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SOLUBILITY DATA SERIES

Volume 62

CARBON DIOXIDE IN WATER AND AQUEOUS ELECTROLYTE SOLUTIONS

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CARBON DIOXIDE IN WATER AND AQUEOUS ELECTROLYTE SOLUTIONS

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INTRODUCTION TO THE SOLUBILITY DATA SERIES

SOLUBILITY OF GASES IN LIQUIDS

NATURE OF THE PROJECT

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

COMPILATIONS AND EVALUATIONS

The formats for the compilations and critical evaluations have been standardized for all volumes. A description of these formats follows.

Compilations

The format used for the compilations is, for the most part, self-explanatory. Normally, a compilation sheet is divided into boxes, with detailed contents described below.

Components: Each component is listed according to IUPAC name, formula, and Chemical Abstracts (CA) Registry Number. The Chemical Abstracts name is also included if this differs from the IUPAC name, as are trivial names if appropriate. IUPAC and common names are cross-referenced to Chemical Abstracts names in the System Index.

The formula is given either in terms of the IUPAC or Hill (1) 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 on a given compilation sheet according to:

(a) saturating components;
(b) non-saturating components according to chemical families; within carbon compounds, according to increasing carbon number;
(c) solvents according to chemical families; within carbon compounds, according to increasing carbon number.

In each class, ordering follows the 18-column IUPAC periodic table. The same order is followed in arranging the compilation sheets within a given volume.

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. In the case of multiple entries (for example, translations) an asterisk indicates the publication used for compilation of the data.

Variables: Ranges of temperature, pressure, etc. are indicated here.

Prepared by: The names of all compilers are given here.

Experimental Values: Components are described as (1), (2), etc., as defined in the "Components" box. 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. Usually, only one type of value (e.g., mass per cent) is found in the original paper, and the compiler has added the mole fractions from calculations based on 1989 atomic weights (2) and referenced sources of densities, where necessary. Temperatures are expressed as t/°C, t/°F or T/K as in the original; if necessary, conversions to T/K are made, sometimes in the compilations, and always in the critical evaluation. However, the author's units are expressed according to IUPAC recommendations (3) as far as possible.

Errors in calculations, fitting equations, etc. are noted, and where possible corrected. Material inserted by the compiler is identified by the word "compiler" or by the compiler's name in parentheses or in a footnote. Details of smoothing equations (with limits) are included if they are present in the original publication and if the temperature or pressure ranges are wide enough to justify this procedure and if the compiler finds that the equations are consistent with the data.

The precision of the original data is preserved when derived quantities are calculated, if necessary by the inclusion of one additional significant figure. In some cases, compilers note that numerical data have been obtained from published graphs using digitizing techniques. In these cases, the precision of the data can be determined by the quality of the original graph and the limitations of the digitizing technique.

Method: The apparatus and procedure are mentioned briefly. Abbreviations used in Chemical Abstracts are often used here to save space, reference being made to sources of further detail if these are cited in the original paper. Several reviews on experimental methods of determining gas solubilities are given in (4-10).

Source and Purity of Materials: For each component, referred to as (1), (2), etc., the following information (in this order and in abbreviated form) is provided if available in the original paper: source and specified method of preparation; properties; degree of purity. The solubility is usually more sensitive to impurities in the gaseous component than in the liquid component. However, the most important source of impurities is traces of unwanted gas dissolved in the liquid. Inadequate preliminary degassing of the absorbing liquid is probably the most often overlooked serious source of error in gas solubility measurements.

Estimated Error: If estimated errors were omitted by the original authors, and if relevant information is available, the compilers have attempted to estimate errors (identified by "compiler" or the compiler's name in parentheses or in a footnote) from the internal consistency of data and type of apparatus used. Methods used by the compilers for estimating and reporting errors are based on Ku and Eisenhart (11).

Comments and/or Additional Data: Compilations may include this section, in which short comments relevant to the general nature of the work or additional experimental and thermodynamic data are included which are judged by the compiler to be of value to the reader.

References: The format for these follows the format for the Original Measurements box, except that final page numbers are omitted. References (usually cited in the original paper) are given where relevant to interpretation of the compiled data, or where cross-reference can be made to other compilations.

Evaluations

The evaluator's task is 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. There are only three boxes on a typical evaluation sheet, and these are described below.

Components: The format is the same as on the Compilation sheets.

Evaluator: Name and affiliation of the evaluator(s); date up to which the literature was checked.

Critical Evaluation:

(a) Critical text. The evaluator checks that the compiled data are correct, assesses their reliability and quality, estimates errors where necessary, and recommends numerical values based on all the published data (including theses, reports and patents) for each given system. Thus, the evaluator reviews the merits or shortcomings of the various data. Only published data are considered. Documented rejection of some published data may occur at this stage, and the corresponding compilations may be removed.

The solubilities in comparatively few systems are known with sufficient accuracy to enable a set of recommended values to be presented, either for measurements near atmospheric pressure or at high pressures. Although many systems have been studied by at least two independent groups of workers, the range of pressures or temperatures is often sufficiently different to make meaningful comparison impossible.

Occasionally, it is not clear why two groups of workers obtained very different but internally consistent sets of results at the same temperature and pressure, although both sets were obtained by reliable methods. In such cases, a decisive assessment may not be possible. In some cases, two or more sets of data have been classified as tentative even though the sets are mutually inconsistent.

Many high pressure solubility data have been published in a smoothed form. Such data are particularly difficult to evaluate, and unless specifically discussed by the authors, the estimated error on such values can be regarded only as an "informed guess".

As well, many high pressure solubility data have been obtained in a more general study of high pressure vapor-liquid equilibrium. In such cases a note is included to indicate that additional vapor-liquid equilibrium data are given in the source. Since the evaluation is for the compiled data, it is possible that the solubility data are given a classification which is better than that which would be given for the complete vapor-liquid data (or vice versa). As an example, it is difficult to determine coexisting liquid and vapor compositions near the critical point of a mixture using some common experimental techniques which yield accurate high pressure solubility data. As another example, conventional methods of analysis may give results with an expected error which would be regarded as sufficiently small for vapor-liquid equilibrium data but an order of magnitude too large for acceptable high pressure gas-liquid solubility.

Sometimes it is possible to judge the reliability of data for a particular gas-liquid system by testing whether the data are consistent with the behavior of homologous gases or liquids.

(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, stating the limits within which it should be used.

(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 reported 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 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, including all those publications appearing in the accompanying compilation sheets and those which, by virtue of their poor precision, have been rejected and not compiled.

(f) Units. While the original data may be reported in the units used by the investigators, the final recommended values are reported in SI units (3) when the data can be accurately converted.

QUANTITIES AND UNITS USED IN COMPILATION AND EVALUATION OF SOLUBILITY DATA

Mixtures, Solutions and Solubilities

A *mixture* (12) describes a gaseous, liquid or solid phase containing more than one substance, where the substances are all treated in the same way.

A *solution* (12) 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 solute 1 (solid, liquid or gas) is the analytical composition of a saturated solution, expressed in terms of the proportion of the designated solute in a designated solvent (13).

"Saturated" implies equilibrium with respect to the processes of dissolution and vaporization; the equilibrium may be stable or metastable. The solubility of a substance in metastable equilibrium is usually greater than that of the same substance in stable equilibrium. (Strictly speaking, it is the activity of the substance in metastable equilibrium that is greater.)

Either point of view, mixture or solution, may be taken in describing solubility. The two points of view find their expression in the reference states used for definition of activities, activity coefficients and osmotic coefficients. Note that the composition of a saturated mixture (or solution) can be described in terms of any suitable set of thermodynamic components.

For gases, the solubility is quoted, where possible, as mole fraction of the saturating gaseous component in the liquid phase at 1 bar partial pressure of gas. The distinction between vapor-liquid equilibria and the solubility of gases in liquids is arbitrary. It is generally accepted that the equilibrium at 300 K between a typical gas such as argon and a liquid such as water is gas liquid solubility whereas the equilibrium between hexane and cyclohexane at 350 K is an example of vapor-liquid equilibrium.

Physicochemical Quantities and Units

Solubilities of gases have been the subject of research for a long time, and have been expressed in a great many ways, as described below. In each case, specification of the temperature and either partial or total pressure of the saturating gaseous component is necessary. The nomenclature and units follow, where possible, ref. (3). A few quantities follow the ISO standards (14) or the German standard (15); see a review by Cvitaš (16) for details.

A note on nomenclature. In the IUPAC Green Book (3), the solute is component B and the solvent is component 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 equations given here with those in the Green Book.

1. *Mole fraction* of substance 1, x_1 or $x(1)$ (condensed phases) or y_1 (gases):

$$x_1 = n_1 / \sum_{s=1}^{c} n_s \qquad [1]$$

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 substance 1 is 100 x_1.

2. *Ionic mole fractions* of salt i, x_{i+}, $x_{i,-}$:
For a mixture of s binary salts i, each of which ionizes completely into ν_{s+} cations and ν_{s-} anions, with $\nu_s = \nu_{s+} + \nu_{s-}$, and a mixture of p non-electrolytes j, of which some may be solvent components, a generalization of the definition in (17) gives:

$$x_{i+} = \frac{\nu_{i+} x_i}{1 + \sum_{i=1}^{s} (\nu_i - 1) x_s}, \qquad x_{i-} = \frac{\nu_{i-} x_{i+}}{\nu_{i+}}, \qquad i = 1 \ldots s \qquad [2]$$

$$x_j' = \frac{x_j}{1 + \sum_{i=1}^{s} (\nu_i - 1) x_i}, \qquad j = (s+1) \ldots p \qquad [3]$$

The sum of these mole fractions is unity, so that, with $c = s + p$,

$$\sum_{i=1}^{s} (x_{i+} + x_{i-}) + \sum_{i=s+1}^{c} x_i' = 1 \qquad [4]$$

General conversions to other units in multicomponent systems are complicated. For a three-component system containing non-electrolyte 1, electrolyte 2 and solvent 3,

$$x_1 = \frac{\nu_{2+} x_1'}{\nu_{2+} - (\nu_2 - 1) x_{2+}} \qquad x_2 = \frac{x_{2+}}{\nu_{2+} - (\nu_2 - 1) x_{2+}} \qquad [5]$$

These relations are used in solubility equations for salts, and for tabulation of salt effects on solubilities of gases (see below).

3. *Mass fraction* of substance 1, w_1 or $w(1)$:

$$w_1 = g_1 / \sum_{s=1}^{c} g_s \qquad [6]$$

where g_s is the mass of substance *s*. *Mass per cent* of substance 1 is 100 w_1. The equivalent terms *weight fraction*, *weight per cent* and *g (1)/100 g solution* are no longer used.

4. *Molality* of solute 1 in a solvent 2, m_1:

$$m_1 = n_1/n_2 M_2 \tag{7}$$

SI base units: mol kg^{-1}. Here, M_2 is the molar mass of the solvent. The equivalent term *weight solubility*, C_w, is no longer used.

5. *Amount concentration* of solute 1 in a solution of volume V, c_1:

$$c_1 = [\text{formula of solute}] = n_1/V \tag{8}$$

SI base units: mol m^{-3}. The symbol c_1 is preferred to [formula of solute], but both are used. The old terms *molarity*, *molar* and *moles per unit volume* are no longer used.

6. *Mass concentration* of solute 1 in a solution of volume V, ρ_1 or γ_1:

$$\rho_1 = g_1/V \tag{9}$$

SI base units: kg m^{-3}.

7. *Mole ratio*, $r_{A,B}$ (dimensionless) (16)

$$r_{A,B} = n_1/n_2 \tag{10}$$

Mass ratio, symbol $\zeta_{A,B}$, may be defined analogously (16).

8. *Ionic strength*, I_m (molality basis), or I_c (concentration basis):

$$I_m = \frac{1}{2}\sum_i m_i z_i^2 \qquad I_c = \frac{1}{2}\sum_i c_i z_i^2 \tag{11}$$

where z_i is the charge number of ion i. While these quantities are not used generally to express solubilities, they are used to express the compositions of non-saturating components. For a single salt i with ions of charges z_+, z_-,

$$I_m = |z_+z_-|\nu m_i, \quad I_c = |z_+z_-|\nu c_i \tag{12}$$

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 between some pairs of these quantities can be carried out using the equations given in Table 1 at the end of this Introduction. Other useful quantities will be defined in the prefaces to individual volumes or on specific data sheets.

In addition to these well-defined SI-based units, other units have been used to express the solubilities of gases. Units and nomenclature follow (4, 5, 7, 18), as modified by IUPAC recommendations (3). The equations describing Bunsen, Kuenen, Ostwald and absorption coefficients, as well as Henry's law constants, hold for ideal gases and perfect solutions only. Corrections for non-ideality should be made where possible. The corrections are less than 1 % for most gases near atmospheric pressure (5).

In much published data, the reference pressure is 1 atm = 0.101325 MPa rather than 1 bar = 0.1 MPa.

9. *Bunsen coefficient*, α (dimensionless):

The volume of saturating gas, V_1, reduced to T^o = 273.15 K, p^o = 1 bar, which is absorbed by unit volume V_2^* of pure solvent at the temperature of measurement and partial pressure p^o = 1 bar. If the gas is ideal, Henry's law (see below) holds, and the liquid is incompressible, then

$$\alpha = \frac{V_1^o}{V_2^*} = \left(\frac{V_1}{V_2^*}\right)\left(\frac{T^o}{T}\right) \qquad [13]$$

10. *Kuenen coefficient, S*:

The volume of saturating gas, $V(g)$, reduced to $T^o = 273.15$ K, $p^o = 1$ bar, which is dissolved by unit mass of pure solvent at the temperature of measurement and partial pressure 1 bar. Thus,

$$S = \frac{V_1 T^o}{g_2 T} = \frac{\alpha V_{m,2}}{M_2} \qquad [14]$$

SI base units: $m^3\ kg^{-1}$. Here, M_2 is the molar mass of the solvent. The Kuenen coefficient is proportional to the molality of the dissolved gas.

11. *Ostwald coefficient, L* (dimensionless) (18):

The volume of saturating gas, V_1, absorbed by a volume V_2^* of pure solvent at the temperature and pressure of the measurement. Thus,

$$L = \frac{V_1}{V_2^*} = \left(\frac{\alpha T}{T^o}\right)\left(\frac{p^o}{p}\right) \qquad [15]$$

The Ostwald coefficient is equal to the ratio of the amount concentrations in the gas and in the liquid.

12. *Absorption coefficient*, β (dimensionless):

The most common of several definitions of absorption coefficient is the volume of gas, reduced to $T^o = 273.15$ K, $p^o = 1$ bar absorbed per unit volume of pure solvent at a total pressure of 1 bar. The absorption and Bunsen coefficients are therefore very similar, and are connected by

$$\beta = \alpha(1 - p_2/p^o) \qquad [16]$$

where p_2 is the partial pressure of the vapor of the solvent.

13. *Henry's Law constant*, k_H:

$$K_H = \lim_{x_1 \to 0}\left(\frac{p_1}{x_1}\right) \qquad [17]$$

SI base units: Pa. Unfortunately, the definition is used often at finite mole fractions, even though this is a limiting law. The following have also been defined as Henry's Law constants:

$$\begin{aligned} K_2 &= p_1/c_1 \\ K_c &= c_1^g/c_1 \end{aligned} \qquad [18]$$

where superscript g refers to the gas phase. K_2 has SI base units Pa $m^3\ mol^{-1}$, and K_c is dimensionless. The Henry's law constant has also been called the Henry coefficient and the Henry constant. Henry's law can be used, with great caution, to convert data from the experimental pressure to 1 bar if the mole fraction of the gas in the liquid is small, and the difference in pressures is small.

The relations between the mole fraction solubility and the various quantities given above are as follows. Note again that these relations hold for ideal gaseous and perfect solution phases only.

$$x_1 = \frac{1}{1+\dfrac{RT^o}{p_1^o V_{m,2}^* \alpha}} = \frac{1}{1+\dfrac{RT^o}{p_1^o M_2 S}} \qquad [19]$$

$$= \frac{1}{1+\dfrac{RT}{p_1 V_{m,2}^* L}} = \frac{1}{1+\dfrac{RT^o}{p^o V_{m,2}^* \beta}}$$

14. *Salt Effects on the Solubility of Gases* (19)

These are often reported as Sechenov (Setchenow, Setschenow) salt effect parameters k_{syz}, which are defined in various ways. The general semi-empirical Sechenov equation is

$$\log(z_1^o/z_1) = k_{syz}\, y \qquad [20]$$

where solubility is expressed in quantities z, with superscript o designating pure solvent, and salt composition is expressed in quantities y. The quantities c_2, m_2, x_2', I_{m} and I_{c} are used for y, and the quantities c_1, m_1, x_{1+}, α, S and L for z, giving 30 definitions of k_{syz}. Here, components 1 and 2 are the gaseous solute and electrolyte, respectively. The ratios of z-values are the same for $z = c_1$, α and L and for m_1 and S, respectively, leaving 15 distinct definitions. If z is the same, the definitions of k_{syz} are related simply through 10 equations between pairs of c_2, m_2, x_2', I_{m} and I_{c}. Some relations among the definitions, in terms of k_{scc}, k_{smm} and k_{sxx}, are:

$$k_{scc} = k_{sc\alpha} = k_{scL} = \frac{m_2}{c_2}k_{smc} = \frac{x_2'}{c_2}k_{sxc} = \frac{I_c}{c_2}k_{sI_c c}$$

$$k_{smm} = \frac{x_2'}{m_2}k_{sxm} = k_{smS} = \frac{c_2}{m_2}k_{scm} = \frac{I_m}{m_2}k_{sI_m m} \qquad [21]$$

$$k_{sxx} = \frac{c_2}{x_2'}k_{scx} = \frac{m_2}{x_2'}k_{smx} = \frac{I_m}{x_2'}k_{sI_m x} = \frac{I_c}{x_2'}k_{sI_c x}$$

These relations hold when a single salt is present; note that the relations between ionic strength and either molality or concentration are simple. If more than one salt is present, the ionic strength is the only practical quantity to be used for y.

Conversions between pairs of k_{scc}, k_{smm} and k_{sxx} are more complicated, and can be found using eqn [5] and Table 1 at the end of this Introduction. For example,

$$k_{sxx} = f(m)\left(\frac{k_{smm}}{\nu_{2+}} + \frac{1}{m_2}\log\frac{f(m)}{f(m^o)}\right) \qquad [22]$$

where

$$f(m) = 1+(m_1+\nu_2 m_2)M_3 \qquad f(m^o) = 1+m_1^o M_3 \qquad [23]$$

Errors in the salt effect parameters, as defined above, can be large. If the relative standard deviation in measurement of solubility is $s(c_1)/c_1$, then the relative standard deviation in k_{scc} is

$$\frac{s(k_{scc})}{k_{scc}} = \frac{\sqrt{2}}{c_2 k_{scc}\ln 10}\frac{s(c_1)}{c_1} \qquad [24]$$

For example, for $k_{scc} = 0.1$ and $c_2 = 0.01$ mol dm^{-3}, $s(k_{scc})/k_{scc}$ is 30 % when $s(c_1)/c_1 = 0.05$ % and 1200 % when $s(c_1)/c_1 = 2$ %. At $c_2 = 1$ mol dm^{-3}, the corresponding errors are 0.3 and 12 %, respectively.

If the solubility of a gas is greater than about $x = 0.01$ at partial pressure 1 bar, then several other factors must be taken into account, such as the density of the solution or the partial molar volume of the dissolved gas. In addition, corrections should be made for non-ideality of the gas. See (18) for details.

In addition, the following definitions concerning density are useful in conversions between concentrations and other quantities.

15. *Density*, ρ or γ:

$$\rho = g/V \qquad [25]$$

SI base units: kg m^{-3}. Here g is the total mass of the system.

16. *Relative density*, $d = \rho/\rho^o$: the ratio of the density of a mixture at temperature t, pressure p to the density of a reference substance at temperature t', pressure p'. For liquid solutions, the reference substance is often water at 4°C, 1 bar. (In some cases 1 atm is used instead of 1 bar.) The term *specific gravity* is no longer used.

Thermodynamics of Solubility (20)

Thermodynamic analysis of solubility phenomena provides a rational basis for the construction of functions to represent solubility data, and thus aids in evaluation, and sometimes enables thermodynamic quantities to be extracted. Both these aims are often difficult to achieve because of a lack of experimental or theoretical activity coefficients. Where thermodynamic quantities can be found, they are not evaluated critically, since this task would involve examination of a large body of data that is not directly relevant to solubility. Where possible, procedures for evaluation are based on established thermodynamic methods. Specific procedures used in a particular volume will be described in the Preface to that volume.

Only one thermodynamic result is mentioned here: the temperature dependence of solubility. Sometimes it is possible to fit the mole fraction solubility at various temperatures using the equation

$$\ln x_1 = A + B(\mathrm{K}/T) + C\ln(T/\mathrm{K}) + D(T/\mathrm{K}) \qquad [26]$$

where A, B, C and D are constants to be determined from least-squares fitting of the data. Sometimes, to avoid singular matrices of the least-squares normal equations, T is scaled; e.g., T is replaced by $T/100$.

If the gas and the solution of the dissolved gas are ideal, the coefficients can be used to find standard thermodynamic functions for transfer of the gas from the vapor to the liquid phase at the standard pressure (1 bar) and infinitely-dilute dissolved gas, as follows.

$$\Delta G^o_{m,1}/R = -A(T/\mathrm{K}) - B - C(T/\mathrm{K})\ln(T/\mathrm{K}) - D(T/\mathrm{K})^2 \qquad [27]$$

$$\Delta S^o_{m,1}/R = A + C\ln(T/\mathrm{K}) + C + 2D(T/\mathrm{K}) \qquad [28]$$

$$\Delta H^o_{m,1}/R = -B + C(T/\mathrm{K}) + D(T/\mathrm{K})^2 \qquad [29]$$

$$\Delta C^o_{m,p}/R = C + 2D(T/\mathrm{K}) \qquad [30]$$

Alternatively (but equivalently), the standard state of infinitely-dilute dissolved gas can be described as a hypothetical ideal dissolved gas at mole fraction $x_1 = 1$, $p = 1$ bar.

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Table 1. Interconversions between Quantities Used as Measures of Solubility
c-component Systems Containing c - 1 Solutes i and Single Solvent c

	x_i	w_i	m_i	c_i
$x_i =$	x_i	$\dfrac{1}{1+\dfrac{M_i}{M_c}\left(\dfrac{1}{w_i}-1+\sum\limits_{j\neq i}^{c-1}\left(\dfrac{M_c}{M_j}-1\right)\dfrac{w_j}{w_i}\right)}$	$\dfrac{1}{1+\dfrac{1}{m_iM_c}+\sum\limits_{j\neq i}^{c-1}\dfrac{m_j}{m_i}}$	$\dfrac{1}{1+\dfrac{1}{M_c}\left(\dfrac{\rho}{c_i}-M_i\right)+\sum\limits_{j\neq i}^{c-1}\dfrac{c_j}{c_i}\left(1-\dfrac{M_j}{M_c}\right)}$
$w_i =$	$\dfrac{1}{1+\dfrac{M_c}{M_i}\left(\dfrac{1}{x_i}-1+\sum\limits_{j\neq i}^{c-1}\left(\dfrac{M_j}{M_c}-1\right)\dfrac{x_j}{x_i}\right)}$	w_i	$\dfrac{1}{1+\dfrac{1}{m_iM_i}\left(1+\sum\limits_{j\neq i}^{c-1}m_jM_j\right)}$	$\dfrac{c_iM_i}{\rho}$
$m_i =$	$\dfrac{1}{M_c\left(\dfrac{1}{x_i}-1-\sum\limits_{j\neq i}^{c-1}\dfrac{x_j}{x_i}\right)}$	$\dfrac{1}{M_i\left(\dfrac{1}{w_i}-1-\sum\limits_{j\neq i}^{c-1}\dfrac{w_j}{w_i}\right)}$	m_i	$\dfrac{1}{\dfrac{1}{c_i}\left(\rho-\sum\limits_{j\neq i}^{c-1}c_jM_j\right)-M_i}$
$c_i =$	$\dfrac{\rho}{M_i+M_c\left(\dfrac{1}{x_i}-1+\sum\limits_{j\neq i}^{c-1}\left(\dfrac{M_j}{M_c}-1\right)\dfrac{x_j}{x_i}\right)}$	$\dfrac{\rho w_i}{M_i}$	$\dfrac{\rho}{\dfrac{1}{m_i}\left(1+\sum\limits_{j\neq i}^{c-1}M_jm_j\right)+M_i}$	c_i

ρ - density of solution; M_i - molar masses of i. For relations for 2-component systems, set summations to 0.

PREFACE

The first description of carbon dioxide gas probably dates back to the beginning of the 17th century (1). Jan B. Helmont (1577-1644) found that the gas he had detected in the fumes of a charcoal fire was able to extinguish a lighted candle. He named the gas *"gas sylvestre"* (in Latin *sylvestris*, of a wood). About a hundred years later Joseph Black (1728-1799) studied the gas liberated by heating calcium carbonate (chalk). He gave the gas the name *"fixed air"* since the "air" (gas) was fixed in the solid state in the chalk. In 1772 Joseph Priestley showed that the gas was produced by the burning of charcoal and in 1774 Antoine Laurent Lavoisier proved that it was an oxide of carbon. Lavoisier proposed the name *"carbonic acid"* because of the acidic properties of the gas. In 1854 Auguste Laurent, recognizing that the acid was essentially a solution of the oxide, proposed that the name carbonic acid should be reserved for the solution and that the gas should be called *"carbonic anhydride"*. The term *dioxide* for an oxide containing two atoms of oxygen came into use in the middle of the 19th century. (1)

Solubility measurements for carbon dioxide in water date back at least as far as to the work of William Henry (1803) in which he postulated his famous law of solubility. The first accurate solubility data, however, began to appear in about the middle of the 19th century with the pioneering work of Robert Bunsen (1855). Since then, the solubility of carbon dioxide in water and aqueous electrolyte solutions has been the subject of intensive research. For this volume, the scientific literature starting historically with Bunsen's work (1855) has been systematically searched. The coverage should include most articles published up to the end of 1994. In spite of careful search, some published measurements may have been missed. We would appreciate having our attention brought to any important source of data that has been omitted so that we can include it in future volumes.

