.20	65.38	0.1798	0.1681	1.9104	1.9132	r	7
25	65.00	65.64	0.1658	0.1697	1.912	1.918	r	52
25	65.50	"	0.1689	"	1.915	"	r	45
25.0	65.51	"	0.1689	"			r	35,38
25	65.55	"	0.1692	"			r	24
25	65.60	"	0.1695	"			r	59
25	65.6	"	0.1695	"			r	54
25	65.61	"	0.1695	"			r	3
25.00	65.67	"	0.1699	"			r	65
25	65.709	"	0.1702	"			r	66
25	65.74	"	0.1703	"			r	64
25	65.74	"	0.1705	"			r	56
25	65.76	"	0.1705	"			r	40a
25	65.77	"	0.1705	"	1.9213	1.918	r	51
25	65.77	"	0.1705	"	1.924	"	r	42
25	65.77	"	0.1705	"			r	53
25	65.8	"	0.1707	"			r	55
25	66.05	"	0.1723	"			r	57
25	66.1	"	0.1728	"			r	21
25	66.1	"	0.1728	"			r	24
25	66.63	"	0.1760	"			t	67
25	69.23	"	0.1940	"			a	7
29.85	66.35	66.27	0.1742	0.1737	1.9359	1.9314	r	4
30	66.3	66.29	0.1739	0.1738			r	5
40	67.40	67.50	0.1812	0.1818			r	38
40	67.4	"	0.1812	"			r	5
45.55	68.10	68.12	0.1860	0.1861	1.9702	1.9691	r	4
50	68.55	68.60	0.1891	0.1895			r	67
50	68.6	"	0.1895	"			r	49
50	68.61	"	0.1896	"	1.991	1.9789	r	42
60.20	69.64	69.63	0.1971	0.1970	2.002	1.9994	r	4
75	70.62	70.98	0.2045	0.2074	2.039	2.026	r	42
75	70.93	"	0.2070	"			r	67
76.10	71.08	71.07	0.2082	0.2082	2.0286	2.0483	r	4
89.50	72.19	72.17	0.2174	0.2172	2.0500	2.0483	r	4
100	72.60	73.00	0.2209	0.2244			r	67
119.4^b	74.36	74.32	0.2368	0.2364	2.0859	2.0862	r	4
119.919^b	74.368						r	9

b = boiling point of saturated solution under atmospheric pressure

r = recommended $e < 0.02$; t = tentative $0.02 < e < 0.05$; a = aberrant

(continued)

COMPONENTS	EVALUATOR:
(1) Caesium chloride; CsCl; [7647-17-8] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987

CRITICAL EVALUATION (continued)

2.3 Solubility of Ice [7732-18-5]

Calculations were made using 55 numerical values. The whole of the experimental and calculated values are presented in Table 3. The measurements of Lange (30), expressed in mol L^{-1}, have not been included in the calculations. The same is true for those of Dejak (33), which reproduce the values of Karagunis (22).

The recommended values correspond to $e = \Delta w/w$(calc) less than 0.02. In the range of low temperatures there is a systematic difference between measured and calculated values, but it is probable that this is due to the choice of fitting equation.

Table 3

Solubility of Ice in Aqueous Solutions of CsCl

T/K - 273.15	mass % $100w_1$ exp.	calc.	mole fraction x_1 exp.	calc.	status	ref.
-0.01851	0.085	0.085	0.000091	0.000091	r	22
-0.01860	0.085	0.086	0.000091	0.000092	r	22
-0.02673	0.124	0.124	0.000133	0.000132	r	22
-0.02701	0.125	0.125	0.000134	0.000134	r	22
-0.03905	0.183	0.182	0.000196	0.000195	r	22
-0.03990	0.187	0.186	0.000200	0.000199	r	22
-0.0480	0.224	0.224	0.000240	0.000241	r	58
-0.06770	0.322	0.319	0.000346	0.000342	r	22
-0.07604	0.365	0.359	0.000392	0.000386	t	22
-0.0778	0.367	0.368	0.000394	0.000395	r	58
-0.0914	0.431	0.434	0.000463	0.000466	r	6
-0.1137	0.546	0.542	0.000587	0.000583	r	58
-0.1374	0.652	0.658	0.000702	0.000709	r	6
-0.1783	0.856	0.860	0.000923	0.000927	r	58
-0.1807	0.861	0.872	0.000928	0.000940	t	6
-0.2081	1.022	1.008	0.001104	0.001088	t	22
-0.21873	1.072	1.061	0.001158	0.001146	r	22
-0.2387	1.154	1.160	0.001248	0.001254	r	58
-0.2681	1.286	1.307	0.001392	0.001415	t	6
-0.32207	1.582	1.576	0.001717	0.001711	r	22
-0.3223	1.568	1.577	0.001702	0.001712	r	58
-0.3571	1.727	1.752	0.001877	0.001904	t	6
-0.3966	1.929	1.950	0.002100	0.002123	t	22
-0.4707	2.345	2.321	0.002563	0.002536	t	58
-0.4937	2.431	2.436	0.002659	0.002665	r	22
-0.4949	2.431	2.442	0.002659	0.002672	r	22
-0.5273	2.568	2.604	0.002812	0.002853	t	6
-0.6547	3.232	3.241	0.003561	0.003571	r	22
-0.6709	3.298	3.322	0.003636	0.003663	r	58
-0.6968	3.399	3.451	0.003751	0.003810	t	6
-0.7402	3.670	3.666	0.004060	0.004056	r	22
-0.8886	4.366	4.399	0.004861	0.004900	r	58

(continued)

COMPONENTS	EVALUATOR:
(1) Caesium chloride; CsCl; [7647-17-8] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987

CRITICAL EVALUATION (continued)

Table 3 (continued)

Solubility of Ice in Aqueous Solutions of CsCl

T/K - 273.15	mass % $100w_1$ exp.	calc.	mole fraction x_1 exp.	calc.	status	ref.
-1.1488	5.628	5.667	0.006341	0.006387	r	58
-1.4420	7.032	7.065	0.008029	0.008069	r	58
-1.5743	7.764	7.684	0.008927	0.008828	t	61
-1.8948	9.144	9.153	0.010654	0.010666	r	58
-2.1975	10.542	10.500	0.012453	0.012397	r	61
-2.3909	11.372	11.340	0.013544	0.013501	r	58
-2.707	12.907	12.679	0.015610	0.015299	a	22
-3.0540	14.410	14.102	0.017696	0.017263	a	61
-3.141	14.641	14.451	0.018023	0.017754	t	22
-3.1560	14.644	14.511	0.018027	0.017839	t	58
-3.753	17.194	16.826	0.021736	0.021188	a	22
-4.0756	18.250	18.023	0.023330	0.022984	t	58
-5.048	21.939	21.418	0.029195	0.028338	a	22
-5.1207	22.024	21.660	0.029336	0.028735	a	58
-5.3020	22.252	22.256	0.029715	0.029722	r	61
-6.235	25.626	25.178	0.035558	0.034755	a	22
-6.2905	25.150	25.344	0.034706	0.035052	r	61
-6.6548	26.951	26.417	0.037979	0.036995	a	58
-7.4223	29.205	28.575	0.042276	0.041051	a	58
-8.1375	29.622	30.468	0.043097	0.044787	a	61
-9.3257	34.176	33.391	0.052633	0.050909	a	58
-9.8023	33.558	34.492	0.051274	0.053336	a	61
-22.3	54.2	54.251	0.1124	0.1126	r	66

r = recommended $e \leq 0.02$; t = tentative $0.02 < e \leq 0.05$; a = aberrant

3. *Vapor pressure of saturated solutions*

Data in the literature are not numerous. Between 0 and 30°C, Foote, Saxton and Dixon (25) propose the relation:

$$\log (p/\text{mmHg}) = -2198.5\ \text{K}/T + 8.562$$

The Earl of Berkeley (4,9) has measured the boiling point of the saturated solution, under atmospheric pressure, with very great precision. Morey and Chen (39) have given some values at high pressure, presented in Table 4, but the data are not precise and should be considered tentative values.

The vapor pressure of the saturated solutions can be calculated in all the areas of crystallization of CsCl using the formulas in the Preface:

$$\ln(p/p_0) = \ln[(1 - x_1)/(1 + x_1)] + a/T + b\ln T + cT + d$$

where x_1 and T are the coordinates of a point on the solubility curve and p_0 = 760 mmHg. Because of the few data available, the constants a,b,c,d have been evaluated using the experimental points. The coefficients are presented in Table 5.

(continued)

COMPONENTS	EVALUATOR:
(1) Caesium chloride; CsCl; [7647-17-8] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987

CRITICAL EVALUATION (continued)

Table 4

Vapor Pressure of Saturated Aqueous Solutions of CsCl

T/K - 273.15	mass % $100x_1$ exp.	mass % $100x_1$ calc.	mole fraction x_1 exp.	mole fraction x_1 calc.	p/bar exp.	p/bar calc.	status	ref.
119.4	74.36	74.32	0.2368	0.2364	1	1.0	r	4
119.919					1	1.0	r	9
400		90.46		0.5035	64	64	t	39
450		93.55		0.6082	(a)	73.2	t	39
500		96.70		0.7581	64		t	39
638					29		t	39

(a) maximum value of pressure

Table 5

System $CsCl-H_2O$ - Coefficients of Fitting Equations for Vapor Pressure

Solid phase	a	b	c	d	Range T/K
CsCl (cubic)	3720.204	29.9167	-0.0264	-177.314	273-745

INFLUENCE OF AN INCREASE IN PRESSURE ON THE SOLUBILITY

This has been calculated at 18°C by Gehlen and Dieter (32). The results, reported in a data sheet, must be regarded as tentative values.

DENSITIES OF SATURATED SOLUTIONS

These have been measured between 0.7 and 119.4°C by the Earl of Berkeley (4). To these results are added the values of Buchanan (7) and of Belyaev and Le T'yuk (45). The experimental values can be correctly represented by the formula:

$$d = a_1 + b_1 + c_1x_1^2$$

where a_1, b_1 and c_1, calculated by least squares, have the values:

$a_1 = 1.03468$ $b_1 = 7.14177$ $c_1 = -11.39483$

with a correlation coefficient $R^2 = 0.9987$.

The numerical values obtained are given in Tables 2 and 5. The recommended values are those of the Earl of Berkeley.

For the branch of solubility of ice, approximate values can be obtained using the same formula, but with coefficients:

$a_1 = 1.000$ $b_1 = 6.167$ $c_1 = 0$.

SOLUBILITY, VAPOR PRESSURE AND DENSITY FOR ROUNDED VALUES OF TEMPERATURE

Values of these quantities are given in Table 6 and Figures 1 and 2.

(continued)

COMPONENTS

(1) Caesium chloride; CsCl; [7647-17-8]

(2) Water; H_2O; [7732-18-5]

EVALUATOR:

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April, 1987

CRITICAL EVALUATION (continued)

Table 6
Solubility for Rounded Values of Temperature

T/K - 273.15	mass % $100w_1$	mole fraction x_1	molality m_1 /mol kg^{-1}	$\ln f_2$	density d/g cm^{-3}	p/bar	solid phase
0	0	0	0	0			ice
-1	4.95	0.0055	0.309	0.0014			"
-2	9.63	0.0113	0.633	0.0031			"
-3	13.88	0.0170	0.958	0.0048			"
-4	17.75	0.0226	1.28	0.0063			"
-5	21.26	0.0281	1.60	0.0076	1.176		"
-6	24.26	0.0335	1.92	0.0087			"
-7	27.40	0.0388	2.24	0.0096			"
-8	30.11	0.0441	2.56	0.0104			"
-9	32.62	0.0492	2.87	0.0109			"
-10	34.94	0.0543	3.19	0.0114	1.334		"
-11	37.10	0.0594	3.50	0.0117			"
-12	39.12	0.0643	3.82	0.0119			"
-13	41.01	0.0692	4.13	0.0119			"
-14	42.79	0.0741	4.44	0.0118			"
-15	44.46	0.0789	4.75	0.0117	1.475		"
-16	46.04	0.0836	5.07	0.0114			"
-17	47.53	0.0884	5.38	0.0110			"
-18	48.94	0.0930	5.69	0.0106			"
-19	50.28	0.0976	6.01	0.0101			"
-20	51.55	0.1022	6.32	0.0094	1.604		"
-21	52.76	0.1068	6.63	0.0087			"
-22	53.91	0.1113	6.95	0.0080			"
-23	55.06	0.1157	7.26	0.0072			"
-24	56.07	0.1202	7.58	0.0062			"
-25	57.08	0.1246	7.90	0.0053			"
-30	61.53	0.1461	9.50	-0.0003			sc CsCl
-30	55.62	0.1183	7.45				"
-25	56.81	0.1234	7.81				"
-20	57.94	0.1285	8.18				"
-15	59.00	0.1334	8.55				"
-10	60.00	0.1383	8.91				"
-5	60.94	0.1431	9.27				"
0	61.83	0.1477	9.62		1.8411	0.0043	"
2	62.18	0.1496	9.76				"
4	62.51	0.1514	9.91				"
6	62.84	0.1532	10.05				"
8	63.16	0.1550	10.18				"
10	63.48	0.1568	10.32		1.8744	0.0084	"
12	63.79	0.1486	10.46				"
14	64.09	0.1603	10.60				"
16	64.38	0.1621	10.74				"
18	64.67	0.1638	10.87				"
20	64.96	0.1655	11.01		1.9046	0.0154	"
22	65.23	0.1672	11.14				"
24	65.51	0.1689	11.28				"
26	65.77	0.1706	11.41				"
28	66.03	0.1722	11.55				"
30	66.29	0.1738	11.68		1.9318	0.0272	"
32	66.54	0.1755	11.81				"

(continued)

COMPONENTS	EVALUATOR:
(1) Caesium chloride; CsCl; [7647-17-8] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987

CRITICAL EVALUATION (continued)

Table 6 (continued)

Solubility for Rounded Values of Temperature

T/K - 273.15	mass % $100w_1$	mole fraction x_1	molality m_1 /mol kg^{-1}	lnf_2	density d/g cm^{-3}	p/bar	solid phase
34	66.79	0.1771	11.94		1.9420	0.034	sc CsCl
36	67.03	0.1787	12.07		1.9469	0.036	"
38	67.26	0.1802	12.21		1.9518	0.042	"
40	67.50	0.1818	12.33		1.9565	0.046	"
42	67.73	0.1834	12.46		1.9611	0.051	"
44	67.95	0.1849	12.59		1.9657	0.057	"
46	68.17	0.1864	12.72		1.9701	0.063	"
48	68.39	0.1880	12.85		1.9745	0.069	"
50	68.60	0.1895	12.98		1.9788	0.076	"
52	68.81	0.1910	13.10		1.9830	0.084	"
54	69.01	0.1925	13.23		1.9871	0.093	"
56	69.21	0.1939	13.35		1.9911	0.102	"
58	69.41	0.1954	13.48		1.9951	0.112	"
60	69.61	0.1968	13.60		1.9990	0.122	"
62	69.80	0.1983	13.73		2.0028	0.134	"
64	69.99	0.1997	13.85		1.0065	0.147	"
66	70.18	0.2011	13.98		2.0102	0.160	"
68	70.36	0.2025	14.10		2.0138	0.174	"
70	70.54	0.2040	14.22		2.0173	0.191	"
72	70.72	0.2053	14.34		2.0207	0.208	"
74	70.89	0.2067	14.47		2.0241	0.226	"
76	71.06	0.2081	14.59		2.0274	0.246	"
78	71.23	0.2095	14.71		2.0307	0.267	"
80	71.40	0.2108	14.83		2.0339	0.289	"
82	71.57	0.2122	14.95		2.0370	0.314	"
84	71.73	0.2135	15.07		2.0401	0.340	"
86	71.89	0.2149	15.19		2.0431	0.368	"
88	72.05	0.2162	15.31		2.0461	0.398	"
90	72.21	0.2175	15.43		2.0490	0.429	"
92	72.36	0.2188	15.55		2.0519	0.463	"
94	72.51	0.2202	15.67		2.0547	0.500	"
96	72.67	0.2215	15.79		2.0575	0.539	"
98	72.82	0.2228	15.91		2.0602	0.580	"
100	72.96	0.2241	16.03		2.0628	0.624	"
102	73.11	0.2254	16.15		2.0654	0.656	"
104	73.25	0.2266	16.27		2.0680	0.690	"
106	73.40	0.2279	16.39		2.0705	0.726	"
108	73.54	0.2292	16.51		2.0730	0.764	"
110	73.68	0.2303	16.63		2.0754	0.803	"
112	73.82	0.2317	16.74		2.0778	0.844	"
114	73.95	0.2330	16.86		2.0801	0.889	"
116	74.09	0.2343	16.98		2.0824	0.931	"
118	74.22	0.2355	17.10		2.0847	0.978	"
120	74.36	0.2368	17.22		2.0869	1.026	"
122	74.49	0.2381	17.34				

(continued)

COMPONENTS	EVALUATOR:
(1) Caesium chloride; CsCl; [7647-17-8] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987

CRITICAL EVALUATION (continued)

Table 6 (continued)

Solubility for Rounded Values of Temperature

T/K - 273.15	mass % $100w_1$	mole fraction x_1	molality m_1 /mol kg^{-1}	lnf_2	density d/g cm^{-3}	p/bar	solid phase
124	74.69	0.2400	17.46			1.131	sc CsCl
126	74.74	0.2406	17.58			1.19	"
128	74.88	0.2418	17.70			1.24	"
130	75.01	0.2431	17.82			1.30	"
132	75.13	0.2443	17.95			1.37	"
134	75.26	0.2456	18.07			1.43	"
136	75.38	0.2468	18.19			1.50	"
138	75.51	0.2481	18.31			1.57	"
140	75.63	0.2493	18.43			1.64	"
142	75.75	0.2506	18.58			1.72	"
144	75.88	0.2518	18.68			1.80	"
146	76.00	0.2531	18.81			1.88	"
148	76.12	0.2543	18.93			1.97	"
150	76.24	0.2556	19.06			2.06	"
160	76.82	0.2618	19.69			2.6	"
170	77.40	0.2682	20.34			3.2	"
180	77.96	0.2746	21.02			3.9	"
190	78.52	0.2812	21.71			4.7	"
200	79.07	0.2879	22.44			5.7	"
210	79.62	0.2948	23.20			6.9	"
220	80.16	0.3019	24.01			8.2	"
230	80.71	0.3092	24.85			9.7	"
240	81.25	0.3168	25.74			11.4	"
250	81.80	0.3247	26.69			13.4	"
260	82.35	0.3330	27.71			15.6	"
270	82.90	0.3415	28.79			18.0	"
280	83.45	0.3505	29.95			20.6	"
290	84.01	0.3599	31.21			23.5	"
300	84.57	0.3697	32.56			26.6	"
310	85.14	0.3800	34.03			30.0	"
320	85.71	0.3909	35.63			33.5	"
330	86.29	0.4024	37.37			37.2	"
340	86.87	0.4145	39.29			41.0	"
350	87.45	0.4272	41.41			44.9	"
360	88.05	0.4408	43.75			48.9	"
370	88.64	0.4551	46.36			52.8	"
380	89.24	0.4703	49.28			56.7	"
390	89.85	0.4864	52.56			60.3	"
400	90.46	0.5035	56.30			63.7	"
410	91.07	0.5218	60.57			66.7	"
420	91.69	0.5413	65.50			69.3	"
430	92.31	0.5621	71.25			71.2	"
440	92.93	0.5844	78.04			72.5	"
450	93.55	0.6082	86.18			72.5	"
460	94.18	0.6339	96.11			72.3	"
470	94.86	0.6637	109.6			70.7	sc CsCl + fcc CsCl

(continued)

COMPONENTS	EVALUATOR:
(1) Caesium chloride; CsCl; [7647-17-8] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987

CRITICAL EVALUATION (continued)

Table 6 (continued)

Solubility for Rounded Values of Temperature

t/°C	mass % $100w_1$	mole fraction x_1	molality /mol kg^{-1}	lnf_2	density d/g cm^{-3}	p/bar	solid phase
480	95.21	0.6801	118.0				sc CsCl (metastable)
490	95.89	0.6969	127.6				fcc CsCl
500	96.21	0.7139	138.5				"
510	96.22	0.7312	151.0				"
520	96.54	0.7489	165.5				"
530	96.85	0.7668	182.6				"
540	97.15	0.7851	202.8				"
550	97.45	0.8038	227.4				"
560	97.75	0.8228	257.8				"
570	98.03	0.8422	296.3				"
580	98.32	0.8620	346.7				"
590	98.59	0.8821	415.4				"
600	98.86	0.9027	514.8				"
610	99.12	0.9236	671.2				"
620	99.38	0.9450	953.5				"
630	99.63	0.9668	1616.0				"
640	99.88	0.9890	5010.6				"
645	100	1					"

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(continued)

COMPONENTS	EVALUATOR:
(1) Caesium chloride; CsCl; [7791-11-9] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987

CRITICAL EVALUATION (continued)

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COMPONENTS	EVALUATOR:
(1) Caesium chloride; CsCl; [7791-11-9] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987

CRITICAL EVALUATION (continued)

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(continued)

COMPONENTS	EVALUATOR:
(1) Caesium chloride; CsCl; [7791-11-9] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987

CRITICAL EVALUATION (continued)

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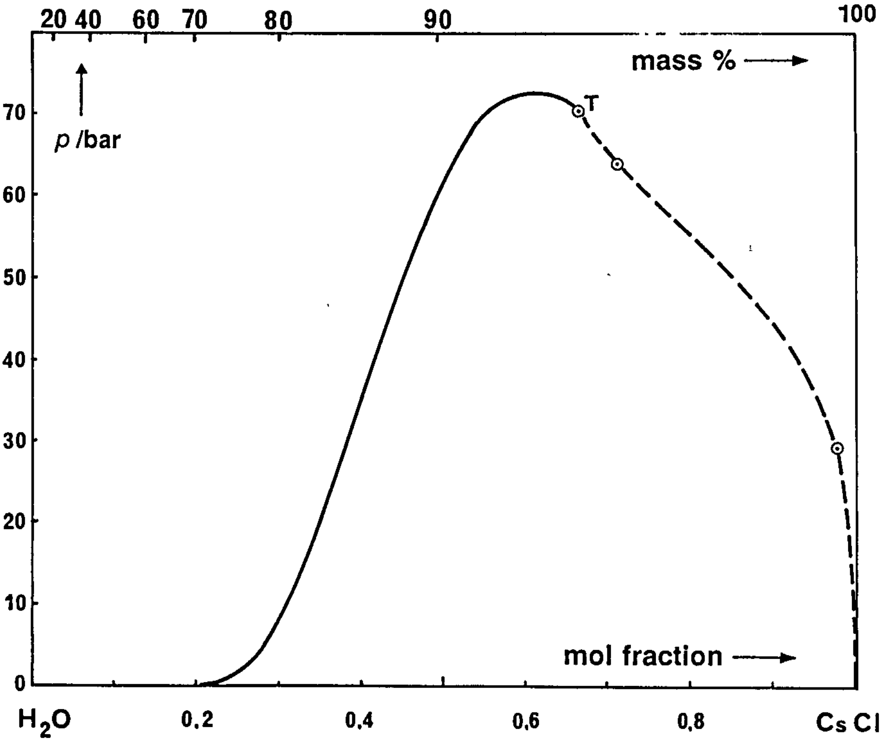

Fig. 1. Vapor pressure-temperature curve for three-phase solid-liquid-vapor equilibria in the binary system $CsCl-H_2O$.

(continued)

COMPONENTS	EVALUATOR:
(1) Caesium chloride; CsCl; [7791-11-9] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad, Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. April, 1987

CRITICAL EVALUATION (continued)

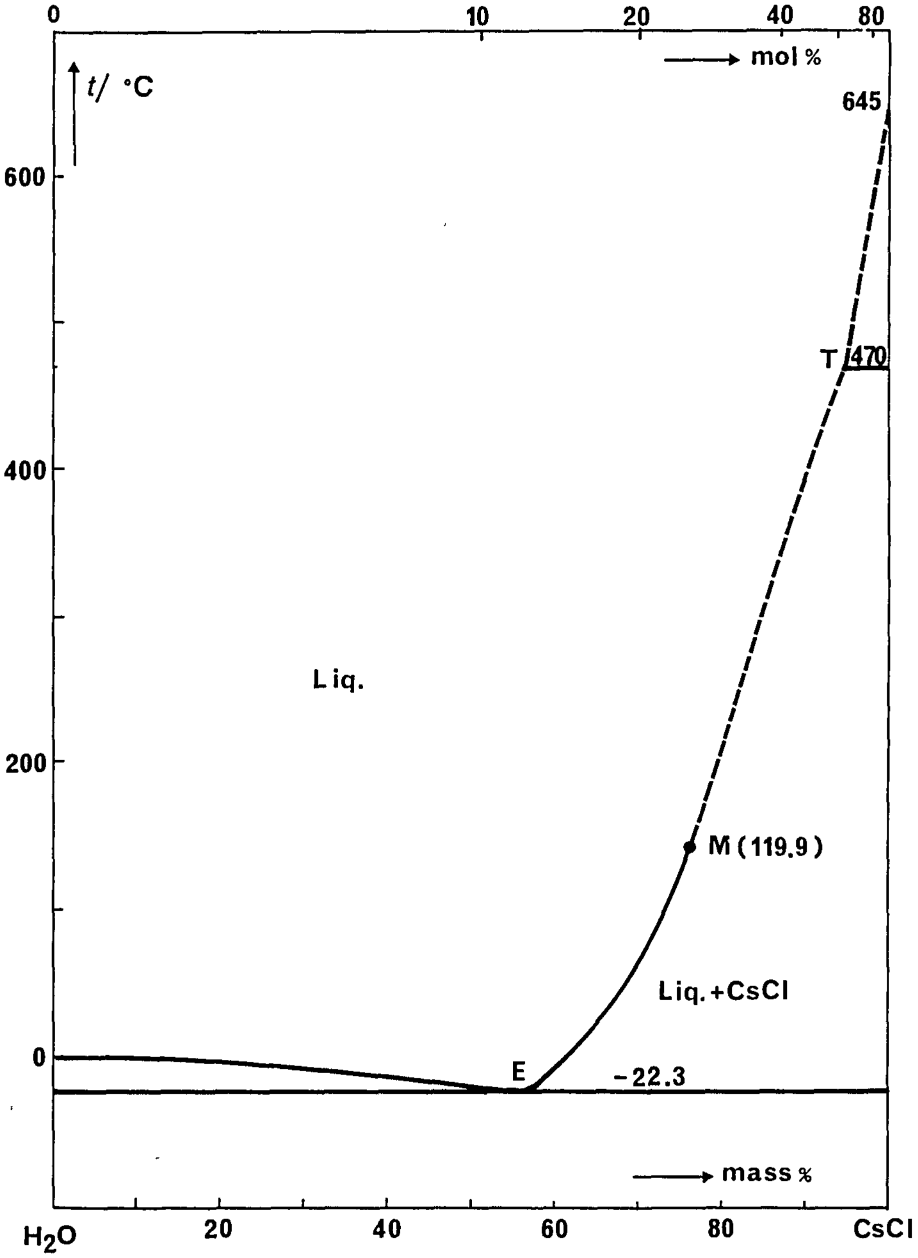

Fig. 2. Temperature-composition phase diagram for the binary system $CsCl-H_2O$ under the vapor pressure of the saturated solution.

(continued)

COMPONENTS:

(1) Caesium chloride; CsCl; [7647-17-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Setterberg, C.

Oefvers. Akad. Stockholm 1882, 6, 23-31.

VARIABLES:

T/K = 288

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass ratio $CsCl/H_2O$	mass % (compiler)	solid phase
15	1.794	64.2	CsCl
15	1.80	64.3	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Not stated.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Caesium chloride; CsCl; [7647-17-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Foote, H.W.

Am. Chem J. 1903, *30*, 339; *Am. J. Sci.* 1927 [5], *13*, 158-66 (same data in both papers).

VARIABLES:

T/K = 298

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	65.61	CsCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Saturated solutions were prepared by shaking the components in small glass-stoppered bottles in a thermostat. Samples were drawn off for analysis through a small filter of glass wool directly into a weighing bottle.

SOURCE AND PURITY OF MATERIALS:

CsCl was prepared by igniting an exceedingly pure caesium perhalide ($CsCl_2I$) prepared by H.L. Wells.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Caesium chloride; CsCl; [7647-17-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Berkeley, Earl of

Phil. Trans. R. Soc. London, A 1904, *203*, 189-214.