For many reasons the systems carbon dioxide + water and carbon dioxide + aqueous electrolyte systems are of great importance in our natural environment as well as in physiology, biology, geology, and in many industrial applications - virtually in all branches of science. The solubility of carbon dioxide in water is an order of magnitude larger than that of many other simple gases. Carbon dioxide is one of the naturally occurring atmospheric gases. It is also one of the greenhouse gases which has been increasing steadily in our atmosphere due to human activity. Based on analyses of air trapped in polar ice cores, it is apparent that the average global atmospheric carbon dioxide volume fraction has increased from a pre-industrial level of around 270×10^{-6} to a value of 355×10^{-6} (2).

Water is the most abundant component of the outer layers of the earth and is a constituent of the cells of all plant and animal tissues. It is justifiable to say that the interaction of carbon dioxide and water is a key to the functioning of living organisms. Approximately 97.3 % of the world's vast supply of water is in the oceans. It is estimated that the oceanic carbon dioxide uptake is about 2×10^{15} g of carbon per year (3). The system water + sodium chloride + carbon dioxide is therefore one of the most important fluid systems in geochemistry. On the basis of the literature search done for this volume, the solubility of carbon dioxide in aqueous sodium chloride solutions has been the subject of investigation much more often than the solubility of carbon dioxide in any other aqueous electrolyte solution.

Because of the large number of data, certain systems have been excluded from this volume. For instance, solubility data were not searched for carbon dioxide in some biological fluids such as blood. Beverages like beers, wines and soft drinks have been omitted. Alkaline systems were not included. In this volume the total carbon dioxide dissolved is considered, regardless of the species present in solution. With the higher pressure data there is always a problem of attempting to distinguish between gas solubilities and vapor-liquid equilibria. We have striven to be reasonable in making this distinction. About 85 % of the data sets presented in this volume are at pressures < 200 kPa.

Since 1982 the IUPAC recommendation for the standard pressure, p°, is 10^5 Pa (= 1 bar). Prior to 1982 the standard pressure was usually taken to be p° = 101 325 Pa (= 1 atm, called the *standard atmosphere*). In the majority of the original articles treated in this volume the standard pressure was chosen to be 1 atm. Therefore, the same choice was adopted in this volume. The expression "STP" used in many papers and data sheets of this volume thus means conditions where p = 101.325 kPa (= 1 atm) and T = 273.15 K (t = 0 °C).

In the original articles gas solubilities are presented in an almost bewildering number of units. In the data pages we present the units given in the original papers with explanatory material where necessary. Where it is feasible the compilers have converted these solubilities into the Ostwald coefficient and/or the mole fraction solubility at 101.325 kPa partial pressure of gas. These conversions were carried out for the convenience of the user, and such compiler-generated conversions are noted on the data sheets.

The molar volume of carbon dioxide gas differs from that of an ideal gas. The extent of the deviation is customarily expressed in terms of the second virial coefficient B_{22}. The second virial coefficient for carbon dioxide varies smoothly with temperature, as shown in Figure 1. The values used in the plot of B_{22} *vs.* T are those of Angus *et al.* and were taken from Dymond and Smith (4).

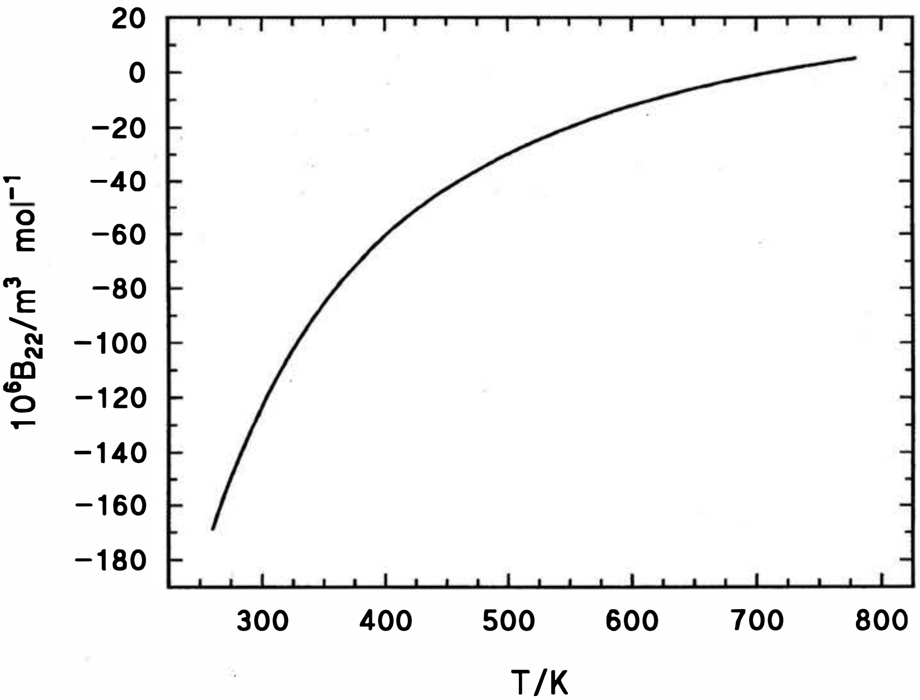

Figure 1. Variation of the second virial coefficient of carbon dioxide with temperature.

The value of the molar volume, V_m, is given by:

$$V_m = ½(RT/p) + ½[(RT/p)^2 + 4B_{22}(RT/p)]^{1/2} \qquad (1)$$

At 273.15 K B_{22} = -151.4 $cm^3\ mol^{-1}$ and at 298.15 K B_{22} = -125.5 $cm^3\ mol^{-1}$ (4). Using equation (1) for calculation of the molar volume of carbon dioxide the values presented in Table 1 are obtained at $p(CO_2)$ = 101.325 kPa. V_m values from the ideal gas equation are also listed in the table.

Table 1.

T/K	$10^3V_m/m^3\ mol^{-1}$ (eq. 1)	$10^3V_m/m^3\ mol^{-1}$ (id.)
273.15	22.262	22.414
298.15	24.340	24.466

The magnitude of the deviation from ideality is relatively small, but not negligible. The compilers have used, as far as possible, the real gas molar volumes in the conversions.

For the solubility of carbon dioxide in water, recommended equations and tables of values are presented. However, for systems which contain water and electrolytes, the experimental gas solubility in water from that paper is given, even when it is at variance with our recommended value. These data of sometimes poorer quality are presented because the author's ratio of gas solubility in water to solubility in the aqueous solution may be more accurate than the solubility itself.

As the title page shows, this volume is the product of the efforts of a number of people: contributors, members of the Editorial Board past and present, and other members of the IUPAC Commission V.8. I wish to acknowledge their combined contributions and to thank them all.

I wish to express my special thanks to Professor Rubin Battino for his continuously inspiring encouragement during this project and for many helpful discussions as well as constructive criticism. Acknowledgment is made to Professor H. Lawrence Clever, Dr Peter G.T. Fogg and Professor John W. Lorimer for their useful comments and suggestions and for reading critically separate sections of this volume. I am indebted to Dr Rosa Crovetto who did most of the literature search prior to 1988 and to Dr Adam Skrzecz who did part of the word processing for the data sheets prior to 1992. I would also like to thank Miss Xhiaohui Shen for her assistance in translating Chinese papers. Grateful acknowledgment is made to the *Foundation of Turku University*, *Acta Chemica Scandinavica* and the *Academy of Finland* for the travel grants which enabled me to participate in the annual meetings of the IUPAC Commission V.8. Finally, I wish to express my sincere thanks to Professor Kalevi Pihlaja, the present head of the Chemistry Department of the University of Turku, who has supported this project by providing the computer and other facilities needed for the completion of this work.

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COMPONENTS:	EVALUATORS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Water; H_2O; [7732-18-5]	John J. Carroll and Alan E. Mather Department of Chemical Engineering University of Alberta Edmonton, Alberta, Canada T6G 2G6 October 1991, updated November 1994

CRITICAL EVALUATION:

The Solubility of Carbon Dioxide in Water at Low Pressure.

Measurements of the solubility of carbon dioxide in water date back to at least the beginning of the nineteenth century. However, the first accurate measurements to appear are those of Bunsen (1). Since that time there have been over 75 investigations of the solubility of CO_2 in water at low pressure.

Carroll *et al.* (2) reviewed all of the solubility data for CO_2 in water for pressures below 1 MPa and for temperatures from 273 to 433 K (0 °C to 160 °C). They developed a model for calculating the solubility of CO_2 in water over this range of pressure and temperature using a Henry's law approach.

Most of the papers used in the review of Carroll et al. (2) are evaluated later in this volume. However, a few papers report values which Carroll et al. (2) concluded were accurate, but contain only one or two points. Thus, it was concluded that they did not warrant a thorough evaluation; however, they did deserve some mention. They are: Just (3), Christoff (4), von Hammel (5), Essery and Gane (6), Bartholomé and Friz (7), Enders *et al.* (8) and Davies *et al.* (9).

The model of Carroll *et al.* (2) was used to calculate the solubility of water when the CO_2 -partial pressure was equal to 101.325 kPa (1 atm). That is, the product of the mole fraction of CO_2 in the vapor and the total pressure ($y_1 \times P$) equals 101.325 kPa. These values are tabulated in Table 1 (next page) and plotted on Fig. 1. The values of the solubilities were then regressed to obtain the following correlation:

$$\ln x_1 = -32.5247 + 0.96017\,\tau + 68.0319/\tau + 12.1522 \ln \tau \qquad (1)$$

where x_1 is the mole fraction of carbon dioxide in the liquid at a partial pressure of 1 atm, and $\tau = T/100$ where T is in K. This equation is valid for temperatures between 273 and 433 K (0 °C and 160 °C). The average absolute deviation between the model and Eq. (1) is 6×10^{-5} mol %. Values based on the correlation are also included in Table 1. From Table 1 and Fig. 1 it can be seen that the solubility, as defined here, becomes a weak function of the temperature for temperatures greater than about 373 K. In fact the solubility shows a shallow minimum at about 421 K.

The solubilities calculated using the model of Carroll *et al.* (2) were then converted to Ostwald coefficients (volume of gas per unit volume of solvent, both at the specified temperature). For this conversion the density of carbon dioxide was calculated using the truncated virial equation. Second virial coefficients were taken from Angus *et al.* (10). The density of water was taken from *The Steam Tables* (11). The Ostwald coefficients are also listed in Table 1. The average difference between the Ostwald coefficients listed in Table 1 and those that would be obtained by assuming that CO_2 is an ideal gas is 0.33 % and the maximum error is 0.68 %.

It is interesting to note that the minimum solubility, when expressed in Ostwald coefficients, occurs at about 408 K (0.300 cm^3 CO_2 / 1 cm^3 H_2O). The difference in the location of the minima for the two solubility units is largely due to the fact that the density of water is a function of temperature.

Using the procedure of Wilhelm *et al.* (12), the change in enthalpy, entropy and heat capacity for solution were derived from Eq. (1). These values are included in Table 1 as well. The minimum in the solubility noted above is the point where the calculated enthalpy change on solution is zero. The change in the sign of the enthalpy change on solution more clearly reveals the minimum solubility than the solubility values themselves. From Table 1 it can be seen that mole fraction solubilities at temperatures from 413 K to 428 K are 1.72×10^{-5} (to three significant figures) whereas the enthalpy change on solution clearly changes sign around 421 K. Finally, this approach predicts that the ΔC_P is a linear function of temperature with $(\partial[\Delta C_P]/\partial T) = 0.08$ kJ mol^{-1} K^{-2}.

The effect of pressure on the solubility of CO_2 is shown in Fig. 2. The curves on this figure were calculated using the model of Carroll *et al.* (2). A few data points from the literature are plotted on this figure.

Table 1. **The solubility of carbon dioxide in water** (P_1 = 101.325 kPa [a])

	Model (Ref. 2)		Equation (1)			
T/K	10^3x_1 [b]	*L* [c]	10^3x_1 [b]	ΔH_1°/kJ mol^{-1}	ΔS_1°/kJ mol^{-1} K^{-1}	$\Delta C_{P,1}^\circ$/kJ mol^{-1} K^{-1}
273.15	1.355	1.676	1.360	-23.0	-0.139	0.145
278.15	1.136	1.431	1.137	-22.3	-0.137	0.145
283.15	0.963	1.235	0.962	-21.6	-0.134	0.146
288.15	0.825	1.076	0.823	-20.8	-0.131	0.147
293.15	0.713	0.946	0.711	-20.1	-0.129	0.148
298.15	0.622	0.839	0.621	-19.3	-0.126	0.149
303.15	0.548	0.750	0.547	-18.6	-0.124	0.149
308.15	0.487	0.677	0.487	-17.8	-0.121	0.150
313.15	0.437	0.616	0.436	-17.1	-0.119	0.151
318.15	0.395	0.564	0.395	-16.3	-0.117	0.152
323.15	0.359	0.520	0.359	-15.6	-0.114	0.153
328.15	0.329	0.484	0.330	-14.8	-0.112	0.153
333.15	0.304	0.452	0.305	-14.0	-0.110	0.154
338.15	0.283	0.426	0.283	-13.3	-0.107	0.155
343.15	0.264	0.403	0.265	-12.5	-0.105	0.156
348.15	0.249	0.384	0.249	-11.7	-0.103	0.157
353.15	0.236	0.367	0.236	-10.9	-0.100	0.157
358.15	0.224	0.353	0.224	-10.1	-0.098	0.158
363.15	0.214	0.431	0.214	- 9.3	-0.096	0.159
368.15	0.206	0.331	0.206	- 8.5	-0.094	0.160
373.15	0.199	0.323	0.199	- 7.7	-0.092	0.161
378.15	0.193	0.316	0.193	- 6.9	-0.090	0.161
383.15	0.188	0.311	0.187	- 6.1	-0.087	0.162
388.15	0.183	0.307	0.183	- 5.3	-0.085	0.163
393.15	0.180	0.303	0.180	- 4.5	-0.083	0.164
398.15	0.177	0.301	0.177	- 3.7	-0.081	0.165
403.15	0.175	0.300	0.175	- 2.9	-0.079	0.165
408.15	0.173	0.300	0.173	- 2.0	-0.077	0.166
413.15	0.172	0.300	0.172	- 1.2	-0.075	0.167
418.15	0.172	0.301	0.172	- 0.4	-0.073	0.168
423.15	0.172	0.303	0.172	0.5	-0.071	0.169
428.15	0.172	0.306	0.172	1.3	-0.069	0.169
433.15	0.173	0.309	0.173	2.2	-0.067	0.170

[a] P_1 = partial pressure of CO_2

[b] x_1 = mole fraction of CO_2

[c] L = Ostwald coefficient [cm^3 cm^{-3}]

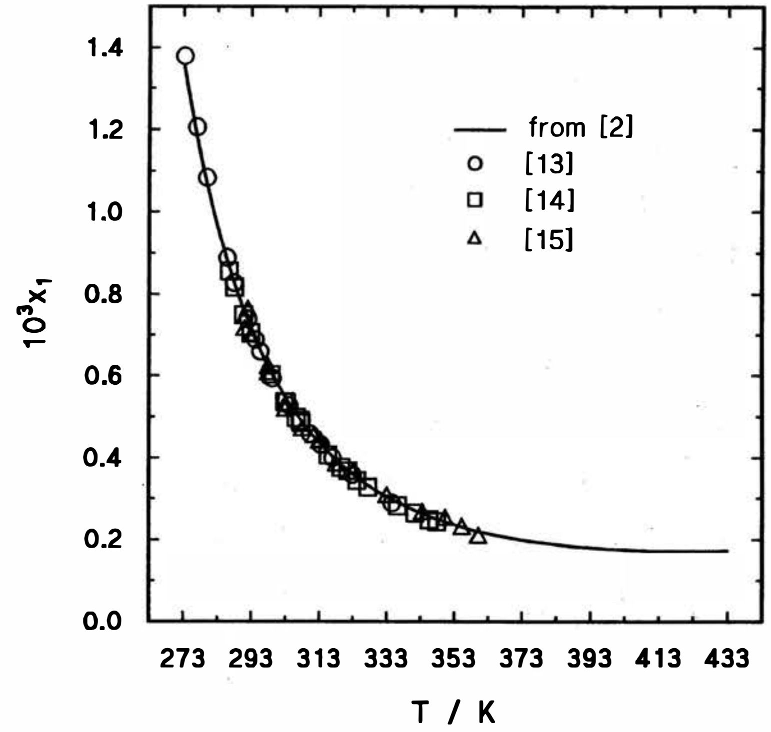

Figure 1. The solubility of carbon dioxide in water. (P_1 = 101.325 kPa)

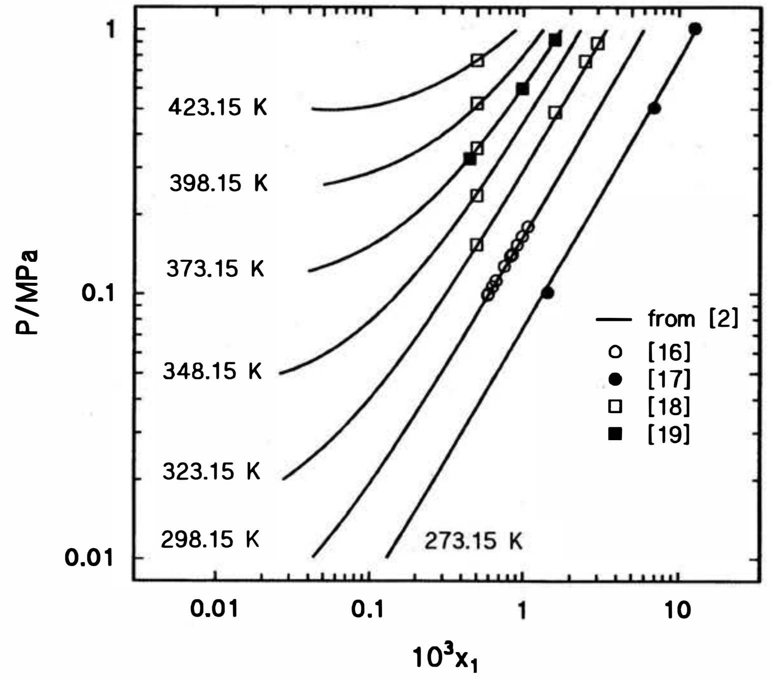

Figure 2. The solubility of carbon dioxide in water as a function of pressure and temperature. (For clarity this plot is presented using lg - lg axes.)

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COMPONENTS:	EVALUATOR:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Water; H_2O; [7732-18-5]	Rosa Crovetto National Institute for Standards and Technology (NIST) Thermophysics Division, B221 Gaithersburg, MD 20899-0001, USA August 1990, updated June 1993

CRITICAL EVALUATION:

Evaluation of Solubility Data of the System CO_2-H_2O from 273 K to the Critical Point of Water

This evaluation covers all of the literature sources for the solubility of carbon dioxide in water through the year 1989.

For describing the two-phase saturation solubility we select Henry's constant. From the equality of the chemical potentials of the solute in the vapor and liquid phase, Henry's constant k_H^0 can be calculated from [see O'Connell (1) and Alvarez *et al.* (2)]

$$k_H^0 = (yP\phi_1/\gamma_1^H x) \exp \int_{P_2^*}^{P} (-V_1/RT)\mathrm{d}P. \tag{1}$$

From the equality of the chemical potentials of the solvent in the liquid and the vapor phase it follows that

$$(1\text{-}y) = [\gamma_2^R(1\text{-}x)P_2^*\phi_2^* \exp \int_{P_2^*}^{P} (V_2^*/RT)\mathrm{d}P]/(P\phi_2) \tag{2}$$

where the symbols are defined at the end of this evaluation. To calculate k_H^0 from the experimental data usually available, namely P, T and x, equations (1) and (2) must be solved simultaneously. The common assumptions for low temperatures and low total pressures and concentrations are that the activity coefficients γ_1^H and γ_2^R equal unity, and that the partial molar volume, V_1 equals the infinite dilution partial molar volume, V_1^0 independent of pressure. Once an equation of state (EOS) is selected, eq. (2) is solved for y by an iterative procedure described elsewhere (3). The explicit pressure dependence of the solubility can be accounted for either by using information on experimental partial molar volumes or by semiempirical perturbation methods (4). For this system experimental partial molar volumes (5,6) were used.

The virial EOS through the second virial coefficient was used for the mixed vapor phase for temperatures between 273 and 353 K. For the higher temperatures, 353 K to the critical temperature of the solvent, the Peng and Robinson (7) EOS was selected. The interaction parameter was chosen as 0.285. [For details on the sensitivity of the Henry's constant to different EOS, smoothing equation selection, and adjustment procedures, see Crovetto (8).] Up to about 500 K all of the EOS tested gave variations of about 1.5 % or less in the calculated values of k_H^0.

Another useful quantity in solubility and liquid/vapor equilibria is the isothermal distribution coefficient, K_D, defined as

$$K_D = y/x \tag{3}$$

The infinite-dilution coefficient, K_D^0, is defined as

$$K_D^0 = \lim_{x \to 0} y/x \tag{4}$$

and can be calculated from the same set of equations and assumptions already presented as

$$K_D^0 = k_H^0/(P_2^*\phi_1^0) \tag{5}$$

where ϕ_1^0 is calculated from the selected EOS. In principle, K_D^0 will be known with the same precision as k_H^0, but the effect of the selected EOS on the values of K_D^0 and k_H^0, respectively, will be different.

Recently, Japas and Levelt Sengers (9) predicted the limiting asymptotic thermodynamic behavior for k_H^0 and K_D^0 and their temperature dependence near the critical temperature of the solvent. They demonstrated that asymptotically as $T \rightarrow T_c$ of the solvent, the following linear correlations will apply:

$$T \ln(k_H^0/f_2^*) = A + B(\rho_2^{liq^*} - \rho_{c2}) \tag{6}$$

$$T \ln K_D^0 = 2B(\rho_2^{liq^*} - \rho_{c2}) \tag{7}$$

$$\text{where } B(R\rho_c^2) = (\partial P/\partial x)_{V,T_c} \equiv - a_{V,x}^c.$$

The quantity $a_{V,x}^c$ is the second derivative of the Helmholtz energy with respect to the volume and the concentration. This relevant derivative can be related to the experimentally measurable initial critical-line slopes of the dilute solution and the pure solvent [see Japas and Levelt Sengers (9)]. The fact that K_D^0 must equal unity for $T = T_c$, provides a valuable clue to whether the asymptotic behavior has been reached.

As stated by Harvey *et al.* (10), when dealing with experimental data the K_D^0 factor, eq. (7), gives a better estimate of the true asymptotic slope and a good agreement with the $a_{V,x}^c$ from experimental critical-line data whereas the slope from the Henry's constant, eq. (6), does not.

It is a fact that the hydration and dissociation of CO_2 in water cannot be separated from its dissolution. In this treatment only the total CO_2 dissolved is considered, regardless of the species present in solution. This assumption can be made because any species other than $CO_2(aq)$ [the not yet isolated, so-called "carbonic acid" $(H_2CO_3)_{aq}$, the H^+, and the HCO_3^-] in a solution of CO_2 in water exist in negligible amounts. These species can be ignored because the ratio of the molalities of "$(H_2CO_3)_{aq}$" and ions to CO_2 is about 3/1000 at 298.15 K (11). Also, experimental and theoretical arguments of Kruse and Franck (12) indicate that $(H_2CO_3)_{aq}$ is not an important species at higher temperatures. The acidity constant of CO_2 goes through a maximum value of 6.3×10^{-7} mol kg^{-1} at 353 K and decreases at higher temperatures (13,14), so that the quantity of ionic species should become smaller as the temperature increases beyond 353 K.

Wherever necessary, values for the pure water properties, ρ, f_2^*, P_2^* were taken from Haar *et al.* (15).

The goal of this evaluation was to cover with one equation the solubility of CO_2 in water for the liquid range of water 273 to 647.126 K. This was not possible within the precision of the available measurements. The data for low temperature solubilities, 273 to 353 K, are always significantly more precise, i.e., at least by a factor of ten than the high temperature ones. For this system there are no data at low temperatures of very high precision similar to those available for inert non-polar gases in water (16, 17).

At the present time equations for the temperature dependence of gas solubilities in water are only empirical showing limiting asymptotic critical behavior and tendencies (9). The parameters for this equation (9) must be adjusted from the data.

The original data were retrieved as mole fraction, total pressure in the system, and temperature. From these data, the selected EOS, and equations (1) and (2), k_H^0 was calculated. For the low temperature data set (273 - 353 K), the equation is

$$\ln(k_H^0/\text{bar}) = 4.800 + 3934.4(T/\text{K})^{-1} - 941290.2(T/\text{K})^{-2}. \tag{8}$$

The standard deviation of the fit is 1.1 % in k_H^0. The coefficients were calculated by a least squares method. A further increase in the number of coefficients in eq. (8) was not statistically significant. The references used for eq. (8) are listed alphabetically in Table 1, entitled "Sources of data". For the low-temperature set, the correction for non-ideality of the vapor phase does not amount more than 0.5 %.

There is available a low-temperature low-pressure evaluation for the carbon dioxide/water system done by Wilhelm *et al.* (18). They made different choices for the number of sources considered and the smoothing equation used. Differences between k_H^0 values calculated from eq. (8) and theirs are important only at the end of the temperature interval of the fitting, i.e., at 273 and 353 K, amounting to 2 % at 353 K.

Any formulation that attempts to cover the entire liquid range of the solvent should be consistent with the facts that the derivative $[d(\ln k_H^0)/dT]_s$ diverges to $-\infty$ as $T \rightarrow T_c$ [Japas and Levelt Sengers (9)], that the infinite dilution solute partial molar isobaric heat capacity of dissolution in the saturated liquid, C_{p1}^0, diverges to $+\infty$ as $T \rightarrow T_c$, and that the value of k_H^0 at T_c is a constant equal to P_2^* times ϕ_1^0.

For the high-temperature data set, 353 K to the critical temperature of water, the system was anchored at the low temperature by adding to the sources used five k_H^0 values calculated from eq. (8) at 273.15, 293.15, 303.15, 323.15 and 353.15 K. They were given the same weight as any other experimental points. However, they were not used for eq. (7). For the CO_2/H_2O system the linear relationship in eq. (7) is obtained starting at densities which correspond to about 373 K.

The high-temperature data set is best represented in K_D^0 by

$$T \ln K_D^0 = 91.22 \text{ K(mol/L)}^{-1} (\rho_2^{\text{liq}*} - \rho_{c2}) \qquad (9)$$

which gave a standard deviation of 8.6 % (in Henry's constant), and in k_H^0 by

$$\ln(k_H^0/\text{bar}) = 1713.53(1-T_r)^{1/3}(T/\text{K})^{-1} + 3.875 + 3680.09(T/\text{K})^{-1} - 1198506.1(T/\text{K})^{-2} \qquad (10)$$

with a standard deviation of 5.1 % in k_H^0. In eq. (10) $T_r = T/T_c$. The asymptotic leading term is adjusted by the results obtained from fitting the data to the form of eq. (7). Coefficients for eq. (10) were obtained from a least squares procedure with no weighting applied. The list of sources used is given in Table 1.

A group of sources exist that are at low temperatures, but higher pressures. This group consists of eight different sources and is listed alphabetically in Table 1. From the experimental data, 23 values of Henry's constant were calculated at different temperatures. This group was difficult to evaluate because for some experimental conditions CO_2 itself is very near its critical point. This group was not included in the fitting.

For this system we estimate an uncertainty in the fitting equations of 1 % for k_H^0 between 273 and 353 K, and an uncertainty of about 5-10 % between 353 and 600 K. For temperatures above 600 K the uncertainty increases rapidly to at least 20 % near the critical point of water.

A high-temperature deviation plot versus temperature shows that there may be some systematic errors between experimental data from different sources.

Smoothed values for $\ln(k_H^0/\text{bar})$ calculated from eq. (8), at 10 K intervals between 273 and 353 K are given in Table 2.

Smoothed values for $\ln(k_H^0/\text{bar})$ between 353 and 647 K at 15 K intervals calculated from equations (9) and (10) are given in Table 3.

Recommended values for k_H^0 calculated from the selected fitting equation (8), considering all sources, at 5 K intervals from 273.15 to 353.15 K are given in Table 4.

List of symbols

$a_{V,x}$	second derivative with respect to the volume and composition of the Helmholtz energy
k_H	Henry's constant
x	mole fraction of solute in the liquid phase
y	mole fraction of solute in the vapor phase
f	fugacity
$C_{p,1}$	partial molar isobaric heat capacity for the solute
K_D	isothermal distribution coefficient
P	total pressure
R	gas constant
T	temperature
T_c	critical temperature of the solvent
$T_r = T/T_c$	reduced temperature
V	molar volume
V_i	partial molar volume of i

Greek symbols:

ρ	molar density
ϕ_i	fugacity coefficient in the gaseous mixture of component i
γ^H	activity coefficient in the liquid phase on the scale defining ideality by means of Henry's law
γ^R	activity coefficient in the liquid phase on the scale defining ideality by means of pure solvent behavior or Raoult's law

Subscripts: 1: solute, 2: solvent, c: critical

Superscripts: 0: infinite dilution, *: pure substance, g: vapor phase, liq: liquid phase, s: saturation, c: critical

TABLE 1. **Sources of data.**

Group A (273 K $< T <$ 353 K, $P <$ 2 bar)

AUS(63): Austin, W.H.; Lacombe, E.; Rand, P.W.; Chatterjee, M. *J. Appl. Physiol.* 1963, *18*, 301-4.
(5:5)

BO(891): Bohr, C.; Bock, J. *Ann. Phys. Chem., NF* 1891, *44*, 318- 43.
(2:0)

BO(899): Bohr, C. *Ann. Phys. Chem.* 1899, *68*, 500-25.
(15:15)

BU(855): Bunsen, R.W.E. *Phil. Mag.* 1855, *9*, 116-30, 181-201; *Gasometrische Methoden, Braunschweig* 1857. The same experimental points are also published in Bunsen, R.W.E. *Justus Liebig's Annalen der Chemie* (also *Ann. Chem.*) 1855, *93*, 1-50.
(6:5)

BUC(28): Buch, K. *Nordiska Kemistmötet (Finland)* 1926, 184-92.
(14:7)

CRA(82): Cramer, S.D. *U.S. Bur. Mines Rep. Invest.* 1982, RI 8706.
(1:0)

CUR(38): Curry, J.; Hazelton, C.L. *J. Am. Chem. Soc.* 1938, *60*, 2771-3.
(4:2)

HAR(43): Harned, H.S.; Davis, R., Jr. *J. Am. Chem. Soc.* 1943, *65*, 2030-7.
(18:18)

KH(867): de Khanikof, M.M.N.; Louguinine, V. *Ann. Chim. Phys. (ser. 4)* 1867, *11*, 412-33.
(10:1)

KOB(35): Kobe, K.A.; Williams, J.S. *Ind. Eng. Chem. (Anal. Edition)* 1935, *7*(1), 37-8.
(1:1)

KOC(49): Koch, H.A., Jr.; Stutzman, L.F.; Blum, H.A.; Hutchings, L.E. *Chem. Eng. Prog.* 1949, *45*(11), 677-82.
(6:1)

TABLE 1. **Sources of data.** (continued)

Group A (273 K $<$ T $<$ 353 K, P $<$ 2 bar)

KUN(22): Kunerth, W. *Phys. Rev.* 1922, *2*, 512-24.
(8:6)

LI(71): Li, Y.-H.; Tsui, T.-F. *J. Geophys. Res.* 1971, *76*(18), 4203-8.
(5:5)

MAR(41): Markham, A.; Kobe, K. *J. Am. Chem. Soc.* 1941, *63*, 449- 54.
(3:3)

MOR(30): Morgan, J.L.R.; Pyne, H.R. *J. Phys. Chem.* 1930, *34*, 1578- 82.
(2:0)

MOR(31): Morgan, O.M.; Maass, O. *Can. J. Res.* 1931, *5*, 162-99.
(19:4)

MOR(52): Morrison, T.J.; Billett, F. *J. Chem. Soc.* 1952, 3819-22.
(19:19)

MUR(71): Murray, C.N.; Riley, J.P. *Deep-Sea Res.* 1971, *18*, 533- 41.
(8:8)

NOV(61): Novák, J.; Fried, V.; Pick, J. *Collect. Czech. Chem. Commun.* 1961, *26*, 2266-70. Measurements at different pressures at 8 different constant temperatures. From the slope of k_H vs. x, k_H^0 is calculated.
(8:0)#

ORC(36): Orcutt, F.S.; Seevers, M.H. *J. Biol. Chem.* 1936, *117*, 501-7.
(1:1)

POW(70): Power, G.G.; Stegall, H. *J. Appl. Physiol.* 1970, *29*, 145- 9.
(1:1)

PR(895): Prytz, K.; Holst, H. *Ann. Phys. Chem., NF* 1895, *54*, 130- 8.
(2:0)

SHE(35): Shedlovsky, T.; MacInnes, D.A. *J. Am. Chem. Soc.* 1935, *57*, 1705-10.
(1:1)

VAN(39): Van Slyke, D.D. *J. Biol. Chem.* 1939, *130*, 545-54.
(6:6)

VE(855): Verdet, M.; report of Bunsen, M. *Ann. Chim. Phys.* 1855, *43*, 496-508.
(21:0)#

YEH(64): Yeh, S.-Y.; Peterson, R.E. *J. Pharmac. Sci.* 1964, *53*, 822-4.
(4:3)

\# See text for details about source rejection.

Group B (low-temperature, 273 K $<$ T 353 K, P $>$ 2 bar)
This group was not considered for data fitting.

KRI(35): Kritschewsky, I.R.; Shaworonkoff, N.M.; Aepelbaum, V.A. *Z. physik. Chem.* A 1935, *175*, 232-8.
i, P = 5-30 bar, (2:0)

MAT(69): Matous, J.; Sobr, J.; Novák, J.P.; Pick, *J. Collect. Czech. Chem. Commun.* 1969, *34*, 3982-5.
ii, P = 9-39 bar, (3:0)

SHA(82): Shaiachmetou, R.A.; Tarzimanov, A.A. *Deposited Doc.* 1981, *SPSTL 200 khp-D81* 1982.
ii, P= 100-400 bar, (1:0)

STE(70): Stewart, P.B.; Munjal, P. *J. Chem. Eng. Data* 1970, *15*, 67-71.
ii, P_1 ≈ 10, 40 bar, (12:0)

VIL(67): Vilcu, R.; Gainar, I. *Rev. Roum. Chim.* 1967, *12*(2), 181- 9.
ii, P_1 ≈ 25, 70 bar, (20:0)

WIE(39): Wiebe, R.; Gaddy, V.L. *J. Am. Chem. Soc.* 1939, *61*, 315- 8.
i, P = 25-700 bar, (2:0)

TABLE 1. **Sources of data.** (continued)

	Group B (low-temperature, 273 K < T 353 K, P > 2 bar) This group was not considered for data fitting.
WIE(40):	Wiebe, R.; Gaddy, V.L. *J. Am. Chem. Soc.* 1940, *62*, 815- 7. i, P = 25-500 bar, (5:0)
ZAW(81):	Zawisza, A.; Malesinska, B. *J. Chem. Eng. Data* 1981, *26*, 388-91. ii, $P_1 \approx 25$ bar, (9:0)
	Group C (T > 373 K, any P)
BO(891):	Bohr, C.; Bock, J. *Ann. Phys. Chem., NF* 1891, *44*, 318- 43. ii, T = 373 K, (1:0)
CRA(82):	Cramer, S.D. *U.S. Bur. Mines Rep. Invest.* 1982, RI 8706. ii, T = 399-486 K, (6:2)
CRO(90):	Crovetto, R.; Wood, R.H. *Fluid Phase Equil.* 1992, *74*, 271-88. ii, T = 623-640 K, P = 170-220 bar, (3:3)
ELL(63):	Ellis, A.J.; Golding, R.M. *Am. J. Sci.* 1963, *261*, 47-60. ii, T = 450-607 K, (15:14)
MAL(59):	Malinin, S.D. *Geokhimiya* 1959 (3) 235-45. i, T = 473-603 K, P = 100-500 bar, (4:2)
SHA(82):	Shaiachmetou, R.A.; Tarzimanov, A.A. *Deposited Doc.* 1981, *SPSTL 200 khp-D81* 1982. i, T = 373-423 K, P = 100-800 bar, (2:2)
TAK(65):	Takenouchi, S.; Kennedy, G. *Am. J. Sci.* 1965, *263*, 445- 54. i, T = 423-623 K, P = 200-1400 bar, (5:4)
WIE(39):	Wiebe, R.; Gaddy, V.L. *J. Am. Chem. Soc.* 1939, *61*, 315- 8. i, T = 373 K, P = 25-700 bar, (1:1)
ZAW(81):	Zawisza, A.; Malesinska, B. *J. Chem. Eng. Data* 1981, *26*, 388-91. ii, T = 373-473 K, (9:0)

The meaning of the symbols used in the table follows:

For Group A: The numbers in parenthesis, (m:n), are m = the number of experimental points given in the source, and n = the number of points actually considered in the evaluation.

For Groups B and C: i: several isothermal solubility measurements are available for different pressures. When feasible, a graphical extrapolation for Henry's constant, $k_{\rm H}$, to the solvent vapor pressure was performed. The numbers in parenthesis, (m:n), are m = the number of $k_{\rm H}^0$'s obtainable from the source, n = the number actually considered.

ii: only one pressure, or a very small pressure range, was experimentally studied in the source. The numbers in parenthesis, (m:n), are in this case m = the number of experimental points informed, n = the number of points considered in the evaluation. The experimental partial molar volume of the solute is considered for calculating $k_{\rm H}^0$ in eq. (1).

In Group C the range of T and P of the measurements is given. In Group B, only the range of P is given.

There are also compiled data sources which were not used in the evaluation: (1) Setchenov, J. [Sechenov, I.M.] *Pflügers Arch. Gesamte Physiol. Menschen Tiere* 1874, *8*, 1-39; *Mem. Acad. Imp. Sci., St. Petersburg* 1879, *26*, 1-62; *Akad. Nauk SSSR, Mem. Acad. Imp. Sci., St. Petersburg* 1887, *35*, 1-59; *Mosk. Obsh. Spyt. Prirody. Nouv. Mem. Soc. Imp. Nat. Moscow* 1889, *15*, 203-74; (2) Hantzsch, A., Vagt, A. *Z. Phys. Chem.* 1901, *38*, 705-40; (3) Sander, W. *Z. Phys. Chem.* 1911-1912, *78*, 513-49; (4) Findlay, A., Shen, B. *J. Chem. Soc.* 1912, *101*, 1459-68; (5) Findlay, A., Howell, O.R. *J. Chem. Soc.* 1915, *107*, 282-84; (6) Wiebe, R., Gaddy, V.L. *J. Am. Chem. Soc.* 1940, *62*, 1055-74; (7) Shchennikova, M. K., Devyatykh, G. G., Korshunov, I. A. *J. Appl. Chem. USSR (Engl. Transl.)* 1957, *30*, 881-6; (8) Ellis, A.J. *Am. J. Sci.* 1959, *257*, 217-34; (9) Bartels, H., Wrbitzky, R. *Pflügers Arch.* 1960, *271*, 162-8; (10) Barton, J.R., Hsu, C.C. *J. Chem. Eng. Data* 1971, *16*, 93-5; (11) Weiss, R.F. *Marine Chemistry* 1974, *2*, 203-15; (12) Postigo, M.A., Katz, M. *J. Solution Chem.* 1987, *16*, 1015-24; and (13) Yuan, C., Yang, J. *Gaodeng Xuexiao Huaxue Xuebao* 1993, *14*, 80-83.

TABLE 2. Values for $\ln(k_H^0/\text{bar})$ calculated at several temperatures: from eq. (8) for all the sources; only for Morrison and Billet, MOR(52), and Murray and Riley, MUR(71) [a]; and from the equation of Wilhelm et al. (Ref. 18).

		$\ln(k_H^0/\text{bar})$				$\ln(k_H^0/\text{bar})$	
T/K	Eq. (8)	Eq. (8) [a]	Ref. 18	T/K	Eq. (8)	Eq. (8) [a]	Ref.18
273.15	6.588	6.594	6.600	323.15	7.961	7.962	7.964
283.15	6.955	6.958	6.962	333.15	8.129	8.130	8.127
293.15	7.268	7.270	7.274	343.15	8.272	8.274	8.262
303.15	7.536	7.537	7.542	353.15	8.393	8.397	8.372
313.15	7.765	7.766	7.771				

TABLE 3. Smoothed values of $\ln(k_H^0/\text{bar})$ calculated from the Peng and Robinson EOS using eqs. 9 and 10.

	$\ln(k_H^0/\text{bar})$			$\ln(k_H^0/\text{bar})$	
	Eq. (10)	Eq. (9)		Eq. (10)	Eq. (9)
T/K	PR	PR	T/K	PR	PR
353.15	8.415		518.15	8.445	8.397
368.15	8.544		533.15	8.363	8.322
383.15	8.632	8.674	548.15	8.271	8.239
398.15	8.687	8.694	563.15	8.171	8.149
413.15	8.715	8.695	578.15	8.060	8.050
428.15	8.721	8.683	593.15	7.935	7.940
443.15	8.708	8.658	608.15	7.790	7.798
458.15	8.679	8.623	623.15	7.611	7.632
473.15	8.636	8.579	638.15	7.344	7.381
488.15	8.582	8.526	643.15	7.187	7.231
503.15	8.518	8.465	647.10	6.791	6.675

T_c = 647.126 K

TABLE 4. Recommended values for k_H^0 calculated from equation (8), considering all the sources, at 5 K intervals from 273.15 K to 353.15 K.

T/K	k_H^0/bar	± σ/bar [a]	T/K	k_H^0/bar	± σ/bar [a]
273.15	726	8	318.15	2610	29
278.15	879	10	323.15	2868	32
283.15	1048	12	328.15	3128	34
288.15	1233	14	333.15	3391	37
293.15	1433	16	338.15	3652	40
298.15	1648	18	343.15	3912	43
303.15	1874	21	348.15	4167	46
308.15	2111	23	353.15	4418	49
313.15	2357	26			

[a] σ = standard deviation at each temperature.

References

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2. Alvarez, J.; Crovetto, R.; Fernández-Prini, R. *Ber. Bunsenges. Phys. Chem.* 1988, *92*, 935.
3. Crovetto, R.; Japas, M.L.; Fernández-Prini, R. *An. Asoc. Quim. Arg.* 1983, *71*, 81.
4. Fernández-Prini, R.; Japas, M.L. *J. Phys. Chem.* 1989, *93*, 3802.
5. Malinin, S.D.; Savalyeva, N.I. *Geochemistry International* 1972 (5) 410; Malinin, S.D. *Geokhimiya* 1959, (3) 235.
6. Crovetto, R.; Wood, R.H. *Fluid Phase Equil.* 1992, *74*, 271.
7. Peng, D.Y.; Robinson, D.B. *ACS Symposium Series 133* in *Thermodynamics of Aqueous Systems with Industrial Applications,* Ed. Newman, S. American Chemical Society, Washington DC, 1980, p. 393.
8. Crovetto, R. *J. Phys. Chem. Ref. Data* 1991, *20*, 575.
9. Japas, M.L.; Levelt Sengers, J.M.H. *AIChE J.* 1989, *35*, 705.
10. Harvey, A.; Crovetto, R.; Levelt Sengers, J.M.H. *AIChE J.* 1990, *36*, 1901.
11. Ellis, A.J. *J. Chem. Soc.* 1959, *4*, 3689.
12. Kruse, R.; Franck, E.U. *Ber. Bunsenges. Phys. Chem.* 1983, *86*, 1036.
13. Read, A.J. *J. Solution Chem.* 1975, *4*, 52.
14. Barbero, J.A.; Hepler, L.G.; McCurdy, K.G.; Tremaine, P.R. *Can. J. Chem.* 1983, *61*, 2509.
15. Haar, L.; Gallagher, J.G.; Kell, G.S. *NBS/NRS Steam Tables* 1984, Hemisphere, Washington DC.
16. Benson, B.B.; Krause, D.; Peterson, M.M. *J. Solution Chem.* 1979, *8*, 655;
    Krause, D.; Benson, B.B. *J. Solution Chem.* 1989, *18*, 823.
17. Rettich, T.R.; Handa, Y.P.; Battino, R.; Wilhelm, E. *J. Phys. Chem.* 1981, *85*, 3230.
18. Wilhelm, E.; Battino, R.; Wilcock, R.J. *Chem. Rev.* 1977, *77*, 219.

Note: The present address of **Rosa Crovetto** is

BETZ Water Management
Boiler Division
1 Quality Way
Trevose, PA 19053
USA

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Verdet, M., report of Bunsen, M.

Ann. Chim. Phys. 1855, *43*, 496-507.

VARIABLES:

$T/K = 273.15\text{-}293.15$

$P_1/kPa = 101.325$

PREPARED BY:

Rosa Crovetto

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	P/bar [a]	$P_1/cmHg$	α [b]	$10^3 x_1$ [a]
0	273.15	1.019	76	1.7967	1.452
1	274.15	1.020		1.7207	1.391
2	275.15	1.020		1.6481	1.332
3	276.15	1.021		1.5787	1.276
4	277.15	1.021		1.5126	1.223
5	278.15	1.022		1.4497	1.172
6	279.15	1.023		1.3901	1.124
7	280.15	1.023		1.3639	1.103
8	281.15	1.024		1.2809	1.036
9	282.15	1.025		1.2311	0.9955
10	283.15	1.026		1.1847	0.9581
11	284.15	1.026		1.1416	0.9233
12	285.15	1.027		1.1018	0.8913
13	286.15	1.028		1.0653	0.8619
14	287.15	1.029		1.0321	0.8352
15	288.15	1.030		1.0020	0.8109
16	289.15	1.031		0.9758	0.7899
17	290.15	1.033		0.9649	0.7812
18	291.15	1.034		0.9318	0.7545
19	292.15	1.035		0.9150	0.7411
20	293.15	1.037		0.9014	0.7302

[a] Calculated by the compiler.

[b] Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A conventional all-glass Bunsen's apparatus was used. It was not stated if stirring was provided.

SOURCE AND PURITY OF MATERIALS:

(1) Not stated.

(2) Distilled.

ESTIMATED ERROR:

Not given.

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Bunsen, R. W. E.

Phil. Mag. 1855, *9*, 116-30, 181-201.
also in: *Gasometrische Methoden*
1857, *Braunschweig*.

VARIABLES:

T/K = 277.55-295.55
P_1/kPa = 101.325

PREPARED BY:

Rosa Crovetto

EXPERIMENTAL VALUES:

t/°C	T/K [a]	P/bar [a]	P_1/atm	α [b]	$10^4 x_1$ [a]
4.4	277.55	1.022	1.00	1.4698	11.88
8.4	281.55	1.024		1.2426	10.05
13.8	286.95	1.029		1.0654	8.621
16.6	289.75	1.032		0.9692	7.846
19.1	292.25	1.035		0.8963	7.260
22.4	295.55	1.040		0.8642	7.005

[a] Calculated by the compiler.

[b] Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

An all-glass apparatus was used with stirring. Liquid samples were analyzed volumetrically for their gas content.

SOURCE AND PURITY OF MATERIALS:

(1) From marble, dried and purified from air.

(2) Not stated.

ESTIMATED ERROR:

Not given.

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

de Khanikof, M.M.N.; Louguinine, V.

Ann. Chim. Phys. Ser. 4 1867, *11*, 412-33

VARIABLES:

T/K = 288.15
P_1/kPa = 90.6-414.6

PREPARED BY:

Rosa Crovetto

EXPERIMENTAL VALUES:

t/°C	T/K [a]	P/bar [a]	P_1/mmHg [b]	S [c]	10^3x_1 [a]
15	288.15	0.947	697.71	0.9441	0.7641
		1.096	809.03	1.1619	0.9402
		1.736	1289.41	1.8647	1.508
		1.977	1469.95	2.1623	1.748
		2.686	2002.06	2.9076	2.349
		2.935	2188.65	3.1764	2.566
		3.175	2369.02	3.4857	2.815
		3.422	2554.00	3.7152	3.000
		3.668	2738.33	4.0031	3.232
		4.163	3109.51	4.5006	3.632

[a] Calculated by the compiler.

[b] The authors measured and corrected for the density of the pure CO_2 gas at the same temperature and pressure.

[c] Solubility as volume of gas reduced at STP per volume of water. (At the equilibrium pressure of the measurement and the real volume of the gas.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

An all-glass apparatus was used. It was not stated if stirring was used. Thermostatted at ± 0.1 °C. The dissolved gas was measured as a pressure difference in a known volume.

SOURCE AND PURITY OF MATERIALS:

(1) From marble. Dried and air free.

(2) Distilled, degassed.

ESTIMATED ERROR:

δT/K = ± 0.1 (by authors)
δS = ± 3 % (by compiler)

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Setchenow, J. [Sechenov, I.M.]

Pflügers Arch. Gesamte Physiol. Menschen Tiere 1874, *8*, 1-39.

VARIABLES:

T/K = 288.35, 290.25

p_1/kPa = 95.79, 122.50

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

t/°C	T/K [a]	p_1/mmHg	p_1/kPa [a]	α/cm^3 (STP) cm^{-3} atm^{-1} [b]
15.2	288.35	718.5	95.79	
		814.4	108.6	1.0090 Av.
		875.2	117.7	
15.2	288.35	721.1	96.14	
		804.9	107.3	1.0090 Av.
		874.5	116.6	
17.1	290.25	767.0	102.3	
		918.8	122.5	0.9619 Av.

[a] Added by the compiler. [b] α = Bunsen coefficient.

The liquid volumes ranged from 322.0 to 370.5 cm^3.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Setchenow (Ref. 1) based his apparatus on those of Fernet (1857) and of Meyer (1857). The manometer was based on ideas he learned from Regnault in 1861. The one meter manometer had three branches, two for measuring the pressure and one a mercury reservoir. The manometer was connected to the absorption cell by a flexible silver capillary. The absorption cell was of two bulbs with a mark in the constricting connection. CO_2 gas was generated, saturated with water vapor and filled the bulbs and manometer to a known pressure less than atmospheric. The liquid was degassed by heating and then passed by the pressure difference into the lower bulb to the mark of known volume. The system was sealed, turned 90 degrees and shaken until equilibrium was established. The gas volume absorbed was reduced to 0 °C and one meter Hg pressure. The Bunsen coefficient was calculated.

SOURCE AND PURITY OF MATERIALS:

(1) Apparently generated from limestone and sulfuric acid. Dried.

(2) Not specified, assumed to be distilled.

ESTIMATED ERROR:

The author makes a qualitative statement that the results are good to the second decimal.

REFERENCES:

1. Setchenow, J.

Akad. Nauk. SSSR Mem. Acad. imp. Sci. St. Petersburg 1887, *35*, [Ser. No. 7], 1-59.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Water; H_2O; [7732-18-5]	Setchenow, J. [Sechenov, I.M.] *Mem. Acad. Imp. Sci. St. Petersbourg.* [7th Ser.] 1879, *26* (13), 1-62.
VARIABLES: T/K = 310.2 - 310.7 p_1/kPa = 49.31, 76.08	PREPARED BY: H. L. Clever

EXPERIMENTAL VALUES:

t/°C	T/K [a]	p_1/mmHg	p_1/kPa [a]	α/cm^3 (STP) cm^{-3} atm^{-1} [b]
37.0- 37.5	310.2- 310.7	432.55 570.68	57.68 76.08	0.569 0.573
37.0- 37.5	310.2- 310.7	369.85 474.95	49.31 63.32	0.569 0.569

---

[a] Added by the compiler. [b] α = Bunsen coefficient.

The water volume was 50.179 cm^3.

The paper gives the results of nearly 100 measurements on the solubility of CO_2 in aqueous Na_2CO_3, Na_3PO_4 and in calf, dog and horse blood, serum and various mixtures. The blood, serum and aqueous base solutions did not obey Henry's law. The data were not compiled. Most of the experiments were done at 15.2 °C.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Setchenow (Ref. 1) based his apparatus on those of Fernet (1857) and of Meyer (1857). The manometer was based on ideas he learned from Regnault in 1861. The one meter manometer had three branches, two for measuring the pressure and one a mercury reservoir. The manometer was connected to the absorption cell by a flexible silver capillary. The absorption cell was of two bulbs with a mark in the constricting connection. CO_2 gas was generated, saturated with water vapor and filled the bulbs and manometer to a known pressure less than atmospheric. The liquid was degassed by heating and then passed by the pressure difference into the lower bulb to the mark of known volume. The system was sealed, turned 90 degrees and shaken until equilibrium was established. The gas volume absorbed was reduced to 0 °C and one meter Hg pressure. The Bunsen coefficient was calculated.