VARIABLES:

T/K = 274-393

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio CsCl/H_2O	mass % (compiler)	density g cm^{-3}	solid phase
0.70	162.29	61.87	1.8458	CsCl
16.20	182.24	64.57	1.8984	"
29.85	197.17	66.35	1.9359	"
45.55	213.45	68.10	1.9702	"
60.20	229.41	69.64	2.0012	"
76.10	245.76	71.08	2.0286	"
89.50	259.56	72.19	2.0500	"
119.4 [a]	289.98	74.36	2.0859	"

---

[a] boiling point

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The salt-water mixture was stirred at the appropriate temperature and the density followed by pycnometric measurement until its value remained constant. The solubilities were determined by evaporation to dryness of the saturated solution in Pt crucibles, except at the boiling point where Jena glass bulbs were used. According to the range, different temperature control systems were used. Temperatures were corrected to the hydrogen scale.

SOURCE AND PURITY OF MATERIALS:

CsCl: Merck purest salt, recrystallized.

ESTIMATED ERROR:

Temperature: ±0.01 K

Solubility: within ±0.16 mass %

REFERENCES:

COMPONENTS:

(1) Caesium chloride; CsCl; [7647-17-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Hinrichsen, F.W.; Sachsel, E.

Z. Phys. Chem. Stoechiom. Verwandtschaftsl. 1904-5, *50*, 81-99.

VARIABLES:

T/K = 273-313

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
0.3	61.9	CsCl
10	63.5	"
20	64.9	"
30	66.3	"
40	67.4	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method: saturated mixtures of salt and water were stirred for many hours in a thermostat. Samples of clear solution were removed and weighed, then evaporated to dryness.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS: (1) Caesium chloride; $CsCl$; [7647-17-8] (2) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Jahn, H. *Z. Phys. Chem., Stoechiom. Verwandtschaftsl.* <u>1905</u>, *50*, 129-68.
VARIABLES: T/K = 272-273	PREPARED BY: R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	molality[a] mol kg^{-1}	solid phase
-0.0913	0.42793	0.02551	ice
-0.0914	0.43068	0.02568	"
-0.1374	0.65169	0.03894	"
-0.1381	0.65020	0.03885	"
-0.1807	0.86041	0.05152	"
-0.1829	0.87020	0.05211	"
-0.2673	1.2810	0.07703	"
-0.2681	1.2862	0.07735	"
-0.3571	1.7264	0.1043	"
-0.3572	1.7200	0.1039	"
-0.5273	2.5676	0.1564	"
-0.6887	3.3697	0.2070	"
-0.6968	3.3988	0.2089	"

---

[a] molar mass of CsCl adopted by the author was 168.424 g mol^{-1}

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE Cryoscopic method.	SOURCE AND PURITY OF MATERIALS: CsCl: Merck reagent, analyzed by gravimetric titration for Cl (as AgCl) and Cs (as Cs_2SO_4).
	ESTIMATED ERROR: No estimates possible.
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Caesium chloride; CsCl; [7647-17-8] (2) Water; H_2O; [7732-18-5]	Buchanan, J.Y. *Am. J. Sci.* 1906, *21* (4), 25-40.
VARIABLES:	**PREPARED BY:**
T/K = 296, 298	R. Tenu

EXPERIMENTAL VALUES:

t/°C	molality mol kg^{-1}	100 x mass ratio $CsCl/H_2O$	mass % a	relative density	solid phase
23.1	12.1563		67.20	1.9104	CsCl
25		225	69.23		"

---

[a] CsCl molar mass: 168.5 g mol^{-1}, according to the author

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE	SOURCE AND PURITY OF MATERIALS:
25 g of distilled water were weighed into a suitable vessel and the salt was gradually added until a small quantity remained undissolved. This quantity was such that a further rise in temperature of 1 K caused all salt to disappear. The salt content was determined by titration with $AgNO_3$.	CsCl: Schuchardt purest salt.
	ESTIMATED ERROR:
	Temperature: ±0.1 K
	REFERENCES:

COMPONENTS: (1) Caesium chloride; CsCl; [7647-17-8] (2) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Berkeley, Earl of; Appleby, M.P. *Proc. R. Soc. London* 1911, *85*, 489-505.
VARIABLES: p/mmHg = 750, 760	PREPARED BY: R. Tenu

EXPERIMENTAL VALUES:

pressure p/mmHg	t/°C (boiling point)	concentration of CsCl c_1/mol dm^{-3}	mass % (compiler)[b]	solid phase
750	119.488	-	-	CsCl
760	119.919[a]	9.214	74.368	"

[a] corrected ot standard conditions
[b] density is recorded in (1)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE Described in previous paper (1).	SOURCE AND PURITY OF MATERIALS: CsCl: recrystallized from Merck's salt.
	ESTIMATED ERROR: Temperature: precision within ± 0.005 K
	REFERENCES: 1. Berkeley, Earl of *Phil. Trans. R. Soc. London, A* 1904, *203*, 189.

COMPONENTS:

(1) Caesium chloride; CsCl; [7647-17-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Malquori, G.

Gazz. Chim. Ital. 1926, 56, 37-41.

VARIABLES:

T/K = 288

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
15	64.750	CsCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Isothermal method.

SOURCE AND PURITY OF MATERIALS:

CsCl: Kahlbaum reagent.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Caesium chloride; CsCl; [7647-17-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Benrath, A.

Z. Anorg. Allg. Chem. 1927, *163*, 396-404.

VARIABLES:

T/K = 298

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mol ratio $H_2O/CsCl$	mass % (compiler)	solid phase
25	4.79	66.1	CsCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Not stated; probably isothermal method.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Caesium chloride; CsCl;
[7647-17-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Karagunis, G.; Hawkinson, A.;
Damkohler, G.

Z. Phys. Chem., Abt. A 1930,
151, 433-66.

VARIABLES:

T/K = 267-273

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	molality mol kg^{-1}	mass % (compiler)	solid phase
-0.0186_0	0.0050_8	0.0855	ice
-0.0185_1	0.0050_6	0.0851	"
-0.0270_1	0.0074_5	0.1253	"
-0.0267_3	0.0074_0	0.1244	"
-0.0390_5	0.0109_1	0.1833	"
-0.0399_0	0.0111_6	0.1875	"
-0.0677_0	0.0191_8	0.3219	"
-0.0760_4	0.0217_9	0.3655	"
-0.2187_3	0.0643_4	1.072	"
-0.2081_0	0.0613_4	1.022	"
-0.3220_7	0.0955_0	1.582	"
-0.3966	0.1171	1.929	"
-0.4937	0.1483	2.431	"
-0.4949	0.1483	2.431	"
-0.6547	0.1988	3.232	"
-0.7402	0.2268	3.670	"
-2.707	0.8822	12.907	"
-3.141[a]	1.021	14.641	"
-3.753	1.236	17.194	"
-5.048	1.673	21.939	"
-6.23_5	2.051	25.626	"

---

[a] Authors give 2.141, which is a typographical error (compiler).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Cryoscopic method: the difference between melting points of ice and solution was measured with a thermocouple. The concentration of solutions was determined with a Haber-Löwe interferometer.

SOURCE AND PURITY OF MATERIALS:

The purity of CsCl was checked by potentiometric titration for Cl^-.

ESTIMATED ERROR:

In quotient $(T/273.15 - 1)/m = 0.002$

REFERENCES:

COMPONENTS:

(1) Caesium chloride; CsCl; [7647-17-8]

(2) Water; H_2O; [7732-185]

ORIGINAL MEASUREMENTS:

Fajans, K.; Karagunis, G. *quoted by* Meyer, K.H.; Dunkel, M.

Z. Phys. Chem., Bodenstein-Festband 1931, 553-573.

VARIABLES:

T/K = 298

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	molality mol kg^{-1}	mass %	mol % (compiler)	solid phase
25	11.3	66.1	0.169	CsCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

No details given.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Caesium chloride; CsCl; [7647-17-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Lannung, A.

Z. Phys. Chem., Abt. A 1934, *170*, 134-44.

VARIABLES:

T/K = 291
p/kPa = 1.4

PREPARED BY:

J.J. Counioux

EXPERIMENTAL VALUES:

t/°C	p/mmHg	molality mol kg^{-1}	mass %	solid phase
18	10.43	11.15	65.24	CsCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The vapor pressure of the solution was plotted against the concentration. The solubility was deduced from the break in this curve.

SOURCE AND PURITY OF MATERIALS:

The purity of the salt has been described in a previous paper (1).

ESTIMATED ERROR:

Temperature: precision ±0.003 K
Pressure: ±7 Pa

REFERENCES:

(1) Lannung, A. *Z. Phys. Chem., Abt. A.* 1932, *161*, 255.

COMPONENTS:

(1) Caesium chloride; CsCl; [7647-17-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Gehlen, H.; Dieter, H.

Z. Phys. Chem. (Leipzig) 1950, *196*, 258-77.

VARIABLES:

T/K = 291
p/atm = 0-10^4

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	*p*/atm	mass % CsCl		solid phase
		a	b	
18	0	65.25	65.25	CsCl
	1000	63.8	63.7	"
	2000	62.2	62.2	"
	3000	60.8	61.0	"
	4000	59.4	59.7	"
	5000	57.8	58.3	"
	6000	56.5	57.2	"
	7000	55.2	56.0	"
	8000	54.0	54.5	"
	9000	52.6	53.0	"
	10000	51.5	51.7	"

a: first approximation
b: second approximation

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Solubilities under pressure were calculated from density and vapor pressure data at atmospheric pressure using Tammann's assumption (1) concerning the coincidence pressure and the compressibility of solid CsCl.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Tammann, G. *Über die Beziehungen zwischen den inneren Kräften und Eigenschaften der Lösungen.* Leopold Voss. Hamburg und Leipzig. 1907.

COMPONENTS:

(1) Caesium chloride; $CsCl$; [7647-17-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Blidin, V.P.

Izv. Akad. Nauk. SSSR, Otdel. Khim. Nauk 1953, (5), 814-9; *Zh. Obshch. Khim.* 1956, *26*, 1281-5; **J. Gen. Chem. USSR (Engl. Transl.)* 1956, *26*, 1449-52.

VARIABLES:

$T/K = 298, 313$

PREPARED BY:

M.-T. Saugier-Cohen Adad, R. Tenu, J. W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25^a	65.51	$CsCl$
40	67.40	"

[a] Value at 25°C given in both papers; value at 40°C in 1956 paper only.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Isothermal method: saturation was obtained by addition of small quantities of salt. A sample of clear solution was weighed and analyzed. The remaining salt was weighed.

SOURCE AND PURITY OF MATERIALS:

Pure salt 2x recrystallized.

ESTIMATED ERROR:

Temperature: ±0.1 K.

REFERENCES:

COMPONENTS:

(1) Caesium chloride; $CsCl$; [7647-17-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Plyushchev, V.E.; Tulinova, V.B.; Kuznetsova, G.P.; Korovin, S.S.; Shipetina, N.S.

Zh. Neorg. Khim. 1957, 2, 2654-60; **Russ. J. Inorg. Chem. (Engl. Transl.)* 1957, 2, 267-75.

$T/K = 298-348$

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	density $g\ cm^{-3}$	solid phase
25	65.77	1.924	$CsCl$
50	68.61	1.991	"
75	70.62	2.039	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Isothermal method. It was found experimentally that equilibrium was established at 25°C in 12 d, at 50°C in 7 d, and at 75°C in 5 d. The samples were removed by a pipet which was fitted at the end with a cotton filter. The concentration of salts in the solution was calculated by chemical analysis.

SOURCE AND PURITY OF MATERIALS:

$CsCl$ was of a high degree of purity. Negligible impurities were present: Na: 0.0025 mass %; K: 0.0020; Ca: 0.0018; Rb: 0.0014.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

COMPONENTS:

(1) Caesium chloride; CsCl; [7647-17-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Makarov, L.L.; Evstrop'ev, K.K.; Vlasov, Yu. G.

Zh. Fiz. Khim. 1957, *31*, 1621.

VARIABLES:

$T/K = 298$

PREPARED BY:

P. Vallée

EXPERIMENTAL VALUES:

t/°C	molality m_1/mol kg^{-1}	mass %	solid phase
25	11.41	65.76	CsCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isopiestic method (compiler).

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Caesium chloride; CsCl; [7647-17-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Belyaev, I.N.; Le T'yuk

Zh. Neorg. Khim. 1965, *10*, 1229-33; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1965, *10*, 664-6.

VARIABLES:

$T/K = 298$

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	viscosity mPa s	density g cm^{-3}	electrical conductivity S cm^{-1}	solid phase
25	65.50	1.4874	1.915	0.229	CsCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The solubility was determined in special vessels with a stirrer and mercury seal in a water thermostat. Equilibrium was established after 8-10 h and was checked by analysis of samples of the liquid phase taken every 2 h. Cl was determined by Volhard's volumetric method. Electrical conductivity, viscosity and density of the saturated solutions were determined.

SOURCE AND PURITY OF MATERIALS:

Twice recrystallized "pure" grade CsCl.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Caesium chloride; CsCl; [7647-17-8] (2) Water; H_2O; [7732-18-5]	Sheveleva, A.D. *Uch. Zap. Permsk. Gos. Univ. im. A.M. Gor'kogo* 1966, No. 159, 3-14.
VARIABLES:	PREPARED BY:
T/K - 293, 323	T. Mioduski

EXPERIMENTAL VALUES:

t/°C	mass%	molality mol kg^{-1}	solid phase
20	65.0	11.03	CsCl
50	68.6	12.98	CsCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The isothermal saturation method was used, with refractometric analysis (1). Known amounts of solid and water were equilibrated until their refractive indices became constant. The compositions of saturated solutions were found from discontinuities in the refractive index-composition plots. the refractometer was thermostated at 50°C.

SOURCE AND PURITY OF MATERIALS:

CsCl: Analar grade was used as received.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Zhuravlev, E.F.; Sheveleva, A.D.; *Zh. Neorg. Khim.* 1960, 5, 2630; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1960, 5, 1270.

COMPONENTS:

(1) Caesium chloride; CsCl; [7647-17-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Vaisfel'd, M.I.; Shevchuk, V.G.

Zh. Neorg. Khim. 1967, *12*, 2497-9; **Russ. J. Inorg. Chem. (Engl. Transl.)* 1967, *12*, 1317-9.

VARIABLES:

$T/K = 298$

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	refractive index	density g cm^{-3}	solid phase
25	65.77	1.4193	1.9213	CsCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method. Chemical and crystal-optical analyses of the liquid and solid phases were made. Equilibrium was reached in 2 - 5 days. Methods for chemical analysis were as in (1,2,3).

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Shevchuk, V.G.; Vaisfel'd, M.I. *Zh. Neorg. Khim.* 1964, *9*, 2769; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1964, *9*, 1491.
2. *Analiz Mineral'nogo Syr'ya (Analysis of Mineral Raw Materials)*. Eds. N. Knipovich; Yu. Morachevskii. 3rd ed. Goskhimizdat. Leningrad. 1959.
3. Shevchuk, V.G.; Kost', L.L. *Zh. Neorg. Khim.* 1964, 9, 432; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1964, *9*, 235.

COMPONENTS:

(1) Caesium chloride; Cscl; [7647-17-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Bykova, I.N.; Kuznetzova, G.P.; Kolotilova, V.Ya.; Stepin, B.D.

Zh. Neorg. Khim. 1968, *13*, 540-4; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1968, *13*, 282-4.

VARIABLES:

$T/K = 298$

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	65.77	CsCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothermal saturation method was used with prolonged stirring of the solid phase and solution. Equilibrium was rached within 15 d. Analysis: gravimetric, with Cl as AgCl.

SOURCE AND PURITY OF MATERIALS:

RbCl: "pure" grade, heated to 400 °C to remove organic impurities, then recryst. from water, dried at 120°C.

ESTIMATED ERROR:

Temperature: precision within ±0.1 K.

REFERENCES:

COMPONENTS:

(1) Caesium chloride; CsCl; [7647-17-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Belyaev, I.N.; Lobas, L.M. *Zh. Neorg. Khim.* 1968, *13*, 1149-55; **Russ. J. Inorg. Chem. (Engl. Transl.)* 1968, *13*, 601-4.

VARIABLES:

T/K = 298

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	density $\mathrm{g\ cm^{-3}}$	viscosity mPa s	conductivity $\mathrm{S\ cm^{-1}}$	solid phase
25	65.00	1.912	1.2631	0.123	CsCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The isothermal method was used. Viscosity, electrical conductivity and density were measured.

SOURCE AND PURITY OF MATERIALS:

CsCl: recrystallized "chemically pure" grade reagent.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Caesium chloride; CsCl; [7647-17-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kirgintsev, A.N.; Trushnikova, L.N. *Zh. Neorg. Khim.* 1968, *13*, 2843-7; **Russ. J. Inorg. Chem. (Engl. Transl.)* 1968, *13*, 1462-6.

VARIABLES:

T/K = 298

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	65.6	CsCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solubility was determined by the method of isothermal relief of supersaturation. The time of mixing was 7-8 h. Samples of the liquid and solid phases were then withdrawn, transferred quantitatively to measuring flasks and analyzed, presumably for Cs.

SOURCE AND PURITY OF MATERIALS:

"Chemically pure" and "analytical reagent" grade salts recrystallized from distilled water were used.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

COMPONENTS:

(1) Caesium chloride; CsCl; [7647-17-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Mironenko, A.P.; Stepina, S.B. Plyushchev, V.E.; Zotova, L.A.

Zh. Neorg. Khim. 1968, *13*, 2838-43; **Russ. J. Inorg. Chem. (Engl. Transl.)* 1968, *13*, 1460-2.

VARIABLES:

T/K = 298

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	65.8	CsCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility was measured at 25°C in special hermetic vessels. Samples of the liquid phase were taken for analysis after the 3 weeks needed to reach equilibrium. Cl^- ion was determined as AgCl and caesium by the tetraphenylborate method.

SOURCE AND PURITY OF MATERIALS:

"Analytical reagent" grade CsCl was twice recrystallized from aqueous solution and dried at room temperature. The product contained less than 0.06 mass % Rb.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Caesium chloride; CsCl; [7647-17-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Merbach, A.; Gonella, J.

Helv. Chim. Acta 1969, 52, 69-76.

VARIABLES:

T/K = 298

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	100 x mol ratio H_2O/CsCl	mass % (compiler)	solid phase
25	487	65.74	CsCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The Brunisholz' saturation method was used (1). Chloride was determined potentiometrically.

SOURCE AND PURITY OF MATERIALS:

CsCl: Merck "Analytical reagent" grade was used.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

1. Brunisholz, G.; Quinche, J.P. Kalo, A.M. *Helv. Chim. Acta* 1964, 47, 14.

COMPONENTS:

(1) Caesium chloride; CsCl; [7647-17-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Momicchioli, F.; Devoto, O.; Grandi, G.; Cocco, G. *Atti Soc. Nat. Modena* 1968, *99*, 226-32; *Ber. Bunsen-Ges. Phys. Chem.* 1970, *74*, 59-66.

VARIABLES:

T/K = 264-273

PREPARED BY:

R. Cohen-Adad

EXPERIMENTAL VALUES:

t/°C (compiler)	molality /mol kg^{-1}	$\Delta T/m$ /K kg mol^{-1}	mass % (compiler)	solid phase
-0.0480	0.0133_4	3.6_0	0.224	ice
-0.0778	0.02186	3.5_6	0.367	ice
-0.1137	0.0325_8	3.4_9	0.546	ice
-0.1783	0.0512_9	3.47_6	0.856	ice
-0.2387	0.0693_4	3.44_3	1.154	ice
-0.3223	0.0946_4	3.40_6	1.568	ice
-0.4707	0.1426_4	3.36_3	2.345	ice
-0.6709	0.2025_8	3.31_2	3.298	ice
-0.8886	0.2711_5	3.27_7	4.366	ice
-1.1488	0.3542_4	3.24_3	5.628	ice
-1.4420	0.4492_7	3.209_7	7.032	ice
-1.8948	0.5978_2	3.169_5	9.144	ice
-2.3909	0.7621_3	3.137_1	11.372	ice
-3.1560	1.0190_2	3.097_1	14.644	ice
-4.0756	1.3259_9	3.073_6	18.250	ice
-5.1207	1.6776_4	3.052_3	22.024	ice
-6.6548	2.1914_0	3.036_8	26.951	ice
-7.4223	2.4503_3	3.029_1	29.205	ice
-9.3257	3.0839_0	3.024_0	34.176	ice

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

A precision apparatus for measuring freezing point depressions by the equilibrium method was used, as described in (1). Temperatures were measured by a Pt resistance thermometer and Mueller bridge. Efficient stirring was accomplished by a high-quality air-driven stirrer. Concentrations were determined by a Hilger-Rayleigh interferometer.

SOURCE AND PURITY OF MATERIALS:

Merck "Suprapur" reagent, Cat. No. 2039.

ESTIMATED ERROR:

Temperature: precision ±3 x 10^{-4} K. Composition: Absolute error almost independent of molality, and about 4-5 x 10^{-5} mol kg^{-1}.

REFERENCES:

(1) Chiorboli, P.; Momicchioli, F.; Grandi, G. *Boll. Sci. Fac. Chim. Ind. Bologna* 1966, *24*, 133.

COMPONENTS:

(1) Caesium chloride; CsCl; [7647-17-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Arkhipov, S.M.; Kashina, N.I.

Zh. Neorg. Khim. <u>1970</u>, *15*, 760-5; **Russ. J. Inorg. Chem. (Engl. Transl.)* <u>1970</u>, *15*, 391-2.

VARIABLES:

T/K = 298

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	66.05	CsCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Isothermal method. Samples were analyzed for Cl volumetrically.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

COMPONENTS:

(1) Caesium chloride; CsCl; [7647-17-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Fedorova, O.N.; Serebrennikova, G.M.; Stepin, B.D.

**Zh. Neorg. Khim.* <u>1971</u>, *16*, 2808-13; *Russ. J. Inorg. Chem. (Engl. Transl.)* <u>1971</u>, *16*, 1495-7.

VARIABLES:

T/K = 298

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	CsCl mass %	solid phase
25	65.60	CsCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility was investigated by an isothermal method in special vessels described previously (1). Equilibrium was established in 14 days, after which samples were analyzed for Cl gravimetrically.

SOURCE AND PURITY OF MATERIALS:

CsCl: "chemically pure" grade, recrystallized.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

1. Serebrennikova, G.M.; Sazikova, L.A.; Stepin, B.D. *Zh. Neorg. Khim.* <u>1967</u>, *12*, 1355; *Russ. J. Inorg. Chem. (Engl. Transl.)* <u>1967</u>, *12*, no. 5.

COMPONENTS:

(1) Caesium chloride; CsCl; [7647-17-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Vilcu, R.; Irenei, F.

An. Univ. Bucuresti Chim. 1971, *20*(2), 103-11.

VARIABLES:

T/K = 263-272

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	molality, mol/kg H_2O	mass %	solid phase
-1.5743	0.5000	7.7643	ice
-2.1975	0.7000	10.5426	"
-3.0540	1.0000	14.4098	"
-5.3020	1.7000	22.2521	"
-6.2905	2.0000	25.1898	"
-8.1375	2.5000	29.6218	"
-9.8023	3.0000	33.5581	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Cryometric measurements.
The method is described in previous publication (1).

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

REFERENCES:

1. Vilcu, R.; Irenei, F. *Rev. Roum. Chim.* 1968, *13*, 258.

COMPONENTS: (1) Caesium chloride; CsCl; [7647-17-8] (2) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Balarev, Kh.; Ketenev, D.N. *Dokl. Bolg. Akad. Nauk* 1975, *28*, 221-3.
VARIABLES: T/K = 298	PREPARED BY: R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	65.74	CsCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: Isothermal decrease of supersaturation. Almost saturated solutions were prepared at higher temperature. They were placed in a thermostatic bath at 25.0°C and shaken for 12 to 15 days. A sample of saturated solution was analyzed by evaporation to dryness.	SOURCE AND PURITY OF MATERIALS: "Pure" grade reagent CsCl was used. ESTIMATED ERROR: Temperature: ±0.1 K REFERENCES:

COMPONENTS: (1) Caesium chloride; CsCl; [7647-17-8] (2) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Kartzmark, E.M. *Can. J. Chem.* 1977, 55, 2792-8.
VARIABLES: T/K = 298	PREPARED BY: R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25.00	65.67	CsCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: The isothermal method was used. The mixture was equilibrated by stirring at 25.00°C for 2 or 3 days. The phases were separated by filtration through sintered glass and were analyzed for chloride by precipitation as AgCl.	SOURCE AND PURITY OF MATERIALS: CsCl: reagent grade was used without further purification. ESTIMATED ERROR: No estimates possible. REFERENCES:

COMPONENTS:

(1) Caesium chloride; CsCl; [7647-17-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Rard, J.A.; Miller, D.G.

J. Chem. Eng. Data 1982, *27*, 169-73.

VARIABLES:

T/K = 298

PREPARED BY:

R. Cohen-Adad

EXPERIMENTAL VALUES:

t/°C	molality m_1/mol kg^{-1}	mass %	solid phase
25	11.382	65.709	CsCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isopiestic method, as described in (1).

SOURCE AND PURITY OF MATERIALS:

CsCl: analyzed for impurities by DC arc optical emission spectroscopy. Stock solution concentrations determined by drying and by chloride analysis.

ESTIMATED ERROR:

Solubility: ± 0.008 mol/kg using 10- and 12-day equilibrations.

REFERENCES:

1. Spedding, F.H.; Weber, H.O.; Saeger, V.W.; Petheram, H.H.; Rard, J.A.; Habenschuss, A. *J. Chem. Eng. Data* 1977, *21*, 341.

COMPONENTS:

(1) Caesium chloride; CsCl; [7647-17-8]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Lazorenko, N.M.; Shevchuk, V.G.

Zh. Neorg. Khim. 1983, *28*, 2675-6; *Russ. J. Inorg. Chem.* *(Engl. Transl.)* 1983, *28*, 1517-8.

VARIABLES:

T/K = 298, 323, 348, 373

PREPARED BY:

T. Mioduski

EXPERIMENTAL VALUES:

t/°C	mass %	molality m_1/mol kg^{-1}	solid phase
25	66.63	11.86	CsCl
50	68.55	12.95	"
75	70.93	14.49	"
100	72.60	15.74	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothermal saturation method was used. Equilibrium was reached within 24 h. The compositions of saturated solutions were found by standard chemical analyses.

SOURCE AND PURITY OF MATERIALS:

CsCl: recrystallized.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS	EVALUATOR:
(1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. July, 1988

CRITICAL EVALUATION

Solubility data for the binary system NH_4Cl-H_2O have been presented in 78 publications. The solid phase in equilibrium with the saturated solution is either ice or the anhydrous salt, depending on the region of concentration.

EXPERIMENTAL METHODS

Solubilities have been measured using analytical methods (1, 6, 7-9, 12, 19, 21, 24-27, 31, 40-45, 47-50, 53, 54, 56, 58-61, 63, 64, 66, 70-72, 75, 77, 80, 81, 83, 84, 86-88, 91-95) or synthetic methods (4, 10, 11, 13, 14, 23, 35, 36, 52, 57, 65, 67, 69, 82). In one case (2), solubility was determined from the dependence of density on the composition of unsaturated and saturated solutions. Determinations were made, for the most part, under isothermal conditions.

ANALYSIS OF SOLUTIONS

Compositions of saturated solutions were determined either by evaporation to dryness and weighing (1, 6-8, 12, 19, 49a, 93), or by chemical analysis for chloride (9, 18, 21, 27, 31, 40, 48-50, 52-54, 56, 60, 61, 64, 66, 70, 71, 73, 75, 77, 83, 84, 88, 91, 92, 94, 95) or for ammonium ion (24-26, 40-43, 51, 58, 59, 63, 77, 80, 81, 84).

CHEMICALS USED

Usually NH_4Cl was a chemically pure reagent, sometimes recrystallized twice or more (4, 18, 24, 25, 30, 35, 49, 52, 54, 56, 60, 67, 69, 80-82, 89, 92) and dried by heating to 85°C (93) or to 100°C (1) or by dehydration with $CaCl_2$ (82). Alluard (6,8) prepared the salt from ammonia and hydrochloric acid. The purity of the sample was checked by Lewis' method in one instance (35).

Water used in the preparation of solutions was usually doubly distilled.