SOURCE AND PURITY OF MATERIALS:

(1) Apparently generated from limestone and sulfuric acid. Dried.

(2) Not specified, assumed to be distilled.

ESTIMATED ERROR:

The author makes a qualitative statement that the results are good to the second decimal.

REFERENCES:

1. Setchenow, J.

Akad. Nauk. SSSR Mem. Acad. imp. Sci. St. Petersburg 1887, *35*, [Ser. No. 7], 1-59.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Setchenow, J. [Sechenov, I.M.]

Akad. Nauk. SSSR, Mem. Acad. Imp. Sci. St. Petersbourg [7th Ser.] 1887, *35*, 1-59.

VARIABLES:

$T/K = 288.4 - 296.2$
$p_1/kPa = 75.15 - 122.50$

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	$p_1/mmHg$	p_1/kPa [a]	α/cm^3 (STP) cm^{-3} atm^{-1} [b]
15.2	288.4	563.67	75.15	1.0101
		718.28	95.76	1.0121
		654.33	87.24	1.008
		866.10	115.47	1.013
		721.10	96.14	1.0112
		804.90	107.31	1.0069
		874.50	116.59	1.0089
		718.50	95.79	1.0094
		814.40	108.58	1.0087
		875.20	116.68	1.008
				Av. $1.009_6 \pm 0.0020$
17.1	290.3	767.00	102.26	(0.963)
		918.80	122.50	0.961
17.6	290.8	645.63	86.08	0.989
		814.43	108.58	0.935
18.38	291.53	634.26	84.56	(0.896)
		903.00	120.39	0.896
19.3	292.5	653.75	87.16	0.883
		849.53	113.26	0.886
21.0	294.2	764.31	101.90	(0.838)
		867.97	115.72	0.838
21.7	294.9	673.50	89.79	0.823
		812.75	108.36	0.827
23.0	296.2	774.39	103.24	0.796
		889.17	118.55	0.798
		777.68	103.68	0.796
		880.29	117.86	0.800
				Av. $0.797_5 \pm 0.0019$

[a] Added by the compiler. [b] α = Bunsen coefficient.

Liquid water volumes ranged from 322.0 to 458.4 cm^3.

Values in ( ) were calculated by the compiler from data in the paper.

AUXILIARY INFORMATION

See other data sheets on J. Setchenow papers.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Water; H_2O; [7732-18-5]	Setchenow, J. [Sechenov, I.M.] *Mosk. Obsh. Spyt. Prirody. Nouv. Mem. Soc. Imp. Nat. Moscow* 1889, *15*, 203-74.
VARIABLES: T/K = 288.35 p_1/kPa = 15.36, 59.78	PREPARED BY: H. L. Clever

EXPERIMENTAL VALUES:

t/°C	T/K [a]	p_1/mmHg	p_1/kPa [a]	α/cm^3 (STP) cm^{-3} atm^{-1} [b]
15.2	288.35	115.2	15.36	1.004
		448.35	59.78	1.016

[a] Added by the compiler. [b] α = Bunsen coefficient.

The water volume was 46.44 cm^3.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Water; H_2O; [7732-18-5]	Setchenow, J. [Sechenov, I.M.] *Ann. Chim. Phys.* [6] 1892, *25*, 226-70.
VARIABLES: T/K = 288.35 p_1/kPa = 15.359-116.68	PREPARED BY: H. L. Clever

EXPERIMENTAL VALUES:

t/°C	T/K [a]	p_1/mmHg	p_1/kPa [a]	α/cm^3 (STP) cm^{-3} atm^{-1} [b]
15.2	288.35	563.67	75.15	1.010
		718.28	95.86	1.012
		654.33	87.24	1.008
		866.10	115.47	1.013
		721.10	96.14	1.011
		804.90	107.31	1.007
		874.50	116.59	1.000
		718.50	95.79	1.009
		814.40	108.58	1.009
		875.20	116.68	1.008
		115.20	15.36	1.004
		448.35	59.78	1.016
				Av. 1.009 ± 0.004

[a] Added by the compiler. [b] α = Bunsen coefficient.

The liquid volumes ranged from 36.65 to 46.44 cm^3.
Earlier papers report liquid volumes up to 459 cm^3.

AUXILIARY INFORMATION

See other data sheets on J. Setchenow papers.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Bohr, C.; Bock, J.

Ann. Phys. Chem. 1891, *44*, 318-43.

VARIABLES:

T/K = 310.44 and 373.15
P_1/kPa = 94.3 and 85.7

PREPARED BY:

Rosa Crovetto

EXPERIMENTAL VALUES:

t/°C	T/K [a]	P/bar [a]	P_1/mmHg	α [b]	10^4x_1 [a]
37.29	310.44	1.006	707.0	0.5629	4.584
100.00	373.15	1.871	643.0	0.2438	2.058

[a] Calculated by the compiler.
[b] Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

An all-glass apparatus was used. The system was equilibrated by bubbling gas through thermostatted water. The solubility was measured in two different ways: by considering the amount of dissolved gas which disappeared from the vapor phase, and by volumetric analysis of the gas removed from a liquid solution sample.

SOURCE AND PURITY OF MATERIALS:

(1) Not stated.

(2) Not stated.

ESTIMATED ERROR:

Not given.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Prytz, K.; Holst, H.

Ann. Phys. Chem. N.F. 1895, *54*, 130-8.

VARIABLES:

T/K = 273.15
P_1/kPa = 101.325

PREPARED BY:

Rosa Crovetto

EXPERIMENTAL VALUES:

t/°C	T/K [a]	P/bar [a]	P_1/atm	S [b]	10^4x_1 [a]
0	273.15	1.019	1.0	1.7294	1.398
0	273.15	1.019		1.7322	1.400
			Average:	1.7308	1.399

[a] Calculated by the compiler.
[b] Kuenen coefficient [cm^3(STP) g^{-1} atm^{-1}].

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

An all-glass apparatus was used. The temperature was kept constant using an ice bath. Good stirring conditions were provided. The amounts of water were determined by weighing.

SOURCE AND PURITY OF MATERIALS:

(1) From solid CO_2, dried and purified from air.

(2) Distilled.

ESTIMATED ERROR: Not given.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Bohr, C.

Ann. Phys. Chem. 1899, *68*, 500-25.

VARIABLES:

$T/K = 273.25\text{-}334.55$
$P_1/kPa = 101.325$

PREPARED BY:

Rosa Crovetto

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	P/bar [a]	P_1/atm	S [b]	10^4x_1 [a]
0.1	273.25	1.019	1.00	1.7062	13.79
3.8	276.95	1.021		1.4922	12.06
6.8	279.95	1.023		1.3411	10.84
12.8	285.95	1.028		1.0985	8.887
14.8	287.95	1.030		1.0232	8.281
18.9	292.05	1.035		0.9128	7.393
21.2	294.35	1.038		0.8497	6.886
22.6	295.75	1.041		0.8137	6.596
26.2	299.35	1.047		0.7314	5.935
31.1	304.25	1.058		0.6487	5.272
37.3	310.45	1.077		0.5629	4.584
40.4	313.55	1.089		0.5304	4.325
43.9	317.05	1.104		0.4905	4.005
49.8	322.95	1.135		0.4382	3.588
61.4	334.55	1.226		0.3508	2.889

[a] Calculated by the compiler.

[b] Solubility expressed as cm^3 of gas at STP dissolved by 1 cm^3 of solution at the temperature of the experiment and at a partial pressure of gas of 1 atm.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

An all-glass apparatus was used. The gas was bubbled through water kept in a constant temperature bath until equilibrium was reached.
After equilibration a liquid sample was volumetrically analyzed for its CO_2 content.
The volume of the solution was pycnometrically determined at the temperature of the measurement.

SOURCE AND PURITY OF MATERIALS:

(1) Not stated.

(2) Not stated.

ESTIMATED ERROR:

1 % in S. (By the author.)

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Hantzsch, A.; Vagt, A.

Z. Phys. Chem. 1901, *38*, 705-42.

VARIABLES:

$T/K = 273.15-363.15$

PREPARED BY:

Rosa Crovetto

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	$10^3c_1^{liq}/mol\ L^{-1}$ [b]	$10^3c_1^{air}/mol\ L^{-1}$ [c]	ratio [d]
0	273.15	8.05	4.08	1.972
10	283.15	6.86	4.96	1.383
20	293.15	4.68	4.27	1.110
30	303.15	3.59	4.18	0.860
40	313.15	3.05	4.16	0.740
50	323.15	2.68	4.27	0.630
70	343.15	1.68	3.72	0.450
90	363.15	1.23	3.27	0.380

[a] Calculated by the compiler.

[b] c_1^{liq} = concentration of CO_2 (mol L^{-1}) in the liquid.

[c] c_1^{air} = concentration on CO_2 (mol L^{-1}) in air.

[d] ratio = quotient of concentrations.

Although not stated, the compiler assumes the total pressure was 1 atm.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

An all-glass apparatus was used. Good stirring was provided during equilibration.
The authors measured the concentration of CO_2 in both phases at equilibrium. They give the distribution coefficient as the volume ratio.
The authors also give data for the distribution coefficient of amines in water and in different solvents.

SOURCE AND PURITY OF MATERIALS:

(1) Not stated.

(2) Not stated.

ESTIMATED ERROR:

Not given.

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Findlay, A.; Creighton, H.J.M.

J. Chem. Soc. 1910, *97*, 536-61.

VARIABLES:

$T/K = 298.15$
$p_1/kPa = 99.1 - 180.1$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

T/K	p_1/kPa [a]	L [b]	10^3x_1 [a]	T/K	p_1/kPa [a]	L [b]	10^3x_1 [a]
298.15	99.1	0.816	0.589	298.15	139.3	0.817	0.829
	100.3	0.817	0.597		141.8	0.819	0.854
	106.7	0.815	0.633		153.7	0.818	0.916
	112.1	0.817	0.667		165.7	0.819	0.988
	127.3	0.8165	0.757		180.1	0.820	1.075

[a] Calculated by compiler; [b] L = Ostwald coefficient [$cm^3\ cm^{-3}$]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was essentially similar to that of Geffcken (Ref. 1) except that the manometer tube was longer.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.42 mole %.

(2) Degassed by boiling.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$
$\delta L = \pm 0.25$ %

REFERENCES:

Geffcken, G.
Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1904, *49*, 257.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Findlay, A.; Shen, B.

J. Chem. Soc. 1912, *101*, 1459-68.

VARIABLES:

$T/K = 298.15$
$p_1/kPa = 100.7 - 180.0$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

T/K	p_1/kPa [a]	L [b]	10^3x_1 [a]	T/K	p_1/kPa [a]	L [b]	10^3x_1 [a]
298.15	100.7	0.826	0.606	298.15	142.5	0.823	0.854
	101.2	0.825	0.608		144.5	0.825	0.868
	111.5	0.825	0.670		161.3	0.825	0.969
	112.1	0.826	0.675		161.5	0.825	0.970
	123.6	0.826	0.744		180.0	0.824	1.080
	124.5	0.824	0.747		180.0	0.826	1.080

[a] Calculated by compiler; [b] L = Ostwald coefficient [$cm^3\ cm^{-3}$]

AUXILIARY INFORMATION

See above.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Sander, W.

Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1911-1912, *78*, 513-49.

VARIABLES:

T/K = 293.15 - 375.15
P/MPa = 2.45 - 16.67

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	10^2x_1	
		(a)	(b)
293.15	24.5	-	0.547
	29.4	-	0.608
	39.2	-	0.649
	49.0	-	0.870
	53.9	-	0.962
308.15	29.4	0.862	0.827
	39.2	1.083	1.306
	49.0	1.381	1.604
	58.8	1.663	1.430
	68.6	1.968	1.824
	78.5	-	2.127
333.15	39.2	0.740	0.591
	49.0	0.831	0.825
	58.8	0.981	0.930
	68.6	1.138	1.075
	78.5	1.357	1.391
333.15	88.3	1.535	1.321
	98.1	1.764	1.704
	107.9	1.943	1.717
	117.7	2.027	2.090
375.15	58.8	0.551	-
	68.6	0.626	0.367
	78.5	0.695	0.537
	88.3	0.794	0.621
	98.1	0.861	0.710
	107.9	0.938	0.931
	117.7	1.033	0.901
	127.5	1.128	0.964
	137.3	1.229	0.974
	147.1	1.292	0.966
	156.9	1.385	-
	166.7	1.429	-

The two values (a) and (b) are the result of duplicate measurements.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

High pressure glass capillary cell. Amount of carbon dioxide absorbed estimated from knowledge of total amount of carbon dioxide and volume, pressure and temperature of nonabsorbed carbon dioxide.

SOURCE AND PURITY OF MATERIALS:

(1) Purified final purity 99.9 mole %.

(2) No details given.

ESTIMATED ERROR:

δT/K = ± 0.1; δP/bar = ± 0.5;
δx_1 = ± 0.001.

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Findlay, A.; Williams, T.

J. Chem. Soc. 1913, *103*, 636-45.

VARIABLES:

$T/K = 298.15$
$p_1/kPa = 35.1 - 102.4$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

T/K	p_1/kPa [a]	L [b]	10^3x_1 [a]	T/K	p_1/kPa [a]	L [b]	10^3x_1 [a]
298.15	35.1	0.817	0.209	298.15	66.0	0.816	0.392
	36.1	0.816	0.215		86.8	0.816	0.516
	50.9	0.814	0.302		88.9	0.817	0.529
	52.3	0.811	0.309		100.3	0.818	0.597
	63.9	0.816	0.380		102.4	0.817	0.609

[a] Calculated by compiler; [b] L = Ostwald coefficient [$cm^3\ cm^{-3}$]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was essentially similar to that of Geffcken (Ref. 1) except that the manometer tube was longer.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.42 mole %.

(2) Degassed by boiling.

REFERENCES:

Geffcken, G.
Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1904, *49*, 257.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$
$\delta L = \pm 0.25$ %

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Findlay, A.; Howell, O.R.

J. Chem. Soc. 1915, *107*, 282-84.

VARIABLES:

$T/K = 298.15$
$p_1/kPa = 36.3 - 131.7$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

T/K	p_1/kPa [a]	L [b]	10^3x_1 [a]	T/K	p_1/kPa [a]	L [b]	10^3x_1 [a]
298.15	36.3	0.823	0.218	298.15	82.9	0.824	0.498
	39.4	0.824	0.236		84.4	0.824	0.507
	39.7	0.824	0.238		86.0	0.824	0.516
	49.6	0.824	0.298		101.0	0.824	0.606
	51.1	0.823	0.307		101.7	0.824	0.610
	53.7	0.824	0.322		101.8	0.824	0.611
	71.0	0.824	0.426		127.8	0.824	0.767
	71.4	0.824	0.428		129.3	0.825	0.777
	73.1	0.824	0.439		131.7	0.824	0.790

[a] Calculated by compiler; [b] L = Ostwald coefficient [$cm^3\ cm^{-3}$]

AUXILIARY INFORMATION

See above.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Water; H_2O; [7732-18-5]	Kunerth, W. *Phys. Rev.* 1922, *2*, 512-24.
VARIABLES:	**PREPARED BY:**
T/K = 293-307 P = "atmospheric"	Rosa Crovetto

EXPERIMENTAL VALUES:

t/°C	T/K [a]	P/bar [a]	P_1/bar [a]	L [b]	10^4x_1 [a]
20	293.15	1.013	0.990	0.900	6.627
22	295.15		0.987	0.872	6.360
24	297.15		0.983	0.836	6.038
26	299.15		0.980	0.800	5.720
28	301.15		0.975	0.765	5.412
30	303.15		0.971	0.729	5.102
32	305.15		0.966	0.693	4.795
34	307.15		0.960	0.656	4.486

[a] Calculated by the compiler.

[b] L = Ostwald coefficient [cm^3 cm^{-3}].

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

McDaniel type apparatus.[1] Vigorous shaking was provided to obtain equilibrium. The equilibrium composition was determined by volumetric analysis. The gas was saturated with solvent at the temperature of the measurement. Total pressure in the system was equal to the barometric pressure.

SOURCE AND PURITY OF MATERIALS:

(1) Obtained by heating $NaHCO_3$. Dried over $CaCl_2$ and stored in a glass bulb.

(2) Distilled. Tested by boiling point and density.

ESTIMATED ERROR:

$\delta L = \pm 1\%$

REFERENCES:

1. McDaniel, J.
J. Phys. Chem. 1911, *15*, 587.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Buch, K.

Nord. Kemistmötet (Finland) 1926, 184-92.

VARIABLES:

$T/K = 292.95$ and 293.95
$P_1/kPa = 101.325$

PREPARED BY:

Rosa Crovetto

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	P/bar [a]	P_1/atm	α [b]	10^4x_1 [a]
19.8	292.95	1.036	1.00	0.859	6.959
				0.858	6.951
				0.853	6.910
				0.855	6.926
20.8	293.95	1.038	1.00	0.84	6.81
				0.85	6.89
				0.85	6.89
				0.84	6.81
				0.94	7.62
				0.89	7.21
				0.84	6.81
				0.72	5.83
				0.75	6.08
				0.79	6.40

[a] Calculated by the compiler.
[b] Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

Average values:

$t/°C$	α
19.8	0.856
20.8	0.83

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

An all-glass apparatus was used. Vigorous stirring was used. The amount of dissolved gas was determined both volumetrically and by titration.

SOURCE AND PURITY OF MATERIALS:

(1) Not stated.

(2) Not stated.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$ (by author)

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Water; H_2O; [7732-18-5]	Morgan, J.L.R.; Pyne, H.R. *J. Phys. Chem.* 1930, *34*, 1578-82.
VARIABLES: T/K = 298.15 p_1/kPa = 101.325	PREPARED BY: H.L. Clever

EXPERIMENTAL VALUES:

t/°C	T/K	L/cm^3 cm^{-3} [a]	10^4x_1 [b]
25	298.15	0.8265	6.135
		0.8267	6.137

[a] L = Ostwald coefficient

The two Ostwald coefficients reported by the authors were the average values reported from measurements using versions 3 and 4 of their apparatuses.

[b] Calculated by the compiler.

A real gas CO_2 volume of 24.340 dm^3 mol^{-1} and a solution density the same as for pure water were assumed.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The authors were concerned that too vigorous shaking might lead to supersaturation because of local pressure differences. They designed four versions of an apparatus in which the gas and solvent would be contacted at atmospheric pressure only.

In the final version the gas is circulated through the degassed solvent in an all-glass apparatus by a pumping system of mercury reservoirs and bulbs activated by a rocking beam.

The solvent was degassed by boiling under reduced pressure for one hour.

SOURCE AND PURITY OF MATERIALS:

(1) Prepared by the action of sulfuric acid on an aqueous solution of sodium bicarbonate. The gas was passed through several wash bottles containing distilled water.

(2) Distilled.

ESTIMATED ERROR:

$\delta L/L = \pm 0.005$ (compiler)

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Morgan, O. M.; Maass, O.

Can. J. Res. 1931, *5*, 162-99.

VARIABLES:

T/K = 273.15-298.15
P_1/kPa = 7.6-113.7

PREPARED BY:

Rosa Crovetto

EXPERIMENTAL VALUES:

t/°C	T/K [a]	P/bar [a]	P_1/cmHg	S [b]	$10^4 x_1$ [a]
0	273.15	0.082	5.70	0.0202	0.8270
		0.219	16.00	0.0661	2.707
		0.476	35.27	0.1412	5.785
		0.713	53.02	0.2143	8.783
		0.914	68.13	0.2929	12.01
		1.143	85.30	0.3676	15.08
10	283.15	0.121	8.17	0.0240	0.9826
		0.287	20.61	0.0611	2.502
		0.578	42.41	0.1297	5.313
		0.872	64.48	0.1975	8.094
		1.126	83.56	0.2475	10.15
18	291.15	0.144	9.23	0.0216	0.8843
		0.327	22.98	0.0580	2.375
		0.676	49.14	0.1140	4.670
		1.013	74.45	0.1740	7.130
25	298.15	0.164	9.89	0.0200	0.8188
		0.369	25.32	0.0502	2.056
		0.752	54.00	0.1025	4.198
		1.128	82.22	0.1559	6.388

[a] Calculated by the compiler.
[b] CO_2 content in mass %.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The authors measured the vapor pressures and electrical conductivities of aqueous solutions of sulphur dioxide, carbon dioxide and ammonia.

The apparatus was provided with good stirring to attain equilibrium.

SOURCE AND PURITY OF MATERIALS:

(1) Pure.

(2) Degassed conductivity water.

ESTIMATED ERROR:

Not stated.

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]
(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kobe, K. A., Williams, J. S.
Ind. Eng. Chem. 1935, *7* (1), 37-8.

VARIABLES:

T/K = 298.15
P_1/kPa = 101.325

PREPARED BY:

Rosa Crovetto

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	P/bar [a]	$P_1/mmHg$	α [b]	$10^4 x_1$ [a]
25	298.15	1.045	760	0.754	6.116

[a] Calculated by the compiler.
[b] Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

All-glass apparatus. The total pressure was kept constant during equilibration. The equilibration cell was shaken in a constant temperature bath. After equilibration, a liquid sample was volumetrically analyzed for water and CO_2 content.

SOURCE AND PURITY OF MATERIALS:

(1) "Pure". Saturated with water vapor.
(2) Distilled.

ESTIMATED ERROR:

$\delta\alpha = \pm 0.005$ (by author)

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Kritschewsky, I.R.;
Shaworonkoff, N.M.; Aepelbaum, V.A.
Z. physik. Chem. 1935, *A 175*, 232-8.

VARIABLES:

T/K = 293.15 and 303.15
P/kPa = 490-2942

PREPARED BY:

Rosa Crovetto

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	P/bar [a]	$P/kg\ cm^{-2}$	α [b]	$10^2 x_1$ [a]
20	293.15	4.903	5	3.97	0.3208
		9.807	10	7.81	0.6289
		14.710	15	11.5	0.9231
		19.61	20	14.8	1.1846
		29.42	30	20.6	1.641
30	303.15	4.903	5	3.42	0.2772
		14.710	15	9.66	0.7786
		19.61	20	12.4	0.9970
		29.42	30	18.7	1.495

[a] Calculated by the compiler.
[b] Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A "conventional" high-pressure apparatus was used. Equilibrium in the system was attained by bubbling gas at constant pressure. The equilibrium composition in the system was determined by measuring the volume of water, and the pressure and volume of the dissolved CO_2 in a buret that was thermostatted. The solubilities of the gas mixtures CO_2-H_2 were also measured with the same experimental apparatus. Details are given in the source. The authors calculated the fugacity of the pure gas from Ref. 1.

SOURCE AND PURITY OF MATERIALS:

Nothing specified.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$
$\delta P/kg\ cm^{-2} = \pm 0.1$

REFERENCES:

1. Jellinek, K.; *Lehrbuch der Physikalischen Chemie*, *Bd. 4*, 1933, 231.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Shedlovsky, T; MacInnes, D.A.

J. Am. Chem. Soc. 1935, *57*, 1705-10.

VARIABLES:

T/K = 298.15
p_1/kPa = 101.325

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

t/°C	T/K	10^2K_H/mol dm^{-3} atm^{-1} [a]	10^4x_1 [b]	L/cm^3 cm^{-3} [b,c]
25	298.15	3.372 ± 0.005	6.089	0.8207

[a] K_H = Henry's constant
[b] Calculated by the compiler.
[c] L = Ostwald coefficient

A real gas volume of 24.340 dm^3 mol^{-1} at 298.15 and 101.325 kPa was used in the calculations. The ideal gas volume would give an Ostwald coefficient value of 0.8250.
It was assumed the solution had the same density as pure water.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The Henry's constant value was obtained by direct titration of CO_2 saturated solutions, knowledge of the solution vapor pressure and barometer readings.

See footnote 12 on page 1708 of the paper.

SOURCE AND PURITY OF MATERIALS:

(1) Tank. Analyzed to be 99.97 % CO_2.

(2) Conductivity water.

ESTIMATED ERROR:

$\delta K_H/K_H$ = ± 0.005 (compiler)

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Orcutt, F.S.; Seevers, M.H.

J. Biol. Chem. 1936, *117*, 501-7.

VARIABLES:

T/K = 298.15
P_1/kPa = 101.325

PREPARED BY:

Rosa Crovetto

EXPERIMENTAL VALUES:

t/°C	T/K [a]	P/bar [a]	P_1/atm	α [b]	10^4x_1 [a,c]
25	298.15	1.045	1.00	0.753	6.108

[a] Calculated by the compiler.
[b] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].
[c] Assuming that $V_{m,1}$ = 22.2605 dm^3 mol^{-1} at STP.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A Van Slyke - Neill apparatus was used to perform the experiments.[1] The authors present the method as "qualitative".

SOURCE AND PURITY OF MATERIALS:

(1) "Commercial tank".

(2) Not stated.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Van Slyke, D.D.; Neill, J.M. *J. Biol. Chem.* 1924, *61*, 523-35.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Zel'venskii, Ya.D.

Zh. Khim. Prom. 1937, *14*, 1250-7.