CRITICAL EVALUATION OF RESULTS

1. *Fitting equations*

All the data on the compilation sheets have been analyzed according to the procedure outlined in the Preface to this volume. Solubility curves for the salt are represented by equations of the form:

$$Y(x_1) - Y(x_0) = A(1/T - 1/T_0) + B\ln(T/T_0) + C(T - T_0) \qquad [1]$$

with:

$$Y(x_1) = 2\ln[2x_1/(1 + x_1)] \qquad [2]$$

where x_1, T are the coordinates of a point lying on the curve, x_0, T_0 are the coordinates of a particular point, and A, B, C are coefficients adjusted by the least squares method. The equation of the solubility curve of ice is expressed (see the Preface) by the relation:

(continued)

COMPONENTS	EVALUATOR:
(1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. July, 1988

CRITICAL EVALUATION

$$\ln\{(1 - x_1)/(1 + x_1)\} = A\,(1/T - 1/T_0) + B\,\ln(T/T_0) - \ln f_2 \qquad [3]$$

where T_0 = 273.15 K is the melting temperature of the ice at atmospheric pressure, and A and B are evaluated from the enthalpy and the molar heat capacity of melting of ice: $A = -(\Delta H_0 - T_0\Delta C_0)/R$, $B = \Delta C_0/R$.
The quantities ΔH_0 and ΔC_0 are given in tables of constants:

$\Delta H_0 = 6009\ \mathrm{J\ mol^{-1}}$; $\Delta C_0 = 37.7\ \mathrm{J\ K^{-1}\ mol^{-1}}$; $R = 8.314\ \mathrm{J\ K^{-1}\ mol^{-1}}$

The logarithm of the activity of the water in the solution is expressed according to the procedure described in the Preface as:

$$\ln f_2 = \{x_1/(1 + x_1)\}^{3/2}\,(E + Fz + Gz^2 + Hz^3)/T \qquad [5]$$

with

$$z = \ln\{x_1/(1 + x_1)\}$$

E, F, G, H are coefficients, adjusted by cubic regression of the experimental values, of the quantity:

$$T\{(1 + x_1)/x_1\}^{3/2}\ln f_2 = E + Fz + Gz^2 + Hz^3 =$$
$$[6]$$
$$T\{(1 + x_1)/x_1\}^{3/2}\left\{\ln\{(1 + x_1)/(1 - x_1)\} + A\,(1/T - 1/T_0) + B\,\ln(T/T_0)\right\}$$

2. *Melting temperature of NH_4Cl*

Ammonium chloride decomposes without melting at 611.4 K at atmospheric pressure (85). It is, however, possible to determine the melting temperature under pressure: Rassow (39) indicates 793.2 K.

3. *Polymorphism of NH_4Cl*

Ammonium chloride exists in three polymorphic forms, but only two (α and β) are observable in the presence of a liquid (29,33,34). The transition temperature of α-NH_4Cl = β-NH_4Cl used in our critical analysis is that given in JANAF (90): 457.7 K.

4. *Critical Evaluation of the Data*

4.1 Solubility curve of β-NH_4Cl (high temperature form)

The solubility was calculated from 22 sets of data points by requiring that the curve pass through the melting point of the salt and through the the transition point, the composition of which was determined from the solubility data of the liquidus branch of α-NH_4Cl.

The coefficients of A, B, C of equation [1] are given in Table 1.

The experimental values agree very well with each other and with the calculated values to better than one percent with the exception of three points. The first, at 191°C, must be considered aberrant; the others, at 211 and 339°C, can be accepted as tentative values.

The dead space available to the vapor is not defined in the publica-

(continued)

COMPONENTS	EVALUATOR:
(1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. July, 1988

CRITICAL EVALUATION

tions and can lead to a systematic error owing to a change in composition of the mixtures studied. Lacking more exact information on the experimental conditions (pressure or relative dead space data), the published and calculated data can be recommended to 520 K, with a precision better than or of the order of one percent (with the exception of the experimental value at 191°C [464 K] noted above). Above this temperature, all values must be considered as tentative.

Table 1

System NH_4Cl-H_2O

Coefficients of fitting equations of solubility

Solid phase	Coefficients	Conditions introduced in calculation	Range/K
β - NH_4Cl	A = 8577.636 B = 32.21678 C = -0.0250646	melting pt (T_m = 793.2 K) of NH_4Cl transition pt (T_t = 457.7 K) (x_t = 0.3350)	793.2 - 457.7
α - NH_4Cl	A = -5454.9 B = -23.7863 C = 0.034872	eutectic pt (T_E = 257.46 K x_E = 0.0742)	457.7 - 258
Ice [a]	A = 514.778 B = 4.532 C = -27.307 E = -3675.0143 F = -2546.9565 G = -565.4145 H = -44.1579	melting pt (T_0 = 273.15 K) of ice eutectic pt (T_E = 257.46 K x_E = 0.0742) heat of fusion of ice heat capacity of fusion of ice	258 - 273

[a] for ice: $A = -(\Delta H_0 - T_0 \Delta C_0)/R$; $B = \Delta C_0/R$; $C = -A - B \ln T_0$

The results of the critical analysis are collected in Table 2.

4.2 Solubility curve of α-NH_4Cl (low temperature form)

Two sets of results have not been compiled: Von Hauer (5), which lack exact temperatures, and Berecz (79), which are graphical only.

(continued)

COMPONENTS	EVALUATOR:
(1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. July, 1988

CRITICAL EVALUATION

A graphic selection preceding calculations permitted the elimination of eight sets of values from the 183 published. The results, very old for the most part, except for (80), lie well outside the solubility curve and cannot, on analysis, be attributed to metastable equilibria. These points, which are not taken into account in calculating the fitting equation, correspond to a relative range $|x_1(\text{exp}) - x_1(\text{calc})|/x_1(\text{calc}) > 0.05$. Fourteen experimental points corresponding to a relative range between 0.02 and 0.05 are considered to be tentative values. For 121 sets of values (73.8%) the relative range between experimental and calculated values is less than 1 %. Therefore, the calculated values can be recommended in the range -16 to 185°C. All the experimental data are given in Table 3.

Table 2

Solubility of β - NH_4Cl in aqueous solutions

T/K - 273.15	mass % $100w_1$ exp	mass % $100w_1$ calc	mole fraction x_1 exp	mole fraction x_1 calc	status	ref.
184.55(2)	59.93	59.93	0.3350	0.3350	r	33
187.3	60.33	60.23	0.3387	0.3377	r	33
187.9	60.33	60.29	0.3387	0.3383	r	33
189.1	60.55	60.42	0.3408	0.3395	r	33
190.15	60.65	60.54	0.3417	0.3406	r	33
191	59.1	60.63	0.3273	0.3415	a	57
191.7	60.83	60.71	0.3434	0.3422	r	33
194.7	61.23	61.04	0.3472	0.3454	r	33
199.1	61.75	61.54	0.3522	0.3502	r	33
200.5	61.93	61.70	0.3539	0.3518	r	33
205.0	62.51	62.23	0.3596	0.3569	r	33
211	62.4	62.96	0.3585	0.3640	t	57
236	66.2	66.15	0.3974	0.3970	r	57
241	66.7	66.82	0.4028	0.4042	r	57
246	67.7	67.50	0.4138	0.4116	r	57
267	70.4	70.41	0.4448	0.4448	t	57
294	74.5	74.24	0.4959	0.4925	t	57
318	77.8	77.65	0.5413	0.5392	t	57
339	80.2	80.60	0.5770	0.5832	t	57
377	85.6	85.71	0.6669	0.6690	t	57
417	90.8	90.62	0.7687	0.7649	t	57
520.05(4)	100.0	100.00	1.0000	1.0000	t	57

$e = |x_1(\text{calc}) - x_1(\text{obs})|/x_1(\text{calc})$ (2) transition point
r - recommended value $e < 0.02$ (4) melting point
t - tentative value $0.02 \leq e < 0.05$ (see text)
a - aberrant value $e > 0.05$

(continued)

COMPONENTS	EVALUATOR:
(1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. July, 1988

CRITICAL EVALUATION

Table 3
Solubility of α-NH_4Cl in aqueous solutions

T/K - 273.15	mass % $100w_1$		mole fraction x_1		relative density		status	ref.
	exp	calc	exp	calc	exp	calc		
-16.0	19.27	19.34	0.0744	0.0747			(1),r	13
-16	19.48	"	0.0753	"			(1),r	46
-16.0	19.5	"	0.0754	"			(1),r	24
-15.8	18.6	19.38	0.0715	0.0749			(1),t	20
-15.8	18.63	"	0.0716	"			(1),t	74
-15.36	19.68	19.48	0.0762	0.0753			(1),r	35
-15.2	19.3	19.52	0.0745	0.0755			(1),r	69
-15	18.5	19.56	0.0710	0.0757			a	62
-15	18.7	"	0.0719	"			a	62
-15	19.5	"	0.0754	"			r	69
-15	19.56	19.56	0.0757	0.0757			(1),r	12
-15.0	19.7	"	0.0763	"			r	24
-15	20	"	0.0777	"			t	13
-12.2	20.0	20.19	0.0777	0.0785			r	24
-10.9	20.3	20.48	0.0790	0.0798			r	24
-10	19	20.69	0.0807	0.0807			a	67
-10	20.8	"	0.0813	"			r	62
-10	20.82	"	0.0814	"	1.060	1.062	r	55
- 9.4	20.6	20.82	0.0804	0.0814			r	69
- 7.4	21.1	21.27	0.0826	0.0834			r	24
- 5.7	21.7	21.65	0.0854	0.0851			r	24
- 5	22	21.81	0.0867	0.0859			r	13
- 2.3	22.3	22.41	0.0881	0.0886			r	24
- 1.1	22.6	22.67	0.0895	0.0899			r	24
0	22.12	22.92	0.0873	0.0910			t	6
0	22.7	22.92	0.0900	0.0910			r	24
0	22.8	"	0.0905	"			r	69
0	22.8	"	0.0905	"			r	7
0	22.81	"	0.0905	"			r	41
0	22.9	"	0.0905	"			r	49a
0	22.9	22.92	0.0909	0.0910			r	9
0	22.9	"	0.0909	"			r	42
0	22.9	"	0.0909	"			r	50
0	22.9	"	0.0909	"			r	62
0	22.9	"	0.0909	"			r	84
0	22.98	22.92	0.0913	0.0910			r	30
0	23.0	"	0.0914	"			r	63
0	23.0	"	0.0914	"			r	7
0	23	"	0.0914	"			r	67
0	23.2	"	0.0923	"			r	13
0	23.97	22.92	0.0962	0.0910	1.066	1.067	a	55
0.4	22.7	23.01	0.0900	0.0914			r	69
0.4	23.09	"	0.0918	"			r	54
3.5	23.80	23.78	0.0952	0.0946			r	31
4.25	23.6	23.85	0.0942	0.0954			r	7
5	23.8	24.02	0.0952	0.0962			r	82
6.2	24.3	24.28	0.0976	0.0975			r	9
8	25	24.68	0.1009	0.0994			r	13

(continued)

COMPONENTS	EVALUATOR:
(1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. July, 1988

CRITICAL EVALUATION

Table 3 (continued)

Solubility of α-NH_4Cl in aqueous solutions

T/K - 273.15	mass % $100w_1$		mole fraction x_1		relative density		status	ref.
	exp	calc	exp	calc	exp	calc		
8.5	24.6	24.77	0.0990	0.0998			r	7
9.4	24.8	24.98	0.1000	0.1009			r	69
9.8	25	25.07	0.1009	0.1013			r	62
10	24.72	25.12	0.0996	0.1015			r	6
10	24.9	"	0.1004	"			r	69
10	24.92	"	0.1005	"	1.072	1.071	r	55
10	24.99	"	0.1009	"			r	41
10	25	25.12	0.1009	0.1015			r	62
10	25.2	"	0.1019	"			r	67
10.8	25.3	25.29	0.1024	0.1023			r	9
15	24.17	26.20	0.0969	0.1068	1.075209	1.0734	a	1
15	26.0	"	0.1058	"			r	44
15	26.1	26.20	0.1063	0.1068			r	43
15	26.28	"	0.1072	"	1.07568	1.0734	r	2
15.5	26.1	26.20	0.1063	0.1068			r	7
16.5	26.4	26.52	0.1078	0.1083			r	7
17	26.5	26.63	0.1083	0.1089			r	65
17	27.14	26.63	0.1115	0.1089			t	32
17.5	27.02	26.74	0.1109	0.1095			r	27
18.5	25.8	26.95	0.1048	0.1105			(3)	18
18.5	27.2	"	0.1118	"			r	18
19	26.9	27.06	0.1103	0.1111	1.0767	1.0751	r	3
19.9	26.9	27.25	0.1103	0.1120			r	69
20	27.1	27.27	0.1113	0.1121			r	69
20	27.16	"	0.1116	"			r	6
20	27.2	"	0.1118	"			r	62
20	27.22	"	0.1119	"	1.0763	1.0754	r	70
20	27.245	27.27	0.1120	0.1121			r	50
20	27.26	"	0.1121	"			r	77
20	27.28	"	0.1122	"	1.076	1.0754	r	55
20	27.35	"	0.1121	"			r	78
20	27.37	"	0.1126	"			r	78
20	27.5	27.27	0.1133	0.1121			r	67
20	27.82	"	0.1149	"			r	80
24.8	28.23	28.30	0.1170	0.1173			r	73
25	27.7	28.34	0.1143	0.1175			r	88
25	27.80	"	0.1148	"			t	31
25	27.9	28.34	0.1153	0.1175			t	7
25	28.15	"	0.1166	"	1.077	1.0774	t	89
25	28.2	"	0.1168	"			r	69
25	28.2	"	0.1168	"			r	83
25	28.20	"	0.1168	"			r	87
25	28.20	28.34	0.1168	0.1175			r	86
25	28.20	"	0.1168	"			r	92
25	28.20	"	0.1168	"			r	95
25	28.27	"	0.1171	"			r	41
25	28.3	"	0.1173	"	1.0761	1.0774	r	83

(continued)

COMPONENTS	EVALUATOR:
(1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. July, 1988

CRITICAL EVALUATION (continued)

Table 3 (continued)

Solubility of α-NH_4Cl in aqueous solutions

T/K - 273.15	mass % $100w_1$ exp	mass % $100w_1$ calc	mole fraction x_1 exp	mole fraction x_1 calc	relative density exp	relative density calc	status	ref.
25	28.30	28.34	0.1173	0.1175			r	60
25	28.31	"	0.1174	"			r	21
25	28.32	"	0.1174	"			r	30
25	28.33	"	0.1175	"			r	59
25	28.33	"	0.1175	"	1.077	1.0774	r	40
25	28.33	28.34	0.1175	0.1175			r	54
25	28.33	"	0.1175	"			r	76
25	28.35	"	0.1176	"			r	64
25	28.37	"	0.1177	"			r	75
25	28.44	"	0.1180	"			r	68
25	28.448	28.34	0.1181	0.1175			r	26
25	28.46	"	0.1181	"			r	61
25	28.48	"	0.1182	"	1.07722	1.0774	r	49
25	28.50	"	0.1184	"			r	63
25	28.50	"	0.1184	"			r	56
25	28.50	28.34	0.1184	0.1175			r	58
25	28.52	"	0.1185	"			r	87
25	28.6	"	0.1189	"			r	82
25	28.53	"	0.1185	"			r	47
25.00	28.63	"	0.1190	"			r	94
25	28.64	28.34	0.1191	0.1175	1.064	1.077	r	55
25.1	28.3	28.36	0.1173	0.1176			r	66
25.2	28.47	28.38	0.1182	0.1177			r	48
28.5	28.8	29.08	0.1199	0.1213			r	69
29.75	29.2	29.34	0.1248	0.1227			r	7
30	28.8	29.39	0.1199	0.1229			t	19
30	29.28	"	0.1224	"			r	73
30	29.3	"	0.1225	"			r	62
30	29.38	"	0.1229	"	1.0832	1.079	r	70
30	29.44	"	0.1232	"			r	6
30	29.47	29.39	0.1234	0.1229			r	93
30	29.49	"	0.1235	"			r	93
30	29.5	"	0.1235	"			r	25
30	29.5	"	0.1235	"			r	28
30	29.6	"	0.1240	"			r	67
31.6	29.8	29.72	0.1251	0.1247			r	9
32	30	29.81	0.1261	0.1251			r	13
33.0	30	30.02	0.1261	0.1262			r	62
35	30.13	30.43	0.1268	0.1284	1.081	1.079	r	55
35	30.2	"	0.1272	"			r	69
35	30.20	30.43	0.1272	0.1284			r	81
35	30.35	"	0.1280	"			r	72
35	30.4	"	0.1282	"			r	45
35	30.52	"	0.1289	"			r	21
38.5	30.7	31.16	0.1298	0.1323			r	69
40	31.58	31.46	0.1345	0.1339			r	6
40.05	31.6	31.47	0.1346	0.1340			r	66
43.1	32.0	32.10	0.1368	0.1373			r	69

(continued)

COMPONENTS

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

EVALUATOR:

R. Cohen-Adad; P. Vallée

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July, 1988

CRITICAL EVALUATION (continued)

Table 3 (continued)

Solubility of α-NH_4Cl in aqueous solutions

T/K - 273.15	mass % $100w_1$ exp	mass % $100w_1$ calc	mole fraction x_1 exp	mole fraction x_1 calc	relative density exp	relative density calc	status	ref.
45	32.43	32.48	0.1391	0.1394	1.085	1.085	r	55
45	32.59	32.48	0.1400	"			r	21
49	33.2	33.30	0.1434	0.1439			r	7
50	30.5	33.50	0.1288	0.1450			a	58
50	33.15	33.50	0.1431	"			r	31
50	32.88	"	0.1416	"	1.0859	1.086	t	55
50	33.5	"	0.1450	"			r	45
50	33.5	33.50	0.1450	0.1450			r	50
50	33.5	"	0.1450	"			r	54
50	33.5	"	0.1450	"			r	63
50	33.5	"	0.1450	"			r	82
50	33.51	"	0.1451	"			r	95
50	33.54	33.50	0.1453	0.1450			r	86
50	33.55	"	0.1453	"			r	64
50	33.60	"	0.1456	"			r	6
50	34.25	"	0.1492	"			t	32
55.3	34.3	34.55	0.1495	0.1910			r	7
60	35.37	35.49	0.1556	0.1563			r	77
60	35.50	"	0.1564	"			r	6
64.9	36.3	36.46	0.1610	0.1620			r	9
65	36.09	36.48	0.1598	0.1621	1.086	1.088	r	55
70	37.30	37.46	0.1669	0.1679			r	6
70	37.60	37.46	0.1687	0.1679			r	91
75	38.64	38.43	0.1750	0.1737			r	50
75	38.70	"	0.1753	"			r	95
80	38.99	39.40	0.1771	0.1796			r	6
80	39.18	"	0.1783	"	1.0876	1.094	r	55
80	39.7	39.40	0.1815	0.1796			t	7
90	40.51	41.33	0.1866	0.1917	1.1020	1.097	t	55
90	40.60	"	0.1871	"			t	6
90.6	40.2	41.44	0.1846	0.1925			t	9
98.4	43.1	42.93	0.2033	0.1962			r	7
100	42.13	43.24	0.1969	0.2042			t	6
100	43.51	"	0.2060	"			r	32
100	43.57	"	0.2064	"			r	64
100	43.57	"	0.2064	"			r	95
110	43.58	45.16	0.2064	0.2171			t	6
115	46.4	46.21	0.2258	0.2237			r	7
115	46.5	"	0.2264	"			r	53
115.65	46.6	46.24	0.2271	0.2246			r	7
116.0	46.6	46.31	0.2271	0.2251			r	51
129	48.9	48.81	0.2437	0.2431			r	57
142	51.1	51.35	0.2603	0.2623			r	57
162.9	55.80	55.55	0.2983	0.2962			r	33
164	54.6	55.78	0.2883	0.2981			t	57
165.65	56.31	56.12	0.3027	0.3010			r	33
169.5	57.07	56.91	0.3093	0.3079			r	33

(continued)

COMPONENTS	EVALUATOR:
(1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. July, 1988

CRITICAL EVALUATION (continued)

Table 3 (continued)

Solubility of α-NH_4Cl in aqueous solutions

T/K - 273.15	mass % $100w_1$ exp	calc	mole fraction x_1 exp	calc	relative density exp	calc	status	ref.
172.0	57.52	57.43	0.3132	0.3124			r	33
176.1	58.33	58.30	0.3204	0.3201			r	33
177.2	58.55	58.53	0.3224	0.3222			r	33
178.55	58.81	58.82	0.3247	0.3248			r	33
178.95	58.86	58.90	0.3252	0.3255			r	33
181.05	59.35	59.35	0.3296	0.3296			r	33
181.75	59.52	59.50	0.3312	0.3310			r	33
182.2	59.40	59.60	0.3301	0.3319			r	33
183.05	59.67	59.78	0.3326	0.3336			r	33
184.55	59.93	60.10	0.3350	0.3366			(2),r	33

$e = |x_1(\text{calc}) - x_1(\text{obs})|/x_1(\text{calc})$

r = recommended value $e < 0.02$ (1) eutectic point

t = tentative value $0.02 \leqslant e < 0.05$ (2) transition point

a = aberrant value $e > 0.05$ (3) data obtained under pressure

4.3 Eutectic liquid + ice + α-NH_4Cl

Ten values are given in the literature (12, 13, 19, 20, 24, 25, 35, 46, 69, 74). Analysis of the results leads to the rejection of the following values:

t/°C	$100w_1$	ref
-15	19.56	12, 13
-15.8	18.6	19
-15.8	18.6	80

which are notably far removed from other experimental values and from results obtained by extrapolation of the solubility curves of ice and of α-NH_4Cl. The coordinates retained for our critical analysis are:

$T_E = 257.45 \pm 0.35$ K $w_E = 0.1944 \pm 0.0025$.

4.4 Solubility of ice in ammonium chloride solutions

The numerical data are comparatively numerous but the results are somewhat spread out and of poorer quality than those for the other MCl-H_2O systems. The values of Klein and Svanberg (38), Jones (16), Loomis (17), Biltz (22), and Jones and Getman (23), expressed in amount concentrations, have not been compiled.

Of the 120 experimental points compiled and given in the bibliography, six have been eliminated, before any calculations, through graphical selection. Eleven others correspond to a relative range $|\Delta x_1/x_1(\text{calc})| > 0.05$ and are also regarded as aberrant. Points corresponding to a relative range of 0.02 and their calculated values can be recommended.

(continued)

COMPONENTS

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

EVALUATOR:

R. Cohen-Adad; P. Vallée

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July, 1988

CRITICAL EVALUATION (continued)

Results of solubility measurements and calculated values are given in Table 4.

Table 4

Solubility of ice in aqueous solutions of NH_4Cl

T/K - 273.15	mass % $100w_1$		mole fraction x_1		status	ref.
	exp	calc	exp	calc		
-0.003810	0.005622	0.0068	0.000019	0.000023	x	52
-0.007160	0.01052	0.0127	0.000035	0.000043	x	52
-0.01006	0.01482	0.0172	0.000050	0.000058	x	52
-0.02159	0.03220	0.0362	0.000108	0.000122	x	52
-0.02841	0.04250	0.0471	0.000143	0.000159	x	52
-0.03691	0.05538	0.0605	0.000187	0.000204	x	52
-0.06833	0.1036	0.1106	0.000349	0.000373	x	52
-0.1043	0.1588	0.1669	0.000535	0.000563	x	52
-0.1440	0.2203	0.2285	0.000743	0.000771	x	52
-0.1812	0.2784	0.2860	0.000939	0.000965	x	52
-0.2403	0.3713	0.3765	0.001254	0.00127	r	52
-0.2764	0.4280	0.4320	0.001246	0.00146	a	52
-0.287	0.448	0.4482	0.00151	0.00151	r	14
-0.363	0.418	0.5670	0.00188	0.00196	a	15
-0.3890	0.6057	0.6033	0.002048	0.00204	r	52
-0.4	1	0.6198	0.00339	0.00210	a	13
-0.4414	0.6889	0.6831	0.002331	0.00231	r	52
-0.45	0.7	0.6957	0.00237	0.00235	r	24
-0.5371	0.8404	0.8280	0.002846	0.00280	r	52
-0.5883	0.9234	0.9052	0.003129	0.00307	r	52
-0.606	0.694	0.932	0.00234	0.00317	a	15
-0.65	0.99	0.9985	0.00336	0.00339	r	4
-0.6596	1.035	1.013	0.003510	0.00343	t	52
-0.6681	1.049	1.026	0.003558	0.00348	r	52
-0.6683	1.048	1.026	0.003554	0.00348	r	52
-0.7454	1.172	1.143	0.003978	0.00388	t	52
-0.7978	1.256	1.222	0.004265	0.00415	t	52
-0.8566	1.348	1.310	0.004581	0.00445	t	52
-0.9003	1.417	1.376	0.004817	0.00468	t	52
-0.9295	1.464	1.420	0.004979	0.00483	t	52
-1.019	1.154	1.553	0.00391	0.00534	a	15
-1.219	1.920	1.857	0.006550	0.00633	t	52
-1.25	1.9	1.903	0.00648	0.00649	r	24
-1.250	1.969	1.903	0.006719	0.00649	r	52
-1.3	1.96	1.979	0.00669	0.00675	r	10-11
-1.35	1.96	2.055	0.00669	0.00702	t	4
-1.4	6	2.129	0.0210	0.00727	a	62
-1.528	2.402	2.322	0.00822	0.00794	t	52
-1.6	2.9	2.431	0.00996	0.00832	a	69
-1.6	3	2.431	0.01031	0.00832	a	13
-1.70	2.7	2.581	0.00926	0.00884	t	24
-1.729	1.911	2.624	0.00652	0.00914	a	15
-1.848	2.897	2.803	0.009948	0.00962	t	52
-1.957	3.069	2.966	0.01055	0.01019	r	52

(continued)

COMPONENTS	EVALUATOR:
(1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. July, 1988

CRITICAL EVALUATION (continued)

Table 4 (continued)

Solubility of ice in aqueous solutions of NH_4Cl

T/K - 273.15	mass % $100w_1$ exp	calc	mole fraction x_1 exp	calc	status	ref.
-1.964	3.078	2.977	0.010582	0.0102	t	52
-2.383	3.714	3.603	0.01284	0.0124	r	52
-2.6	3.85	3.925	0.01331	0.0136	r	4
-2.643	4.106	3.989	0.014215	0.0138	t	52
-2.850	4.413	4.295	0.01531	0.0149	t	52
-3.05	4.6	4.590	0.01598	0.0159	r	24
-3.1	5	4.663	0.01742	0.0162	a	13
-3.174	4.900	4.771	0.01706	0.0166	r	52
-3.208	4.937	4.821	0.01719	0.0168	r	52
-3.400	5.224	5.101	0.01822	0.0178	r	52
-3.591	5.505	5.38	0.01924	0.0188	r	52
-3.6	5.8	5.39	0.02031	0.0188	a	69
-3.611	5.522	5.41	0.01930	0.0189	t	52
-3.730	2.859	5.58	0.00990	0.0195	a	15
-3.822	5.833	5.71	0.02043	0.0200	r	52
-3.9	5.66	5.82	0.01981	0.0204	t	4
-4.4	7.1	6.53	0.02770	0.0230	a	53
-4.45	6.6	6.60	0.02325	0.0233	r	24
-4.6	7	6.81	0.02472	0.0240	t	13
-5	7.5	7.37	0.02658	0.0261	r	67
-5.2	7.41	7.64	0.02625	0.0271	t	4
-5.3	8.4	7.78	0.0299	0.0276	a	69
-5.73	8.49	8.36	0.0303	0.0298	r	35
-6.3	10	9.12	0.0360	0.0327	a	62
-6.4	9.2	9.25	0.0330	0.0332	r	24
-6.5	9.09	9.38	0.0325	0.0337	t	4
-6.65	9.09	9.57	0.0325	0.0344	a	10
-7.1	10	10.14	0.0360	0.0366	r	13
-7.5	10.9	10.65	0.0395	0.0386	t	69
-7.550	5.603	10.71	0.01954	0.0388	a	23
-7.63	10.93	10.81	0.0396	0.0392	r	35
-7.8	10.71	11.02	0.0388	0.0400	t	4
-7.80	11.16	11.02	0.04059	0.0400	r	35
-8.0	10.71	11.26	0.03883	0.0410	a	10
-8.25	11.4	11.56	0.04153	0.0422	r	24
-8.60	12.10	11.98	0.04431	0.0438	r	35
-9.45	12.28	12.97	0.04502	0.0478	a	10
-9.5	13.5	13.03	0.04994	0.0480	t	69
-9.7	13.1	13.25	0.04832	0.0489	r	24
-9.9	13	13.48	0.04791	0.0498	t	13
-10	13.3	13.59	0.04913	0.0503	t	62
-10	13.8	"	0.05116	"	r	67
-10.58	14.45	14.23	0.05382	0.0529	r	35
-10.9	13.79	14.57	0.05112	0.0543	a	10
-11.700	10.77	15.57	0.0383	0.0585	a	23
-11.8	15.9	15.52	0.05986	0.0583	t	69
-11.80	15.82	"	0.05952	"	t	35

(continued)

COMPONENTS	EVALUATOR:
(1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. July, 1988

CRITICAL EVALUATION (continued)

Table 4 (continued)

Solubility of ice in aqueous solutions of NH_4Cl

T/K - 273.15	mass % $100w_1$ exp	mass % $100w_1$ calc	mole fraction x_1 exp	mole fraction x_1 calc	status	ref.
-11.9	15.3	15.62	0.05735	0.0587	t	24
-12.0	15	15.72	0.05610	0.0591	a	13
-12.2	15.25	15.93	0.05714	0.0600	t	10
-12.44	16.62	16.1699	0.06291	0.06100	t	35
-12.60	16.62	16.3300	0.06291	0.06168	r	35
-13.0	16	16.7257	0.06028	0.06336	t	13
-13.25	16.7	16.9697	0.06325	0.06440	r	24
-13.65	16.67	17.3551	0.06312	0.06605	t	10
-13.75	16.67	17.4505	0.06312	0.06646	a	10
-13.9	18.21	17.5929	0.06975	0.06708	t	69
-14.0	17	17.6873	0.06453	0.06748	t	13
-14.03	18.30	17.7156	0.07014	0.06761	t	35
-14.5	19.0	18.1540	0.07321	0.06951	a	69
-14.70	18.1	18.3382	0.06927	0.07031	r	24
-15.0	18	18.6118	0.06884	0.07151	t	13
-15	18.9	"	0.07277	"	r	67
-15.0	19.0	"	0.07321	"	t	69
-15	19.56	"	0.07569	"	(1),a	12
-15.10	19.44	18.7022	0.07516	0.07190	t	35
-15.2	19.3	18.7924	0.07454	0.07230	(1),t	69
-15.36	19.68	18.9359	0.07623	0.07293	t	35
-15.4	18.9	18.9716	0.07277	0.07309	r	24
-15.4	18.9	"	0.07277	"	(1),r	67
-15.8	18.6	19.3261	0.07146	0.07466	(1),t	74
-15.8	18.63	"	0.07159	"	(1),t	20
-15.8	19	19.3261	0.07321	0.07466	r	13
-16.0	19.27	19.5014	0.07441	0.07543	(1),r	13
-16	19.48	19.5014	0.07534	0.07543	(1),r	46
-16.0	19.5	19.5014	0.07543	0.07543	(1),r	24

$e = |x_1(\text{calc}) - x_1(\text{obs})|/x_1(\text{calc})$

(1) eutectic point r = recommended value $e < 0.02$

t = tentative value $0.02 \leq e < 0.05$ a = aberrant value $e > 0.05$

x = error could not be evaluated for dilute solutions

4.5 Vapor pressure of the saturated solution

The only numerical data given in the literature are those of Pearce *et al.* (60) who give 18.281 mmHg at 25°C ($100w_1 = 28.30$), of Alluard (6) who gives 718 mmHg at 115.8°C, of von Stackelberg (18) (p = 500 atm, 25.8 mass %), of Denecke (36), who demonstrated the influence of pressure on the equilibrium liquid-ice-NH_4Cl, and of Aronova and Lunskaya (51), who give 748 mmHg at 116.0°C.

4.6 Density of the saturated solution

Eighteen experimental values between -10 and 90°C can be represented by the formula:

(continued)

COMPONENTS	EVALUATOR:
(1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. July, 1988

CRITICAL EVALUATION (continued)

$$d = a_1 + b_1 x_1 + c_1 x_1^2 \qquad [6]$$

where a_1, b_1, c_1, calculated by parabolic regression, have the values:

a_1 = 1.01411 g cm^{-3}; b_1 = 0.71305 g cm^{-3}; c_1 = -1.48176 g cm^{-3}

with a correlation coefficient R^2 = 0.921. The values are reported in Tables 3 and 5.

SOLUBILITY AND DENSITY FOR ROUNDED VALUES OF TEMPERATURE

These values are presented in Table 5 and in the Figure, along with the logarithm of the activity of water in the saturated solution.

Table 5

Solubility and density for rounded values of temperature

T/K - 273.15	mass % $100w_1$	mole fraction x_1	molality m_1/mol kg^{-1}	lnf_2	density g cm^{-3}	solid phase
-1	1.5265	0.00519	0.28979	0.0006907		ice
-2	3.0311	0.01042	0.58436	0.0014333		"
-3	4.5163	0.01568	0.88424	0.0022433		"
-4	5.9655	0.02092	1.18618	0.0030049		"
-5	7.3707	0.02610	1.48755	0.0036285		"
-6	8.7227	0.03118	1.78650	0.0040543		"
-7	10.0201	0.03615	2.08182	0.0042463		"
-8	11.2628	0.04099	2.37276	0.0041860		"
-9	12.4521	0.04571	2.65895	0.0038666		"
-10	13.5902	0.05030	2.94021	0.0032892		"
-11	14.6799	0.05477	3.21653	0.0024596		"
-12	15.7242	0.05912	3.48802	0.0013867		"
-13	16.7257	0.06336	3.75481	0.0000805		"
-14	17.6873	0.06748	4.01708	-0.0014478		"
-15	18.6118	0.07151	4.27504	-0.0031874		"
-15.695	19.2336	0.07425	4.45189	-0.0045151		ice + α-NH_4Cl (1)
-16	19.5014	0.07543	4.52888	-0.0051274		ice, m
-17	20.3585	0.07927	4.77882	-0.0072575		"
-18	21.1852	0.08301	5.02503	-0.0095677		"
-19	21.9834	0.08667	5.26772	-0.0120489		"
-20	22.7549	0.09026	5.50705	-0.0146924		"
-21	23.5014	0.09376	5.74320	-0.0174902		"
-22	24.2242	0.09720	5.97631	-0.0204346		"
-23	24.9247	0.10057	6.20652	-0.0235187		"
-24	25.6043	0.10387	6.43399	-0.0267361		"
-25	26.2640	0.10711	6.65881	-0.0300806		"
-20	18.44	0.0707	4.23			α-NH_4Cl, m
-19	18.66	0.0717	4.29			"
-18	18.89	0.0727	4.35			"
-17	19.11	0.0737	4.42			"
-16	19.34	0.0747	4.48			"
-14	19.79	0.0767	4.61			α-NH_4Cl
-12	20.24	0.0787	4.74			"
-10	20.69	0.0807	4.88		1.062	"
-8	21.13	0.0828	5.01			"
-6	21.58	0.0848	5.15			"

(continued)

COMPONENTS

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

EVALUATOR:

R. Cohen-Adad; P. Vallée

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July, 1988

CRITICAL EVALUATION (continued)

Table 5 (continued)

Solubility and density for rounded values of temperature

T/K - 273.15	mass % $100w_1$	mole fraction x_1	molality m_1/mol kg^{-1}	lnf_2	density g cm^{-3}	solid phase
-4	22.03	0.0869	5.28			α-NH_4Cl
-2	22.47	0.0889	5.42			"
0	22.92	0.0910	5.56		1.067	"
2	23.36	0.0931	5.70			"
4	23.80	0.0952	5.84			"
6	24.24	0.0973	5.98			"
8	24.68	0.0994	6.13			"
10	25.12	0.1015	6.27		1.071	"
12	25.55	0.1036	6.42			"
14	25.98	0.1057	6.56			"
16	26.42	0.1079	6.71			"
18	26.85	0.1100	6.86			"
20	27.27	0.1121	7.01			"
22	27.70	0.1143	7.16			"
24	28.13	0.1164	7.32			"
26	28.55	0.1186	7.47			"
28	28.97	0.1208	7.62			"
30	29.39	0.1229	7.78		1.079	"
32	29.81	0.1251	7.94			"
34	30.22	0.1273	8.10			"
36	30.64	0.1295	8.26			"
38	31.05	0.1317	8.42			"
40	31.46	0.1339	8.58		1.083	"
42	31.87	0.1361	8.75			"
44	32.28	0.1383	8.91			"
46	32.69	0.1406	9.08			"
48	33.09	0.1428	9.25			"
50	33.50	0.1450	9.42		1.086	"
55	34.50	0.1507	9.85		1.088	"
60	35.49	0.1563	10.29		1.089	"
65	36.48	0.1621	10.74		1.089	"
70	37.46	0.1679	11.20		1.092	"
75	38.43	0.1737	11.67		1.093	"
80	39.40	0.1796	12.16		1.094	"
85	40.37	0.1856	12.65		1.095	"
90	41.33	0.1917	13.17		1.096	"
95	42.28	0.1979	13.70		1.097	"
100	43.24	0.2042	14.24		1.098	"
105	44.20	0.2106	14.81		1.098	"
110	45.16	0.2171	15.39			"
115	46.11	0.2237	16.00			"
120	47.07	0.2305	16.63			"
125	48.04	0.2374	17.28			"
130	49.01	0.2445	17.97			"
135	49.98	0.2518	18.68			"
140	50.96	0.2592	19.43			"
145	51.95	0.2669	20.21			"
150	52.94	0.2748	21.03			"

(continued)

COMPONENTS	EVALUATOR:
(1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	R. Cohen-Adad; P. Vallée Université Claude Bernard (Lyon I), Laboratoire de Physico-chimie Minérale II, 69622 Villeurbanne, France. July, 1988

CRITICAL EVALUATION (continued)

Table 5 (continued)

Solubility and density for rounded values of temperature

T/K - 273.15	mass % $100w_1$	mole fraction x_1	molality m_1/mol kg^{-1}	lnf_2	density g cm^{-3}	solid phase
155	53.95	0.2829	21.90			α-NH_4Cl
160	54.96	0.2912	22.81			"
165	55.98	0.2999	23.78			"
170	57.02	0.3088	24.80			"
175	58.06	0.3180	25.88			"
180	59.12	0.3276	27.04			"
184.50	60.09	0.3365	28.15			α-NH_4Cl + β-NH_4Cl (2)
190	60.52	0.3405	28.66			β-NH_4Cl
200	61.65	0.3512	30.05			"
210	62.84	0.3628	31.61			"
220	64.08	0.3753	33.35			"
230	65.37	0.3886	35.28			"
240	66.69	0.4027	37.43			"
250	68.05	0.4177	39.81			"
260	69.43	0.4334	42.46			"
270	70.83	0.4499	45.39			"
280	72.24	0.4671	48.66			"
290	73.67	0.4851	52.30			"
300	75.09	0.5038	56.37			"
310	76.52	0.5233	60.92			"
320	77.94	0.5433	66.05			"
330	79.35	0.5641	71.83			"
340	80.74	0.5854	78.39			"
350	82.12	0.6073	85.86			"
360	83.47	0.6298	94.43			"
370	84.80	0.6527	104.33			"
380	86.10	0.6761	115.84			"
390	87.37	0.6998	129.37			"
400	88.61	0.7237	145.43			"
410	89.81	0.7480	164.72			"
420	90.97	0.7723	188.26			"
430	92.08	0.7967	217.48			"
440	93.16	0.8210	254.56			"
450	94.19	0.8451	302.93			"
460	95.17	0.8690	368.31			"
470	96.10	0.8925	461.00			"
480	96.99	0.9155				"
490	97.82	0.9379				"
500	98.60	0.9595				"
510	99.33	0.9803				"
520	100.00	1.0000	(melting point)			"

(1) eutectic point (2) transition point m = metastable point

All metastable ice values from -17 to -25°C are *tentative*.

All metastable α-NH_4Cl values from -20 to -16°C are *tentative*.

All values for β-NH_4Cl are *tentative*.

(continued)

COMPONENTS

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

EVALUATOR:

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CRITICAL EVALUATION (continued)

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COMPONENTS	EVALUATOR:
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COMPONENTS	EVALUATOR:
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COMPONENTS	EVALUATOR:
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COMPONENTS	EVALUATOR:
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CRITICAL EVALUATION (continued)

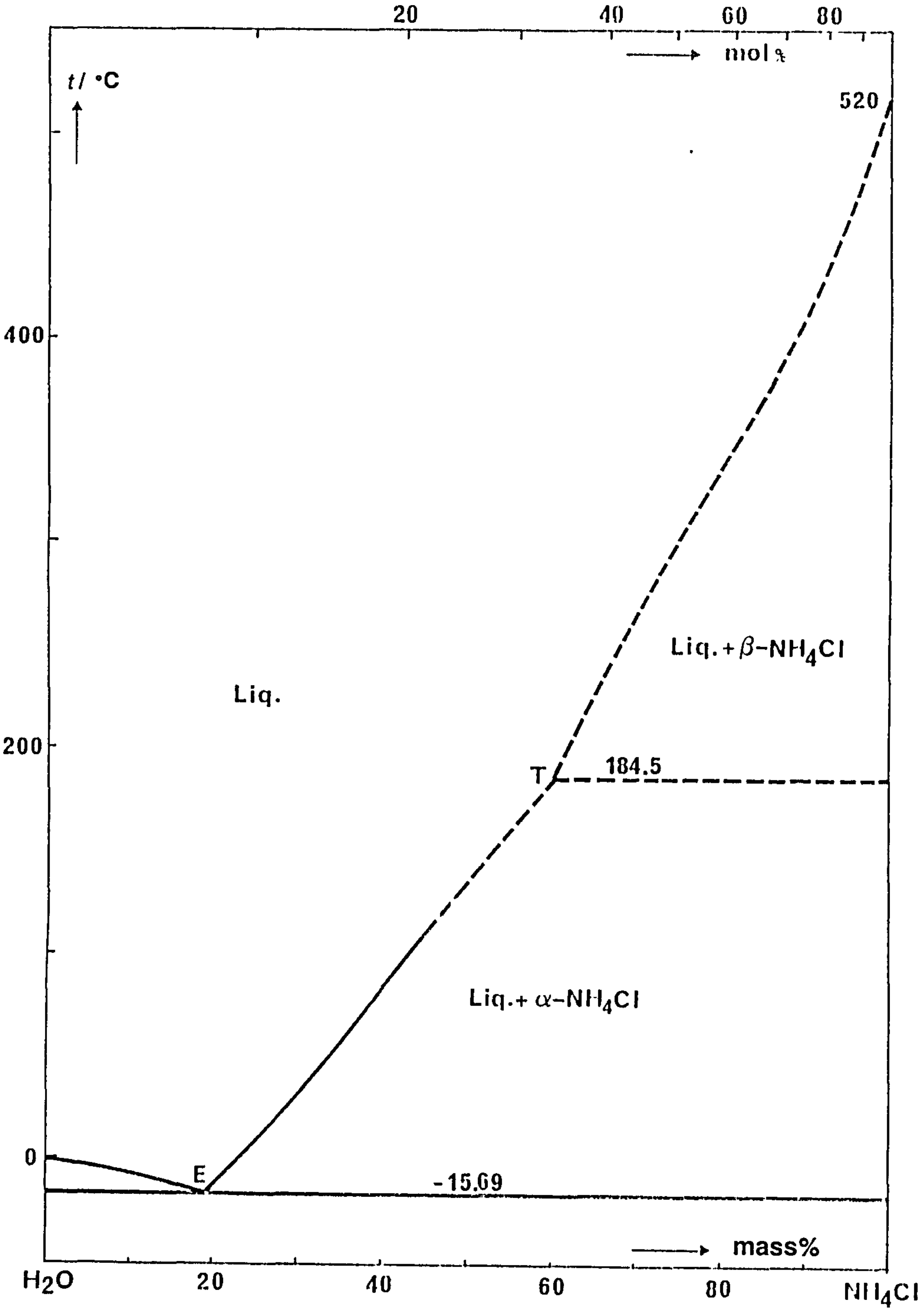

Fig. 1. Temperature-composition phase diagram for the binary system NH_4Cl-H_2O.

COMPONENTS: (1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Michel, A.; Krafft, L. *Ann. Chim. Phys.*[3] 1854, *41*, 471-83.
VARIABLES: T/K = 288	PREPARED BY: R. Tenu

EXPERIMENTAL VALUES:

t/°C	concentration g dm^{-3}	mass %	relative density d^{15}_{15}	solid phase
15	259.920	24.17	1.075209	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: The mixtures of water and excess salt were maintained for 1 month in the range 14-16°C and stirred often. After 1 day at 15°C, samples of solution were drawn off and analyzed by evaporation to dryness and weighing.	SOURCE AND PURITY OF MATERIALS: The pure salt was dried at 100°C. ESTIMATED ERROR: No estimates possible. REFERENCES:

COMPONENTS: (1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Schiff, H. *Justus Liebigs Ann. Chem.* 1859, *109*, 325-32.
VARIABLES: T/K = 292	PREPARED BY: R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	100 x mass ratio NH_4Cl/H_2O	density g cm^{-3}	solid phase
19	26.9	36.8	1.0767	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: The variation of volume during the dissolution of salt was calculated. The method is described in a previous paper (1).	SOURCE AND PURITY OF MATERIALS: Not stated. ESTIMATED ERROR: No estimates possible. REFERENCES: 1. Schiff, H. *Justus Liebigs Ann. Chem.* 1858, *108*, 324.

COMPONENTS:

(1) Ammonium chloride; NH_4Cl;
[12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Gerlach, Th. G. *Spezifische Gewichte der gebrauchlichsten Salzlosungen bei Verschiedenen Concentrationsgraden.* J.G. Engelhardt. Freiberg. 1859. pp. 1-7, 11.

VARIABLES:

T/K = 288

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t = 15°C

mass %	relative density, d_{15}^{15}	solid phase
5	1.01580	
10	1.03081	
15	1.04524	
20	1.05929	
25	1.07304	
satd sln	1.07568	NH_4Cl

The author found the solubility from graphical extrapolation. The compiler found that the density could be represented by the equation $(d_{15}^{15} - 1)/100w_1 = A_1 + A_2(100w_1) + A_3(100w_1)^2$ where w_1 is the mass fraction of the salt, with least-square coefficients:

$A_1 = 3.25 \times 10^{-3}$ $s(A_1) = 2.0 \times 10^{-6}$
$A_2 = -1.93 \times 10^{-5}$ $s(A_2) = 3.0 \times 10^{-7}$
$A_3 = 2.49 \times 10^{-7}$ $s(A_3) = 9.7 \times 10^{-9}$

and overall estimated std dev. 9.1×10^{-7}. Solution of this equation gave the solubility as: 26.28 mass %.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Solutions were made up by mass, using calibrated weights and vacuum corrections. Densities were measured by hydrostatic weighing, using a glass sinker attached to a balance. The method of saturation is not given.

SOURCE AND PURITY OF MATERIALS:

Pure NH_4Cl was thoroughly dried.

ESTIMATED ERROR:

Temperature: precision ±0.1 K.
Solubility: no estimates possible.

REFERENCES:

COMPONENTS: (1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Rudorff, F. *Ann. Phys. Chem.* 1861, *114*, 63-81.
VARIABLES: $T/K = 265 - 272$	PREPARED BY: R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass ratio NH_4Cl/H_2O	mass % (compiler)	solid phase
-0.65	0.01	0.99	ice
-1.35	0.02	1.96	"
-2.6	0.04	3.85	"
-3.9	0.06	5.66	"
-5.2	0.08	7.41	"
-6.5	0.10	9.09	"
-7.8	0.12	10.71	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The freezing point of solutions of known composition was measured.

SOURCE AND PURITY OF MATERIALS:

Pure salt was recrystallized several times.

ESTIMATED ERROR:

Temperature: ±0.1K

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Mulder, G.J. *Scheikundige Verhandelingen en Onderzoeken. Part 3, vol. 3. Bijdragen tot de Geschiedenis van het Scheikundig Gebonden Water.* H.A. Kramers. Rotterdam. 1864. pp. 51-6.

VARIABLES:

T/K = 272-389

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	100x mass ratio NH_4Cl/H_2O	mass %	solid phase
0	29.5	22.8	NH_4Cl
	29.9	23.0	"
4.25	30.9	23.6	"
8.5	32.6	24.6	"
15.5	35.3	26.1	"
16.5	35.9	26.4	"
25	38.7	27.9	"
29.75	41.2	29.2	"
49	49.7	33.2	"
55.3	52.2	34.3	"
80	65.8	39.7	"
98.4	75.7	43.1	"
115	86.6 boils	46.4	"
115.65	87.3 boils	46.6	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The method of isothermal saturation was used. Ice baths, cool cellars and heated water baths were used to control temperature. mixtures of salt and water were shaken for at least 7 d. The saturated solution was weighed and evaporated, and the residue was dried at 100°C, then weighed.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

Temperature: ±0.1 K at 0°C, ±1 K at other temperatures.

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Alluard, M.

C. R. Séances Hebd. Acad. Sci. 1864, *59*, 500-7; *Justus Liebigs Ann. Chem.* 1869, *133*, 292-3.

VARIABLES:

$T/K = 273 - 389$

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass ratio NH_4Cl/H_2O	mass % (compiler)	solid phase
0	0.2840	22.12	NH_4Cl
10	0.3284	24.72	"
20	0.3728	27.16	"
30	0.4172	29.44	"
40	0.4616	31.58	"
50	0.5060	33.60	"
60	0.5504	35.50	"
70	0.5948	37.30	"
80	0.6392	38.99	"
90	0.6836	40.60	"
100	0.7280	42.13	"
110	0.7724	43.58	"
115.8[a]			

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[a] boiling point at 718 mm Hg

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method: a thermostatic jacket was used to fix various temperatures by ebullition of various liquids under constant pressure. A solubility curve was drawn from experimental data and values for rounded temperatures were deduced by interpolation. Saturated solutions were analyzed by evaporation to dryness at 100°C.

SOURCE AND PURITY OF MATERIALS:

NH_4Cl was prepared.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Nordenskjold, A.E.

Ann. Phys. Chem. 1869, *136*, 309-17.

VARIABLES:

T/K = 273 - 364

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass ratio NH_4Cl/H_2O	mass % (compiler)	solid phase
0	0.297	22.9	NH_4Cl
6.2	0.322	24.3	"
10.8	0.342	25.3	"
31.6	0.422	29.8	"
64.9	0.579	36.3	"
90.6	0.672	40.2	"

Data are from G. Lindstróm, author's assistant.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The saturated solutions were prepared in a thermostat. Salt content was determined by titration with $AgNO_3$.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	de Coppet, L.C. *Ann. Chim. Phys.* 1872, *25*, 502-27; *Bull. Soc. Vaudoise Sci. Nat.* 1871, *11*, 1-126.
VARIABLES:	**PREPARED BY:**
T/K = 260 - 272	R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass % NH_4Cl	100 x mass ratio NH_4Cl/H_2O	solid phase
- 1.3	1.96	2	ice
- 6.65	9.09	10	"
- 8.0	10.71	12	"
- 9.45	12.28	14	"
-10.9	13.79	16	"
-12.2	15.25	18	"
-13.75	16.67	20	"
-13.65	16.67	20	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The method was described in a previous paper (1). A sample of known composition was cooled in a mixture of ice and NaCl (or $CaCl_2$) maintained at some degrees below the freezing point. A small piece of ice was added to the sample when its temperature was lower than the freezing point by some tenths of a degree.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

1. de Coppet, L.C. *Ann. Chim. Phys.* 1871, *23*, 366.

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Guthrie, F.

Philos. Mag. <u>1875</u> [4], *49*, 1-20.

VARIABLES:

T/K = 258

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass % NH_4Cl	
-15	19.56	eutectic point

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A saturated solution of NH_4Cl was cooled in ice and the liquid portion transferred to a beaker surrounded by an ice-salt freezing mixture. The temperature remained constant at -15°C. The mother liquor was analyzed by weighing into glass basins and evaporating at 100°C.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Raoult, F.M.

C. R. Hebd. Séances Acad. Sc. <u>1878</u>, *87*, 167-9.

VARIABLES:

T/K = 274

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass ratio NH_4Cl/H_2O	mass % (compiler)	solid phase
−0.287	0.0045	0.448	ice

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Cryoscopic method.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	Guthrie, F. *Philos. Mag.* 1876 [5], *50*, 354-69.
VARIABLES:	PREPARED BY:
$T/K = 257 - 305$	R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
- 0.4	1	ice
- 1.6	3	"
- 3.1	5	"
- 4.6	7	"
- 7.1	10	"
- 9.9	13	"
-12.0	15	"
-13.0	16	"
-14.0	17	"
-15.0	18	"
-15.8	19	"
-16.0	19.27	ice + NH_4Cl[a]
-15	20	NH_4Cl
- 5	22	"
0	23.2	"
8	25	"
32	30	"

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[a] eutectic

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The salt solution was cooled in a test tube until some ice formed; this was very nearly completely remelted under constant stirring with the thermometer and then the tube was plunged momentarily into a eutectic mixture. The minute spicula of ice so formed were again nearly remelted. The mean of four or five readings of the thermometer when the minute quantity of ice began to increase was taken as the true temperature of ice formation. For the determination of the temperature above 0°C at which salt and hydrate separate, a given weight of salt and water was warmed in a stoppered bottle.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Arrhenius, S.

Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1888, *2*, 491-505.

VARIABLES:

T/K = 271-273

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	g/100 cm³ water	mass % (compiler)[a]	solid phase
-0.363	0.419	0.418	ice
-0.606	0.698	0.694	ice
-1.019	1.167	1.154	ice
-1.729	1.945	1.911	ice

---

[a] Calculated using densities of water from (1).

COMMENTS: It appears that solutions were made using anhydrous LiCl (compiler).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

A double-walled freezing point apparatus was used, with a thermometer that could be read to 0.002 K. The apparatus was filled with solution, then cooled to about 0.1 K below the f.p. with a mixture of salt, water and ice at about 2 K below the f.p. Addition of an ice crystal caused a rise in temperature, which attained a constant value for several minutes. This value was taken to be the freezing point. The concentration of the solution was determined by titration.

SOURCE AND PURITY OF MATERIALS:

The salts were "chosen by Prof. van't Hoff with special consideration as to their purity".

ESTIMATED ERROR:

Precision in f.p. within ±0.005 K above -2°C, 0.005-0.1 K below -2°C.

REFERENCES:

1. *International Critical Tables.* McGraw-Hill. New York. 1928. Vol. III, p. 26.

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Von Stackelberg, E.F.

Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1896, *20*, 337-58.

VARIABLES:

T/K = 292
p/atm = 0, 500

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	p/atm	mass %	solid phase
18.5	0	27.2	NH_4Cl
	500	25.8	"

Each quoted solubility value is the mean of 8 measurements.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The salt-water mixture was confined in a steel bomb containing mercury. The selected pressure was obtained by means of a Cailletet pump and the temperature was controlled by a thermostat. The solution was stirred with a magnetic stirrer. Analysis was for Cl by titration with $AgNO_3$.

SOURCE AND PURITY OF MATERIALS:

Kalhbaum's salt was purified by recrystallization.

ESTIMATED ERROR:

Pressure: precision within 1%
Temperature and solubility:
precision within 1%

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Bathrick, H.A.

J. Phys. Chem. 1896-7, *1*, 157-69.

VARIABLES:

T/K = 303

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
30	28.8	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Excess salt and water were placed in stoppered flasks and left for 24 h in a thermostat. Solutions were analyzed by evaporation.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

Temperature: procision probably within ±0.1 K (compiler).
Solubility: probably ±1 %.

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

de Coppet, L.C.

Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1897, *22*, 239-40.

VARIABLES:

$T/K = 257$

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio NH_4Cl/H_2O	mass % (compiler)	solid phase
-15.8	22.9	18.6	NH_4Cl + ice

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Previously described (1).

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. de Coppet, L.C. *Bull. Soc. Vaudoise Sci. Nat.* 1871, 11, 1.

COMPONENTS: (1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	**ORIGINAL MEASUREMENTS:** Mohr, E.C.J. *Z. Phys. Chem., Stoechiom. Verwandtschaftsl.* 1898, *27*, 193-221.
VARIABLES: T/K = 298 - 318	**PREPARED BY:** R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass ratio NH_4Cl/H_2O	mass % (compiler)	solid phase
25	0.1330	28.31	NH_4Cl
35	0.1479	30.52	"
45	0.1628	32.59	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The mixtures were prepared in test-tubes and stirred for about 24 h. The saturated solution was drawn into a pipet after decantation and put in a weighing bottle. The temperature was kept constant in an Ostwald thermostat. Chloride was determined volumetrically by the Volhard method.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-0]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Jones, H.C.; Getman, F.H.

Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1903, *46*, 244-86.

VARIABLES:

T/K = 262-273

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	concentration mol dm^{-3}	mass % (compiler^a)	solid phase
-3.730	1.0	2.859	ice
-7.550	2.0	5.603	"
-11.700	3.0	10.77	"

COMMENTS: The compiler's calculations of mass % uses densities taken from the Critical Evaluation in this volume for solutions of NH_4Cl saturated with ice.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The freezing-point method used a Beckmann thermometer and a stirred freezing-point tube immersed in a freezing mixture. A small correction was calculated to account for ice formed on supercooling, but the authors state that this correction is approximate only, and introduces some error.

SOURCE AND PURITY OF MATERIALS:

NH_4Cl: Kahlbaum "chemically pure", dried for several d over P_2O_5.

Water: redistilled, conductivity 2.0×10^{-6} S cm^{-1}.

ESTIMATED ERROR:

Temperature: precision probably within ±0.1 K (compiler).

Solubility: estimated precision ±1 %.

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Meerburg, P.A.