VARIABLES:

$T/\mathrm{K} = 273\text{-}373$

$p_1/\mathrm{MPa} = 1.084\text{-}9.446$

PREPARED BY:

Yu.P. Yampol'skii

EXPERIMENTAL VALUES:

T/K [a]	p_1/atm	S_1 [b]	10^2x_1	T/K [a]	p_1/atm	S_1 [b]	10^2x_1
273	10.70	16.79	1.332	323	89.60	26.00	2.0611
	15.74	22.93	1.810		91.50	25.68	2.0363
	29.47	33.72	2.639		92.00	25.86	2.0503
298	10.98	7.66	0.617	348	18.84	5.48	0.441
	11.03	7.75	0.6234		19.00	5.38	0.434
	22.92	15.51	1.2399		32.24	8.96	0.724
	24.66	15.91	1.2714		32.68	9.05	0.7272
	24.77	16.08	1.2849		46.61	12.26	0.983
	26.00	16.81	1.3427		60.27	15.24	1.2185
	31.40	19.54	1.5570		60.92	15.06	1.2043
	34.41	20.88	1.662		61.03	15.11	1.2083
	38.83	23.34	1.8541		61.22	15.25	1.2193
	39.18	23.46	1.8635		75.70	17.62	1.4062
	44.10	25.66	2.0348		75.95	18.00	1.4360
	45.05	25.70	2.0378		76.35	17.83	1.4227
	56.10	29.05	2.297		92.05	20.17	1.6064
	62.9	30.42	2.4032		93.22	20.33	1.6111
323	19.14	7.75	0.623	373	19.10	4.30	0.3477
	32.58	12.31	0.987		19.27	4.29	0.3460
	32.79	12.49	1.001		32.07	7.13	0.5738
	46.80	15.93	1.2730		32.58	7.33	0.5898
	46.88	16.32	1.304		32.69	7.23	0.582
	57.00	19.11	1.5233		32.78	7.18	0.5778
	60.30	20.05	1.5970		46.10	9.98	0.8013
	60.92	20.30	1.6166		46.75	10.13	0.813
	61.10	20.39	1.6236		46.89	9.89	0.7942
	62.00	20.52	1.6338		60.95	12.24	0.9810
	73.22	22.59	1.7957		61.30	13.52	1.0825
	73.82	23.27	1.8487		75.00	18.17	1.448
	74.50	23.00	1.8277		90.00	18.17	1.448

[a] Calculated by the compiler.

[b] S_1 = solubility of CO_2 in water [cm^3 (STP) cm^{-3}]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The saturation of water with CO_2 was achieved in a thermostatted rocking autoclave with inner walls plated with silver. CO_2 solubility was determined by measuring the volume of the gas desorbed from the solution under ambient conditions. The equipment was similar to that used in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

Nothing specified.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

1. Wiebe, R.; Gaddy, V.L.; Heins, Jr. C.

Ind. Eng. Chem. 1932, *24*, 823.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Water; H_2O; [7732-18-5]	Curry, J.; Hazelton, C. L. *J. Am. Chem. Soc.* 1938, *60*, 2271-3.
VARIABLES:	**PREPARED BY:**
$T/K = 298.15$ K $P_1/kPa = 94.57 - 97.09$	H. L. Clever

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	$P/mmHg$	$P_1/mmHg$	10^4x_1 [b]	$L/cm^3\ cm^{-3}$ [c]
25.00	298.15	749.4	722.9		0.816
		754.0	728.2		0.822
		747.5	721.5		0.834
		735.5	709.3		0.813
				6.09	Av. 0.821 ± 0.007

[a] Added by the compiler.

[b] The mole fraction solubility was calculated by the compiler for a partial pressure of CO_2 of 101.325 kPa (760 mmHg) using a real gas molar volume of 24.34 $dm^3\ mol^{-1}$.

[c] L = Ostwald coefficient.

According to the authors the Ostwald coefficient corresponds to a molality of 0.0337 mol kg^{-1} at a CO_2 partial pressure of 101.325 kPa.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was an Ostwald type using the "dry method" as described by Just (Ref. 1).

The apparatus was of small size because it was to be used to determine the solubility of CO_2 in heavy water. The buret was 10 cm^3 graduated to 0.05 cm^3. The sample bulb had a volume of 6.811 cm^3.

The four water samples ranged from 2.2735 to 4.7374 g.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial tank. Analyzed by reaction with KOH and found to be 99.8 % pure.

(2) Distilled. Refluxed to remove dissolved gases.

ESTIMATED ERROR:

$\delta T/K = \pm 0.01$
$\delta L/L = \pm 0.01$

REFERENCES:

1. Just, G. *Z. physik. Chem.* (Leipzig) 1901, *37*, 342.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Wiebe, R.; Gaddy, V. L.

J. Am. Chem. Soc. 1939, *61*, 315-8.

VARIABLES:

T/K = 323.15-373.15
P/MPa = 2.53-70.9

PREPARED BY:

Rosa Crovetto

EXPERIMENTAL VALUES:

t/°C	T/K [a]	P/bar [a]	P/atm	S [b]	10^2x_1 [a]
50	323.15	25.33	25	9.71	0.7797
		50.66	50	17.246	1.377
		75.99	75	22.534	1.791
		101.325	100	25.628	2.032
		126.66	125	26.77	2.120
		152.0	150	27.643	2.188
		202.6	200	29.143	2.304
		304.0	300	31.34	2.474
		405.3	400	33.29	2.623
		608.9	600	36.73	2.887
		709.3	700	38.34	3.009
75	348.15	25.33	25	6.815	0.5485
		50.66	50	12.59	1.009
		75.99	75	17.044	1.361
		101.325	100	20.61	1.640
		152.0	150	24.58	1.950
		202.6	200	26.66	2.112
		304.0	300	29.51	2.332
		405.4	400	31.88	2.515
		709.3	700	37.59	2.952
100	373.15	25.33	25	5.365	0.4323
		50.66	50	10.179	0.8170
		75.99	75	14.289	1.143
		101.325	100	17.67	1.410
		152.0	150	22.725	1.806
		202.6	200	25.694	2.037
		304.0	300	29.53	2.334
		405.3	400	32.39	2.554
		709.3	700	38.50	3.022

[a] Calculated by the compiler.
[b] Solubility of CO_2 (cm^3 at STP per gram of water).

Authors' note: There is a change in solubility vs pressure in the low temperature range and at 100-200 atm that could suggest the coexistence of two liquid phases.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A high-pressure autoclave was used. Two flasks helped to maintain pressure constant during sampling. Pressure was read on a dead weight gauge. The liquid sample was analyzed for its CO_2 content by expansion into a thermostatted gas buret. It was not stated if stirring was used.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.98 %.

(2) Not stated.

ESTIMATED ERROR:

Not given.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Water; H_2O; [7732-18-5]	Van Slyke, D.D. *J. Biol. Chem.* 1939, *130*, 545-54.
VARIABLES: $T/K = 295.95\text{-}298.65$ $P_1/kPa = 101.325$	PREPARED BY: Rosa Crovetto

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	P/bar [a]	P_1/atm	α [b]	10^4x_1 [a,c]
22.8	295.95	1.041	1.00	0.806	6.534
22.8	295.95	1.041		0.807	6.542
24.7	297.85	1.044		0.764	6.197
24.8	297.95	1.045		0.758	6.148
25.4	298.55	1.046		0.752	6.101
25.5	298.65	1.046		0.753	6.109

[a] Calculated by the compiler.

[b] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[c] Assuming that $V_{m,1}$ = 22.2605 dm^3 mol^{-1} at STP.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Measurements were made in a Van Slyke/ Neill apparatus.[1,2] In this kind of apparatus the equilibration and analysis were done in the same chamber. Shaking was done during saturation and degassing. Once equilibration was achieved the undissolved gas was removed and the solution analyzed for absorbed gases manometrically in a known volume.

SOURCE AND PURITY OF MATERIALS:

(1) 99.9 %.

(2) Not specified. Degassed.

ESTIMATED ERROR:

Not stated.

REFERENCES:

1. Van Slyke, D.D.; Neill, J.M. *J. Biol. Chem.* 1924, *61*, 523-35.

2. Van Slyke, D.D. *J. Biol. Chem.* 1927, *73*, 121-34.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Wiebe, R.; Gaddy, V. L.

J. Am. Chem. Soc. 1940, *62*, 815-7.

VARIABLES:

T/K = 291.15-313.15
P/MPa = 2.53-50.66

PREPARED BY:

Rosa Crovetto

EXPERIMENTAL VALUES:

t/°C	T/K [a]	P/bar [a]	P/atm	S [b]	10^2x_1 [a]
18	291.15	25.33	25	19.51	1.554
		50.66	50	32.03	2.527
25	298.15	50.66	50	27.23	2.156
31.04	304.19	25.33	25	14.18	1.134
		50.66	50	24.15	1.917
35	308.15	25.33	25	12.95	1.037
		50.66	50	22.21	1.766
		75.99	75	27.84	2.203
		101.33	100	29.13	2.303
		152.0	150	30.52	2.410
		202.6	200	31.83	2.511
		405.3	400	35.73	2.810
		506.6	500	37.99	2.983
40	313.15	25.33	25	11.62	0.9316
		50.66	50	20.35	1.620
		75.99	75	25.81	2.046
		101.33	100	27.81	2.201
		126.7	125	28.71	2.271
		152.0	150	29.39	2.323
		202.6	200	31.74	2.504
		405.3	400	34.87	2.744
		506.6	500	36.73	2.887

[a] Calculated by the compiler.
[b] Solubility of CO_2 (cm^3 at STP per gram of water).

At each temperature: Only data at a pressure lower than the corresponding vapor pressure of CO_2 can be considered as gas-liquid solubility measurements.

Authors' note: At 12 °C and 18 °C and above 300 atm aside from formation of solid carbon dioxide hexahydrate, the composition of both phases is the same.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Apparatus and procedure are described in ref. 1. A high-pressure autoclave was used with stirring.

Note that some measurements were done at pressures higher than the corresponding vapor pressure of CO_2. In these conditions liquid-liquid equilibria will exist.

For reference, for CO_2 T_c = 304.2 K and P_c = 72.8 atm.

SOURCE AND PURITY OF MATERIALS:

(1) 99.98 %.

(2) Not stated.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Wiebe, R.; Gaddy, V. L.
J. Am. Chem. Soc. 1939, *61*, 315-8.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Water; H_2O; [7732-18-5]	Markham, A.E.; Kobe, K.A. *J. Am. Chem. Soc.* 1941, *63*, 449-54.
VARIABLES: T/K = 273.35-313.15 P_1/kPa = 101.325	**PREPARED BY:** Rosa Crovetto

EXPERIMENTAL VALUES:

t/°C	T/K [a]	P/bar [a]	P_1/mmHg	α [b]	10^4x_1 [a]
0.2	273.35	1.019	760	1.7023	13.76
25	298.15	1.045		0.7565	6.118
40	313.15	1.087		0.5133	4.152

[a] Calculated by the compiler.

[b] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

The results in α were obtained from an average of 8, 12 and 5 experimental points at each temperature, respectively.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was a thermostatted all-glass absorption flask provided with stirring. The solubility was calculated from the change in volume of the gas before and after equilibration at constant pressure. The partial pressure was maintained at 760 mmHg once all the corrections including solvent vapor pressure were done.

SOURCE AND PURITY OF MATERIALS:

(1) From commercial cylinder. 99.8 %.

(2) Freshly distilled and degassed.

ESTIMATED ERROR:

At 0.2 °C δt/°C = ± 0.1 %
$\delta\alpha$ = ± 0.2 %

At 25 and 40 °C δt/°C = ± 0.03 %
$\delta\alpha$ = ± 0.06 %

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Wiebe, R.; Gaddy, V. L.

J. Am. Chem. Soc. 1941, *63*, 475-7.

VARIABLES:

T/K = 298.15-348.15
P/MPa = 0.1 - 70.9

PREPARED BY:

Rosa Crovetto

EXPERIMENTAL VALUES:

Vapor phase composition [a]

P/atm	t/°C			
	25	31.04	50	75
1	0.023	0.032	0.093	0.242
25	0.00132	0.00183	0.00498	0.00855
50	0.00104	0.00129	0.00308	
60			0.00287	
75			0.00281	
100	0.00267	0.00293	0.00361	0.00666
110				0.00652
125				0.00687
150	0.00289		0.00490	0.00768
200	0.00303	0.00338	0.00544	0.00910
400		0.00383	0.00610	0.01060
450	0.00322			
475	0.00321			
500	0.00319	0.00386		
525		0.00382		
550		0.00384		
600			0.00637	0.01120
700			0.00544	0.01125

[a] Vapor phase composition in equilibrium, expressed in grams of water per liter of expanded gas at STP.

Note: Whenever the total pressure is larger than the corresponding vapor pressure of CO_2, there will be a possibility of liquid-liquid equilibria instead of gas-liquid.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus used was the same high pressure autoclave as in Ref. 1. After equilibration, samples were taken from the gas phase. No pressure stability was provided during sampling. The authors could not discard completely the possibility of spray formation in the sampling procedure. The samples were analyzed by weighing.

For CO_2, T_c = 304.20 K (31.05 °C)
P_c = 72.8 atm

SOURCE AND PURITY OF MATERIALS:

(1) Not stated.

(2) Not stated.

ESTIMATED ERROR:

REFERENCES:

1. Wiebe, R.; Gaddy, V. L.
J. Am. Chem. Soc. 1939, *61*, 315-8.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Harned, H.S.; Davis, R. Jr.

J. Am. Chem. Soc. 1943, *65*, 2030-7.

VARIABLES:

T/K = 273.15-323.15
P_1/kPa = 101.325

PREPARED BY:

Rosa Crovetto

EXPERIMENTAL VALUES:

t/°C	T/K [a]	P/bar [a]	$10^2 S$ [b]	$10^3 x_1$ [a]
0	273.15	1.019	7.726	1.390
			7.676	1.381
5	278.15	1.022	6.402	1.152
10	283.15	1.026	5.359	0.9645
			5.367	0.9659
15	288.15	1.030	4.554	0.8197
20	293.15	1.037	3.923	0.7062
			3.928	0.7071
25	298.15	1.045	3.438	0.6190
			3.458	0.6226
30	303.15	1.056	3.026	0.5448
			3.021	0.5439
35	308.15	1.070	2.678	0.4822
40	313.15	1.087	2.407	0.4334
			2.407	0.4334
45	318.15	1.109	2.192	0.3947
50	323.15	1.137	1.982	0.3569
			1.969	0.3546

[a] Calculated by the compiler.
[b] $S = m_1/P_1$ where m_1 is the molality of CO_2 [mol kg^{-1}].
The S values are at P_1 = 1 atm.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The same apparatus and method were used for measurements of solubility and electromotive force. A detailed description of the experimental procedure is available in the source.

Equilibrium in the cell was attained by bubbling CO_2 through the solvent while gently rocking the thermostatted cell. Pressure was maintained constant at 1 atm. The concentration was determined by titrating about 90 cm^3 of solution with excess standard $Ba(OH)_2$ solution and back-titrating the excess.

SOURCE AND PURITY OF MATERIALS:

(1) From commercial tank.
Purity 99.67 % ± 0.05 %.

(2) Quality not stated.
Degassed by CO_2 bubbling and evacuation.

ESTIMATED ERROR:

δS = ± 0.2 % (By authors)

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Koch, H. A.; Stutzman, L. F.; Blum, H. A.; Hutchings, L. E.

Chem. Eng. Prog. 1949, *45*(11), 677-82.

VARIABLES:

$T/K = 291.45-295.05$
$P_1/kPa = 12.46-17.63$

PREPARED BY:

Rosa Crovetto

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	P/bar [a]	P_1/atm	y_1 [b]	10^4x_1 [c]
21.7	294.85	0.163	0.135	0.1461	1.000
20.5	293.65	0.177	0.151	0.1514	1.261
18.3	291.45	0.145	0.123	0.1230	0.9930
21.7	294.85	0.180	0.152	0.1569	1.045
21.9	295.05	0.176	0.148	0.1490	1.172
21.1	294.25	0.202	0.174	0.1781	1.263

[a] Calculated by the compiler.

[b] Mole fraction of CO_2 in gas phase.

[c] Mole fraction of CO_2 in liquid phase.

Also, gas-liquid transfer coefficients were determined and they are given in the original paper.

Only equilibrium values are given here.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Equilibration was obtained by flowing the gas through a column of water packed with Raschig rings.

SOURCE AND PURITY OF MATERIALS:

(1) Not stated.

(2) Distilled.

ESTIMATED ERROR:

$\delta x = \pm 3$ % (estimated by compiler)

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Water; H_2O; [7732-18-5]	Morrison, T.J.; Billett, F. *J. Chem. Soc.* 1952, 3819-22.
VARIABLES: T/K = 286.45-347.85 P_1/kPa = 101.325	PREPARED BY: Rosa Crovetto

EXPERIMENTAL VALUES:

t/°C	T/K [a]	P/bar [a]	P_1/atm	S [b]	10^4x_1 [a]
13.3	286.45	1.029	1.00	1.059	8.563
14.9	288.05	1.030		1.010	8.167
17.6	290.75	1.033		0.927	7.496
19.8	292.95	1.036		0.873	7.060
25.8	298.95	1.046		0.7447	6.023
29.8	302.95	1.055		0.6622	5.356
30.3	303.45	1.056		0.6600	5.338
33.2	306.35	1.064		0.6152	4.976
34.3	307.45	1.067		0.6067	4.907
34.6	307.75	1.068		0.5998	4.852
42.5	315.65	1.097		0.5020	4.061
46.4	319.55	1.116		0.4650	3.762
48.4	321.55	1.127		0.4550	3.681
51.1	324.25	1.144		0.4256	3.443
54.3	327.45	1.166		0.4046	3.273
63.1	336.25	1.243		0.3491	2.824
68.2	341.35	1.302		0.3273	2.648
72.4	345.55	1.359		0.3069	2.483
74.7	347.85	1.394		0.3006	2.432

[a] Calculated by the compiler

[b] S = Kuenen coefficient at a gas partial pressure of 1 atm [cm^3 (STP) g^{-1}].

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
An improved apparatus for solvent pretreatment was used (Ref. 1). The gas content in the solution was analyzed with a gas burette. The solvent was equilibrated by flowing a liquid film through the gas. No supersaturation was observed.	(1) Prepared from marble. The systen was sealed to prevent contamination with air. (2) Pure. Degassed.
	ESTIMATED ERROR: Not stated.
	REFERENCES: 1. Morrison, T.J.; Billett, F. *J. Chem. Soc.* 1948, 2033-8.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Shchennikova, M.K.; Devyatykh, G.G.; Korshunov, I.A.
Zh. Prikl. Khim. (Leningrad) 1957, *30*, 833-8; * *J. Appl. Chem. USSR* (Engl. Transl.) 1957, *30*(6), 881-6.

VARIABLES:

$T/K = 293 - 348$
$P_1/kPa = 101.325$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/^\circ C$	T/K [a]	α [b]	α_{mean} [b]	L [a,c]	L_{mean} [a,c]
20	293.15	0.88		0.94	
		0.90		0.97	
		0.88		0.94	
		0.91		0.98	
20	293.15		0.892		0.957
28	301.15	0.72	0.72	0.79	0.79
40	313.15	0.55		0.63	
		0.54		0.62	
40	313.15		0.545		0.625
50	323.15	0.441	0.441	0.522	0.522
60	333.15	0.336		0.409	
		0.341		0.416	
		0.333		0.406	
		0.329		0.401	
		0.324		0.395	
		0.313		0.382	
		0.349		0.425	
60	333.15	0.356		0.434	
		0.330		0.402	
60	333.15		0.335		0.409
75	348.15	0.235	0.235	0.300	0.300

[a] Calculated by the compiler.

[b] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[c] L = Ostwald coefficient [cm^3 cm^{-3}].

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Isotopic dilution method, with C^{14} radioactive carbon isotope as a tracer. Experimental procedure described in detail in the original source.

SOURCE AND PURITY OF MATERIALS:

(1) Not specified.

(2) Redistilled.

ESTIMATED ERROR:

Not given.

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Ellis, A.J.

Am. J. Sci. 1959, *257*, 217-34.

VARIABLES:

T/K = 387 - 621
p/MPa = 0.506 - 16.40

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

t/°C	T/K	p/atm	p_1/atm	p_1/kPa	p_2/atm	K_H/atm^{-1} ^{a}	10^3x_1
Series A							
114	387	5.00	3.41	346	1.59	4800	0.710
128	401	6.00	3.53	358	2.47	4640	0.761
147	420	8.25	3.80	385	4.45	4940	0.769
175	448	12.85	4.17	423	8.68	4960	0.841
182	455	14.1	3.89	394	10.21	4680	0.831
192	465	16.7	3.93	398	12.77	3890	1.01
195	468	17.5	3.87	392	13.63	4040	0.958
208	481	22.0	4.14	419	17.86	3770	1.10
227	500	30.1	4.45	451	25.65	4080	1.09
228	501	30.7	4.4	446	26.3	4160	1.06
228	501	30.3	4.0	405	26.3	3750	1.07
231	504	32.3	4.2	426	28.1	3840	1.09
232	505	32.6	4.3	436	28.3	3980	1.08
255	528	47.1	4.9	496	42.2	4060	1.2
257	530	48.5	4.9	496	43.6	3980	1.2
291	564	78.5	4.8	486	73.7	3150	1.5
298	571	85.9	4.4	446	81.5	2690	1.6
305	578	94.5	4.6	466	89.9	2780	1.7
314	587	105.8	3.9	395	101.9	2030	1.9
322	595	117.1	4.0	405	113.1	2250	1.8
343	616	152.3	4.2	426	148.1	1870	2.2
348	621	161.9	4.3	436	157.6	1860	2.3

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static bomb of approximately 100 cm^3 capacity. Heated in electric tube furnace. Liquid volume of approximately half to two thirds bomb volume. Samples of mixture analysed by absorbing water in Anhydrone and carbon dioxide in carbsorb. Details in source.

SOURCE AND PURITY OF MATERIALS:

Carbon dioxide generated in apparatus by reaction of sodium bicarbonate and hydrochloric acid.

Two series studied:

Series A: 0.02 moles $NaHCO_3$; 0.00797 moles HCl; 42 or 52 cm^3 of water.

Series B: 0.007 moles $NaHCO_3$; 0.00302 moles HCl; 55 cm^3 of water.

ESTIMATED ERROR:

δT/K = ± 2.0; δx_1 = ± 4 % (estimated compiler).

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Water; H_2O; [7732-18-5]	Ellis, A.J. *Am. J. Sci.* 1959, *257*, 217-34.

EXPERIMENTAL VALUES:

(continued)

$t/^{\circ}C$	T/K	p/atm	p_1/atm	p_1/kPa	p_2/atm	K_H/atm^{-1} [a]	10^3x_1
Series B							
163	436	7.85	1.31	133	6.54	4730	0.28
179	452	11.25	1.64	166	9.61	4530	0.36
197.5	470.7	14.7	1.55	157	13.15	4220	0.37
199	472	16.3	1.37	139	14.93	3760	0.36
222	495	25.2	1.58	160	23.62	3640	0.43
224	497	26.0	1.47	149	24.53	3890	0.38
227	500	27.5	1.56	158	25.94	3900	0.40
233	506	30.4	1.44	146	28.96	3550	0.41
242.5	515.7	36.0	1.7	172	34.3	3730	0.46
244	517	36.8	1.6	162	35.2	3530	0.45
287	560	71.6	1.8	182	69.8	3310	0.54
288	561	72.5	1.7	172	70.8	3250	0.52
317	590	106.7	1.7	172	105.0	2600	0.65
319	592	111.1	1.8	182	109.3	2680	0.67

[a] K_H = Henry's law coefficient.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Malinin, S.D.

Geokhimiya 1959, (3), 235-45.

VARIABLES:

$T/K = 473.15 - 603.15$
$P/MPa = 9.8 - 49.0$

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	10^2x_1 [a]	T/K	P/bar	10^2x_1 [a]
473.15	98	1.22	473.15	490	4.56
	98	1.21		490	4.36
	98	1.22		490	4.38
	196	2.47		490	4.45
	196	2.44		490	4.32
	196	2.35		490	4.28
	196	2.38			
	196	2.40	523.15	98	1.07
	196	2.41		98	1.07
	294	3.28		98	1.08
	294	3.24		196	2.77
	294	3.17		196	2.74
	294	3.29		196	2.56
	294	3.26		196	2.74
	294	3.26		196	2.71
	392	3.84		196	2.79
	392	3.93		294	4.34
	392	4.00		294	4.34
	392	4.05		294	4.17
	392	3.76		294	4.30
	392	3.76		294	4.40
	490	4.44		392	5.69
	490	4.39		392	5.61
	490	4.56		392	5.53
	490	4.36		392	5.60
	490	4.38		392	5.53

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Rocking static equilibrium cell. Temperature measured with cromelalumel thermocouple. Pressure measured with Bourdon gauge. Liquid phase analysed by dissolving carbon dioxide in alkali and estimating both water and dissolved carbon dioxide gravimetrically. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Distilled into filling vessel.

(2) No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 2$; $\delta P/bar = \pm 2$;
$\delta x_1 = \pm 1$ %.
(estimated by compiler).

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Water; H_2O; [7732-18-5]	Malinin, S.D. *Geokhimiya* 1959, (3), 235-45.

EXPERIMENTAL VALUES:

(continued)

T/K	P/bar	10^2x_1 [a]
523.15	392	5.58
	392	5.54
	490	6.5
	490	6.6
573.15	157	1.76
	157	1.81
	157	1.73
	196	2.85
	196	2.78
	196	2.74
	196	2.71
	294	5.45
	294	5.38
	294	5.59
	294	5.57
	294	5.32
	294	5.40
	294	5.30
	294	5.49
	392	8.06
	392	8.38
	392	8.31
	392	8.03
	392	8.29
	490	12.8
603.15	294	6.1
	294	5.9
	294	6.0

T/K	P/bar	y_1 [b]
473.15	196	0.849
	196	0.851
	196	0.847
	196	0.834
	196	0.850
	196	0.842
	588	0.818
523.15	196	0.644
	196	0.630
	196	0.656
	196	0.615
	490	0.673
	490	0.674
	490	0.669
	490	0.694
573.15	196	0.382
	196	0.367
	196	0.370
	196	0.360
	196	0.359
	294	0.452
	294	0.460
	294	0.450
	294	0.466
	294	0.465
	392	0.451
	392	0.458
	392	0.445
	392	0.434
	392	0.470
	490	0.403
	490	0.411
	490	0.413
	490	0.410
603.15	294	0.265
	294	0.290
	294	0.287

[a] x_1 = mole fraction of carbon dioxide in liquid

[b] y_1 = mole fraction of carbon dioxide in vapor

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Water; H_2O; [7732-18-5]	Bartels, H; Wrbitzky, R. *Pflügers Arch.* 1960, *271*, 162-8.

VARIABLES:	PREPARED BY:
$T/K = 288.15 - 311.15$ P = "atmospheric"	Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	$\alpha/[cm^3 (STP)\ cm^{-3}\ atm^{-1}]$ [b]	n [c]
15	288.15	0.9891 ± 0.006	8
20	293.15	0.8533 ± 0.003	8
25	298.15	0.7431 ± 0.004	5
30	303.15	0.6483 ± 0.014	8
35	308.15	0.5796 ± 0.004	5
38	311.15	0.5439 ± 0.003	11

[a] Added by the compiler.