Z. Anorg. Allg. Chem. 1903, 37, 199-221; 1905, 45, 3-10; 1908, 59, 136-42.

VARIABLES:

T/K = 257 - 303

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
- 0.45	0.7	ice
- 1.25	1.9	"
- 1.70	2.7	"
- 3.05	4.6	"
- 4.45	6.6	"
- 6.4	9.2	"
- 8.25	11.4	"
- 9.7	13.1	"
-11.9	15.3	"
-13.25	16.7	"
-14.70	18.1	"
-15.4	18.9	"
≈-16.0	≈19.5	ice + NH_4Cl (interpolated)
-15.0	19.7	NH_4Cl
-12.2	20.0	"
-10.9	20.3	"
- 7.4	21.1	"
- 5.7	21.7	"
- 2.3	22.3	"
≈- 1.1	22.6	"
0	22.7	"
30	29.5[a]	"

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[a] Only this value is given in the second and third papers.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

For all but the last data point, the mixture was weighed out and immersed in a freezing bath. Then it was warmed and the temperature was recorded at which the last crystal disappeared.

For the last data point, known quantities of dried NH_4Cl and H_2O were introduced into tightly closed bottles and stirred in a thermostat for about 2 days at the desired temperature. When equilibrium was established, the solution was analyzed for NH_4Cl by distillation with KOH. The free ammonia was absorbed in standard H_2SO_4 and the excess of acid back titrated iodometrically in the presence of methyl orange (Kjeldahl's method).

SOURCE AND PURITY OF MATERIALS:

NH_4Cl: recrystallized many times.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS: (1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	**ORIGINAL MEASUREMENTS:** Kernot, G.; D'Agostino, E.; Pellegrino, M. *Gazz. Chim. Ital.* 1908, *38*, 532-54.
VARIABLES: T/K = 298	**PREPARED BY:** R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass ratio NH_4Cl	mass % (compiler)	solid phase
25	0.39758	28.448	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: Isothermal method. NH_4Cl was analyzed by Kjeldahl's method.	**SOURCE AND PURITY OF MATERIALS:** NH_4Cl: not given. Distilled water was prepared by the method of Hulett. **ESTIMATED ERROR:** No estimates possible. **REFERENCES:**

COMPONENTS: (1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	**ORIGINAL MEASUREMENTS:** Strömholm, D. *Z. Anorg. Allg. Chem.* 1908, *57*, 72-103.
VARIABLES: T/K = 291	**PREPARED BY:** R. Tenu

EXPERIMENTAL VALUES:

t/°C	concentration mol dm^{-3}	solid phase
17.5	5.4346	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: A mixture of salt and pure water was stirred for 5 days and chloride was determined in the saturated solution.	**SOURCE AND PURITY OF MATERIALS:** Not stated. **ESTIMATED ERROR:** No estimates possible. **REFERENCES:**

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Schreinemakers, F.A.H.

Z. Physik. Chem., Stoechiom. Verwandtschaftsl. 1909, *69*, 557-68.

VARIABLES:

T/K = 303

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
30	29.5	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Not stated; probably isothermal method.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Demassieux, N.

C. R. Hebd. Séances Acad. Sc. 1913, *156*, 892-4.

VARIABLES:

T/K = 290-373

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
17	27.14	NH_4Cl
50	34.25	"
100	43.51	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Not stated.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	Armstrong, H.E.; Eyre, J.V. *Proc. R. Soc. London, A* <u>1911</u>, *84*, 123-36.
VARIABLES:	**PREPARED BY:**
T/K = 273, 298	R. Tenu

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio NH_4Cl/H_2O I	II	mass % (compiler)	solid phase
0	29.840		22.98	NH_4Cl
25	39.50(A) 39.51(B)	39.52(A) 39.50(B)	28.32	"

The values given in columns I and II are the results of separate experiments, A and B representing results obtained with 2 samples of the same liquid. Sample B was withdrawn 1 h after A . Values of mass % are averages calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The method was described in a previous communication (1). At 0°C, the mixture was constantly stirred in a bath of crushed ice and water. The temperature was easily maintained constant and very close to 0°C for several hours.

SOURCE AND PURITY OF MATERIALS:

"Pure" salt was recrystallized twice.

ESTIMATED ERROR:

Mass ratio: about 0.1% (compiler)

REFERENCES:

1. Armstrong, H.E.; Eyre, J.V.; Hussey, A.V.; Paddisson, W.P. *Proc. R. Soc. London, A* <u>1907</u>, *79*, 564.

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Biltz, W.; Marcus, E.

Z. Anorg. Allg. Chem. <u>1911</u>, *71*, 166-81.

VARIABLES:

T/K = 277-323

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mole ratio NH_4Cl/H_2O	mass % (compiler)	solid phase
3.5	0.1052	23.80	NH_4Cl
25	0.1297	27.80	"
50	0.167	33.15	"

---

[a] The same value was obtained starting from either unsaturated or supersaturated solutions.

COMMENTS: The authors give values in mass %, which are actually 100 x mass NH_4Cl/mass H_2O (compiler).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothermal saturation method was used, starting from both unsaturated and supersaturated solutions in at least one case. Chloride was determined by the Volhard method.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

Temperature: precision ±0.1 K.

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Scheffer, F.E.C.

Vers. Akad. Wet. Amsterdam 1916, *24*, 271-83.

VARIABLES:

$T/K = 436 - 478$

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass ratio NH_4Cl/H_2O	mass % (compiler)	solid phase
162.9	1.2626	55.80	α - NH_4Cl
165.65	1.2891	56.31	"
169.5	1.3295	57.07	"
172.0	1.3540	57.52	"
176.1	1.3999	58.33	"
177.2	1.4127	58.55	"
178.55	1.4279	58.81	"
178.95	1.4306	58.86	"
181.05	1.4603	59.35	"
181.75	1.4703	59.52	"
182.2	1.4632	59.40	"
183.05	1.4793	59.67	"
184.55	1.4957	59.93	α-NH_4Cl + β-NH_4Cl
187.3	1.5211	60.33	β - NH_4Cl
187.9	1.5207	60.33	"
189.1	1.5350	60.55	"
190.15	1.5415	60.65	"
191.7	1.5531	60.83	"
194.7	1.5791	61.23	"
199.1	1.6143	61.75	"
200.5	1.6264	61.93	"
205.0	1.6674	62.51	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

A sample of known composition was prepared in a glass test tube which was sealed and heated in an oil bath. The temperature of disappearance of the last crystal was determined by visual observation. A correction to the composition of the sample was made, assuming that the vapor is essentially H_2O and that it is a perfect gas.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Rodebush, W.H.

J. Am. Chem. Soc. 1918, *40*, 1204-13.

VARIABLES:

T/K = 258-267

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio NH_4Cl/H_2O	mass % (compiler)	solid phases
-5.73	9.28	8.49	ice
-7.63	12.27	10.93	"
-7.80	12.56	11.16	"
-8.60	13.76	12.10	"
-10.58	16.89	14.45	"
-11.80	18.80	15.82	"
-12.44	19.94	16.62	"
-12.60	19.93	16.62	"
-14.03	22.40	18.30	"
-15.10	24.13	19.44	"
-15.36	24.50	19.68	ice + NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Freezing point lowerings were measured directly by means of a Cu-constantan thermocouple connected to a potentiometer. The saturation point was taken as the point at which the temperature stopped falling and began to rise slowly. The composition of the saturated solution was determined by conductivity measurements. For the determination of the eutectic temperature, salt and ice were mixed, frozen to a solid mass, broken up into small pieces and placed in a Dewar. The mixture warmed up rapidly to a definite temperature and then remained constant within 0.01K for 20-30 min.

SOURCE AND PURITY OF MATERIALS:

The salt was the purest commercially available. It was recrystallized and its purity determined by Lewis' equation (1).

ESTIMATED ERROR:

Temperature: ±0.01 to 0.02 K
Solubility: ±0.1%

REFERENCES:

1. Lewis, G.N. *Proc. Am. Acad.* 1907, *43*, 284.

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Denecke, W.

Z. Anorg. Allg. Chem. <u>1919</u>, *108*, 1-43.

VARIABLES:

$T/K = 245, 257$
$p/MPa = 35\text{-}313$

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

$t/°C$	$p/kg\ cm^{-2}$	solid phases
-17.5	350	NH_4Cl + ice I
-22.5	1190	"
-32.4	2028	"
-32.5	2410	NH_4Cl + ice III'
-31.2	2520	"
-29.4	2800	"
-29.1	2890	"
-28.0	3130	"

COMMENTS AND ADDITIONAL DATA:

The composition of the liquid phase at these 3-phase isothermally invariant points was not determined; reference was made to the value of de Coppet (1) (18.6 mass %, -15.8°C) for the value at $p = 1$ atm. The intersection of the two curves (1 + NH_4Cl + ice I) and (1 + NH_4Cl + ice III') was estimated to occur at -34.4°C.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Water and NH_4Cl were confined in a steel bomb with pentane for transmitting pressure. The bomb was immersed in an ethanol-CO_2 bath. The temperature was then increased at a rate of about 0.4 K per minute. A graph of temperature vs pressure allowed determination of the solid-liquid equilibria.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: ±0.01 K

REFERENCES:

1. de Coppet, L.C. *Z. Phys. Chem., Stoechiom. Verwandtschaftsl.* <u>1897</u>, *22*, 239.

COMPONENTS: (1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Clendinnen, F.W.J.; Rivett, A.C. *J. Chem. Soc.* <u>1921</u>, *119*, 1329-39.
VARIABLES: T/K = 298	PREPARED BY: R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	density	solid phase
25	28.33	1.077	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: Isothermal method. Ammonium and chloride were determined directly.	SOURCE AND PURITY OF MATERIALS: Not stated.
	ESTIMATED ERROR: No estimates possible.
	REFERENCES:

COMPONENTS: (1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Mondain-Monval, P. *C. R. Hebd. Séances Acad. Sci.* <u>1922</u>, *175*, 162-4; <u>1922</u>, *174*, 1014-17 (2).
VARIABLES: T/K = 273-288	PREPARED BY: R. Tenu

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio NH_4Cl/H_2O	mass % (compiler)	solid phase	reference
0	29.7	22.9	NH_4Cl	paper 1
15	35.3	26.1	"	paper 2

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: Saturated solution was obtained by stirring the mixture of salt and water for about 4 h. Ammonium ion was determined volumetrically and chloride was analyzed gravimetrically.	SOURCE AND PURITY OF MATERIALS: Not stated.
	ESTIMATED ERROR: No estimates possible.
	REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	Sborgi, U.; Franco, C. *Gazz. Chim. Ital.* 1921, *51*, 1-57.
VARIABLES:	**PREPARED BY:**
T/K = 273-298	R. Tenu

EXPERIMENTAL VALUES:

$t/°C$	mole ratio NH_4Cl/H_2O	mass % (compiler)	solid phase
0	0.09952	22.81	NH_4Cl
10	0.11222	24.99	"
25	0.13270	28.27	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Solubility was determined by the isothermal method.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Toporescu, E.

C. R. Hebd. Séances Acad. Sci. 1922, *174*, 870-3; 1922, *175*, 268-70.

VARIABLES:

$T/K = 288-323$

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio NH_4Cl/H_2O	mass % (compiler)	solid phase	reference
15	35.1	26.0	NH_4Cl	paper 1
35	43.6	30.4	"	paper 2
50	50.4	33.5	"	paper 2

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Salt-water mixtures were stirred for 3 to 6 h in a thermostat. Samples of clear solution were weighed and analyzed.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: ±1 K

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Mondain-Monval, P.

C. R. Hebd. Séances Acad. Sci. 1923, *176*, 1313-6.

VARIABLES:

$T/K = 257$

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
- 16	19.48	ice + NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method was described in a previous paper (1).

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Mondain-Monval, P. *C. R. Hebd. Séances Acad. Sci.* 1923, *176*, 889.

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Benrath, A.

Z. Anorg. Allg. Chem. 1927, *163*, 396-404.

VARIABLES:

$T/K = 298$

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mol ratio H_2O/NH_4Cl	mass % (compiler)	solid phase
25	7.44	28.53	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Not stated; probably isothermal method.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Lanzing, J.C.

Recl. Trav. Chim. Pays-Bas 1928, *47*, 901-3.

VARIABLES:

$T/K = 298.2$

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25.2	28.47[a]	NH_4Cl

[a] mean of 28.51 and 28.43

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The mixture was weighed into a bottle and was shaken for about 3 weeks at 25.2°C. The Cl content of the solution was determined by Volhard titration.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Palitzsch, S.

Z. Phys. Chem., Abt. A 1928, *138*, 379-98; *Studier over Oplosnigers Overfladespaending*. Habilitation Thesis. Levin & Munksgaards Forlag. Copenhagen 1927.

VARIABLES:

$T/K = 298$

PREPARED BY:

R. Tenu; J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	molality mol kg^{-1}	mass %	relative density d_4^{25}	solid phase
25	7.43	28.48	1.07722	NH_4Cl

COMMENTS AND ADDITIONAL DATA: Solubilities were measured in connection with studies of surface tensions. The experimental molalities and densities are given on pp. 386-95 of the paper. In the Thesis, the primary data are mass of solution and titer of 0.1 mol dm^{-3} $AgNO_3$. The compiler has calculated molalities and mass fractions from these data, which differ in the last figure from the values given by the author. The primary data follow.

mass of sln/g	titer/cm^3	molality/mol kg^{-1}	mass %
0.4777	25.30	7.389	28.33
0.6538	34.69	7.384	28.38
0.5774	30.84	7.478	28.57
0.5821	31.15	7.470	28.62

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solution and solid were rotated in sealed flasks in a thermostat. After saturation, which was continued up to 15 h, the mixture was filtered through cotton wool. Cl was determined by titration with $AgNO_3$. Densities were measured by pycnometer.

SOURCE AND PURITY OF MATERIALS:

NH_4Cl (Kahlbaum or Merck) was recrystallized and checked by analysis. Chloride was determined volumetrically. Water was redistilled over alkaline permanganate.

ESTIMATED ERROR:

Temperature: precision to 0.02 K.
Solubility: precision within 0.1 mass %, from data in thesis.
Density: precision 1-10 x 10^{-5}.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	Askenazy, P.; Nessler, F. *Z. Anorg. Allg. Chem.* 1930, *189*, 305-28.
VARIABLES:	PREPARED BY:
$T/K = 273$	T. Mioduski

EXPERIMENTAL VALUES:

$t/°C$	mol ratio H_2O/NH_4Cl	mass % (compiler)	solid phase
0	10	22.9	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE	SOURCE AND PURITY OF MATERIALS:
No experimental details are given, but presumably the method of isothermal saturation was used. The saturated solution was analyzed for chloride and (by evaporation) for NH_4Cl.	No information given.
	ESTIMATED ERROR:
	No estimates possible.
	REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Gerassimow, I.

Z. Anorg. Allg. Chem. 1930, *187*, 321-33.

VARIABLES:

T/K = 293, 348

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	100X mass ratio NH_4Cl/H_2O	mass %	solid phase
0	50.01	22.9	NH_4Cl
20	63.02	27.245	"
50	84.86	33.5	"
75	106.03	38.64	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The apparatus was described by Meyerhoffer and Saunders (1). Experiments were carried out in an ice thermostat at 0°C and in an Ostwald thermostat between 20 and 75°C. The mixtures were stirred for many hours. NH_4Cl was determined by distillation in H_2SO_4 and chloride titrated gravimetrically as AgCl.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Meyerhoffer, W.; Saunders, A.P. *Z. Phys. Chem., Stoechiom. Verwandtschaftsl.* 1899, *28*, 464.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	Aronova, S.I.; Lunskaya, S.N. *Zhur. Khim. Prom.-sti* 1931, *8*, 23-7.
VARIABLES:	PREPARED BY:
$T/K = 389$	A. Szafranski

EXPERIMENTAL VALUES:

t/°C	mass %	pressure /mm Hg	solid phase
116.0	46.6	748	NH_4Cl

These data are for the boiling point of the saturated solution.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The boiling point was measured in an open vessel thermostatted in an oil bath. The sample was stirred, and Hg thermometers reading to 1 K were used. Satruration was checked by sampling and analyzing the liquid phase for NH_3 (bromo-iodometry and Kjeldahl), Cl and sometimes water. Solid phases were not analyzed. Two duplicate measurements were made.

SOURCE AND PURITY OF MATERIALS:

NH_4Cl: chemically pure, from Goslaborsnabzhenie, 99.85-99.90 % pure by analysis (1).

ESTIMATED ERROR:

Temperature; precision ± 1 K.

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Scatchard, G.; Prentiss, S.S.

J. Am. Chem. Soc. 1932, *54*, 2696-705.

VARIABLES:

T/K = 269-273

PREPARED BY:

P. Vallée

EXPERIMENTAL VALUES:

t/°C	j function[a]	molality /mol kg^{-1}	mass %	solid phase
-0.003810	0.0245	0.001051	0.005622	ice
-0.007160	0.0199	0.001966	0.01052	"
-0.01006	0.0230	0.002771	0.01482	"
-0.02159	0.0350	0.006021	0.03220	"
-0.02841	0.0379	0.007949	0.04250	"
-0.03691	0.0411	0.010358	0.05538	"
-0.06833	0.0513	0.019383	0.1036	"
-0.1043	0.0560	0.029738	0.1588	"
-0.1440	0.0610	0.041279	0.2203	"
-0.1812	0.0656	0.052182	0.2784	"
-0.2403	0.0718	0.06968	0.3713	"
-0.2764	0.0744	0.08036	0.4280	"
-0.3890	0.0812	0.11392	0.6057	"
-0.4414	0.0841	0.12968	0.6889	"
-0.5371	0.0877	0.15844	0.8404	"
-0.5883	0.0914	0.17424	0.9234	"
-0.6596	0.0920	0.19550	1.035	"
-0.6681	0.0928	0.19818	1.049	"
-0.6683	0.0913	0.19792	1.048	"
-0.7454	0.0952	0.22171	1.172	"
-0.7978	0.0973	0.23783	1.256	"
-0.8566	0.0973	0.25536	1.348	"
-0.9003	0.0985	0.26877	1.417	"
-0.9295	0.0993	0.2777	1.464	"
-1.219	0.1041	0.36611	1.920	"
-1.250	0.1039	0.37550	1.969	"
-1.528	0.1062	0.46011	2.402	"
-1.848	0.1083	0.55777	2.897	"
-1.957	0.1101	0.59181	3.069	"
-1.964	0.1096	0.59368	3.078	"
-2.383	0.1106	0.72116	3.714	"
-2.643	0.1117	0.80055	4.106	"
-2.850	0.1115	0.86311	4.413	"
-3.174	0.1132	0.96328	4.900	"
-3.208	0.1109	0.97093	4.937	"
-3.400	0.1122	1.0305	5.224	"
-3.591	0.1128	1.0891	5.505	"
-3.611	0.1106	1.0927	5.522	"
-3.822	0.1117	1.1579	5.833	"

---

[a] Lewis and Randall function: $j = 1 - \Delta T/\nu K_f m$, where ΔT = f.p. lowering, $\nu = 2$, the stoichiometric number, $K_f = 1.858$ kg mol^{-1} K, the freezing point constant, and m = molality.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Freezing points were measured by the "equilibrium method" and concs. were determined by conductivity, as in (1). Concentrations of stock solutions were determined gravimetrically as AgCl with error as av. dev. < 0.05 %.

SOURCE AND PURITY OF MATERIALS:

NH_4Cl: C.P. product was recrystallized three times from doubly-distilled water.

ESTIMATED ERROR:

Temperature: precision ±3 x 10^{-5} K (see (1)).

REFERENCES:

1. Scatchard, G.; Jones, P.T.; Prentiss, S.S. *J. Am. Chem. Soc.* 1932, 54, 2690.

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Voskresenskaya, N.K.

Zh. Obshch. Khim. 1934, *14*, 153-67.

VARIABLES:

T/K = -268.6, 388

PREPARED BY:

B. Russer

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
- 4.4	7.1	ice
115	46.5	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

For the low temperature value, the sample was cooled in liquid air, then heated with stirring until the last crystal of ice had just melted. The equilibrium temperature was checked by observing formation and melting of ice. For the high temperature value, the method of isothermal saturation was used, with equilibrium established after 1½ to 2 h. Analysis was by titration for chloride.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

Temperature: below 0°C, precision ±0.2 K; above, ±0.1 K.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	Prutton, C.F.; Brosheer, J.C.; Marron, J.H. J. Am. Chem. Soc. 1935, 57, 1656-7.
VARIABLES:	PREPARED BY:
T/K = 274-323	R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
0.4	23.09	NH_4Cl
25	28.33	"
50	33.50	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Mixtures to yield a desired composition were weighed into 100 cm^3 oil sample bottles, which were stoppered, sealed and rotated for about 18 h at the desired temperature. Chlorine was determined by Mohr's method.

SOURCE AND PURITY OF MATERIALS:

NH_4Cl: Baker and Adamson reagent grade, recrystallized from distilled water.

ESTIMATED ERROR:

Temperature: ±0.1 K at 0.4 and 50°C; ±0.02 K at 25°C.

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Voskresenskaya, N.K.; Yanat'eva, O.K.

Izv. Sekt. Fiz.-Khim. Anal., Inst. Obshch. Neorg. Khim., Akad. Nauk SSSR 1936, 9, 291-3.

VARIABLES:

$T/K = 298$

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

$t/°C$	mass %	solid phase
25	28.50	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The authors investigated the ternary systems NH_4Cl, LiCl, H_2O. The mixtures were stirred in a thermostat for 24 h. Saturated solution was then taken off and analyzed for Cl^- gravimetrically.

SOURCE AND PURITY OF MATERIALS:

C.P. NH_4Cl (Kahlbaum) was recrystallized.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Pearce, J.N.; Pumplin, G.G.

J. Am.Chem. Soc. 1937, 59, 1219-20.

VARIABLES:

$T/K = 298$

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

$t/°C$	molality mol kg^{-1}	mass % (compiler)	vapor pressure p/mm Hg	solid phase
25	7.3800	28.30	18.281	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus used has been described by Pearce and Blackman (1). The saturated solution was carefully analyzed gravimetrically for its chloride content by precipitation as AgCl.

SOURCE AND PURITY OF MATERIALS:

NH_4Cl: reagent grade was purified by 3 recrystallizations.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Pearce, J.N.; Blackman, L.E. *J. Am. Chem. Soc.* 1935, 57, 24.

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Yarluikov, M.M.

Zhur. Prikl. Khim. (*Leningrad*) 1936, 7(2), 902-5.

VARIABLES:

T/K = 263-363

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio NH_4Cl/H_2O	mass %	density g cm^{-3}	solid phase
-10	26.31	20.82	1.060	NH_4Cl
0	29.82	23.97	1.066	"
10	33.20	24.92	1.072	"
20	37.51	27.28	1.076	"
25	40.14	28.64	1.064	"
35	43.13	30.13	1.081	"
45	47.99	32.43	1.085	"
50	48.98	32.88	1.0859	"
65	56.48	36.09	1.086	"
80	64.43	39.18	1.0876	"
90	68.09	40.51	1.1020	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	Benrath, A.; Gjedebo, F.; Schiffers, B.; Wunderlich, H. *Z. Anorg. Allg. Chem.* 1937, *231*, 285-97.
VARIABLES:	PREPARED BY:
T/K = 402-690	R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
129	48.9	NH_4Cl
142	51.1	"
164	54.6	"
191	59.1	"
211	62.4	"
236	66.2	"
241	66.7	"
246	67.7	"
267	70.4	"
294	74.5	"
318	77.8	"
339	80.2	"
377	85.6	"
417	90.8	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Salt and water were introduced into a small diameter glass tube which was stirred during heating. The temperature was read when the last crystal disappeared.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kurnakov, N.S.; Luzhnaya, N.P.; Kuznetsov, V.G.

Izv. Akad. Nauk SSSR, Otd. Mat. Estest. Nauk 1937, 577-606.

VARIABLES:

T/K = 298, 348

PREPARED BY:

B. Russer

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	28.50	NH_4Cl
50	30.50	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The isothermal saturation method was used. A stream of dry air was passed over the solution during equilibration. Equilibration took place for 5-6 d, then for 1-2 days in a thermostat. Analysis was for NH_3 by evaporation, hen titration with HCl (Kjeldahl method).

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kurnakov, N.S.; Voskresenskaya, N.K.

Izv. Akad. Nauk SSSR, Otd. Mat. Estest. Nauk 1937, 607-30.

VARIABLES:

T/K = 298

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	28.33	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Saturated solutions were evaporated isothermally. After crystals appeared, the mixtures were kept in a thermostat for several d. Analyses: Cl by gravimetry, NH_3 by Kjeldahl method.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	Wilkinson, L.; Bathurst, N.O.; Parton, H.N. *Trans. Faraday Soc.* 1937, 33, 623-8.
VARIABLES:	PREPARED BY:
T/K = 298	R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass ratio NH_4Cl/H_2O	mass %	solid phase
25	0.3978	28.46	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE	SOURCE AND PURITY OF MATERIALS:
Mixtures were brought to equilibrium by rotating in sealed tubes in a thermostat at the appropriate temperature. Solid and liquid phases were separated by filtration, using a Gooch crucible. Solutions were analyzed for chloride as AgCl.	Not stated. ESTIMATED ERROR: Temperature: ±0.1K REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Bergman, A.G.

Izv. Akad. Nauk SSSR, Otd. Mat. Estest. Nauk 1938, *1*, 203-16.

VARIABLES:

$T/K = 263-306$

PREPARED BY:

B. Russer

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase	method
- 1.4[d]	6	ice	a
- 6.3	10	ice	a
-10	13.3	NH_4Cl[c]	b
-15	18.7	NH_4Cl	b
-15	18.5	"	b
-10	20.8	"	b
0	22.9	"	b
9.8	25	"	a
10	25	"	b
20	27.2	"	b
30	29.3	"	b
33.0	30	"	a

---

a polythermal method
b isothermal method
c probably ice (compiler)
d see COMMENTS.

COMMENTS: In Table 4, section VI of this paper, the value for ice is for 6% KNO_3, not 6% NH_4Cl; the values for KNO_3 and NH_4Cl appear to have been interchanged in both sections IV and VI of this Table (compiler).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Method a: polythermal method, in which the temperatures of appearance and disappearance of crystals were noted (compiler; no details given). Method b: Isothermal saturation method, with no details given.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: precision ±0.5 K for appearance of crystals; ±0.2 K for appearance of ice crystals.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	Kurnakov, N.S.; Egorov, V.S. *Izv. Sekt. Fiz.-Khim. Anal., Inst. Obshch. Neorg. Khim., Akad. Nauk SSSR* 1938, *11*, 101-34.
VARIABLES:	PREPARED BY:
T/K = 273-323	Ch. Balarew; D. Stoilova

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
0	23.0	NH_4Cl
25	28.50	"
50	33.5	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Solubility was determined using the isothermal evaporation method. Saturated solutions were stirred with solid phases for 10-12 d in a thermostat in order to reach equilibrium. Ammonium was determined by the Kjeldahl method (distillation with NaOH, absorption of NH_3 in H_2SO_4 solution). The composition of the solid phase was found by chemical analysis of the dried solid, or by the method of wet residues.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: ±0.1 K.

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Restaino, S.

Int. Congr. Pure Appl. Chem., [Proc.], 10th 1938, *2*, 761-6.

VARIABLES:

T/K = 298-373

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	28.35	NH_4Cl
50	33.55	"
100	43.57	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The method of Noyes (1) was used at 25 and 50°C and that of Meyerhoffer and Saunders (2) at 100°C. Mixtures were placed in Jena glass bottles and stirred in a thermostat for many days. Samples of saturated solution were removed and chloride was determined by Volhard's method.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

1. Noyes, A.A. *Z. Phys. Chem., Stoechiom. Verwandtschaftsl.* 1892, *9*, 603.
2. Meyerhoffer, W.; Saunders, A.P. *Z. Phys. Chem.* 1899, *28*, 453.

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Mochalov, K.I.

Zh. Obshch. Khim. 1939, *9*, 1701-6.

VARIABLES:

T/K = 290

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
17	26.5	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Synthetic method. The refractive index of solutions is measured at constant temperature for various solutions. It becomes constant when solution is saturated.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Irving, H.; Cherry, G.W.

J. Chem. Soc. 1941, 25-30.

VARIABLES:

T/K = 298, 313

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25.1	28.3	NH_4Cl
40.05	31.6	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method. Known weights of salt and air-free water were sealed off in a nitrogen atmosphere in glass tubes with specially thin bottoms and brought to equilibrium. Phases were separated by filtration through sintered glass in an apparatus immersed in the thermostat, weighed and analyzed for chloride by precipitation of AgCl, with a small known excess being determined by the Volhard method.