[b] α = Bunsen coefficient. The values given are mean values of several measurements. The error is standard deviation.

[c] Number of measurements.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Water was saturated with CO_2 in rotating tonometer. The technique is described in Ref. 1.

The CO_2 contents of the equilibrated solutions was determined in the manometric gas apparatus (Ref. 2).

SOURCE AND PURITY OF MATERIALS:

(1) From cylinder; purity 99.8 %.

(2) Distilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$

$0.004 < |\delta\alpha/\alpha| < 0.02$

REFERENCES:

1. Laue, D. *Pflügers Arch. ges. Physiol.* 1951, *254*, 142.
2. Van Slyke, D. D.; Sendroy, J., Jr.; Hastings, A. B.; Neill, J. M. *J. Biol. Chem.* 1928, *78*, 765.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Novák, J.P.; Fried, V; Pick, J.

Collect. Czech. Chem. Commun. 1961, *26*, 2266-70.

VARIABLES:

T/K = 284.65-350.15

P/kPa = 12.8-97.5

PREPARED BY:

Rosa Crovetto

EXPERIMENTAL VALUES:

t/°C	T/K [a]	P/mmHg	P/bar [a]	10^4x_1
11.5	284.65	96	0.128	1.059
		125	0.167	1.411
		211	0.281	2.409
		237	0.316	2.716
		489	0.652	5.641
		714	0.952	8.262
20.0	293.15	127	0.169	0.982
		225	0.300	1.948
		391	0.521	3.429
		599	0.799	5.359
		678	0.904	6.179
		620	0.931	6.400
30.0	303.15	110	0.147	0.519
		126	0.168	0.724
		246	0.328	1.538
		261	0.348	1.579
		471	0.628	3.101
		696	0.928	4.758

(continued)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Saturation method. Five cylinders containing water were saturated with CO_2 in a thermostat at the pressure of measurement. No stirring was provided. Samples were withdrawn at constant pressure and titrated. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Tank quality. Light gases were distilled.

(2) Distilled.

ESTIMATED ERROR:

δT/K = ± 0.1; δx = ± 1 %

δP/kPa = ± 0.07

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Water; H_2O; [7732-18-5]	Novák, J.P.; Fried, V; Pick, J. *Collect. Czech. Chem. Commun.* 1961, *26*, 2266-70.

EXPERIMENTAL VALUES: (continued)

t/°C	T/K [a]	P/mmHg	P/bar [a]	10^4x_1
40.0	313.15	132	0.176	0.458
		274	0.365	1.203
		490	0.653	2.422
		490	0.653	2.433
		696	0.928	3.526
		702	0.936	3.596
50.0	323.15	176	0.235	0.352
		345	0.460	1.137
		520	0.693	2.053
		527	0.703	2.059
		583	0.777	2.303
		589	0.785	2.358
		687	0.916	2.834
60.0	333.15	200	0.267	0.264
		296	0.395	0.585
		508	0.677	1.358
		699	0.932	2.123
		731	0.975	2.274
69.0	342.15	310	0.413	0.368
		325	0.433	0.388
		333	0.444	0.462
		408	0.544	0.654
		429	0.572	0.695
		453	0.604	0.834
		564	0.752	1.231
		670	0.893	1.554
		710	0.947	1.669
		721	0.961	1.730
77.0	350.15	466	0.621	0.433
		468	0.624	0.491
		573	0.764	0.794
		583	0.777	0.834
		654	0.872	0.982
		699	0.932	1.162
		699	0.932	1.137
		701	0.935	1.157

---

[a] Calculated by the compiler

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Austin, W.H.; Lacombe, E.;
Rand, P.W.; Chatterjee, M.

J. Appl. Physiol. 1963, *18*, 301-4.

VARIABLES:

$T/K = 293.2 - 311.2$

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

		Bunsen coefficient, α		
T/K	No. of determinations	Mean	Range	σ [a]
293.2	4	0.8568	0.0037	0.0015
297.2	3	0.7641	0.0005	0.0003
303.2	3	0.6503	0.0039	0.0015
308.2	5	0.5825	0.0038	0.0018
311.2	4	0.5453	0.0021	0.0014

[a] σ = Standard deviation.

Unit for α is cm^3 (STP) cm^{-3} atm^{-1}

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Humidified gas dissolved in water. After equilibrium established 1 cm^3 sample withdrawn and analysed with manometric Van Slyke apparatus. It was claimed that deionised, distilled water gave the same results as acidified water.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial sample, no other details given.

(2) Distilled acidified with hydrochloric acid (0.01 mol dm^{-3}).

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$.

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Ellis, A. J.; Golding, R. M.

Am. J. Sci. 1963, *261*, 47-60.

VARIABLES:

$T/K = 450.15\text{-}607.15$

$P_1/MPa = 1.59\text{-}7.65$

PREPARED BY:

Rosa Crovetto

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	P/bar [a]	P_1/atm	10^3S [b]	10^2x_1 [a]
177	450.15	25.254	15.7	2.24	0.2235
202	475.15	34.132	17.7	2.84	0.2832
204	477.15	53.458	36.1	5.85	0.5816
229	502.15	74.355	46.3	7.73	0.7671
		71.518	43.5	7.60	0.7543
235	508.15	60.697	29.7	4.75	0.4728
261	534.15	101.463	53.1	10.9	1.078
		97.917	49.6	10.2	1.010
265	538.15	74.227	23.1	4.74	0.4718
		71.492	20.4	4.28	0.4262
309	582.15	173.76	75.5	21.6	2.114
		170.31	72.1	19.6	1.922
		166.26	68.1	18.6	1.826
334	607.15	198.70	62.6	21.7	2.124
		195.26	59.2	20.3	1.990

[a] Calculated by the compiler.

[b] $S = \dfrac{n_1/\text{mol}}{n_2/\text{mol}}$. (Mole ratio of CO_2 and water.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A static all-metal high-pressure autoclave was used. There was no stirring. Long equilibration times were used. The amounts of water and carbon dioxide in the liquid sample were determined by weighing. The H_2O was absorbed by anhydrone and the CO_2 in Carbosorb.

SOURCE AND PURITY OF MATERIALS:

(1) Not stated.

(2) Degassed.

ESTIMATED ERROR:

Not given.

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Takenouchi, S.; Kennedy, G.

Am. J. Sci. 1964, *262*, 1055-74.

VARIABLES:

T/K = 383.15-598.15

P/MPa = 10-160

PREPARED BY:

Rosa Crovetto

EXPERIMENTAL VALUES:

t/°C	T/K [a]	$K_{H,a}$/atm [b]	$K_{H,b}$/atm [b]	V_1/cm^3 mol^{-1}
110	383.15	5010	5500	28.4
150	423.15	5560	6300	30.0
200	473.15	4840	6000	27.0
250	523.15	4170	5250	4.0
275	548.15		4400	
300	573.15		3800	
325	598.15		2950	

[a] Calculated by the compiler.

[b] Henry's constants $K_{H,a}$ and $K_{H,b}$ were calculated by the authors from vapor-liquid equilibria data. $K_{H,a}$ is obtained from $K_{H,b}$ using the Krichevsky and Kasarnovsky equation[1] with the partial molar volume. Comparison with reliable partial molar volume data shows those volumes to be too low and unrealistic, especially at high temperatures. The authors state that the Henry's constants are valid to 250 °C (523.15 K).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was a high-pressure autoclave with sampling valves for both phases. No stirring was used. Samples of the dense and light phases were extracted and analyzed for their CO_2 content by titration.
The Henry's constants were obtained by graphical methods from the vapor-liquid equilibrium data.

SOURCE AND PURITY OF MATERIALS:

(1) Not stated.

(2) Distilled. Degassed by boiling.

ESTIMATED ERROR:

δT/K = ± 1.5 or larger

δP/bar = ± 5 (by compiler)

REFERENCES:

1. Krichevsky, I.R.; Kasarnovsky, J.S.
J. Am. Chem. Soc. 1935, *57*, 2168-71.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Yeh, S-Y.; Peterson, R. E.

J. Pharm. Sci. 1964, *53*, 822-4.

VARIABLES:

T/K = 298.15-318.15
P/kPa = 101.325

PREPARED BY:

Rosa Crovetto

EXPERIMENTAL VALUES:

t/°C	T/K [a]	P/bar [b]	P_1/bar [a]	L [c]	10^4x_1 [a]
25	298.15	1.013	0.982	0.8129	5.842
30	303.15		0.971	0.7264	5.084
37	310.15		0.950	0.6282	4.215
45	318.15		0.917	0.5453	3.153

[a] Calculated by the compiler.

[b] Experiments were done at a total pressure equal to atmospheric pressure.

[c] L = Ostwald coefficient [cm^3 cm^{-3}].

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method and apparatus used are described in Ref. 1 with two minor modifications: the mercury sealing cup was eliminated in the new version and the gas was presaturated with water vapor.

SOURCE AND PURITY OF MATERIALS:

(1) Research grade Matheson Co. Minimum purity 99.7 %.

(2) Redistilled from all glass still. Degassed.

ESTIMATED ERROR:

δT/K = ± 0.05; δP/mmHg = ± 2
δL = ± 1 % (authors)
(δP/bar = ± 0.003)

REFERENCES:

1. Yeh, S-Y.; Peterson, R.E.

J. Pharm. Sci. 1963, 5[illegible], 453-6.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Takenouchi, S.; Kennedy, G.

Am. J. Sci. 1965, *263*, 445-54.

VARIABLES:

T/K = 423.15-623.15
P/bar = 100-1400

PREPARED BY:

Rosa Crovetto

EXPERIMENTAL VALUES:

t/°C	T/K	P/bar	S [a]	10^2x_1 [b]
150	423.15	100	3.1	1.293
		200	5.1	2.152
		300	6.1	2.590
		400	6.9	2.944
		500	7.5	3.212
		600	8.0	3.437
200	473.15	100	3.2	1.335
		200	6.1	2.590
		300	7.9	3.392
		400	9.5	4.120
		500	10.8	4.722
		600	11.8	5.192
		800	13.2	5.860
		1000	14.2	6.345
		1200	15.0	6.737
		1400	15.6	7.034
250	523.15	100	2.8	1.165
		200	6.0	2.546
		300	9.6	4.166
		400	12.1	5.334
		500	14.3	6.394
		600	16.4	7.433
		800	20.4	9.495
		1000	24.2	11.56
		1200	27.2	13.26
		1400	28.8	14.21
300	573.15	100	1.0	0.4118
		200	6.4	2.723
		300	12.2	5.382
		400	18.2	8.347
		500	26.4	12.80
350	623.15	200	3.6	1.506
		300	14.3	6.394

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[a] Solubility of CO_2, expressed as mass % of CO_2 in water.
[b] Calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The experimental equipment and apparatus are the same as used in previous experimental work.[1] After equilibration, the liquid samples are analyzed for the amounts of CO_2. The composition of the co-existing gas phase was not determined.

(The authors also present data for the solubility of CO_2 in aqueous solutions of NaCl.)

SOURCE AND PURITY OF MATERIALS:

(1) Not stated.

(2) Not stated.

ESTIMATED ERROR:

δT/K = ± 0.8 % (by authors)
δS = ± 2 % (by authors)

REFERENCES:

1. Takenouchi, S.; Kennedy, G.
   Am. J. Sci. 1964, *262*, 1055-74.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Vilcu, R.; Gainar, I.

Rev. Roum. Chim. 1967, *12*(2), 181-9.

VARIABLES:

T/K = 293.16-308.16

P/MPa = 2.53-6.08

PREPARED BY:

Rosa Crovetto

EXPERIMENTAL VALUES:

T/K	P/bar [a]	P/atm	S [b]	10^2x_1 [a]
293.16	25.33	25	0.0130	1.300
	30.40	30	0.0145	1.450
	40.53	40	0.0174	1.740
	45.60	45	0.0188	1.880
	50.66	50	0.0204	2.040
298.16	35.46	35	0.0127	1.270
	40.53	40	0.0134	1.340
	44.58	44	0.0155	1.550
	50.66	50	0.0172	1.720
	55.73	55	0.0187	1.870
	60.80	60	0.0203	2.030
308.16	35.46	35	0.0081	0.810
	40.53	40	0.0099	0.990
	45.60	45	0.0112	1.120
	50.66	50	0.0131	1.310
	55.73	55	0.0148	1.480
	60.80	60	0.0163	1.630
	65.86	65	0.0181	1.810
	70.93	70	0.0196	1.960
	75.99	75	0.0214	2.140

[a] Calculated by the compiler.

[b] Solubility of CO_2 (cm^3 at STP per cm^3 of water at the pressure of experiment).

Compiler: The vapor pressure of CO_2 at the temperature of the measurements:

T/K	P/atm
293.16	56.5
298.16	63.5

Data at pressures larger than the vapor pressure of CO_2 are not considered gas-liquid equilibria.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A conventional high-pressure cell was used. During equilibration the system was constantly stirred. The amount of CO_2 in the liquid was determined by gas chromatografic analysis. A good temperature control and measurement system was built into the system.

SOURCE AND PURITY OF MATERIALS:

(1) Pure.

(2) Not given.

ESTIMATED ERROR:

Not stated.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Matous, J.; Sobr, J.; Novak, J.P.; Pick, J.

Collect. Czech. Chem. Commun. 1969, *34*, 3982 - 5.

VARIABLES:

T/K = 303.15 - 353.15

P_1/MPa = 0.99 - 3.90

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P_1/bar	10^2x_2
303.15	9.9	0.507
	19.3	0.932
	30.3	1.364
	38.9	1.697
323.15	9.9	0.334
	19.2	0.606
	29.9	0.938
	39.0	1.198
353.15	8.8	0.197
	9.8	0.218
	18.8	0.407
	29.8	0.620
	38.8	0.794

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Cell charged with components, equilibrated and pressure measured with Bourdon gauge. Liquid sampled and analysed by stripping with nitrogen and absorbing dried carbon dioxide on absorbent containing sodium hydroxide.

SOURCE AND PURITY OF MATERIALS:

(1) Lachema, Novy Bohumin purity better than 99 mole %.
(2) Deionised sample.

ESTIMATED ERROR: (by compiler)

δT/K = ± 0.1; δP_1/bar = ± 0.5

δx_1 = ± 0.2 x 10^{-4}

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Power, G.G.; Stegall, H.

J. Appl. Physiol. 1970, *29*, 145 - 9.

VARIABLES:

T/K = 310.15

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	α [a]	σ [b]	No. of measurements
310.15	0.5485	0.0011	4

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]
[b] σ = Standard deviation

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

5 to 12 cm^3 samples placed in a stirrer cell and gas, saturated with water vapor, passed through water for 30-60 min. Samples of saturated liquid withdrawn and transferred to Van Slyke apparatus. Dissolved gas removed under reduced pressure.

SOURCE AND PURITY OF MATERIALS:

(1) Matheson sample, purity better than 99.7 mole %.
(2) Nothing stated.

ESTIMATED ERROR:

δT/K = ± 0.1

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]
(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Stewart, P.B.; Munjal, P.
J. Chem. Eng. Data 1970, *15*, 67-71.

VARIABLES:

$T/K = 273.15 - 298.15$
$P/MPa = 1.013 - 4.560$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	10^2x_1	$10^2m_1/m_2$ [a]	T/K	P/bar	10^2x_1	$10^2m_1/m_2$ [a]
273.15	10.13	1.267	3.133	283.15	10.13	0.8535	2.102
	25.33	2.394	5.988		20.26	1.533	3.801
	30.40	2.637	6.614		38.50	2.185	5.455
278.15	10.13	1.055	2.603	285.55	45.60	2.204	5.503
	20.26	1.806	4.492	298.15	20.26	1.026	2.403
	38.50	2.532	6.342		45.60	1.655	4.110

[a] m_1/m_2 = solubility of carbon dioxide; m_1 = mass of CO_2 ; m_2 = mass of H_2O

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Rocking equilibrium cell fitted with Bourdon-type pressure gauges. Carbon dioxide gas admitted to cell containing water. After equilibrium established samples of liquid withdrawn and analyzed by stripping out carbon dioxide, absorbing in excess barium hydroxide and back-titrating.

SOURCE AND PURITY OF MATERIALS:

(1) Matheson research grade, purity 99.99 mole %.

(2) Degassed and distilled.

ESTIMATED ERROR: (by compiler)

$\delta T/K = \pm 0.06$; $\delta P/kPa = \pm 2$ below 3.6 MPa, ± 3.4 above 3.6 MPa; $\delta x_1/x_1 = \pm 1$ %

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]
(2) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Barton, J. R.; Hsu, C. C.
J. Chem. Eng. Data 1971, *16*, 93-5.

VARIABLES:

$T/K = 273.35 - 313.15$
$P_1/kPa = 101.325$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	P_1/atm	P_1/kPa [a]	$\alpha/[cm^3\ (STP)\ cm^{-3}\ atm^{-1}]$ [b]
0.2	273.35	1	101.325	1.699 ± 0.003
25	298.15	1	101.325	0.758 ± 0.001
40	313.15	1	101.325	0.530 ± 0.002

[a] Added by the compiler; [b] α = Bunsen coefficient

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The Ostwald type apparatus used in the measurements was based on the original design of Markham and Kobe (Ref.1) but also included the modifications suggested by Yen and McKetta (Ref. 2).

SOURCE AND PURITY OF MATERIALS:

(1) Matheson Co. The Coleman grade CO_2. Minimum purity of 99.99 %.

(2) Distilled. Refractive index of 1.3332 at 19.5 °C.

REFERENCES:

1. Markham, A. E.; Kobe, K. A. *J. Am. Chem. Soc.* 1941, *63*, 449.

2. Yen, L. C.; McKetta, J. J. *J. Chem. Eng. Data* 1962, *7*, 288.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; The maximum error in determination of a gas volume was estimated to be ± 0.05 %.

$\delta\alpha/\alpha$ = ± 0.18 % at 0.2 °C
± 0.13 % at 25 °C
± 0.38 % at 40 °C

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Li, Y.-H.; Tsui, T.-F.

J. Geophys. Res. 1971, *76*, 4203-7.

VARIABLES:

T/K = 273.85-303.15

P_1/kPa = 101.325

PREPARED BY:

Rosa Crovetto

EXPERIMENTAL VALUES:

t/°C	T/K [a]	P/bar [a]	P_1/atm	$10^2 S/S^\ominus$ [b]	$10^3 x_1$ [a]
0.7	273.85	1.020	1.00	7.501	1.350
4.0	277.15	1.021		6.603	1.188
10.2	283.35	1.026		5.302	0.9545
20.0	293.15	1.037		3.911	0.7053
30.0	303.15	1.056		2.997	0.5420

[a] Calculated by the compiler.

[b] S = solubility of CO_2; $S^\ominus$ = 1 mol L^{-1} atm^{-1}.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Equilibration was achieved by bubbling gas through thermostatted water overnight.
A liquid sample was analyzed for CO_2 using an IR technique.

SOURCE AND PURITY OF MATERIALS:

(1) Pure, (99.99 ± 0.01)%.

(2) Distilled.

ESTIMATED ERROR:

Temperature controlled to ± 0.02 K.
δP/mmHg = ± 0.005 (by authors).

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Murray, C. N.; Riley, J. P.

Deep-Sea Res. 1971, *18*, 533-41

VARIABLES:

T/K = 274.19-308.15

P_1/kPa = 101.325

PREPARED BY:

Rosa Crovetto

EXPERIMENTAL VALUES:

t/°C	T/K [a]	P/bar [a]	P_1/atm	α [b]	$10^4 x_1$ [a]
1.04	274.19	1.020	1.000	1.6471	13.31
5.00	278.15	1.022		1.4199	11.48
10.00	283.15	1.026		1.1926	9.645
15.00	288.15	1.030		1.0100	8.174
20.00	293.15	1.037		0.8652	7.009
25.00	298.15	1.045		0.7519	6.099
32.00	305.15	1.061		0.6336	5.150
35.00	308.15	1.070		0.5905	4.805

[a] Calculated by the compiler.

[b] Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].
The results are the mean of at least three measurements.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Equilibrated solutions were prepared by bubbling gas through magnetically stirred water till equilibrium was reached.
The CO_2 content was determined by acidifying the solutions and after degassing them, precisely weighing the evolved CO_2.

SOURCE AND PURITY OF MATERIALS:

(1) 99.9 %, tested by mass spectrometry.

(2) Conductivity water, degassed.

ESTIMATED ERROR:

δT/K = ± 0.02 (by authors)

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Weiss, R. F.

Mar. Chem. 1974, *2*, 203-15.

VARIABLES:

$T/K = 293.8$

PREPARED BY:

Rosa Crovetto

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	$10^2 K_0/\text{mol L}^{-1}\text{ atm}^{-1}$ [b]
20.61	293.76	3.848
20.63	293.78	3.843
20.60	293.75	3.867
20.59	293.74	3.834
20.61	293.76	3.840

[a] Calculated by the compiler.

[b] Solubility of CO_2. Only the gaseous CO_2 is considered. Ionized dissolved CO_2 has been deducted from this quantity. There are not enough data in the source to convert to total dissolved molar fraction. No raw experimental data are given.

Besides the experimental values given, the author corrected and fitted Murray's et al data[1] and provides a table of smoothed data.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Microgasometric tecnique.[2]
The paper also reports on solubilities in seawater.

Very careful corrections were performed. The data were corrected for change of volume of water due to dissolution, real gas behavior, and dissociation.

SOURCE AND PURITY OF MATERIALS:

(1) High purity CO_2. Tank. Matheson. Purity better than 99.99%.

(2) Distilled water.

ESTIMATED ERROR:

The overall accuracy in K_0 is estimated as ± 0.2 % by author.

REFERENCES:

1. Murray, C. N.; Riley, J. P. *Deep-Sea Res.* 1971, *18*, 533-41.

2. Weiss, R. F. *Deep-Sea Res.* 1970, *17*, 721-35.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Shagiakhmetov, R.A.; Tarzimanov, A.A.

Deposited Doc. 1981, *SPSTL 200 khp - D 81*, 1982.

VARIABLES:

T/K = 323.15-423.15
P/MPa = 10-80

PREPARED BY:

Rosa Crovetto

EXPERIMENTAL VALUES:

t/°C	T/K [a]	P/bar [a]	P/MPa	S [b]	10^2x_1 [a]
50	323.15	100	10	25.2	1.999
		200	20	29.0	2.293
		400	40	33.7	2.655
		600	60	36.3	2.854
100	373.15	100	10	18.1	1.444
		200	20	25.6	2.030
		400	40	31.8	2.509
		600	60	37.0	2.907
		800	80	45.1	3.521
150	423.15	100	10	14.5	1.160
		200	20	26.4	2.092
		400	40	38.7	3.037
		600	60	55.4	4.291
		800	80	76.4	5.823

[a] Calculated by the compiler.

[b] Solubility of CO_2 (cm^3 of gas at STP per gram of water).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A static method with sampling and analysis of the liquid phase was used. To attain equilibrium, the cell was gently rocked over 160 degrees.

(The authors also did measurements at 298.15 K, but as the experimental pressures are greater than the CO_2 vapor pressure at that temperature, the data at 298.15 K are not given here.)

SOURCE AND PURITY OF MATERIALS:

(1) Not stated.

(2) Not stated.

ESTIMATED ERROR:

$\delta S = \pm$ (3-5) % (by authors)

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Water; H_2O; [7732-18-5]	Zawisza, A.; Malesinska, B. *J. Chem. Eng. Data* 1981, *26*, 388-91.

VARIABLES:	PREPARED BY:
$T/K = 323.15-473.15$ $P/MPa = 0.154-5.389$ $x_2 = 0.9924-0.9995$	Rosa Crovetto

EXPERIMENTAL VALUES:

T/K	P/bar [a,b]	x_1 [a]	T/K	P/bar [a,b]	x_1 [a]
323.15	2.54	0.0005	423.15	7.69	0.0005
	4.88	0.0016		15.56	0.0016
	7.62	0.0025		21.24	0.0025
	8.92	0.0030		24.99	0.0030
	14.41	0.0046		36.09	0.0046
	25.05	0.0076			
			448.15	11.97	0.0005
348.15	2.37	0.0005		19.77	0.0016
	21.00	0.0046		25.96	0.0025
	35.91	0.0076		30.37	0.0030
				40.80	0.0046
373.15	3.56	0.0005			
	27.10	0.0046	473.15	18.44	0.0005
	45.60	0.0076		25.39	0.0016
				31.75	0.0025
398.15	5.27	0.0005		35.85	0.0030
	11.45	0.0016		46.16	0.0046
	17.73	0.0025			
	21.38	0.0030			
	32.35	0.0046			
	53.89	0.0076			

[a] Calculated by the compiler.
[b] Bubble point pressure.

The authors calculated Henry's constants from the data using the virial equation of state. Various corrections were applied. The values of Henry's constants at different temperatures, given as they are in the original source, are listed in the following table:

T/K	323.15	348.15	373.15	398.15	423.15	448.15	473.15
H_p/MPa	303.4	449.6	525.6	588.9	632.8	631.8	593.7

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A static method was used to determine the dew and boiling points of CO_2/H_2O mixtures at several pressures and temperatures[1]. The apparatus and the method were checked by measuring the vapor pressure of pure water.

Also given are gas phase compositions, dew points, and molar volume of the gas phase over all the concentration range of both components.

SOURCE AND PURITY OF MATERIALS:

(1) Prepared from Na_2CO_3 treated with 10 % aqueous H_2SO_4. Dried over P_2O_5.

(2) Distilled twice.

ESTIMATED ERROR:

$\delta T/K = \pm 0.005$ (by authors)
$\delta P = \pm 0.03$ % (by authors)

REFERENCES:

1. Aftienjew, J.; Zawisza, A.

J. Chem. Thermodyn. 1977, *9*, 153.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Cramer, S. D.

Rep. Invest. - U.S., Bur. Mines 1982, RI 8706.

VARIABLES:

$T/K = 306.15\text{-}486.25$
$P/MPa = 0.8\text{-}5.8$

PREPARED BY:

Rosa Crovetto

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	P/bar [a]	P/MPa	K_H/MPa [b]	10^3x_1 [a]
33	306.15	8.0	0.8	206	3.760
126.3	399.45	20.0	2.0	602	2.865
132.5	405.65	20.0	2.0	617	2.716
146.0	419.15	28.0	2.8	565	4.158
153.5	426.65	31.0	3.1	580	4.356
198.1	471.25	41.0	4.1	537	4.758
213.1	486.25	58.0	5.8	484	7.172

[a] Calculated by the compiler.

[b] Henry's constant as given by the author, equals partial pressure of CO_2 times fugacity coefficient from generalized chart divided by the composition in the liquid phase. ($K_H = P_1\phi_1/x_1$). The author assumes $P_1 = P-P_2$, where P_2 is the vapor pressure of water at the corresponding temperature.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A two liter, 316 stainless steel stirred reactor was used.
Water was degassed "in situ".
The concentration of the gas in the liquid was determined by desorption from a known volume of liquid followed by volumetric analysis of the evolved gas.
Equilibration times were of the order of five hours at 150 °C and above.

SOURCE AND PURITY OF MATERIALS:

(1) 99.5 %.

(2) Demineralized.

ESTIMATED ERROR:

In Henry's constant 5.8 % (by author). (Detailed analysis of experimental contributions to the total error is given in the source.)

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Postigo, M.A.; Katz, M.

J. Solution Chem. 1987, *16*, 1015-24.

VARIABLES:

T/K = 288.15-308.15
p/kPa = 101.3

PREPARED BY:

R.W. Cargill

EXPERIMENTAL VALUES:

t/°C	T/K [a]	K_H/MPa [b]	L [a,c]	$10^3 x_1$ [a]
15	288.15	123.7	1.075	0.819
20	293.15	143.3	0.943	0.707
25	298.15	165.5	0.829	0.612
30	303.15	188.8	0.738	0.537
35	308.15	211.7	0.668	0.479

[a] Calculated by compiler.

[b] K_H = Henry's law constant.

[c] L = Ostwald coefficient [cm^3 cm^{-3}].

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Known volumes of gas and solvent were introduced into 250 cm^3 flask, then initial and final pressures were measured by a transducer connected to a digital multimeter. The flask was submerged in a thermostatic bath. Full details given in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Carbon dioxide: no information

(2) Water: degassed by boiling; composition checked by refractive index measurement at 298 K.

ESTIMATED ERROR:

δT/K = ± 0.02;
δP_1/Pa = ± 10;
$\delta L/L$ = 1 %

REFERENCES:

1. Postigo, M.A.; Pedrosa, G.C.; Katz, M.
Anal. Asoc. Quim. Argentina, 1978, *66*, 25.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Müller, G.; Bender, E.; Maurer, G.

Ber. Bunsenges. Phys. Chem. 1988, *92*, 148-60.

VARIABLES:

$T/K = 373.15 - 473.15$
$p/MPa = 0.325 - 8.11$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

T/K	p/MPa	10^2x_1 [a]	10^2y_1 [b]	T/K	p/MPa	10^2x_1 [a]	10^2y_1 [b]
373.15	0.325	0.045	71.2 ± 1.1	433.15	2.183	0.249	67.7 ± 0.9
	0.600	0.098	84.5 ± 0.7		2.588	0.308	72.5 ± 0.9
	0.920	0.159	89.3 ± 0.5		3.48	0.434	78.9 ± 0.7
	1.191	0.208	92.3 ± 0.4				
	1.452	0.261	93.1 ± 0.3	453.15	1.439	0.081	27.2 ± 0.7
	1.816	0.328	94.6 ± 0.2		2.101	0.186	47.8 ± 0.9
	2.307	0.414	95.5 ± 0.2		2.615	0.270	56.9 ± 0.9
					3.28	0.374	64.1 ± 0.9
393.15	0.599	0.071	66.3 ± 1.1		4.07	0.493	70.0 ± 0.8
	0.939	0.127	79.5 ± 0.8		4.91	0.615	74.3 ± 0.7
	1.265	0.181	84.0 ± 0.7		6.27	0.783	79.3 ± 0.6
	1.631	0.239	87.8 ± 0.6				
	1.995	0.298	89.8 ± 0.5	473.15	2.000	0.068	23.3 ± 0.7
	2.412	0.363	91.7 ± 0.4		2.494	0.156	37.1 ± 1.0
	2.848	0.428	92.6 ± 0.3		3.10	0.257	48.6 ± 1.0
					3.76	0.374	57.4 ± 0.9
413.15	0.650	0.047	43.1 ± 1.2		4.57	0.500	63.5 ± 0.8
	0.926	0.092	59.4 ± 1.2		6.04	0.712	70.8 ± 0.6
	1.193	0.133	68.3 ± 1.1		7.80	0.932	75.6 ± 0.6
	1.603	0.197	75.8 ± 0.9				
	2.010	0.258	80.0 ± 0.8		2.027	0.091	24.5 ± 0.7
	2.489	0.325	83.9 ± 0.6		2.638	0.196	40.8 ± 0.9
	3.247	0.430	87.2 ± 0.5		3.40	0.320	52.9 ± 0.9
					4.20	0.448	60.8 ± 0.8
433.15	0.878	0.039	26.8 ± 0.9		5.12	0.586	66.8 ± 0.8
	1.144	0.084	42.1 ± 1.1		6.52	0.789	72.4 ± 0.6
	1.417	0.131	52.4 ± 1.1		8.11	1.032	76.2 ± 0.6
	1.777	0.186	61.2 ± 1.1				

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[a] x_1 = mole fraction of CO_2 in the liquid phase

[b] y_1 = mole fraction of CO_2 in the vapor phase

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A static high-pressure apparatus was used. A schematic diagram of the apparatus and details of the method are in the original source.

(The authors also present data for the vapor-liquid equilibria in the binary system $NH_3 + H_2O$, and in the ternary system $NH_3 + CO_2 + H_2O$.)

SOURCE AND PURITY OF MATERIALS:

(1) Linde, Höllriegelskreuth; 99.9996 vol. %

(2) Double distilled and degassed. Conductivity $\kappa = 1.2 \times 10^{-4}$ S m^{-1}

ESTIMATED ERROR:

$\delta T/K < \pm 0.1$
$\delta p/p \approx \pm 0.01$
$\delta x_1/x_1 < 0.018$

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Water; H_2O; [7732-18-5]	Versteeg, G.F.; van Swaaij, W.P.M. *J. Chem. Eng. Data* 1988, *33*, 29-34.
VARIABLES:	PREPARED BY:
$T/K = 291 - 360.1$ $P/kPa \leq 10^2$	Pirketta Scharlin

EXPERIMENTAL VALUES:

T/K	$10^4 K_H$/mol m^{-3} Pa^{-1} [a]
291	4.05
292	4.15
292	3.89
293	3.80
298	3.37
298	3.29
303	2.80
308	2.54
311.4	2.44
313	2.37
313.4	2.38
318	2.06
323	1.94
333	1.63
343.5	1.40
350.2	1.32
355.2	1.20
360.1	1.08

[a] K_H = Henry's law constant

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility was measured in a glass vessel which was filled with a calibrated volume of solvent. The solvent was degassed, and the vapor-liquid equilibrium was established. Equilibrium pressure was recorded by a pressure transducer. The gas was fed to the vessel until an arbitrary pressure ($P \leq 10^5$ Pa) was reached. The pressure was recorded again. The vessel was closed, and the magnetic stirrer was started to agitate the liquid. After the equilibrium pressure was reached the solubility was calculated, based on Henry's law.

In the paper the authors report solubility and diffusivity of CO_2 and N_2O in water and aqueous alkanolamine solutions.

SOURCE AND PURITY OF MATERIALS:

(1) Nothing specified.

(2) Distilled. Degassed.

ESTIMATED ERROR:

The reproducibility between the various experiments was within 3 %.

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

ORIGINAL MEASUREMENTS:

Yuan, C-B.; Yang, J-Z.

Gaodeng Xuexiao Huaxue Xuebao 1993, *14*, 80-3.

VARIABLES:

$T/K = 278.15 - 318.15$
$P/kPa = 101.325$

PREPARED BY:

Pirketta Scharlin
Xiaohui Shen

EXPERIMENTAL VALUES:

Table 1. Solubility of CO_2 in water

T/K	$10^2 S_1/mol\ kg^{-1}$ [a]
278.15	6.11
288.15	4.29
298.15	3.13
308.15	2.56
318.15	2.10

[a] S_1 = solubility of CO_2

The experimental solubilities from Table 1 were fitted to an equation

$$\lg S_1 = A/T + B + CT \tag{1}$$

The coefficients of eq. (1) and the standard deviation in lg S_1 are listed in Table 2.

Table 2. Coefficients of eq. (1) for smoothed results for solubility of CO_2 in H_2O

A	B	C	σ [a]
4608.8	-28.953	0.04018	0.02

[a] σ = standard deviation in lg S_1

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static-state method. The authors designed a solubility apparatus which is composed of three isothermal pre-saturators, saturator and sampler. A schematic diagram of the apparatus is in the original source. CO_2 was introduced (10 hours) through the pre-saturators and the saturator which contained about 120 g of solvent. The equilibrated sample (about 100 g) was transferred from the saturator into the weighed sampler which contained a weighed amount of standard NaOH solution. The sampler was weighed again and shaken to complete the reaction between CO_2 and NaOH. The excess of NaOH and the $NaHCO_3$ was titrated potentiometrically with standard HCl solution. The mass of dissolved CO_2 was calculated from the equation

$$w = c_{HCl}(V_2 - V_1)M$$

where w = mass of dissolved CO_2, c_{HCl} = concentration of HCl; V_1 and V_2 are volumes of the HCl solution to the first and second end point, respectively, and M = molar mass of CO_2.

(The authors also report solubilities of CO_2 in 15 mass % glucose/H_2O and in NaCl + 15 mass % glucose/H_2O.)

SOURCE AND PURITY OF MATERIALS:

(1) Purity of CO_2 99.95 %.

(2) Double deionized. Conductivity of H_2O was $< 1.5\times10^{-4}$ S m^{-1}

ESTIMATED ERROR:

$\delta T/K = \pm 0.02$

When fitting the data to the equation $\lg S_1 = A/T + B + CT$, the standard deviation was $\sigma = 0.02$. (Table 2.)

COMPONENTS:	EVALUATOR:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Water-d_2; D_2O; [7789-20-0] (3) Water; H_2O; [7732-18-5]	Pirketta Scharlin Department of Chemistry University of Turku FIN-20500, Turku, Finland August 1995

CRITICAL EVALUATION:

The Solubility of Carbon Dioxide in D_2O and in Mixtures of D_2O and H_2O.

The system CO_2-D_2O has not been studied by many workers. The first solubility measurements were made by Curry and Hazelton (1) in 1938, a few years after the discovery of deuterium. Since then only three research groups have reported solubility data for CO_2 in heavy water. Salomaa *et al.* (3) measured the solubility of CO_2 in pure H_2O, pure D_2O and in mixtures of H_2O and D_2O at 298.15 K and atmospheric pressure using the same method as Curry and Hazelton. Kratochvil *et al.* (5) report solubility values in pure D_2O at three temperatures (303.15, 323.15, and 353.15 K) and partial pressures of CO_2 between 55 and 3972 kPa. The data from references (1), (3) and (5) are used in this evaluation. At high temperatures and pressures there exists one set of measurements by Kapitanov *et al.* (6). Unfortunately, there is not enough information in Kapitanov's paper for the calculation of mole fraction solubilites, and these data will not be handled further in this evaluation.

To represent the temperature dependence of the mole fraction solubility of CO_2 in D_2O at 101.325 kPa partial pressure of gas the data from references (1), (3) and (5) were fitted to equation 1.

$$\ln x_1 = A + B / (T/100\ \mathrm{K}) + C \ln(T/100\ \mathrm{K}) \tag{1}$$

The best fit for the five points in the temperature range 298 - 353 K gave equation 2,

$$\ln x_1 = -34.0577 + 49.6909 / (T/100\ \mathrm{K}) + 9.1455 \ln(T/100\ \mathrm{K}) \tag{2}$$

where x_1 is the mole fraction solubility of CO_2 at 101.325 kPa partial pressure of gas. The fit in $\ln x_1$ gave a standard deviation of 1.1 %. Smoothed values of the mole fraction solubility and changes in the thermodynamic functions on solution are shown in Table 1 at 5 K intervals. The thermodynamic properties were calculated from the smoothing equation according to the following equations:

$$\Delta S_1^\circ = R\,[A + C \ln(T/100\ \mathrm{K}) + C] \tag{3}$$

$$\Delta H_1^\circ = R\,(-100B + CT) \tag{4}$$

Table 1. Smoothed values of the solubility of carbon dioxide in water-d_2, and thermodynamic functions[a] at 5 K intervals using equation 2 at 101.325 kPa partial pressure of gas.

T/K	$10^3 x_1$	ΔH_1°/kJ mol^{-1}	ΔS_1°/J K^{-1} mol^{-1}
298.15	0.611	-18.6	124
303.15	0.540	-18.3	123
308.15	0.481	-17.9	122
313.15	0.431	-17.5	120
318.15	0.388	-17.1	119
323.15	0.351	-16.7	118
328.15	0.320	-16.4	117
333.15	0.293	-16.0	116
338.15	0.269	-15.6	114
343.15	0.248	-15.2	113
348.15	0.230	-14.8	112
353.15	0.214	-14.5	111

[a] For the calculation of $\Delta C_{p,1}^\circ$ an equation $\Delta C_{p,1}^\circ = RC$ can be derived from equation 1. This gives a value of 76 J K^{-1} mol^{-1} for $\Delta C_{p,1}^\circ$.

Figure 1 shows the temperature dependence of the mole fraction solubility for carbon dioxide in D_2O at 101.325 kPa partial pressure of gas. The curve was obtained from the smoothing equation 2. For comparison, the temperature dependence of the mole fraction solubility for CO_2 in H_2O is presented in the same figure as a dotted curve which was obtained from the smoothing equation given by Carroll and Mather in the CO_2-H_2O section of this volume ("The Solubility of Carbon Dioxide in Water at Low Pressure", Eq. (1)).

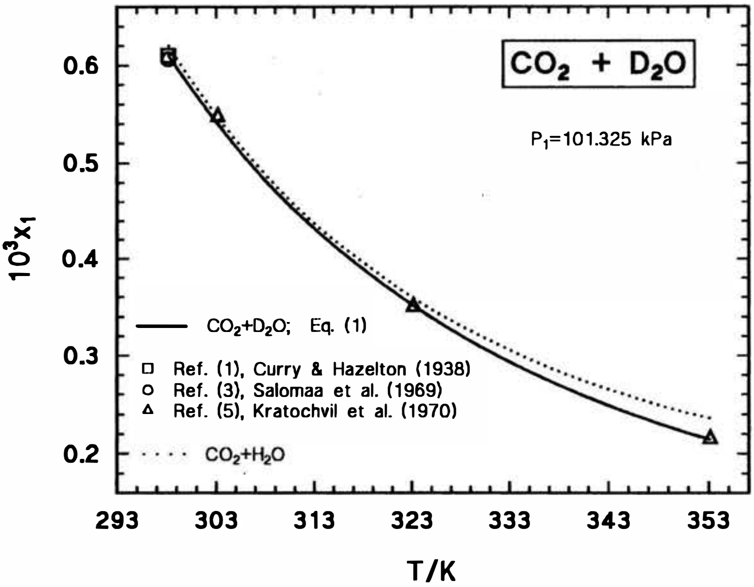

Figure 1. Mole fraction solubility of carbon dioxide in D_2O at 298.15 to 353.15 K and 101.325 kPa partial pressure of gas. For comparison, the mole fraction solubility of CO_2 in H_2O in the same temperature interval is presented as the dotted curve.

In Figure 2 the pressure dependence of the mole fraction solubility of carbon dioxide in D_2O at three different temperatures is presented.

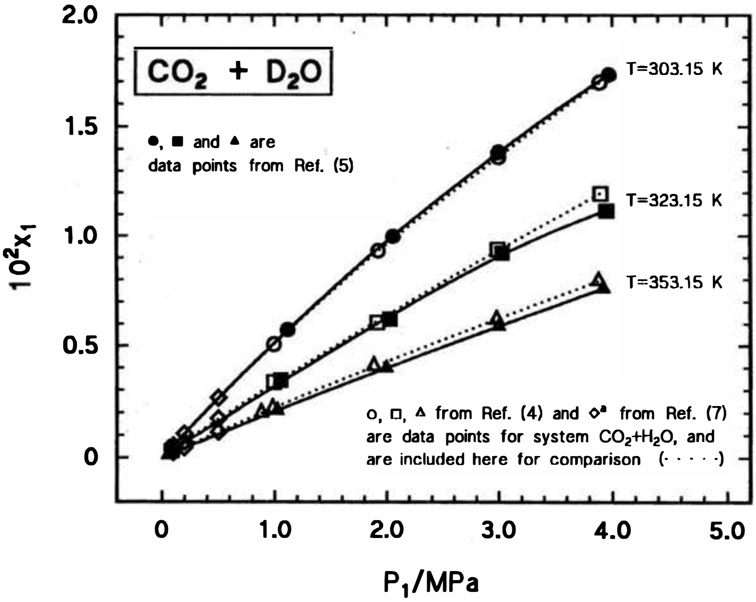

Figure 2. Mole fraction solubility of CO_2 *vs.* partial pressure of CO_2 at different temperatures. [a] Data points ◇ are from calculated values obtained using the model outlined in Ref. (7).

The only reported data for the solubility of CO_2 in mixtures of D_2O and H_2O are the data of Salomaa *et al.* (3). In the original paper the Ostwald coefficients are given. To calculate the molality of CO_2 in mixed solutions the H_2O-D_2O density data are needed. Salomaa has unpublished density data which are worth publishing in this connection. In his measurements, Salomaa used the procedure described by Kirshenbaum (2). The values for the density of L_2O (L = H,D) at 298.15 K are listed in Table 2.

Table 2. Density of H_2O-D_2O mixtures at 298.15 K.

$x(D;L_2O)$ [a]	$\rho(L_2O)/g\ cm^{-3}$ (L = H,D)
0.4524	1.045974
0.4695	1.048081
0.6156	1.063921
0.9373	1.098754
0.9399	1.099030
0.9881	1.104246
0.9980	1.105312

[a] $x(D;L_2O)$ = deuterium isotope mole fraction of water, (L = H,D)

By the method of least squares equation (5) is obtained from the data of Table 2. The linear correlation between $\rho(L_2O)$ and $x(D;L_2O)$ is excellent (correlation coefficient r = 0.999995), and at $x(D;L_2O) = 0$ the density values extrapolate well to the density of pure H_2O at 298.15 K, as they should.

$$\rho(L_2O)/g\ cm^{-3} = (0.10852 \pm 0.00015) \times x(D;L_2O) + (0.99704 \pm 0.00012) \tag{5}$$

Using a real gas molar volume of 24.34 $dm^3\ mol^{-1}$ and the L_2O densities obtained from equation (5), the evaluator calculated the molalities of CO_2 in the mixtures of H_2O and D_2O from the Ostwald coefficients given in (3). In Figure 3 the molality of CO_2 at 298.15 K and 101.325 kPa partial pressure of CO_2 is presented as a function of the deuterium isotope mole fraction $x(D;L_2O)$ in the solvent water.

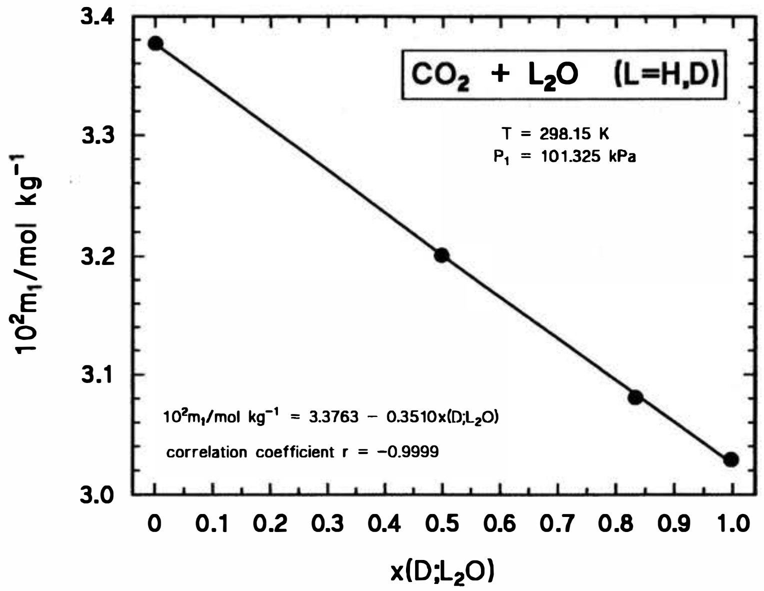

Figure 3. Molality of CO_2 *vs.* the deuterium isotope mole fraction of solvent water.

Comparison of the smoothed mole fraction solubilities of CO_2 in D_2O (from Table 1) with corresponding solubilities of CO_2 in H_2O (Carroll & Mather, CO_2-H_2O section, "The Solubility of Carbon Dioxide in Water at Low Pressure", Table 1, Equation (1)) shows that between 298.15 and 323.15 K the solubility of CO_2 in D_2O is 1.5 - 2 % lower than the solubility of CO_2 in H_2O. The difference increases with increasing temperature, and at 353.15 K the mole fraction solubility of CO_2 in D_2O is about 9 % lower than in H_2O (see also Fig. 1). This differs from most simple nonpolar gases for which the mole fraction solubility in D_2O is higher than in H_2O by about 5 - 15 % at 288.15 to 318.15 K and 101.325 kPa partial pressure of gas (8, 9).

The experimental values of Kratochvil *et al.* (5) predict a higher value for the solubility of CO_2 in D_2O at 298.15 K and 101.325 kPa than the value for the solubility of CO_2 in H_2O. However, the two independent measurements (1, 3) at 298.15 K and 101.325 kPa, which are in good agreement with each other, support the value of $x_1 = 0.611 \cdot 10^{-3}$ for the solubility of CO_2 in D_2O, which is 1.6 % lower than the solubility in H_2O. The systematic solubility measurements of Salomaa *et al.* (3) in both isotopically pure waters and in their mixtures show that the solubility of CO_2 decreases with increasing deuterium content of water (Fig. 3) supporting the result that CO_2 is more soluble in H_2O than in D_2O at 298.15 K and 101.325 kPa. The measurements of Kratochvil *et al.* (5) at 323.15 and 353.15 K and at higher pressures also indicate a higher solubility of CO_2 in H_2O than in D_2O.

Because of the rather small number of measurements on the solubility of carbon dioxide in D_2O, the results are classed as tentative until confirmed by additional measurements.

References:

1. Curry, J.; Hazelton, C. L. *J. Am. Chem. Soc.* 1938, *60*, 2271.
2. Kirshenbaum, I. *Physical Properties and Analysis of Heavy Water*, McGraw-Hill Book Company, Inc., New York, 1951, pp- 2-17 and pp. 249-251.
3. Salomaa, P.; Vesala, A.; Vesala, S. *Acta Chem. Scand.* 1969, *23*, 2107.
4. Matouš, J.; Šobr, J.; Novák, J. P.; Pick, J. *Collect. Czech. Chem. Commun.* 1969, *34*, 3982.
5. Kratochvil, J.; Šobr, J.; Matouš, J.; Pick, J. *Collect. Czech. Chem. Commun.* 1970, *35*, 3761.
6. Kapitanov, V. F.; Shcherbakova, O. M. *Zh. Fiz. Khim.* 1983, *57*, 1785; **Russ. J. Phys. Chem.* (Engl. Transl.) 1983, *57*(7), 1080.
7. Carroll, J. J.; Slupsky, J. D.; Mather, A. E. *J. Phys. Chem. Ref. Data* 1991, *20*, 1201.
8. Scharlin, P.; Battino, R. *J. Solution Chem.* 1992, *21*, 67.
9. Scharlin, P.; Battino, R. *Fluid Phase Equil.* 1994, *94*, 137.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Water-d_2; D_2O; [7789-20-0]

ORIGINAL MEASUREMENTS:

Curry, J.; Hazelton, C. L.

J. Am. Chem. Soc. 1938, *60*, 2271-3.

VARIABLES:

$T/K = 298.15$ K
$P_1/kPa = 94.62 - 97.49$

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	$P/mmHg$	$P_1/mmHg$	10^4x_1 [b]	$L/cm^3\ cm^{-3}$ [c]
25.00	298.15	741.2	718.6		0.817
		743.7	720.4		0.818
		749.9	726.6		0.817
		732.8	709.7		0.831
		735.9	712.6		0.823
		754.5	731.2		0.810
				6.10	Av. 0.819 ± 0.005

[a] Added by the compiler.

[b] The mole fraction solubility at a carbon dioxide partial pressure of 101.325 kPa (760 mmHg) was calculated by the compiler using a real gas molar volume of 24.34 $dm^3\ mol^{-1}$ and a heavy water density of 1.1042 $g\ cm^{-3}$ at 298.15 K.

[c] L = Ostwald coefficient.

According to the authors the Ostwald coefficient corresponds to a molality of 0.0304 $mol\ kg^{-1}$ at a CO_2 partial pressure of 101.325 kPa.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was an Ostwald type using the "dry method" as described by Just (Ref. 1).

The apparatus was of small size because of a small sample of heavy water available. The buret was 10 cm^3 graduated to 0.05 cm^3. The sample bulb had a volume of 6.811 cm^3.

The six water samples ranged in weight from 2.6003 to 4.0429 g.

The physical properties of water-d_2 at 298.15 K were estimated from data of Wahl and Urey (Ref. 2). The authors used a vapor pressure of 20.7 mmHg and a density of 1.1042 $g\ cm^{-3}$ for the 99.8 percent water-d_2.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial tank. Analyzed by reaction with KOH and found to be 99.8 % pure.

(2) Commercial source. Distilled from alkaline permanganate, then from phosphoric anhydride, then without reagents. Average composition for the solubility measurements was 99.8 %.

ESTIMATED ERROR:

$\delta T/K = \pm 0.01$
$\delta L/L = \pm 0,01$

REFERENCES:

1. Just, G. *Z. physik. Chem.* (Leipzig) 1901, *37*, 342.

2. Wahl, M.H.; Urey, H.C. *J. Chem. Phys.* 1935, *3*, 411.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Water-d_2; D_2O; [7789-20-0]

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

ORIGINAL MEASUREMENTS:

Salomaa, P.; Vesala, A.; Vesala, S.