SOURCE AND PURITY OF MATERIALS:

NH_4Cl: AnalaR grade.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

COMPONENTS: (1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Pavlov, B.A.; Butovich, N.A.; Bergmann, A.G. *Dokl. Akad. Nauk. SSSR, Ser. Khim.* 1943, 39(7), 265-7.
VARIABLES: $T/K = 258-303$	PREPARED BY: R. Tenu

EXPERIMENTAL VALUES:

$t/°C$	mass %	solid phase	remark
-15.4	--	ice + NH_4Cl	eutectic point
-15	18.9	ice	
-10	13.8	"	
-10	19	NH_4Cl	
- 5	7.5	ice	
0	23	NH_4Cl	
10	25.2	"	
20	27.5	"	
30	29.6	"	

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The first crystals which appeared on cooling the solution and the temperature at which the last crystal disappeared from the solution on heating were determined by the visual method. NH_4Cl was precipitated in the form of a silvery dust.

SOURCE AND PURITY OF MATERIALS:

The salt was recrystallized.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	Flatt, R.; Burkhardt, G. *Helv. Chim. Acta* 1944, *27*, 1605-10.
VARIABLES:	PREPARED BY:
T/K = 298	R. Tenu

EXPERIMENTAL VALUES:

t/°C	mole ratio H_2O/NH_4Cl	mass % (compiler)	solid phase
25	7.47	28.44	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

A mixture of salt and water was warmed until dissolution was complete. The solution was then cooled at 25°C in a thermostat until saturation was reached (1).

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Flatt, R.; Wilhelm, J.; Burkhardt, G. *Helv. Chim. Acta* 1944, *27*, 1600.

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Polosin, V.A.

Zh. Fiz. Khim. 1946, *20*, 1471-4.

VARIABLES:

T/K = 258-316

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
0	0	ice
- 1.6	2.9	"
- 3.6	5.8	"
- 5.3	8.4	"
- 7.5	10.9	"
- 9.5	13.5	"
-11.8	15.9	"
-13.9	18.21	"
-14.5	19.0	"
-15.0	19.0	"
-15.2	19.3	ice + NH_4Cl
-15	19.5	NH_4Cl
- 9.4	20.6	"
0	22.8	"
0.4	22.7	"
9.4	24.8	"
10	24.9	"
19.9	26.9	"
20	27.1	"
25	28.2	"
28.5	28.8	"
35	30.2	"
38.5	30.7	"
43.1	32.0	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The polythermal visual method was used.

SOURCE AND PURITY OF MATERIALS:

NH_4Cl was doubly recrystallized.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Dolique, R.; Pauc, M.

Trav. Soc. Pharm. Montpellier 1946-7, 6, 86-9; *Trav. Soc. Pharm. Montpellier* 1948, 8, 27-30.

VARIABLES:

T/K = 293, 303

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	100 x mass ratio NH_4Cl/H_2O	mass % (compiler)	density	solid phase	reference
20	37.4	27.22	1.076_3	NH_4Cl	paper 1
30	41.6	29.38	1.083_2	"	paper 2

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method. The operative technique has been described in an earlier publication (1). The chlorine was titrated by the Charpentier-Volhard method.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: ±0.05 K

REFERENCES:

1. Dolique, R. *Trav. Soc. Pharm. Montpellier* 1944, 3, 55.

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Luzhnaya, N.P.

Izv. Akad. Nauk SSSR, Otdel. Khim. Nauk 1949, (1), 27-34.

VARIABLES:

T/K = 308

PREPARED BY:

Ch. Balarew; D. Stoilova

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
35	30.35	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

A saturated solution was made at high temperature, then was cooled in a thermostat, and stirred for several days to reach equilibrium. Ammonium was determined by the Kjeldahl method (distillation with NaOH, absorption of NH_3 in acid).

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: precision probably within ±0.1 K (compiler)

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Remy-Genneté, P.; Bourhis, J.

Bull. Soc. Chim. Fr. 1950, 1159-62.

VARIABLES:

T/K = 298, 303

PREPARED BY:

J.W. Lorimer

EXPERIMENTAL VALUES:

t/°C	mass salt /mass water	mass % (compiler)	solid phase
24.8	0.3934	28.23	NH_4Cl
30	0.4141	29.28	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Presumably the method of isothermal saturation was used. Equilibrium was reached in 5-6 hours, or longer, as determined by experiment. Analysis was for Cl gravimetrically as AgCl on weighed samples removed with an automatic pipette.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

Temperature: precision probably within ±0.2 K (compiler).

REFERENCES:

COMPONENTS: (1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Garrett, A.B.; Woodruff, S.A. *J. Phys. Coll. Chem.* 1951, 55, 477-90.
VARIABLES: T/K = 257	PREPARED BY: R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
-15.8	18.6	ice + NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: The test solution was cooled with stirring until copious amounts of crystals formed. The temperature was then raised slowly until the last crystal disappeared. The eutectic point was found by extrapolation of graphical data.	SOURCE AND PURITY OF MATERIALS: NH_4Cl: reagent quality ESTIMATED ERROR: No estimates possible. REFERENCES:

COMPONENTS: (1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Ricci, J.E.; Skarulis, J.A. *J. Am. Chem. Soc.* 1951, 73, 3618-27.
VARIABLES: T/K = 298	PREPARED BY: R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	28.37	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: The mixtures were rotated in wax-lined bottles for at least 2 or 3 weeks. Chloride was determined by precipitation with excess of standard $AgNO_3$ in ammoniacal solution by the cyanide method.	SOURCE AND PURITY OF MATERIALS: NH_4Cl, c.p., was used without further purification. ESTIMATED ERROR: Temperature: ±0.02 K REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Wishaw, B.F.; Stokes, R.H.

Trans. Faraday Soc. 1953, *49*, 27-31.

VARIABLES:

$T/K = 298$

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	molality mol/kg H_2O	mass % (compiler)	solid phase
25	7.390	28.33	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isopiestic method. The reference solutions were prepared with NaCl, KCl or H_2SO_4. The solubility was determined by the method of Scatchard, Hamer and Wood (1).

SOURCE AND PURITY OF MATERIALS:

Ammonium, potassium and sodium chloride were B.D.H. A.R. salts.

ESTIMATED ERROR:

Reproducibility averaging 0.05%.

REFERENCES:

1. Scatchard, G.; Hamer, W.J.; Wood, S.E. *J. Am. Chem. Soc.* 1938, *60*, 3061.

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Labash, J.A.; Lusby, G.R.

Can. J. Chem. 1955, 33, 774-96.

VARIABLES:

T/K = 293, 323

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
20	27.26	NH_4Cl
60	35.37	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method. The saturated solution was sampled by allowing salts to settle and then quickly drawing a sample into a pipet, heated in the case of solutions above room temperature. A short length of glass tubing containing a wad of absorbent cotton was attached by a rubber tube to the lower end of the pipet. Chloride was analyzed by the volumetric method using $AgNO_3$ in excess and back titrating. Ammonium was determined by the method of Ronchèse (1).

SOURCE AND PURITY OF MATERIALS:

NH_4Cl: A.R. grade.

ESTIMATED ERROR:

Temperature: ±0.1K
Mass %: ±0.002

REFERENCES:

1. Sutton, F. Volumetric Analysis. 12th ed. P. Blakiston's. Philadelphia. 1935. p. 75.

COMPONENTS: (1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Novoselova, A.V.; Pashinkin, A.S.; Semenenko, K.N. *Vest. Mosk. Univ., Ser. Fiz. Mat. Estest. Nauk* 1955, (3), 49-56.
VARIABLES: $T/K = 293$	PREPARED BY: B. Russer

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
20	27.35	NH_4Cl
20	27.37	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE The method of isothermal saturation was used. Solid phases in the system investigated (NH_4Cl - $BeCl_2$ - H_2O) were determined by X-ray analysis.	SOURCE AND PURITY OF MATERIALS: NH_4Cl: chemically pure grade.
	ESTIMATED ERROR: No estimates possible.
	REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Karnaukhov, A.S.

Izv. Vyssh. Uchebn. Zaved., Khim. Khim. Tekhnol. 1958, 3, 34-9.

VARIABLES:

T/K = 293

PREPARED BY:

Ch. Balarew; D. Stoilova

EXPERIMENTAL VALUES:

t/°C	mass%	solid phase
20	27.82	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Solubility was determined using the isothermal method (1). Equilibrium was reached in 24-48 h. Ammonium was determined by the Kjeldahl method (distillation with NaOH, absorption of NH_3 in 0.05 *M* H_2SO_4).

SOURCE AND PURITY OF MATERIALS:

NH_4Cl: A.R., twice recrystallized.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Karnaukhov, A.S. *Zh. Neorg. Khim.* 1957, 2, 915.

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Zolotarev, L.L.

Izv. Vyssh. Ucheb. Zaved., Tsvetn. Metall. 1958, 2, 107-11.

VARIABLES:

T/K = 308

PREPARED BY:

Ch. Balarew; D. Stoilova

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
35	30.20	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Saturated solutions were stirred periodically in a sealed glass vessel immersed in a thermostat. Solid phase compositions were determined by the method of wet residues, by chemical analysis after washing the solid phases with alcohol, and by microscopy. Ammonium was determined by the Kjeldahl method (distillation with NaOH, absorption of NH_3 in 0.05 *M* H_2SO_4 solution).

SOURCE AND PURITY OF MATERIALS:

NH_4Cl: A.R., recrystallized.

ESTIMATED ERROR:

Temperature: ±0.2 K.

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Zhuravlev, E.F.; Bychkova, M.N.

Zh. Neorg. Khim. 1959, 4, 2367-75; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1959, 4, 1082-7.

VARIABLES:

$T/K = 278-323$

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

$t/°C$	mass %	solid phase
5	23.8	NH_4Cl
25	28.6	"
50	33.5	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Solubility was determined by use of the graphical method known as the isothermal method of sections and used in the investigation of individual phase equilibria (1,2). Its application to water-salt systems was demonstrated by Mertslin and Krupatkin (3).

SOURCE AND PURITY OF MATERIALS:

NH_4Cl was recrystallized and dried over anhydrous $CaCl_2$.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Mertslin, R.V. *Izv. Estestvennonauchn. Inst. Permsk. Gos. Univ.* 1937, 11 (1, 2), 1-16; *Uchen. Zap. Permsk. Gos. Univ. im. A.M. Gor'kogo* 1939, 3(4), 37.
2. Mochalov, K.I. *Zh. Obshch. Khim.* 1939, 9, 1701.
3. Mertslin, R.V.; Krupatkin, I.L. *Zh. Obshch. Khim.* 1940, 10, 22.

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Morozov, I.S.; Toptygina, G.M.

Zh. Neorg. Khim. 1960, 5, 1637-8; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1960, 5, 794-5.

VARIABLES:

T/K = 273

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass % (compiler)	solid phase
0	22.9	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chloride was determined by Volhard's method and ammonia by Kjeldahl's method.

SOURCE AND PURITY OF MATERIALS:

NH_4Cl: "pure" grade

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Zhdanov, A.K.

Dokl. Akad. Nauk. UzSSR 1960, *8*, 34-7; *Zh. Neorg. Khim.* 1956, *1*, 2024-6; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1956, *1*, 93-5.

VARIABLES:

T/K = 298

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	density	solid phase	reference
25	28.2		NH_4Cl	paper 1
25	28.3	1.0761	"	paper 2

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothermal method was used. The solution was continuously stirred for 8 to 10 h. Saturated solution was removed by suction and passed through a filter. Chlorine was determined by potentiometric titration with $AgNO_3$.

SOURCE AND PURITY OF MATERIALS:

All the reagents were of CP grade. Redistilled water was used.

ESTIMATED ERROR:

Temperature: ±0.1 K.

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Shevtsova, Z.N.; Zhizhina, L.I.; El'Tsberg, L.E.

Izv. Vyssh. Uchebn. Zaved., Khim. Khim. Tekhnol. <u>1961</u>, 4, 176-8.

VARIABLES:

T/K = 298

PREPARED BY:

Ch. Balarew; D. Stoilova

EXPERIMENTAL VALUES:

t/°C	mass%	solid phase
25	28.52	NH_4Cl
25	28.20	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Solutions in contact with solid were stirred in a thermostat for several days. The methods of analysis are not given.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Shevtsova, Z.N.; Kulichkina, L.I.; El'Tsberg, L.E.

Izv. Vsssh. Uchebn. Zaved., Khim. Khim. Tekhnol. <u>1961</u>, 4, 178-9.

VARIABLES:

T/K = 298, 323

PREPARED BY:

Ch. Balarew; D. Stoilova

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	28.20	NH_4Cl
50	33.54	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Solutions in contact with solid were stirred in a thermostat for several days. The methods of analysis are not given.

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Shapiro, K.Y.; Yurkevich, Y.N.; Kulakova, V.V.

Zh. Neorg. Khim. 1965, *10*, 555-7; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1965, *10*, 301-2.

VARIABLES:

$T/K = 298$

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	pH	solid phase
25	27.7	5.8	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solution was prepared by dissolving the salt in water. Solubility was determined in special vessels fitted with stirrers and hydraulic seals. The vessels were put in a thermostat. At equilibrium (after 6 days), the composition of the liquid and solid phases was determined by analysis for chloride using Volhard's method.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Belyaev, I.N.; Le T'yuk

Zh. Neorg. Khim. 1966, *11*, 1919-25; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1966, *11*, 1025-8.

VARIABLES:

$T/K = 298$

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	viscosity mPa s	density g cm^{-3}	electrical conductivity S cm^{-1}	solid phase
25	28.15	1.0941	1.077	0.221	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The method was described in earlier publications (1,2). Solubility, electrical conductivity, viscosity and density were determined.

SOURCE AND PURITY OF MATERIALS:

"Chemically pure" grade NH_4Cl was recrystallized twice before use.

ESTIMATED ERROR:

Temperature: ±0.1 K.

REFERENCES:

1. Belyaev, I.N.; Le T'yuk, *Zh. Neorg. Khim.* 1965, *10*, 1229; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1965, 664.

2. Belyaev, I.N.; Le T'yuk, *Zh. Neorg. Khim.* 1965, *10*, 2355; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1965, *10*, 1279.

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Shchedrina, A.P.; Mel'nichenko, L.M.; Raeva, O.S.

Zh. Neorg. Khim. 1971, *16*, 504-7; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1971, *16*, 266-8.

VARIABLES:

T/K = 343

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
70	37.60	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solubility was determined by the method of isothermal relief of supersaturation. The method of determining Cl^- was described in an earlier publication (1).

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Nikitin, B.A. *Izbrannye Trudy (Selected Works)*. Izv. Akad. Nauk. SSSR. Moscow-Leningrad. 1965. p. 61.

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Partala, A.I.; Slivko, T.A.; Plyushchev, V.E.

Zh. Neorg. Khim. 1974, *19*, 1086-90; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1974, *19*, 593-5.

VARIABLES:

T/K = 298

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	28.20	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility in the system was studied by the method of additions. Chloride was determined by the Volhard method.

SOURCE AND PURITY OF MATERIALS:

NH_4Cl: "chemically pure" grade was recrystallized twice.

ESTIMATED ERROR:

Temperature: ±0.1 K

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Bakhoda, B.

Thesis. Pars College 1975.

VARIABLES:

T/K = 303

PREPARED BY:

R. Tenu

EXPERIMENTAL VALUES:

t/°C	molality m	mass % (compiler)	solid phase
30	7.81[a]	29.47	NH_4Cl
	7.82[b]	29.49	"

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[a] from undersaturation
[b] from supersaturation

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Isothermal method. Equilibrium was obtained from under- and supersaturation. In the first case, the salt was dissolved in water at 30°C. In the second case, salt was added to water at 32-33°C. The mixture was stirred for about 30 min and cooled to 30°C. Stirring was maintained for 4 days. The solution was filtered and the solid phase transferred to filter paper and wrapped completely. The moist salt was weighed; it was then dried at 85°C for 6 h and weighed again. Composition of saturated solution was deduced from the mass of moist and dry salt.

SOURCE AND PURITY OF MATERIALS:

NH_4Cl (Merck's reagent) was dried at 85°C for 5 hours.

ESTIMATED ERROR:

Temperature: ±1 K

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Ammonium chloride; NH_4Cl; [12125-02-9] (2) Water; H_2O; [7732-18-5]	Kartzmark, E.M. *Can. J. Chem.* 1977, 55, 2792-8.
VARIABLES:	**PREPARED BY:**
T/K = 298.15	R. Tenu

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25.00	28.63	NH_4Cl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The mixture was equilibrated by stirring at 25.00°C for a period of 2 or 3 days. The solid phase was separated by filtration and was analyzed by precipitation as AgCl.

SOURCE AND PURITY OF MATERIALS:

NH_4Cl: reagent grade

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

COMPONENTS:

(1) Ammonium chloride; NH_4Cl; [12125-02-9]

(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Lazorenko, N.M.; Kiesel', N.N.; Storozhenko, D.A.; Shevchuk, V.G. *Zh. Neorg. Khim.* 1982, *27*, 1575-7; *Russ. J. Inorg. Chem. (Engl. Transl.)* 1982, *27*, 888-90.

VARIABLES:

T/K = 298, 323, 348, 473

PREPARED BY:

T. Mioduski

EXPERIMENTAL VALUES:

t/°C	mass %	solid phase
25	28.20	NH_4Cl
50	33.51	"
75	38.70	"
100	43.57	"

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothermal saturation method was used. Equilibrium was reached with continuous stirring within 15-20 hours. Compositions of saturated solutions and solid phases were determined by analysis for chloride by the Volhard method.

SOURCE AND PURITY OF MATERIALS:

NH_4Cl: "chemically pure" grade, recrystallized.

ESTIMATED ERROR:

Temperature: precision ±0.1 K.

REFERENCES:

COMPONENTS	EVALUATORS:
(1) Alkali metal chloride; MCl (2) Water-d_2; D_2O; [7789-20-0]	J. W. Lorimer, Department of Chemistry, The University of Western Ontario, London, Ontario N6A 5B7, Canada. January, 1990

CRITICAL EVALUATION

SOLUBILITIES IN THE SYSTEMS: ALKALI METAL CHLORIDE-D_2O-H_2O

This section introduces concepts which are peculiar to systems with heavy water as solvent. These concepts arise, in part, because of the close similarity between ordinary water and heavy water in structure and physical properties.

1. *Methods of expressing compositions of saturated solutions*

Many papers containing data on solubilities of alkali metal chlorides in D_2O or mixtures of D_2O and ordinary water express compositions in terms of the special mole ratio: mole salt/55.51 mole D_2O or mole salt/55.51 mole D_2O-H_2O mixture. The numerical value 55.51 is equal to $1000/M_{r,3}$ where $M_{r,3}$ is the average molar mass (molecular weight) of pure water. The reason for using this mole ratio is to compare solubilities (and other data relevant to solvent isotope effects) on the basis of equal amounts of substance of solvent (1).

If an amount of substance n_1 of salt is dissolved in a mass g_3 of ordinary water, the molality is

$$m_1 = n_1/g_3 = (n_1/n_3)(n_3/g_3) = (n_1/n_3)/M_3 \qquad [1]$$

where M_3 is the molar mass of ordinary water. Because kg mol^{-1}/M_3 $= 1000/M_{r,3}$ the molality and the mole ratio: mole salt/55.51 mole water are numerically equal. For solutions in pure D_2O or in mixtures of D_2O (component 2) and H_2O (component 3), the mole ratio salt/(55.51 solvent) is

$$\begin{aligned} &1000n_1/(n_2 + n_3)M_{r,3} \\ &= \{1000n_1/(g_2 + g_3)\}\{(g_2 + g_3)/(n_2 + n_3)M_{r,3}\} \\ &= 1000m_1(n_2M_2 + n_3M_3)/(n_2 + n_3)M_{r,3} \\ &= 1000m_1\{x_2'M_2 + (1 - x_2')M_3\}/M_{r,3} \\ &= 1000m_1M/M_{r,3} \qquad [2] \end{aligned}$$

where m_1 is the molality, M is the average molar mass of the solvent

$$M = x_2'M_2 + (1 - x_2')M_3 \qquad [3]$$

and $x_2' = n_2/(n_2 + n_3)$ is the solvent mole fraction of D_2O. Because of the simple relation between molality and the mole ratio salt/(55.51 solvent), the quantity

$$m_1^{(3)} = m_1M/M_3 \qquad [4]$$

has been called (2) the *aquamolality* of component 1. Unfortunately, the correct distinction among the special mole ratio, molality and aquamolality has not been observed clearly in the literature; one finds aquamolalities and mole ratios both called "molal solubilities", with no units attached. In the following evaluations, mole fractions are used as the primary composition variables; they give a direct comparison of solubilities on the basis of the same total amount of substance of solution. Molalities are also given, and if aquamolalities are desired, they can be found easily by multiplying the molalities by 1.111 70, the ratio of the molar masses of heavy water and ordinary water.

(continued)

COMPONENTS	EVALUATORS:
(1) Alkali metal chloride; MCl (2) Water-d_2; D_2O; [7789-20-0]	J. W. Lorimer, Department of Chemistry, The University of Western Ontario, London, Ontario N6A 5B7, Canada. January, 1990.

CRITICAL EVALUATION (continued)

2. *Thermodynamic aspects of solubilities in D_2O-H_2O mixtures*

(a) Dependence of solubility on solvent composition

Consider an anhydrous salt (component 1) which saturates each of three solutions at constant temperature and pressure. In solution *A*, the chemical potential of the salt is μ_{1S}, and the solvent *s* is a mixture containing components 2 and 3, with solvent mol fractions x_2' and $1 - x_2'$. In solutions *B* and *C*, the chemical potentials of the salt are μ_{12} and μ_{13}, corresponding to pure solvents 2 and 3, respectively. The chemical potentials of the salt are equal in each solution, and are separately equal to the chemical potential of the solid. As a result, the identity

$$\mu_{1S} = \alpha\mu_{12} + (1 - \alpha)\mu_{13} \qquad [5]$$

holds, where α is an arbitrary constant chosen so that $\mu_{1S} = \mu_{12}$ for $\alpha = 1$, and $\mu_{1S} = \mu_{13}$ for $\alpha = 0$. While it is natural to choose $\alpha = x_2'$, clearly this choice is arbitrary, and other choices such as solvent mass fraction or solvent volume fraction would be equally valid.

If the chemical potentials are now written in terms of ionic mole fractions, and α is taken to be the solvent mole fraction of one solvent component, then, for a 1-1 electrolyte and an anhydrous solid phase,

$$\begin{aligned} \mu_{1S}^0 + 2RT\ln \{2f_{1S}x_1/(1 + x_1)\} = {} \\ x_2'\{\mu_{12}^0 + 2RT\ln [2f_{12}x_{12}/(1 + x_{12})]]\} \\ + (1 - x_2')\{\mu_{13}^0 + 2RT\ln [2f_{13}x_{13}/(1 + x_{13})]]\} \end{aligned} \qquad [6]$$

In general, this equation is a complex relation among the solubilities of the salt in the mixed solvent and in the end-member pure solvent components. For solvent mixtures containing 2 = D_2O and 3 = H_2O, the approximations

$$\mu_{1S}^0 = x_2'\mu_{12}^0 + (1 - x_2')\mu_{13}^0 \qquad [7]$$

$$\ln f_{1S} = x_2'\ln f_{12} + (1 - x_2')\ln f_{13} \qquad [8]$$

are reasonable, in which case the solubility equation [6] becomes

$$\begin{aligned} \ln [x_{1S}/(1 + x_{1S})] = x_2'\ln [x_{12}/(1 + x_{12})] \\ + (1 - x_2')\ln [x_{13}/(1 + x_{13})] \end{aligned} \qquad [9]$$

If $\ln [x_{13}/(1 + x_{13})]$ is subtracted from each side of this equation, then, after rearrangement,

$$\begin{aligned} \ln[1 + (x_{1S} - x_{13})/x_{13}(1 + x_{13})] = {} \\ x_2'\ln[1 + (x_{12} - x_{13})/x_{13}(1 + x_{12})] \end{aligned} \qquad [10]$$

When, as for all the MCl-D_2O systems, $x_{12} \approx x_{13}$, expansion of the logarithms gives

$$\begin{aligned} x_{1S} = x_2'x_{12}(1 + x_{13})/(1 + x_{12}) \\ + [1 - x_2'(1 + x_{13})/(1 + x_{12})]x_{13} \end{aligned} \qquad [11]$$

(continued)

COMPONENTS	EVALUATORS:
(1) Alkali metal chloride; MCl (2) Water-d_2; D_2O; [7789-20-0]	J. W. Lorimer, Department of Chemistry, The University of Western Ontario, London, Ontario N6A 5B7, Canada. January, 1990.

CRITICAL EVALUATION (continued)

or, since $x_{12} \approx x_{13}$,

$$x_{1S} = x_2'x_{12} + (1 - x_2')x_{13} \qquad [12]$$

Equations of the same form can be deduced using molalities or aquamolalities instead of mole fractions. The approximations [7] and [8] remain the same, when appropriate activity coefficients are used. The mean activity coefficient of the salt on the molality scale, $\gamma_\pm$ is related to that on the aquamolality scale, $\gamma_\pm^{(3)}$, by

$$\gamma_\pm m_1 = \gamma_\pm^{(3)} m_1^{(3)} \qquad [13]$$

The analog of eqn (12) for aquamolalities is

$$\ln\{m_1^{(3)}/m_{13}\} = x_2'\ln\{m_{12}^{(3)}/m_{13}\} \qquad [14]$$

or, approximately,

$$m_1^{(3)} = x_2'm_{12}^{(3)} + (1 - x_2')m_{13} \qquad [15]$$

Equations [11], [12], [14] and [15] form the basis of correction of observed solubilities to pure D_2O.

(b) Dependence of solubility on temperature

The dependence of solubility on temperature is expressed by an equation of the form discussed in the *Preface* to this volume:

$$Y = A(\mathrm{K}/T) + B\ln(T/\mathrm{K}) + C(T/\mathrm{K}) + D + J(T/\mathrm{K})^2 \qquad [16]$$

where, for a salt hydrate $MCl.H_2O$

$$Y = \ln[27x_1^2(1 - x_1)/(1 + x_1)^3] \qquad [17]$$

and for an anhydrous salt

$$Y = 2\ln\{2x_1/(1 + x_1)\} \qquad [18]$$

Where appropriate, the coefficients for solutions in deuterium water have been evaluated by least squares.

3. *An Overview of Solubilities of Alkali Metal Chlorides in Heavy Water*

Solubilities have been reported in the literature for LiCl (solid phase $LiCl\cdot D_2O$), NaCl, KCl and CsCl (solid phase: anhydrous salt) in heavy water. No data for RbCl have been reported, nor for NH_4Cl, which would be expected to substitute D for H in D_2O solutions through hydrolysis of NH_4^+.

In the figures on the next page, the ratios of the mole fraction solubilities in D_2O and H_2O, $x_1(D_2O)/x_1(H_2O)$, are plotted against $1/T$. Values of $x_1(D_2O)$ have been calculated from the critically-evaluated fitting equations used in this volume. The reference numbers are those given on the specific Critical Evaluations. These plots provide a sensitive test for consistency of solubility data.

(continued)

COMPONENTS	EVALUATORS:
(1) Alkali metal chloride; MCl (2) Water-d_2; D_2O; [7789-20-0]	J. W. Lorimer, Department of Chemistry, The University of Western Ontario, London, Ontario N6A 5B7, Canada. January, 1990.

CRITICAL EVALUATION (continued)

REFERENCES

1. Arnett, E.M.; McKelvey, D.R. *in* J.F. Coetzee and C.D. Ritchie, eds. *Solute-Solvent Interactions.* Marcel Dekker. New York, London. 1969. p. 370.
2. Kerwin, K.E. *Ph.D. Thesis.* University of Pittsburgh. 1964.

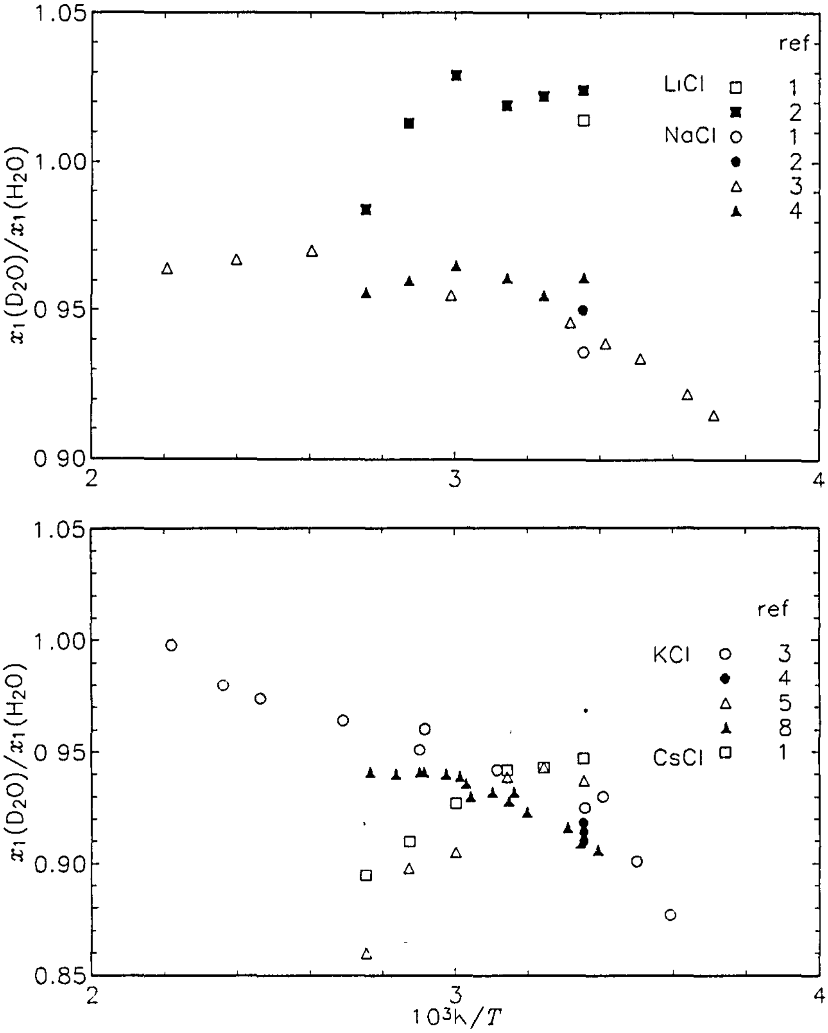

Fig. 1. Ratio of mole fraction solubilities as a function of $1/T$. The references are given in the respective Critical Evaluations.

COMPONENTS	EVALUATORS:
(1) Lithium chloride; LiCl; [7447-41-8] (2) Water-*d*$_2$; D_2O; [7789-20-0]	G. Jancsó, Chemistry Department, Central Research Institute for Physics, Budapest, Hungary. J.W. Lorimer, Department of Chemistry, The University of Western Ontario, London, Ontario, Canada. January, 1990.

CRITICAL EVALUATION

Seven values of the solubility of LiCl in D_2O have been reported. Birnthaler and Lange (1) determined the solubility in 99.6 mol % D_2O at a single temperature, 298 K, using salt of unspecified purity and heavy water from Norway containing 99.6 mole % D_2O. They apparently used the method of isothermal saturation. Selecki, Tyminski and Mariankowska (2) used discontinuities in plots of refractive indices of salt solutions against concentration to obtain solubilities in 99.8 mol % D_2O (origin U.S.S.R.) at six temperatures between 298 and 363 K. The salt was of analytical purity. No data in either study are available on control of temperature.

Birnthaler and Lange (1) give the equilibrium solid phase at 25°C as $LiCl{\cdot}D_2O$. No evidence is available concerning the phase transition to anhydrous LiCl at a higher temperature, but by analogy with the system LiCl - H_2O, it might be expected that this temperature would be near 95°C, so that the equilibrium solid phase is probably $LiCl{\cdot}D_2O$ at all temperatures between 25 and 90°C.

Table 1 gives the observed values of the solubility; corrections to 100 mole % D_2O as described in the introductory section *Solubilities in the Systems: Alkali Metal Chloride-D_2O-H_2O* have been calculated, using the aquamolalities. The corrections are within the precision of the data, estimated in (2) to be ±0.1 mole % at 298, 308 and 318 K, ±0.3 mole % at 333 K and ±0.2 mole % at 348 and 363 K.

Table 1

Solubility of LiCl in D_2O; solid phase $LiCl{\cdot}D_2O$[a]

T/K - 273.15	solvent mole % D_2O x_2'	mole fraction x_1 obs.	corr.	calc.	$x_1(D_2O)$ / $x_1(H_2O)$	molality[b] m_1 /mol kg^{-1}	status[c]	ref.
25	99.6	0.2676	0.2677	0.2677	1.014	18.3	r	1
25	99.8	0.270	0.2703	0.2677	1.024	"	r	2
35	99.8	0.278	0.2777	0.2785	1.022	19.3	t	2
45	99.8	0.286	0.2860	0.2892	1.019	20.3	t	2
60	99.8	0.305	0.3049	0.3048	1.029	21.9	t	2
75	99.8	0.320	0.3200	0.3200	1.013	23.5	t	2
90	99.8	0.336	0.3362	0.3347	0.984	25.1	t	2

[a] $x(D_2O)/x(H_2O)$ from corrected observed x_1; molalities from calc. x_1.

[b] To calculate aquamolalities, multiply molalities by 1.111 7.

[c] Status: $\Delta = 100\{x_1(\text{obs})/x_1(\text{calc}) -1\}$
r - recommended value t - tentative value

(continued)

COMPONENTS	EVALUATORS:
(1) Lithium chloride; LiCl; [7447-41-8] (2) Water-d_2; D_2O; [7789-20-0]	G. Jancsó, Chemistry Department, Central Research Institute for Physics, Budapest, Hungary. J.W. Lorimer, Department of Chemistry, The University of Western Ontario, London, Ontario, Canada. January, 1990.

CRITICAL EVALUATION (continued)

The agreement between the results in (1) and (2) for the solubility at 298 K is within 0.9 % and the average value at that temperature, x_1 = 0.269, is *recommended*. The precision of the results in (2) at higher temperatures is difficult to assess because of possible evaporation from the prisms of the refractometer. However, the accompanying plot of the ratio of mole fraction solubility in D_2O and H_2O against $1/T$, when compared with similar plots for NaCl, KCl and CsCl (see plot for NaCl, and Critical Evaluations for the systems KCl - D_2O and CsCl - D_2O) indicates that the values of Selecki *et al.* (2) for these systems at these higher temperatures are in fact consistent. This conclusion is supported by fitting the data to the equation (see *Introduction*)

$$Y = \ln[27x_1^2(1 - x_1)/(1 + x_1)^3] = A_1 + A_2\mathrm{K}/T$$

which fits all data well, with standard error of estimate $S(Y) = 0.011$ and $A_1 = 0.198$, $A_2 = -573.0$. Values of x_1 calculated from this equation are given in the Table; the values above 298 K are *tentative*.

It is also found that mole fraction is linear in T:

$$x_1 = 0.242 + 0.001046(T/\mathrm{K} - 273.15), \quad s(x_1) = 0.001$$

The ratio of the molality in D_2O to that in H_2O is 0.918, s = 0.025, for the tentative and recommended values, using values for H_2O from the critical evaluation in this volume. The corresponding ratio of aquamolalities is 1.021, s = 0.027, and of mole fractions 1.015, s = 0.0015.

REFERENCES

1. Birnthaler, W.; Lange, E. *Z. Elektrochem. Angew. Phys. Chem.* *1937*, *15*, 130.

2. Selecki, A.; Tyminski, B.; Mariankowska, B. *J. Chem. Eng. Data* *1970*, *15*, 130.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Lithium chloride; LiCl; [7447-41-8] (2) Water-d_2; D_2O; [7789-20-0]	Birnthaler, W.; Lange, E. *Z. Elektrochem. Angew. Phys. Chem.* 1937, *43*, 643-59.
VARIABLES:	PREPARED BY:
T/K = 298	G. Jancsó; J.W. Lorimer

EXPERIMENTAL VALUES:

t = 25°C

Solubility of LiCl in 99.6 mole % D_2O

mol/mol solvent	molality m_1/mol kg^{-1}	mass % $100w_1$	mole % $100x_1$	solid phase
0.3654	18.25	43.62	26.76	$LiCl \cdot D_2O$

Molality, mass %, mole % calc. by compiler

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE	SOURCE AND PURITY OF MATERIALS:
Not given.	LiCl: not specified. D_2O: heavy water was obtained from Hydro-Elektrisk Kvaelstafaktieselskab in Oslo and had a deuterium concentration of 99.6%.
	ESTIMATED ERROR:
	REFERENCES:

COMPONENTS:

(1) Lithium Chloride; LiCl; [7447-41-8]

(2) Water-d_2; D_2O; [7789-20-0]

ORIGINAL MEASUREMENTS:

Selecki, A.; Tyminski, B.; Mariankowska, B.

J. Chem. Eng. Data 1970, *15*, 130.

VARIABLES:

$T/K = 298\text{-}363$

PREPARED BY:

W. A. Van Hook

EXPERIMENTAL VALUES:

Solubility of NaCl in 99.8 mole % D_2O. Solid phase presumably $LiCl \cdot D_2O$ (compiler)

t/°C	mole %	n_D^t	mass %	molality m_1/mol kg^{-1}
25	27.0 ± 0.1	1.4328	43.9	18.5
35	27.8 ± 0.1	1.4340	44.9	19.2
45	28.6 ± 0.2	1.4353	45.9	20.0
60	30.5 ± 0.3	1.4393	48.2	21.9
75	32.0 ± 0.2	1.4424	49.9	23.5
90	33.6 ± 0.2	-	51.7	25.3
91	-	1.4460	-	-

n_D^t - refractive index, sodium D line, temperature t°C.
Mass %, molality calc. by compiler.

ADDITIONAL DATA:

Refractive indices, measured with a RL refractometer with Amici prisms (PZO, Warsaw) had a precision of ±0.0002. The corresponding solubilities in H_2O were not determined.

Presumably the solid phase in equilibrium at both 25 and 35°C is $LiCl.D_2O$.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Refractive indices of equilibrated solutions were compared against a standard curve. A break occurs at the saturation point. The method was checked with a run for NaBr in H_2O (25 to 70°C), obtaining results in agreement with (1). The composition of the solvent was found from density measurements.

SOURCE AND PURITY OF MATERIALS:

Heavy water of Russian manufacture, $D/(H + D) = 0.998$, was employed. The oxygen isotopic composition was normalized by electrolytic decomposition of the water followed by burning the evolved hydrogen in air. The salt was of analytical purity and was not purified further.

ESTIMATED ERROR:

Difficult to estimate because of evaporation from prisms. No error on temperature is reported.

REFERENCES:

1. Kogan, V.B.; Fridman, V.M.; Kafarov, V.M. *Spravochnik po rastvorimosti* 1961, *I*, 1 Acad. Sci. USSR.

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water-d_2; D_2O; [7789-20-0]	J.W. Lorimer, Department of Chemistry, The University of Western Ontario, London, Ontario N6A 5B7, Canada. January, 1990

CRITICAL EVALUATION

Seventeen values of solubility for this system, and 6 more for the system $NaCl-D_2O-H_2O$, are found in four publications. The solid phase is presumably NaCl in all cases. One case is doubtful, that given by Eddie and Menzies (3) at 269.4 K. The critical evaluation given below is consistent, however, with NaCl as the solid phase even at this temperature, and thus suggests that the NaCl - $NaCl \cdot D_2O$ transition temperature is lower than that for the NaCl - $NaCl \cdot H_2O$ transition (273.2 K).

EXPERIMENTAL METHODS

The isothermal saturation method was used by Taylor *et al.* (1) to measure the solubility of NaCl in 92 mol % D_2O at 298.15 K. Chang and Chu (2) used the same method to measure solubilities at 298.15 K in mixtures of D_2O and ordinary water, over a range of solvent mol fractions in D_2O of 0.0002 (ordinary water) to 0.9954. These data are the only ones for an alkali chloride in D_2O-H_2O mixtures. Eddy and Menzies (3) measured solubilities by the synthetic method between 269 and 458 K, and calculated and applied a correction for solvent lost to the vapor phase for data above 373 K. Selecki *et al.* (4) determined solubilities at six temperatures between 298 and 368 K. Their use of a break in a plot of refractive index against concentration is a method of questionable accuracy for measurement of solubilities, especially as a refractometer with Amici prisms was used, where there is a possibility of loss of solvent during placing samples on the prism face, a possible error which should be more pronounced at higher temperatures.

CHEMICALS, ANALYSIS OF SOLUTIONS AND CONTROL OF TEMPERATURE

Eddy and Menzies (3) prepared NaCl from recrystallized Na_2CO_3 and redistilled HCl. The salt was then recrystallized twice. Selecki *et al.* (4) used NaCl of analytical purity; the other authors did not specify the purity of the salt. Taylor *et al.* (1) used deuterium water, 92 mol% D, from an unspecified source, Chang and Chu (2) used D_2O from Norway with purity 99.54 mol %, and Selecki *et al.* (4) used D_2O from the U.S.S.R with purity 99.8 mol %. Eddy and Menzies (3) prepared D_2O by electrolysis of 2 % NaOD in 92 mol % D_2O, and, after neutralization with CO_2, distilled the solution to produce material of purity 99.4 mol %.

For analysis, both Taylor *et al.* (1) and Chang and Chu (2) evaporated the solution to dryness, using micro techniques to deal with and conserve small amounts of deuterium water.

Temperature was controlled by Chang and Chu to within ±0.03 K, and both measured and controlled to within ±0.02 K by Eddy and Menzies (3). The other authors do not specify the control of temperature.

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water-d_2; D_2O; [7789-20-0]	J.W. Lorimer, Department of Chemistry, The University of Western Ontario, London, Ontario N6A 5B7, Canada. January, 1990

CRITICAL EVALUATION (continued)

CRITICAL EVALUATION OF RESULTS

(1) The System $NaCl-D_2O-H_2O$

While only one paper (2) contains data for this system, the data form the basis for correction of solubilities to 100 mole % D_2O. These data were fitted to six different equations:

$$x_{1s} = x_2'x_{12} + (1 - x_2')x_{13} \quad [1]$$

$$Y_{1s} = x_2'\ln[2x_{12}/(1 + x_{12})] + (1 - x_2')\ln[2x_{13}/(1 + x_{13})] \quad [2]$$

$$m_{1s}^{(3)} = x_2'm_{12}^{(3)} + (1 - x_2')m_{13}^{(3)} \quad [3]$$

$$\ln m_{1s}^{(3)} = x_2'\ln m_{12}^{(3)} + (1 - x_2')\ln m_{13}^{(3)} \quad [4]$$

and two equations in m_{1i} analogous to eqns [3] and [4]. Here, subscript 1s refers to the mixed solvent, 12 to pure D_2O and 13 to ordinary water, x_{1i} is the mole fraction, $Y_{1i} = 2\ln[2x_{1i}/(1 + x_{1is})]$, m_{1i} the molality, and $m_{1i}^{(3)}$ the aquamolality. The solvent mass fraction, w_2', and the mass ratio NaCl/solvent, $r = w_1/(w_2 + w_3)$, are known from the data. The mole fraction of NaCl is thus

$$x_1 = 1/\{1 + (m_1/r)[1/M_3 + w_2'(1/M_2 - 1/M_3)]\} \quad [5]$$

where M_2, M_3 are the molar masses of pure D_2O and pure H_2O, respectively. All six equations, when fitted by least squares, represent the data well, but the two equations involving the molality, and equation [1], are inferior, and are rejected. The other three fitting equations are:

$$Y = -3.415 - 0.09206\ x_2', \quad s = 0.0012 \quad [6]$$

$$m_{1s}^{(3)}\text{mol kg}^{-1} = 6.1457 - 0.3344x_2', \quad s = 0.0041 \quad [7]$$

$$\ln[m_{1s}^{(3)}/\text{mol kg}^{-1}] = 1.8160 - 5.596x_2', \quad s = 0.0072 \quad [8]$$

The standard errors of estimate, s, are all within the estimated errors for the various composition variables. Table 1 shows the excellent fit according to eqns [6] and [7]. An equation of the form of [7] was given by Chang and Chu (2). Each of the equations [6] to [8] conform to the

Table 1.

Solubility of NaCl in D_2O-H_2O mixtures at 298.15 K; solid phase NaCl

solvent mole fraction, x_2'	solubility Y_{1s} observed	Y_{1s} calculated	$m_{1s}^{(3)}$/mol kg^{-1} observed	$m_{1s}^{(3)}$/mol kg^{-1} calculated
0.0000	-	-3.4148	-	6.146
0.0002	-3.4166	-3.4148	6.141	6.146
0.1601	-3.4278	-3.4296	6.100	6.092
0.3738	-3.4494	-3.4492	6.018	6.021
0.4969	-3.4603	-3.4606	5.978	5.980
0.6214	-3.4717	-3.4720	5.938	5.938
0.7371	-3.4823	-3.4827	5.900	5.899
0.8900	-3.4964	-3.4968	5.850	5.848
0.9954	-3.5076	-3.5065	5.811	5.813
1.0000	-	-3.5068	-	5.811

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water-d_2; D_2O; [7789-20-0]	J.W. Lorimer, Department of Chemistry, The University of Western Ontario, London, Ontario N6A 5B7, Canada. January, 1990

CRITICAL EVALUATION (continued)

thermodynamic theory given in the section on Solubilities in the Systems: Alkali Metal Chloride-D_2O-H_2O.

(2) The System: NaCl-D_2O

All data for this system are summarized in Table 2. A plot of $x_1(D_2O)/x_1(H_2O)$ is given in the section *Solubilities in the Systems: Alkali Metal Chloride-D_2O-H_2O.*

Table 2. Solubility of NaCl in D_2O; solid phase NaCl

T/K -273.15	solvent mole % D_2O x_2'	mole fraction x_1 obs.	corr.	calc.	$\frac{x_1(D_2O)}{x_1(H_2O)}$	status	ref.
-3.8	99.4	0.0906	0.0905	0.0906	0.915	r	3
1.7	99.4	0.0914	0.0913	0.0914	0.922	r	3
11.7	99.4	0.0928	0.0927	0.0928	0.934	r	3
19.7	99.4	0.0936	0.0935	0.0938	0.939	r	3
25	92	0.0947	0.0935	0.0945	0.936	t	1
25	99.8	0.096	0.0959	0.0945	0.961	t	4
25	99.54	0.09481	0.0948	0.0945	0.950	r	2
28.2	99.4	0.0947	0.0946	0.0949	0.946	r	3
35	99.8	0.096	0.0959	0.0957	0.955	r	4
45	99.8	0.0972	0.0972	0.0968	0.961	r	4
60	99.8	0.0989	0.0989	0.0985	0.965	r	4
61.5	99.4	0.0980	0.0980	0.0986	0.955	r	3
75	99.8	0.0998	0.0999	0.1000	0.960	r	4
90	99.4	0.1013	0.1013	0.1014	0.956	r	4
110.8	99.4	0.1057	0.1056	0.1031	0.970	a	3
144.1	99.4	0.1110	0.1109	0.1057	0.967	a	3
180.3	99.4	0.1181	0.1180	0.1081	0.964	a	3

$x_1(D_2O)/x_1(H_2O)$ calc. from observed solubility in D_2O and evaluated solubility in H_2O.

Status: $\Delta = 100\{x_1(\text{obs})/x_1(\text{calc}) - 1\}$

$0 \leq \Delta \leq 1$ recommended value (r)

$1 < \Delta \leq 2$ tentative value (t)

$2 < \Delta$ aberrant value (a)

Observed data as molalities were corrected to 100 mol % D_2O using eqn [8], and the corrected values were then used to calculate mole fractions, which were fitted by least squares to the equation

$$Y = 2\ln[2x_1/(1 + x_1)] = A_1 + A_2\text{K}/T$$

with coefficients $A_1 = -2.799$, $A_2 = -212.9$ K. Additional terms did not improve the fit. Before fitting, it was found from plots of Y or of the ratio of the mole fraction solubilities in D_2O and H_2O, $x_1(D_2O)/x_1(H_2O)$ against $1/T$ that the data of Eddy and Menzies (3) above 373 K were aberrant, and were therefore rejected. Of the remaining 14 data, only two gave differences between calculated and observed values greater than 1 %,

(continued)

COMPONENTS	EVALUATOR:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water-d_2; D_2O; [7789-20-0]	J.W. Lorimer, Department of Chemistry, The University of Western Ontario, London, Ontario N6A 5B7, Canada. July, 1989

CRITICAL EVALUATION (continued)

which is the accuracy claimed by Eddy and Menzies (3) for their data.

The rejected data of Eddy and Menzies (3) are those for which the authors applied a correction for water lost to the vapor phase in their apparatus. These corrections were checked satisfactorily by an independent method: from the dead space volumes given by the authors, and the specific volumes of vapor in equilibrium with saturated NaCl-H_2O solutions (5), the amount of water in the dead space could be found directly. It may be that corrosion products from the Pyrex apparatus at the high temperatures (up to 453 K) and pressures (up to 7 bar) encountered affect significantly the solubility of NaCl.

Table 3 gives *recommended* solubilities in various units at rounded values of temperature, as calculated from the fitting equation.

Table 3.

Solubility of NaCl in 100 mol % D_2O at Rounded Temperatures

T/K -273.15	mole fraction, x_1	mass fraction, w_1	molality,[a] m_1/mol kg^{-1}	$x_1(D_2O)/x_1(H_2O)$
-5	0.0905	0.0330	4.97	0.915
0	0.0912	0.0332	5.01	0.921
10	0.0926	0.0338	5.09	0.933
15	0.0932	0.0340	5.13	0.938
20	0.0939	0.0343	5.17	0.942
25	0.0945	0.0345	5.21	0.946
30	0.0951	0.0348	5.25	0.950
35	0.0957	0.0350	5.28	0.953
40	0.0963	0.0352	5.32	0.955
45	0.0968	0.0354	5.35	0.957
50	0.0974	0.0357	5.39	0.959
60	0.0985	0.0361	5.45	0.960
70	0.0995	0.0365	5.51	0.961
80	0.1004	0.0369	5.57	0.959
90	0.1014	0.0372	5.63	0.956
100	0.1022	0.0376	5.69	0.952

[a] To calculate aquamolality, multiply molality by 1.111 7

REFERENCES:

1. Taylor, H.S.; Caley, E.R.; Eyring, H. *J. Am. Chem. Soc.* 1933, *55*, 4334.
2. Chang, T.-L.; Chu, T.-C. *Z. Phys. Chem., Abt. A.* 1939, *184*, 411.
3. Eddy, R.D.; Menzies, A.W.C. *J. Phys. Chem.* 1940, *44*, 207.
4. Selecki, A.; Tyminski, B.; Mariankowska, B. *J. Chem. Eng. Data* *1970*, *15*, 130.
5. Haas, Jr., J.L. *Physical Properties of the Coexisting Phases and Thermochemical Properties of the H_2O Component in Boiling NaCl Solutions. Geol. Surv. Bull. 1421-A,* 1976.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Sodium chloride; NaCl; [7647-14-5] (2) Water-d_2; D_2O; [7789-20-0]	Taylor, H.S.; Caley, E.R.; Eyring, H. *J. Am. Chem.Soc.* <u>1933</u>, *55*, 4334.
VARIABLES:	PREPARED BY:
$T/K = 298$	G. Jancsó; J.W. Lorimer

EXPERIMENTAL VALUES:

Solubility of NaCl in 92 mole % D_2O

t/°C	mass ratio $NaCl/D_2O$	mass % (compiler)	molality m_1/mol kg^{-1}	mole fraction	solid phase
25	0.305	23.4	5.22	0.0947	NaCl

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The isothermal saturation method was used. Analysis was by evaporation of a weighed sample to dryness.

SOURCE AND PURITY OF MATERIALS:

NaCl: no information available.

D_2O: 92 mol % as 100D/(D + H)

ESTIMATED ERROR:

Temperature: precision probably within ±0.1 K (compiler).
Solubility: precision > 1 % (authors).

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water-d_2; D_2O; [7789-20-0]

(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Chang, T.-L.; Chu, T.-C.

Z. Phys. Chem., Abt. A. 1939, *184*, 411-5.

VARIABLES:

T/K = 298

PREPARED BY:

G. Jancsó; J.W. Lorimer

EXPERIMENTAL VALUES:

t = 25°C

Solubility of NaCl in D_2O-H_2O mixtures. Solid phase: NaCl

solvent mass % D_2O	solvent mole % D_2O, x_2'	mass ratio NaCl/solvent	solubility[a] mass %	molality m_1/mol kg^{-1}	mole fraction
0.0002	0.0002	0.3589	26.41	6.141	0.09961
0.1749	0.1601	0.3502	25.94	5.993	0.09902
0.3989	0.3738	0.3377	25.24	5.777	0.09781
0.5233	0.4969	0.3311	24.87	5.664	0.09723
0.6460	0.6214	0.3245	24.50	5.552	0.09664
0.7571	0.7371	0.3186	24.16	5.451	0.09607
0.8999	0.8900	0.3110	23.72	5.321	0.09534
0.9959	0.9954	0.3056	23.41	5.230	0.09477

---

[a] All values of mass %, molality and mole fraction recalculated or calculated by the compilers. The authors' aquamolalities are the same as those calculated by the compilers' to 0.001 mol kg^{-1}. Here, aquamolality is $m_1^{(3)} = m_1[M_3 + (M_2 - M_3)x_2']/M_3$, 1 = NaCl, 2 = D_2O, 3 = H_2O.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

About 2 cm^3 of solvent mixture and 0.8 g NaCl were agitated in a sealed tube for 2 h. A sample of the solution was delivered into a weighing bottle. The solvent was evaporated and the residue was dried and weighed.

SOURCE AND PURITY OF MATERIALS:

NaCl: c.p. salt was heated before use.

D_2O: Norsk Hydro-Elektrisk Kvalstofaktieselskab, Oslo; 99.54 mol %, d_4^{20} = 1.10496; distilled before use.

H_2O: conductivity grade.

ESTIMATED ERROR:

Temperature: precision within ±0.03 K, accuracy of thermometer ±0.05 K.

Solubility: precision ±0.1 % (authors).

REFERENCES:

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water-d_2; D_2O; [7789-20-0]

ORIGINAL MEASUREMENTS:

Eddy, R.D.; Menzies, A.W.C.

J. Phys. Chem. 1940, *44*, 207-35.

VARIABLES:

$T/K = 269 - 453$

PREPARED BY:

G. Jancsó; J.W. Lorimer

EXPERIMENTAL VALUES:

Solubility of NaCl in 99.4 mole % D_2O. Solid phase: NaCl

t/°C	contents of apparatus salt/g	contents of apparatus water/g	mass of water in vapor/g	mass %	solubility[a] molality m_1/mol kg^{-1}	mole fraction
-3.8	0.3040	1.0454	–	22.53	4.976	0.0906
1.7	0.3040	1.0356	-	22.69	5.022	0.0914
11.7	0.3040	1.0181	-	22.99	5.108	0.0928
19.7	0.2753	0.9134	-	23.16	5.157	0.0936
28.2	0.3040	0.9957	-	23.39	5.224	0.0947
61.5	0.2753	0.8679	-	24.08	5.427	0.0980
110.8	0.2753	0.8007	0.0023	25.64	5.900	0.1057
144.1	0.3040	0.8400	0.0055	26.70	6.233	0.1110
180.3	0.3040	0.7910	0.0127	28.09	6.684	0.1181

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[a] All values recalculated or calculated by compiler.

The authors' values of aquamolality are the same to within 0.01 mol kg^{-1} as those calculated by the compilers, except for the last 3 entries, where their values are lower by 0.01 mol kg^{-1} than the compiler's. Here, aquamolality is $m_1^{(3)} = m_1[M_3 + (M_2 - M_3)x_2']/M_3$, 1 = NaCl, 2 = D_2O, 3 = H_2O.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The synthetic method, in the form used by Menzies (1), was used. The apparatus consists of a sealed tube containing salt and water, with the water contained in a calibrated side-arm which can be sealed off from the rest of the apparatus by a trap containing a sealant which can be melted. Correction is made for the mass of solvent in the vapor phase.

SOURCE AND PURITY OF MATERIALS:

NaCl: made by ppt with HCl (Grasselli reagent) from a sln of Na_2CO_3, then 2x recryst., dried by heating to incipient fusion for 20 min.

D_2O: prepared by electrolysis of NaDH in 92 mol % D_2O to 1/6 its volume. Product distilled 2X under reduced pressure at 60°C. F.p. 3.80±0.02 °C, corr. to 99.4 mol %.

ESTIMATED ERROR:

Temperature: precision probably within ±0.1 K (compiler).

Solubility: estimated precision ±1 %; similar accuracy claimed.

REFERENCES:

1. Menzies, A.W.C. *J. Am. Chem. Soc.* *1936*, *58*, 934.

COMPONENTS:

(1) Sodium chloride; NaCl; [7647-14-5]

(2) Water-d_2; D_2O; [7789-20-0]

ORIGINAL MEASUREMENTS:

Selecki, A.; Tyminski, B.; Mariankowska, B.

J. Chem. Eng. Data 1970, *15*, 130.

VARIABLES:

$T/K = 298-363$

PREPARED BY:

W. A. Van Hook

EXPERIMENTAL VALUES:

Solubility of NaCl in 99.8 mole % D_2O. Solid phase NaCl.

t/°C	mole %	n_D^t	mass %	molality m_1/mol kg^{-1}
25	9.6 ± 0.1	1.3792	23.7	5.30
35	9.6 ± 0.1	1.3727	23.7	5.30
45	9.72 ± 0.09	1.3715	23.9	5.38
60	9.89 ± 0.09	1.3699	24.3	5.48
75	9.98 ± 0.09	1.3673	24.4	5.54
90	10.13 ± 0.09	-	24.8	5.63
91	-	1.3650		

n_D^t - refractive index, sodium D line, temperature t°C.

ADDITIONAL DATA:

Refractive indices, measured with a RL refractometer with Amici prisms (PZO, Warsaw) had a precision of ±0.0002. The corresponding solubilities in H_2O were not determined.
Mass %, molality and mole fraction calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Refractive indices of equilibrated solutions were compared against a standard curve. A break occurs at the saturation point. The method was checked with a run for NaBr in H_2O (25 to 70°C), obtaining results in agreement with (1). The composition of the solvent was found from density measurements.

SOURCE AND PURITY OF MATERIALS:

Heavy water of Russian manufacture, D/(H + D) = 0.998, was employed. The oxygen isotopic composition was normalized by electrolytic decomposition of the water followed by burning the evolved hydrogen in air. The salt was of analytical purity and was not purified further.

ESTIMATED ERROR:

Difficult to estimate because of evaporation from prisms. No error on temperature is reported.

REFERENCES:

1. Kogan, V.B.; Fridman, V.M.; Kafarov, V.M. *Spravochnik po rastvorimosti* 1961, *I*, 1 Acad. Sci. USSR.

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water-*d*$_2$; D_2O; [7789-20-0]	J.W. Lorimer, Department of Chemistry, The University of Western Ontario, London, Ontario N6A 5B7, Canada. December, 1989

CRITICAL EVALUATION

Thirty-five values of solubility for this system are found in four publications. The solid phase is presumably KCl in all cases.

EXPERIMENTAL METHODS

The synthetic method was used by Miles, Shearman and Menzies (2) in a preliminary study, and by Miles, Shearman and Menzies (3), both using the micro method described by Menzies (1), over the range in temperature 281 to 449 K and using 98.2 mole % D_2O. The same method was used by Sunier and Baumbach (8), using the apparatus described by Sunier and Rosenblum (6) and Sunier (7), over the range 295 to 362 K and using 99.7 mole % D_2O.

The isothermal saturation method was used by Chang and Hsieh (4) at 298 K only, using 99.7 mol % D_2O. Selecki *et al.* (5) determined solubilities at six temperatures between 298 and 368 K, and using 98.5 mole % D_2O. Their use of a break in a plot of refractive index against concentration is a method of questionable accuracy for determination of solubilities, especially as a refractometer with Amici prisms was used, where there is a possibility of loss of solvent during placing samples on the prism face, a possible error which should be more pronounced at higher temperatures. However, their data are consistent with data of other workers.

CHEMICALS, ANALYSIS OF SOLUTIONS AND CONTROL OF TEMPERATURE

All authors used KCl of analytical reagent grade. Shearman and Menzies (3) dried their sample carefully, while Sunier and Baumbach (8) recrystallized their material twice. Chang and Hsieh (4) used D_2O from Norway with purity 99.7 mol %, Selecki *et al.* (5) used D_2O from the U.S.S.R with purity 98.5 mol %, and Sunier and Baumbach used commercial D_2O of purity 99.7 mole %. Shearman and Menzies (3) prepared D_2O by electrolysis of 2 % NaOD in 92 mol % D_2O, and, after neutralization with CO_2, distilled the solution to produce material of purity 98.2 mol %.

Chang and Hsieh's (4) method of analysis and of temperature control was unspecified. Temperature was both measured and controlled by Shearman and Menzies (3) to within ±0.02 K, and to ±0.01 K by Sunier and Baumbach (8). Temperature control was not specified by Selecki *et al.* (5).

CRITICAL EVALUATION OF RESULTS

The System: KCl-D_2O

All data for this system are summarized in Table 1. Observed data as molalities were corrected to 100 mol % D_2O using a linear dependence of aquamolality on solvent mole fraction, as in the Critical Evaluation for the system NaCl - D_2O, and the corrected values were then used to calculate mole fractions, which were fitted by least squares to the equation

(continued)

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water-d_2; D_2O; [7789-20-0]	J.W. Lorimer, Department of Chemistry, The University of Western Ontario, London, Ontario N6A 5B7, Canada. December, 1989

CRITICAL EVALUATION (continued)

$$Y = 2\ln[2x_1/(1 + x_1)] = A_1 + A_2\text{K}/T$$

with coefficients $A_1 = 0.052$, $A_2 = -1202.1$ K. Additional terms did not improve the fit.

Table 1. Solubility of KCl in D_2O

T/K -273.15	solvent mole % D_2O x_2'	mole fraction x_1 obs.	corr.	calc.	$x_1(D_2O)$ / $x_1(H_2O)$	status[a]	ref.
5.3	100	0.0584	0.0583	0.0630	0.877	a	3
12.5	100	0.0641	0.0641	0.0668	0.901	a	3
20.4	100	0.0708	0.0709	0.0709	0.930	r	3
21.51	99.7	0.06970	0.06967	0.0715	0.906	a	8
24.7	100	0.0730	0.0730	0.0732	0.925	r	3
25	98.8	0.07281	0.0727	0.0734	0.918	r	4
25	98.8	0.07285	0.0726	"	0.918	r	4
25	98.2	0.07289	0.0723	"	0.914	r	4
25	98.2	0.07293	0.072	"	0.910	r	4
25	98.5	0.0742	0.0741	"	0.937	r	5
25.78	99.7	0.07236	0.07233	0.0738	0.909	t	8
28.99	99.7	0.07475	0.07472	0.0755	0.916	r	8
35	98.5	0.0805	0.0804	0.0787	0.943	a	5
39.48	99.7	0.08115	0.0811	0.0811	0.923	r	8
43.16	99.7	0.08396	0.08394	0.0831	0.932	r	8
44.53	99.7	0.08432	0.08429	0.0839	0.928	r	8
45	98.5	0.0858	0.0856	0.0841	0.939	t	5
47.8	100	0.0873	0.0874	0.0856	0.942	a	3
49.19	99.7	0.08719	0.08717	0.0864	0.932	r	8
55.54	99.7	0.09037	0.09034	0.0898	0.930	r	8
56.87	99.7	0.09161	0.09159	0.0906	0.936	t	8
58.72	99.7	0.09284	0.09282	0.0916	0.939	t	8
60	98.5	0.0902	0.0901	0.0923	0.905	a	5
63.00	99.7	0.09510	0.09508	0.0939	0.940	t	8
70.06	99.7	0.09877	0.09875	0.0978	0.941	r	8
71.4	100	0.1005	0.1005	0.0985	0.951	r	3
71.45	99.7	0.09941	0.09941	0.0985	0.941	r	8
75	98.5	0.0968	0.0966	0.1005	0.898	a	5
79.36	99.7	0.10319	0.10317	0.1029	0.940	r	8
88.42	99.7	0.10760	0.10757	0.1079	0.941	r	8
90	98.5	0.099	0.099	0.1087	0.860	a	5
98.7	100	0.1150	0.1150	0.1135	0.964	t	3
133.0	100	0.1313	0.1314	0.1323	0.974	r	3
150.5	100	0.1398	0.1397	0.1418	0.980	t	3
177.4	100	0.1541	0.1540	0.1563	0.998	t	3

[a] $x_1(D_2O)/x_1(H_2O)$ calc. from observed solubility in D_2O and evaluated solubility in H_2O.

Status: $\Delta = 100\{x_1(\text{obs})/\{x_1(\text{calc}) -1\}$

$0 \leq \Delta \leq 1$ recommended value (r)

$1 < \Delta \leq 2$ tentative value (t)

$2 < \Delta$ aberrant value (a)

(continued)

COMPONENTS	EVALUATOR:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water-d_2; D_2O; [7789-20-0]	J.W. Lorimer, Department of Chemistry, The University of Western Ontario, London, Ontario N6A 5B7, Canada. December, 1989

CRITICAL EVALUATION (continued)

Table 2 gives *recommended* solubilities in various units at rounded values of temperature. These values were calculated from the fitting equation.

Table 2.

Solubility of KCl in 100 mol % D_2O at Rounded Temperatures

T/K -273.15	mole fraction, x_1	mass fraction, w_1	molality,[a] m_1/mol kg^{-1}	$x_1(D_2O)/x_1(H_2O)$
0	0.0603	0.0169	3.20	0.958 [b]
10	0.0655	0.0185	3.50	0.933
15	0.0681	0.0193	3.65	0.935
20	0.0707	0.0200	3.80	0.931
25	0.0734	0.0208	3.95	0.927
30	0.0760	0.0216	4.11	0.925
35	0.0787	0.0224	4.27	0.924
40	0.0841	0.0233	4.43	0.923
45	0.0841	0.0241	4.59	0.923
50	0.0868	0.0249	4.75	0.924
60	0.0923	0.0266	5.08	0.927
70	0.0977	0.0283	5.41	0.932
80	0.1032	0.0300	5.75	0.938
90	0.1087	0.0317	6.09	0.945
100	0.1142	0.0335	6.44	0.953

[a] To calculate aquamolality, multiply molality by 1.111 7

[b] Ratio calculated from extrapolated curve NaCl-H_2O, with solid phase NaCl.

REFERENCES:

1. Menzies, A.W.C. *J. Am, Chem. Soc.* 1936, *58*, 1067.
2. Miles, F.T.; Shearman, R.W.; Menzies, A.W.C. *Nature* 1936, *138*, 121.
3. Shearman, R.W.; Menzies, A.W.C. *J. Am. Chem. Soc.* 1937, *59*, 185.
4. Chang, T.-L.; Hsieh, Y.-Y. *J. Chinese Chem. Soc. (Peking)* 1949, *16*, 10.
5. Selecki, A.; Tyminski, B.; Mariankowska, B. *J. Chem. Eng. Data* *1970*, *15*, 130.
6. Sunier, A.A.; Rosenblum, C. *J. Phys. Chem.* 1928, *32*, 1049.
7. Sunier, A.A. *J. Phys. Chem.* 1930, *32*, 2562.
8. Sunier, A.A.; Baumbach, J. *J. Chem. Eng. Data* 1976, *21*, 335.

COMPONENTS:

(1) Potassium chloride; KCl;
[7447-40-7]

(2) Water-d_2; D_2O; [7789-20-0]

ORIGINAL MEASUREMENTS:

Shearman, R.W.; Menzies, A.W.C.
J. Am. Chem. Soc. <u>1937</u>, *59*, 185-6.

Miles, F.T.; Shearman, R.W.;
Menzies, A.W.C.
Nature <u>1936</u>, *138*, 121.

VARIABLES:

$T/K = 281-449$

PREPARED BY:

G.Jancsó; J.W. Lorimer

EXPERIMENTAL VALUES:

Solid phase: KCl

$t/°C$	aquamolality $m_1^{(3)}/\text{mol kg}^{-1}$	molality $m_1/\text{mol kg}^{-1}$	mass %	mol %
5.3	3.44	3.09	18.7	5.84
12.5	3.80	3.42	20.3	6.41
20.4	4.23	3.81	22.1	7.08
24.7	4.37	3.93	22.7	7.30
47.8	5.31	4.78	26.3	8.73
71.4	6.20	5.58	29.4	10.05
98.7	7.21	6.49	32.6	11.50
133.0	8.39	7.55	36.0	13.13
150.5	9.02	8.11	37.7	13.98
177.4	10.11	9.09	40.4	15.41

COMMENTS AND ADDITIONAL DATA:

The authors results are for solubilities estimated in pure D_2O, which were obtained by linear extrapolation from the results in 98.2 mol % D_2O and the corresponding solubilities in ordinary water. Molality, mass%, mol % calculated by compilers.
The second paper by Miles, Shearman and Menzies (first historically) gives only approximate results:

$t/°C$	$100\{m_1^{(3)}(D_2O)/m_1(H_2O) - 1\}$	$m_1(D_2O)/m_1(H_2O)$ (compiler)
30	7	1.18
100	3.6	1.147
180	1.5	1.124

Here, $m_1^{(3)}$ is the aquamolality of the solution in D_2O, and m_1 is the molality of the solution in water at the same temperature.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

One form of the synthetic method of solubility measurement was used. Known masses of solvent and solute were sealed in a glass tube, which was slowly heated until the last crystal disappeared. Details of the experimental technique are given in (1).

SOURCE AND PURITY OF MATERIALS:

KCl: highest purity. The authors estimated that the impurities other than water were less than 0.05 %.
D_2O: commercial, 98.2 mole %.

ESTIMATED ERROR:

No estimates possible.

REFERENCES:

1. Menzies, A.W.C. *J. Am. Chem. Soc.* <u>1936</u>, *58*, 934.

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water-d_2; D_2O; [7789-20-0]

ORIGINAL MEASUREMENTS:

Chang, T.-L.; Hsieh, Y.-Y.

J. Chinese Chem. Soc. (Peking) 1949, *16*, 10-13.

VARIABLES:

$T/K = 298$

PREPARED BY:

G. Jancsó; J.W. Lorimer

EXPERIMENTAL VALUES:

Solubility of KCl in D_2O, of stated purity. Solid phase: KCl.

$t/°C$	mol % D_2O	mass salt/g	mass D_2O/g	molality m_1/mol kg^{-1}	mass %	mole fraction
25	98.8	0.1299	0.4444	3.921	4.354	0.07281
		0.1440	0.4924	3.923	4.362	0.07285
	98.2	0.1797	0.6141	3.925	4.356	0.07289
		0.1856	0.6338	3.928	4.359	0.07293

COMMENTS:

Molality calculated by compilers. The authors' calculations of aquamolality are consistently 0.005 mol kg^{-1} lower than those calculated by the compilers, which cannot be accounted for by the slightly lower average molar mass of 98.8 or 98.2 mol % D_2O. This has been taken into account by the compilers, and already makes the aquamolalities lower by 0.005 mol kg^{-1} than they would be in pure D_2O. Here, aquamolality is $m_1^{(3)} = m_1[M_3 + (M_2 - M_3)x_2']/M_3$, 1 = NaCl, 2 = D_2O, 3 = H_2O.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Saturated solutions of KCl were made by the method of supersaturation. Saturated solutions were made by agitating excess salt with D_2O for 1 h at 80°C, then for several hours in a thermostat at 25°C. A sample of clear solution was transferred to a weighing bottle and weighed. The solvent was then evaporated, and the residual pure salt was dried in vacuum and weighed.
The D_2O content of the water was determined before and after each measurement from the relative density at 25°C (1).

SOURCE AND PURITY OF MATERIALS:

D_2O: 99.7 mol % (Norsk Hydro-Elektrisk Kvaelstafaktieselskab, Oslo).
KCl: Baker Analyzed, c.p.

ESTIMATED ERROR:

Temperature: no estimates possible.
Solubility: precision within ±0.01 %.

REFERENCES:

1. Swift, Jr., E. *J. Am. Chem. Soc.* 1939, *61*, 198.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Potassium chloride; KCl; [7447-40-7] (2) Water-d_2; D_2O; [7789-20-0]	Selecki, A.; Tyminski, B.; Mariankowska, B. *J. Chem. Eng. Data* 1970, *15*, 130.
VARIABLES:	**PREPARED BY:**
$T/K = 298-363$	W. A. Van Hook

EXPERIMENTAL VALUES:

Solubility of KCl in 98.5 mole % D_2O. Solid phase KCl.

t/°C	mole %	$n_D{}^t$	mass %	molality m_1/mol kg^{-1}
25	7.42 ± 0.07	1.3651	23.0	4.01
35	8.05 ± 0.05	1.3660	24.6	4.38
45	8.58 ± 0.05	1.3665	25.9	4.69
60	9.02 ± 0.07	1.3670	27.0	4.96
75	9.68 ± 0.07	1.3669	28.5	5.36
90	9.9 ± 0.1	-	29.1	5.49
91	-	1.3640	-	-

$n_D{}^t$ - refractive index, sodium D line, temperature t°C.

ADDITIONAL DATA:

Refractive indices, measured with a RL refractometer with Amici prisms (PZO, Warsaw) had a precision of ±0.0002. The corresponding solubilities in H_2O were not determined.
Mass %, molality calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Refractive indices of equilibrated solutions were compared against a standard curve. A break occurs at the saturation point. The method was checked with a run for NaBr in H_2O (25 to 70°C), obtaining results in agreement with (1). The composition of the solvent was found from density measurements.

SOURCE AND PURITY OF MATERIALS:

Heavy water of Russian manufacture, D/(H + D) = 0.985, was employed. The oxygen isotopic composition was normalized by electrolytic decomposition of the water followed by burning the evolved hydrogen in air. The salt was of analytical purity and was not purified further.

ESTIMATED ERROR:

Difficult to estimate because of evaporation from prisms. No error on temperature is reported.

REFERENCES:

1. Kogan, V.B.; Fridman, V.M.; Kafarov, V.M. *Spravochnik po rastvorimosti* 1961, *I*, 1 Acad. Sci. USSR.

COMPONENTS:

(1) Potassium chloride; KCl; [7447-40-7]

(2) Water-d_2; D_2O; [7789-20-0]

ORIGINAL MEASUREMENTS:

Sunier, A.A.; Baumbach, J.

J. Chem. Eng. Data 1976, *21*, 335-6.

VARIABLES:

T/K = 295 - 362

PREPARED BY:

G. Jancsó; J.W. Lorimer

EXPERIMENTAL VALUES:

Solubility of KCl in 99.7 mole % D_2O. Solid phase: KCl.

t/°C	mass KCl/g	mass D_2O/g	mass %	mol %	molality m_1/mol kg^{-1}	aquamolality $m_1^{(3)}$/mol kg^{-1}
21.51	0.2746	0.9843	21.81	6.970	3.742	4.159
25.78	0.3248	1.1182	22.51	7.236	3.896	4.330
28.99	0.3202	1.0644	23.13	7.475	4.035	4.485
39.48	0.3709	1.1279	24.75	8.115	4.411	4.902
43.16	0.3372	0.9880	25.45	8.396	4.578	5.088
44.53	0.4027	1.1744	25.53	8.432	4.599	5.112
49.19	0.3841	1.0800	26.23	8.719	4.771	5.302
55.54	0.3105	0.8394	27.00	9.037	4.962	5.515
56.87	0.3464	0.9225	27.30	9.161	5.037	5.598
58.72	0.3142	0.8245	27.59	9.284	5.112	5.681
63.00	0.3627	0.9269	28.13	9.510	5.249	5.833
70.06	0.3571	0.8751	28.98	9.877	5.474	6.083
71.45	0.4055	0.9862	29.14	9.944	5.515	6.130
79.36	0.4570	1.0667	29.99	10.319	5.747	6.387
88.42	0.4062	0.9048	30.98	10.760	6.022	6.692

COMMENTS AND ADDITIONAL DATA:

All calculations by compilers from original analytical data. The authors' aquamolalities agree with those of the compilers to within 0.003 mol kg^{-1}. The authors quote other work from the same laboratory in the form of fitting equations of the form

$$m_1^{(3)} = A + B(T/\text{K} - 273.15) + C(T/\text{K} - 273.15)^2$$

with constants as follows.

Experimenter	Solvent mol % D_2O	Range of Temp./°C	No. of Data	A	10^2B	10^4C	av. dev. of fitting
this paper	99.7	21-88	15	3.165	4.800	-9.12	0.0093
Schmude	99.5	24-67	6	3.199	4.660	-7.77	0.0058

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

The sealed tube method was used which involved introducing weighed quantities of solute and solvent into a tube and sealing. Then the tube was heated slowly with shaking to determine the temperature at which the last small crystal remained. Mercury in glass thermometers were employed.

SOURCE AND PURITY OF MATERIALS:

KCl: best grade of J.T. Baker, twice recrystallized from deionized water and fused.

D_2O: Stuart Oxygen Co., who claimed 99.7 mol % D_2O.

ESTIMATED ERROR:

Temperature: ±0.01 K

Solubility: see fitting equations.

REFERENCES:

COMPONENTS	EVALUATOR:
(1) Caesium chloride; CsCl; [7647-17-8] (2) Water-d_2; D_2O; [7789-20-0]	J.W. Lorimer, Department of Chemistry, The University of Western Ontario, London, Ontario N6A 5B7, Canada. July, 1989

CRITICAL EVALUATION

Although there is only one publication (1) containing solubility data for this system, some of the data of these authors for other systems are of sufficiently good quality that the data for CsCl are worth close examination. Selecki *et al.* (1) determined solubilities at six temperatures between 298 and 363 K using 98.5 mole % D_2O of U.S.S.R. origin and salt of reagent grade. Their use of a break in a plot of refactive index against concentration is a method of questionable accuracy for determination of solubilities, especially as a refractometer with Amici prisms was used, with the possibility of loss of solvent during placing samples on the prism face. This possible error should be more pronounced at higher temperatures.

Table 1 gives the observed values of the solubility; corrections to 100 mole % D_2O as described in the introductory section *Solubilities in the Systems: Alkali Metal Chloride-D_2O-H_2O* have been calculated, using the aquamolalities. The corrections are within the precision of the data, estimated in (1) to be ±0.08 mole % at 298 and 308 K, and ±0.07 mole % at the remaining temperatures.

Table 1

Solubility of CsCl in D_2O; solid phase CsCl[a]

T/K - 273.15	solvent mole % D_2O x_2'	mole fraction x_1 obs.	corr.	calc.	$\frac{x_1(D_2O)}{x_1(H_2O)}$	molality[b] m_1 /mol kg^{-1}	status[c]	ref.
25	99.8	0.1612	0.1612	0.1626	0.947	9.70	t	1
35	99.8	0.1682	0.1682	0.1682	0.943	10.1	t	1
45	99.8	0.1753	0.1753	0.1737	0.942	10.5	t	1
60	99.8	0.1831	0.1830	0.1817	0.927	11.1	t	1
75	99.8	0.1893	0.1892	0.1893	0.910	11.7	t	1
90	99.8	0.1952	0.1951	0.1966	0.895	12.2	t	1

[a] $x(D_2O)/x(H_2O)$ and molalities from calculated mole fractions.
[b] To calculate aquamolalities, multiply molalities by 1.111 7·
[c] Status: $\Delta = 100\{x_1(\text{obs})/x_1(\text{calc}) - 1\}$
t - tentative value

The plot of the ratio of mole fraction solubilities in D_2O and H_2O against $1/T$, when compared with similar plots for NaCl, KCl and CsCl (see plot in the section *Solubilities in the Systems: Alkali Metal Chloride-D_2O-H_2O*) indicates that the values of Selecki *et al.* (2) at all temperatures are consistent. This conclusion is supported by fitting the data to the equation (see *Introduction*)

$$Y = 2\ln[2x_1/(1 + x_1)] = A_1 + A_2K/T$$

(continued)

COMPONENTS	EVALUATOR:
(1) Caesium chloride; CsCl; [7647-17-8] (2) Water-d_2; D_2O; [7789-20-0]	J.W. Lorimer, Department of Chemistry, The University of Western Ontario, London, Ontario N6A 5B7, Canada. July, 1989

CRITICAL EVALUATION (continued)

which fits all data well, with standard error of estimate $s(Y) = 0.011$ and $A_1 = -0.749$, $A_2 = -536.4$. Values of x_1 calculated from this equation are given in Table 1; the values above 298 K are *tentative*.

It is also found that mole fraction is linear in T:

$$x_1 = 0.242 + 0.001046(T/K - 273.15) \quad s(x_1) = 0.001$$

The ratio of the molality in D_2O to that in H_2O decreases with increasing temperature, as do the ratios of the aquamolalities or molalities.

The difference $Y(H_2O) - Y(D_2O) = 0.0226$, and the ratio $m_1(D_2O)/m_1(H_2O) = 0.852$ at 298.15 K (see *Introduction*).

REFERENCES

1. Selecki, A.; Tyminski, B.; Mariankowska, B. *J. Chem. Eng. Data* *1970*, *15*, 130.

COMPONENTS:

(1) Caesium Chloride; CsCl; [7647-17-8]

(2) Water-d_2; D_2O; [7789-20-0]

ORIGINAL MEASUREMENTS:

Selecki, A.; Tyminski, B.; Mariankowska, B.

J. Chem. Eng. Data 1970, *15*, 130-4.

VARIABLES:

$T/K = 298-363$

PREPARED BY:

W. A. Van Hook; J.W. Lorimer

EXPERIMENTAL VALUES:

Solubilities in 99.8 mole % D_2O. Solid phase: CsCl

t/°C	mole %	$n_D{}^t$	mass %	molality m_1/mol kg^{-1}
25	16.12 ± 0.08	1.4125	61.77	9.598
35	16.82 ± 0.08	1.4142	62.97	10.10
45	17.53 ± 0.07	1.4154	64.12	10.62
60	18.31 ± 0.07	1.4170	65.33	11.19
75	18.93 ± 0.07	1.4178	66.25	11.66
90	19.52 ± 0.07	-	67.10	12.11

$n_D{}^t$ - refractive index, sodium D line, temperature t°C.

ADDITIONAL DATA:

Refractive indices, measured with a RL refractometer with Amici prisms (PZO, Warsaw) had a precision of ±0.0002. The corresponding solubilities in H_2O were not determined.
Mass %, molality calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Refractive indices of equilibrated solutions were compared against a standard curve. A break occurs at the saturation point. The method was checked with a run for NaBr in H_2O (25 to 70°C), and results in agreement with (1) were found. The composition of the solvent was found from density measurements.

SOURCE AND PURITY OF MATERIALS:

Heavy water of Russian manufacture, D/(H + D) = 0.998, was employed. The oxygen isotopic composition was normalized by electrolytic decomposition of the water followed by burning the evolved hydrogen in air. The salt was of analytical purity and was not purified further.

ESTIMATED ERROR:

Temperature: no estimates possible.
Solubility: difficult to estimate because of evaporation from prisms.

REFERENCES:

1. Kogan, V.B.; Fridman, V.M.; Kafarov, V.M. *Spravochnik po rastvorimosti* 1961, *I*, 1 Acad. Sci. USSR.

SYSTEM INDEX

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FORMULA/NAME/REGISTRY NUMBER INDEX

Ammonium chloride	NH_4Cl	12125-02-9
Caesium chloride	$CsCl$	7647-17-8
$CsCl$	caesium chloride	7647-17-8
D_2O	water-d_2	7789-20-0
H_2O	water	7732-18-5
Halite	$NaCl$	14672-51-7
Heavy water	water-d_2	7789-20-0
Hydrohalite	$NaCl\cdot 2H_2O$	24270-49-3
KCl	potassium chloride	7447-40-7
$LiCl$	lithium chloride	7447-41-8
$LiCl\cdot H_2O$	lithium chloride monohydrate	16712-20-2
$LiCl\cdot 2H_2O$	lithium chloride dihydrate	16712-19-9
$LiCl\cdot 3H_2O$	lithium chloride trihydrate	38851-62-6
$LiCl\cdot 4H_2O$	lithium chloride tetrahydrate	56088-71-2
$LiCl\cdot 5H_2O$	lithium chloride pentahydrate	
Lithium chloride	$LiCl$	7447-41-8
Lithium chloride dihydrate	$LiCl\cdot 2H_2O$	16712-19-9
Lithium chloride monohydrate	$LiCl\cdot H_2O$	16712-20-2
Lithium chloride pentahydrate	$LiCl\cdot 5H_2O$	
Lithium chloride tetrahydrate	$LiCl\cdot 4H_2O$	56088-71-2
Lithium chloride trihydrate	$LiCl\cdot 3H_2O$	38851-62-6
$NaCl$	sodium chloride	7647-14-5
$NaCl\cdot 2H_2O$	sodium chloride dihydrate; hydrohalite	24270-49-3
NH_4Cl	ammonium chloride	12125-02-9
Potassium chloride	KCl	7447-40-7
$RbCl$	rubidium chloride	7797-11-9
Rubidium chloride	$RbCl$	7797-11-9
Sodium chloride	$NaCl$	7647-14-5
Sodium chloride dihydrate	$NaCl\cdot 2H_2O$	24270-49-3
Sylvite	KCl	14336-88-0
Water	H_2O	7732-18-5
Water-d_2	heavy water	7789-20-0

REGISTRY NUMBER INDEX

7789-20-0	water-d_2	D_2O
7447-40-7	potassium chloride	KCl
7447-41-8	lithium chloride	$LiCl$
7647-14-5	sodium chloride	$NaCl$
7647-17-8	caesium chloride	$CsCl$
7732-18-5	water	H_2O
7797-11-9	rubidium chloride	$RbCl$
12125-02-9	ammonium chloride	NH_4Cl
14336-88-0	sylvite	KCl
14672-51-7	halite	$NaCl$
16712-19-9	lithium chloride dihydrate	$LiCl\cdot 2H_2O$
16712-20-2	lithium chloride monohydrate	$LiCl\cdot H_2O$
24270-49-3	hydrohalite	$NaCl\cdot 2H_2O$
38851-62-6	lithium chloride trihydrate	$LiCl\cdot 3H_2O$
56088-71-2	lithium chloride tetrahydrate	$LiCl\cdot 4H_2O$

AUTHOR INDEX

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