Acta Chem. Scand. 1969, *23*, 2107-15.

VARIABLES:

T/K = 298.15
P/kPa = 101.325
$x(D;L_2O)$ = 0.000 - 0.997

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

T/K [a]	$x(D;L_2O)$ [b]	$L/cm^3\ cm^{-3}$ [c]	$\rho(L_2O)/g\ cm^{-3}$ [d]	$10^2 m_1/mol\ kg^{-1}$ [a,e]
298.15	0.000	0.8196 (20)	0.99705 [f]	3.377
	0.498_5	0.8189 (20)	1.05113	3.201
	0.833	0.8154 (23)	1.08743	3.081
	0.997	0.8149 (18)	1.10523	3.029

[a] Calculated by the compiler.

[b] $x(D;L_2O)$ is the deuterium mole fraction of solvent water (L = H, D).

[c] L = Ostwald coefficient.
The figure in the parentheses after each L is the number of measurements made in the corresponding solvent composition.

[d] $\rho(L_2O)$ = density of solvent water (L = H, D). Densities were calculated by the compiler using equation (5) in the evaluation section.

[e] m_1 = molality of carbon dioxide

[f] Density for pure H_2O at 298.15 K was taken from *Recommended Reference Materials for the Realization of Physicochemical Properties*, Edited by K.N. Marsh, Blackwell, 1987, p. 27.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The equipment employed for the solubility measurements on CO_2 was of the Ostwald type.[1,2] Before each measurement, the water was freed from dissolved air by boiling under reflux. The CO_2 which was passed into the absorption apparatus was purified by passing it subsequetly through acidic ferric sulfate, iodine, potassium permanganate, and water. The gas was finally dried carefully with magnesium perchlorate.

SOURCE AND PURITY OF MATERIALS:

(1) From commercial tank.

(2) Norsk Hydro-Elektrisk Kvaelstofaktieselskab, Norway. Analyzed and purified as described in Ref. 3.

(3) Distilled, degassed.

ESTIMATED ERROR:

$\delta L \approx \pm 0.2$ % (estimated by compiler)

REFERENCES:

1. Just, G. *Z. physik. Chem.* (Leipzig) 1901, *37*, 342.
2. Curry, J.; Hazelton, C. L. *J. Am. Chem. Soc.* 1938, *60*, 2771.
3. Salomaa, P. *Acta Chem. Scand.* 1966, *20*, 1263.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Water-d_2; D_2O; [7789-20-0]	Kratochvil, J.; Sobr, J.; Matous, J.; Pick, J. *Collect. Czech. Chem. Commun.* 1970, *35*, 3761 - 4.
VARIABLES: T/K = 303.15 - 353.15 P_1/MPa = 0.055 - 3.97	PREPARED BY: C. L. Young

EXPERIMENTAL VALUES:

T/K	P_1/bar	10^2x_2
303.15	0.94	0.051
	11.1	0.573
	20.6	0.998
	30.0	1.386
	39.7	1.731
323.15	0.87	0.029
	10.5	0.344
	20.3	0.621
	30.3	0.922
	39.5	1.118
353.15	0.55	0.012
	10.2	0.210
	20.0	0.400
	30.0	0.589
	39.2	0.761

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Cell charged with components, equilibrated and pressure measured with Bourdon gauge. Liquid sampled and analysed by stripping with nitrogen and absorbing dried carbon dioxide on absorbent containing sodium hydroxide.

SOURCE AND PURITY OF MATERIALS:

(1) Lachema, Novy Bohumin sample purity better than 99.8 mole %.

(2) Redistilled sample, purity probably better than 99 mole %. (compiler)

ESTIMATED ERROR:

δT/K = ± 0.1; δP_1/bar = ± 0.5
δx_1 = ± 0.2 x 10^{-4}

(estimated by compiler)

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Water-d_2; (deuterium oxide); D_2O; [7789-20-0]

ORIGINAL MEASUREMENTS:

Kapitanov, V. F.; Shcherbakova, O. M.

Zh. Fiz. Khim. 1983, *57*, 1785-7;
**Russ. J. Phys. Chem.* (Engl. Transl.) 1983, *57*(7), 1080-1.

VARIABLES:

T/K = 303 -473
P/MPa = 1 - 20

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

The solubility (g dm^{-3}) of CO_2 in D_2O as a function of P and T.

P/MPa	303 K	313 K	323 K	333 K	343 K	353 K
1	14.5	10.5	7.5	5.5	4.9	3.5
2	22.8	18.0	14.5	12.1	10.4	9.2
3	31.7	25.5	21.0	17.8	15.4	13.7
4	38.9	31.0	26.5	22.7	19.9	17.9
5	44.9	37.0	31.2	27.0	23.9	21.6
6	50.0	41.6	35.4	30.9	27.5	25.0
7	54.6	45.7	39.2	34.5	30.9	28.3
8		49.5	42.8	37.8	34.1	31.4
9		53.0	46.0	40.9	37.1	34.3
10		57.0	49.2	43.9	40.0	37.1
11		60.0	53.0	46.8	43.0	39.3
12		63.5	55.4	49.7	45.5	42.5
13		66.0	58.5	52.5	48.0	45.0
14		69.0	61.6	56.0	51.5	48.0
15		72.1	63.5	58.5	54.0	50.3
16		75.3	66.5	60.5	56.5	53.0
17		78.4	70.0	63.0	59.0	55.5
18		80.5	73.0	66.5	62.3	57.5
19		83.2	76.2	70.5	66.2	62.1
20		86.0	78.5	73.5	69.0	65.3

(continued on the next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility was studied by a static method (1) in an autoclave thermostatted at the required temperature. The autoclave was filled with D_2O, constant specified temperature and pressure were attained, and the autoclave was bubbled with carbon dioxide.

The CO_2 dissolved in D_2O was absorbed by baryta water and the excess of the latter was then titrated with a solution of oxalic acid (2). The CO_2 which remained dissolved in water was titrated with a solution of alkali using phenolphthalein as an indicator (3).

SOURCE AND PURITY OF MATERIALS:

(1) Carbon dioxide. Alimentary grade (GOST 8050-64) freed beforehand from moisture and oil with the aid of ultrafine glass fibre filters, NaA zeolites, and BAU activated charcoal.

(2) Water-d_2. 99.78 %

ESTIMATED ERROR:

According to the authors the error of the determination of the composition of the phases is 5 %.

REFERENCES:

1. Tsiklis, D.S. "Tekhnika Fiziko-Khimicheskikh Isseledovanii poi Vysokikh i Sverkhvysokikh Davleniyakh", Izd. Khimiya, Moscow, 1976.
2. Blazhenova, A.N.; Il'inskaya, A.A.; Rapoport, F.M. "Analiz Gazov v Khimicheskoi Promyshlennosti", Goskhimizdat, Moscow, 1964, pp. 118-22.
3. Godovskaya, K.I.; Ryabina, L.V.; Novik, E.Yu.; Gerner, M.M. "Tekhnicheskii Analiz", Izd. Vysshaya Shkola, Moscow, 1967, p. 70.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Water-*d*$_2$; (deuterium oxide); D_2O; [7789-20-0]	Kapitanov, V. F.; Shcherbakova, O. M. *Zh. Fiz. Khim.* 1983, *57*, 1785-7; **Russ. J. Phys. Chem.* (Engl. Transl.) 1983, *57*(7), 1080-1.

EXPERIMENTAL VALUES: (continued)

The solubility (g dm^{-3}) of CO_2 in D_2O as a function of *P* and *T*.

P/MPa	363 K	373 K	383 K	393 K	403 K	413 K
1	2.5	2.2	2.0	1.9	1.8	1.7
2	8.4	7.7	5.5	4.9	4.7	4.5
3	12.5	11.6	10.3	9.9	9.0	8.5
4	16.4	15.3	14.9	13.3	12.8	12.0
5	19.9	18.7	17.5	14.8	16.0	15.0
6	23.2	21.9	20.0	19.0	18.5	18.0
7	26.4	24.9	23.5	22.3	21.5	20.5
8	29.4	27.8	26.5	25.5	24.0	23.5
9	32.2	30.7	28.7	27.6	27.0	26.0
10	35.0	33.7	31.2	30.0	29.0	28.5
11	37.0	35.0	33.5	32.5	31.0	30.0
12	39.5	37.5	36.1	34.3	33.5	32.0
13	42.3	39.5	38.3	36.5	35.0	34.0
14	44.9	41.8	40.0	38.2	37.0	36.1
15	47.0	44.0	42.9	40.7	39.0	38.0
16	49.5	46.5	44.3	42.5	41.0	39.5
17	51.9	49.0	46.5	44.9	43.0	41.3
18	54.7	51.5	48.5	47.0	45.0	43.5
19	57.5	54.0	51.5	49.0	47.0	45.8
20	60.5	56.5	54.3	51.2	49.5	48.0

P/MPa	423 K	433 K	443 K	453 K	463 K	473 K
1	1.5	1.3	0.9	0.7	0.5	0.3
2	4.2	4.0	3.7	3.5	3.4	3.2
3	8.1	7.5	7.2	7.0	6.8	6.7
4	11.6	11.0	10.5	10.2	9.8	9.6
5	14.5	14.0	13.8	13.6	13.4	13.0
6	17.5	17.0	16.5	16.0	15.5	15.0
7	19.5	18.6	18.0	17.5	18.0	17.5
8	22.5	21.5	21.0	20.5	20.0	19.0
9	25.0	24.0	23.0	22.5	22.0	21.5
10	27.2	26.5	25.7	25.0	24.0	24.0
11	29.2	28.0	27.5	27.0	26.5	26.0
12	31.5	30.5	29.7	29.2	28.5	27.7
13	33.5	32.5	32.0	31.0	30.5	30.0
14	35.5	34.0	33.0	32.5	32.0	31.0
15	37.0	36.0	35.5	35.0	34.8	34.0
16	38.5	37.5	37.0	36.5	36.0	35.5
17	40.0	39.0	38.5	38.0	37.5	36.0
18	42.0	41.5	40.8	40.0	39.6	39.4
19	44.3	43.0	42.0	41.5	41.0	40.6
20	46.5	45.0	44.0	43.5	43.0	42.5

COMPONENTS:	EVALUATOR:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Sea Water	Denis A. Wiesenburg Center for Marine Sciences University of Southern Mississippi Stennis Space Center, MS 39529 USA January, 1995

CRITICAL EVALUATION:

AN EVALUATION OF THE SOLUBILITY OF CARBON DIOXIDE IN SEA WATER AT A PARTIAL PRESSURE OF 101.3 kPa

In spite of the importance of carbon dioxide in the ocean, only a few measurements have been made of the solubility of carbon dioxide in sea water at a partial pressure of gas of 101.3 kPa. References 1 - 6 are considered to be of historical interest. They were not used in the present evaluation although they contain some data of value. Since the early measurements, most authors have chosen to extrapolate from data based on the solubility of carbon dioxide in aqueous sodium chloride solutions. This situation persisted until the 1970's when four independent solubility data sets for carbon dioxide in sea water were produced using a variety of techniques.

These four sets of modern measurements were considered for this evaluation. Three of these are of carbon dioxide solubility in natural sea water and one in synthetic or artificial sea water. Two of the independent data sets are extensive enough to allow evaluation and computation of a smoothing equation. Li and Tsui (9) analyzed compositions of equilibrium solutions using infrared spectroscopy, while Murray and Riley (10) used a gravimetric determination. Unfortunately, the agreement between the two sets of measurements is poor: the data of Murray and Riley are as much as 3.8 % lower than those of Li and Tsui at higher temperatures and salinities. The agreement is better at lower temperatures and in distilled water. Weiss (11) examined both data sets and made measurements of his own to determine which were most accurate. Weiss also noted that neither Murray and Riley nor Li and Tsui made corrections for the non-ideal behavior of carbon dioxide. For carbon dioxide, the departure from the ideal gas approximation is much larger than the precision with which its solubility can be measured. Also, neither Murray and Riley nor Li and Tsui made corrections for the dissociation of dissolved hydrated carbon dioxide to form bicarbonate in distilled water. Making these corrections reduces the distilled water values for both of the published data sets by ~ 0.18 % at 273.15 K to ~ 0.46 % at 313.15 K. The 15 measurements that Weiss (11) made confirmed the accuracy of the measurements of Murray and Riley (10). The values of Li and Tsui (9) were shown to be in error by as much as 4 % at the higher temperatures and salinities. The data of Murray and Riley (10), after correction for the effects of non-ideal behavior and for dissociation in the distilled water measurements (11), are believed to be accurate enough to develop a smoothing equation.

Stewart and Munjal (7) made measurements of the solubility of carbon dioxide in synthetic sea water which the evaluator calculated to have a salinity of 34.42 ‰. The compiler estimated the error of these measurements to be ± 1 %, which is greater than the error of the better methods. A comparison of their data with the measurements of Murray and Riley (10) and Weiss (11) revealed their artificial sea water solubility values to be low by an average of 6%. For this reason, the data of Stewart and Munjal (7) were not considered further.

Solubilities of carbon dioxide are generally used in calculations of chemical equilibria and are given typically as amount concentration ($c_1 = n_1/V$) or amount per unit mass of solution or as mass fractions. Weiss (11) evaluated the solubility of carbon dioxide in sea water in terms of the equilibrium constant K_0, defined as the amount of solute per liter or kilogram of solution, when the fugacity (f) of the solute and the total pressure are both 1 atm. According to the modified form (11) of Henry's law, $m_1 = K_0 f$, where m_1 is the concentration of dissolved gas in molar or gravimetric units and f is the fugacity. In terms of the Bunsen coefficient, $K_0 = \alpha/V^*$ in molar units, or $K_0 = \alpha/V^*\rho$ in gravimetric units, where V^* is the molar volume of the pure real gas at standard temperature and pressure and ρ is the density of the solution. Weiss (11) fitted the corrected Murray and Riley (10) data to the smoothing equation:

$$\ln (K_0 / \text{mol dm}^{-3}\,\text{atm}^{-1}) = -58.0931 + 90.5069\,(100\text{ K} / T) + 22.2940 \ln (T/100\text{ K}) + (S/\text{‰})[\,0.027766 - 0.025888\,(T/100\text{ K}) + 0.0050578\,(T/100\text{ K})^2\,] \qquad (1)$$

where S is the salinity (‰) and T is the Kelvin temperature. Weiss (11) also fitted the same data to an equation that represented the solubility in terms of mass of the solution rather than volume,

$$\ln (K_0 \,/\, \text{mol kg}^{-1}\,\text{atm}^{-1}) = -60.2409 + 93.4517\,(100\,\text{K} \,/\, T) + 23.3585 \ln (T/100\,\text{K}) + (S/‰)[\,0.023517 - 0.023656\,(T/100\,\text{K}) + 0.0047036\,(T/100\,\text{K})^2\,]. \qquad (2)$$

The Murray and Riley (10) data show a standard error of estimate of about 0.3 %, or 1.4 x 10^{-4} mol dm^{-3} atm^{-1} in terms of K_0. Weiss (11) gives extensive tables of the carbon dioxide solubility in sea water at various temperatures and salinities from both of the above equations. These equations are recommended for calculation of the solubility of carbon dioxide in sea water.

Although the solubility coefficients of carbon dioxide in sea water are well defined by the above equations, for practical purposes oceanographers and atmospheric scientists require the atmospheric equilibrium solubility for their work. Weiss (8) has proposed equations similar to the above which express the atmospheric equilibrium solubility from moist air at 1 atm total pressure in units of volume (STP), as a function of temperature and salinity. In working with samples from depths in the ocean, it is also advantageous to express atmospheric solubilities in terms of mol kg^{-1}, which are pressure and temperature independent (8). Weiss and Price (12) produced a smoothing equation for carbon dioxide solubility in sea water from the Murray and Riley (10) data in terms of the function F, for a total pressure of 1 atm where $m_1 = x_1F$ and x_1 is the mole fraction of carbon dioxide in dry air:

$$\ln (F \,/\, \text{mol dm}^{-3}\,\text{atm}^{-1}) = -160.7333 + 215.4152\,(100\,\text{K} \,/\, T) + 89.8920 \ln (T/100\,\text{K}) - 1.47759\,(T/100\,\text{K})^2 + (S/‰)[\,0.029941 - 0.027455\,(T/100\,\text{K}) + 0.0053407\,(T/100\,\text{K})^2\,] \qquad (3)$$

Weiss and Price (12) also fitted the Murray and Riley (10) data to an equation that represented the solubility in terms of mass of the solution rather than volume:

$$\ln (F \,/\, \text{mol kg}^{-1}\,\text{atm}^{-1}) = -162.8301 + 218.2968\,(100\,\text{K} \,/\, T) + 90.9241 \ln (T/100\,\text{K}) - 1.47696\,(T/100\,\text{K})^2 + (S/‰)[\,0.025695 - 0.025225\,(T/100\,\text{K}) + 0.0049867\,(T/100\,\text{K})^2\,] \qquad (4)$$

These two equations can be used to calculate accurately the atmospheric equilibrium solubility of carbon dioxide in sea water between 272.15 K and 313.15 K and salinities between 0 and 40 ‰.

In the following table some numerical values, calculated from equations (1), (2) and (4), are presented for the solubility coefficient K_0. More extensive tables can be found in references 11 and 12.

T/K	Salinity S/‰				
	0	34	35	36	38
Eq. (1).	Solubility Coefficient 10^2K_0 / mol dm^{-3} atm^{-1}				
273.15	7.758	6.498	6.465	6.431	6.364
283.15	5.366	4.529	4.507	4.485	4.440
293.15	3.910	3.337	3.322	3.306	3.275
303.15	2.983	2.583	2.572	2.561	2.540
313.15	2.370	2.090	2.082	2.074	2.059
Eq. (2).	Solubility Coefficient 10^2K_0 / mol kg^{-1} atm^{-1}				
273.15	7.758	6.325	6.287	6.249	6.175
283.15	5.367	4.413	4.328	4.363	4.313
293.15	3.916	3.258	3.241	3.223	3.189
303.15	2.995	2.530	2.517	2.505	2.480
313.15	2.389	2.054	2.045	2.036	2.018
Eq. (4).	Function F for moist air at 1 atm, 10^2F / mol kg^{-1} atm^{-1}				
273.15	7.681	6.264	6.226	6.189	6.115
283.15	5.280	4.342	4.318	4.293	4.244
293.15	3.814	3.174	3.157	3.140	3.106
303.15	2.862	2.419	2.407	2.395	2.371
313.15	2.209	1.902	1.894	1.886	1.869

Added by the editor:

Note that Weiss (11) defined the Bunsen coefficient as the volume of gas (STP) absorbed per unit volume of the *solution* at the temperature of the measurement, when the *total* pressure and the fugacity are both 1 atm. According to the usual definition, Bunsen coefficient is the volume of gas (STP) absorbed per unit volume of the solvent at the temperature of measurement and 1 atm partial pressure of gas.

Concerning the thermodynamics of the carbon dioxide system in sea water, there exist several articles in the literature. See for instance the recent paper of Millero (18) and the references therein.

The definitions of salinity and chlorinity have been changed during the years. For these definitions and the salinity - chlorinity relationship, see for instance references 13, 14, 15, and 16.

In 1981 the Joint Panel of Experts on Oceanographic Tables and Standards proposed a new definition of salinity and recommended the use of a new salinity scale - the Practical Salinity Scale 1978 (PSS 78) (13). The Practical Salinity 1978 was defined for the salinities within the salinity range 2 - 42. An extension of the Practical Salinity Scale 1978 to salinities up to 50 is given in reference 17.

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16. Grasshoff, K.; Ehrhardt, M.; Kremling, K., Editors, *Methods of Seawater Analysis*, 2nd Edition, Verlag Chemie, 1983.
17. Poisson, A.; Gadhoumi, M.H. *Deep-Sea Res.* 1993, *40*, 1689.
18. Millero, F.J. *Geochim. Cosmochim. Acta* 1995, *59*, 661.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9]	Stewart, P.B.; Munjal, P.
(2) Synthetic sea water	*J. Chem. Eng. Data* 1970, *15*, 67-71.

VARIABLES:	PREPARED BY:
T/K = 268.15 - 298.15	C. L. Young
P/MPa = 0.101 - 4.560	

EXPERIMENTAL VALUES:

A. Synthetic sea water [a]

T/K	P/bar	$10^2m_1/m_2$ [b]
268.15	1.01	0.310
	5.07	1.446
	10.13	2.752
	20.26	4.781
	30.40	5.604
273.15	1.01	0.265
	5.07	1.248
	10.13	2.358
	15.20	3.312
	20.26	4.152
	30.40	5.604
	34.45	6.007
278.15	1.01	0.220
	5.07	1.043
	10.13	2.004
	20.26	3.548
	30.40	4.843
	38.50	5.601
283.15	1.01	0.191
	5.07	0.889
	10.13	1.701
	20.26	3.042
	30.40	4.140
	38.50	4.801
285.55	1.01	0.173
	5.07	0.790
	10.13	1.558
	20.26	2.805
	30.40	3.805
	45.60	4.852
288.15	1.01	0.155
	5.07	0.740
	10.13	1.411
	20.26	2.531
	30.40	3.453
	45.60	4.379
298.15	1.01	0.110
	5.07	0.551
	10.13	1.023
	20.26	1.822
	30.40	2.397
	45.60	3.090

B. Synthetic sea water concentrate [a]
(Salts content 3 times normal)

T/K	P/bar	$10^2m_1/m_2$ [b]
273.15	10.13	2.149
	20.26	3.892
	34.45	5.451
285.55	10.13	1.351
	20.26	2.411
	45.60	4.052
298.15	10.13	0.907
	20.26	1.612
	45.60	2.751

C. Synthetic sea water concentrate [a]
(Salts content 5 times normal)

T/K	P/bar	$10^2m_1/m_2$ [b]
273.15	10.13	2.043
	20.26	3.552
	34.45	5.253
285.55	10.13	1.214
	20.26	2.192
	45.60	3.672

[a] Composition of sea water is given in the following table. m_i = mass of component i.

	m_i/g			
	NaCl	$MgCl_2$	$MgSO_4$	$CaCl_2$
A	26.518	2.447	3.305	1.141
B	79.554	7.341	9.915	3.423
C	132.590	12.235	16.525	5.705
	KCl	$NaHCO_3$	NaBr	H_2O
A	0.725	0.202	0.083	965.579
B	2.175	0.606	0.249	896.737
C	3.625	1.010	0.415	827.895

[b] m_1/m_2 = solubility of carbon dioxide; m_1 = mass of CO_2 ; m_2 = mass of solvent

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Rocking equilibrium cell fitted with Bourdon-type pressure gauges. Carbon dioxide gas admitted to cell containing sea water. After equilibrium established samples of liquid withdrawn and analyzed by stripping out carbon dioxide, absorbing in excess barium hydroxide and back-titrating.

SOURCE AND PURITY OF MATERIALS:

(1) Matheson research grade, purity 99.99 mole %.

(2) Degassed

ESTIMATED ERROR: (by compiler)

δT/K = ± 0.06; δP/kPa = ± 2 below 3.6 MPa, ± 3.4 above 3.6 MPa; $\delta(10^2m_1/m_2)$ = ± 1 %

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Sea water; (3) Water; H_2O; [7732-18-5]	Murray, C.N.; Riley, J.P. *Deep-Sea Res.* 1971, *18*, 533-41.
VARIABLES:	PREPARED BY:
T/K = 274.20 - 308.16 P/kPa = 101.325 Mass % of salt = 0 - 3.735	D.M. Mason

EXPERIMENTAL VALUES:

$t/^\circ C$	T/K	Salinity [a]	Chlorinity [b]	α [c]
1.04	274.19	0.00	0.00	1.6471
		6.58	3.64	1.5883
		19.60	10.85	1.4943
		24.50	13.56	1.4463
		36.40	20.07	1.3641
5.00	278.15	0.00	0.00	1.4199
		9.75	5.40	1.3446
		20.60	11.40	1.2785
		28.00	15.50	1.2290
		36.75	20.34	1.1690
10.00	283.15	0.00	0.00	1.1926
		16.90	9.35	1.0962
		20.40	11.13	1.0768
		28.45	15.75	1.0330
		35.25	19.51	0.9931
15.00	288.15	0.00	0.00	1.0100
		10.15	5.62	0.9563
		19.05	10.54	0.9173
		26.55	14.70	0.8852
		35.30	19.54	0.8470

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

In a constant temperature bath, a 2.5L sample of water or sea water solution was saturated with water-saturated carbon dioxide in 3-L round bottom flask fitted with a magnetic stirrer and dip tube. After saturation, 250 mL of the solution was transferred to a volumetric flask also fitted with a dip tube and magnetic stirrer. The carbon dioxide was stripped from the sample by passing carbon dioxide-free air through it. Water and carbon dioxide were removed from the air by passing it through a freeze-out trap cooled to -80°C and then through three absorption tubes, the first of which contained magnesium perchlorate and the other two soda asbestos and magnesium perchlorate. The weight increase of the second absorption tube gave the amount of dissolved carbon dioxide.

SOURCE AND PURITY OF MATERIALS:

(1) Distillers Co., Ltd; 99.9 % by supplier, confirmed by mass spectrometry.

(2) Canary Islands vicinity, filtered, acidified to pH 2.2 and boiled.

ESTIMATED ERROR:

Not given.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Sea water; (3) Water; H_2O; [7732-18-5]	Murray, C.N.; Riley, J.P. *Deep-Sea Res.* 1971, *18*, 533-41.

EXPERIMENTAL VALUES: (continued)

$t/^{\circ}C$	T/K	Salinity [a]	Chlorinity [b]	α [c]
20.00	293.15	0.00	0.00	0.8652
		11.15	6.17	0.8230
		16.60	9.19	0.8081
		24.20	13.40	0.7779
		35.65	19.73	0.7345
25.00	298.15	0.00	0.00	0.7519
		8.40	4.65	0.7238
		13.90	7.69	0.7088
		20.95	11.60	0.6841
		35.50	19.65	0.6406
32.00	305.15	0.00	0.00	0.6336
		8.55	4.73	0.6042
		15.45	8.55	0.5876
		27.40	15.17	0.5589
		35.40	19.57	0.5412
35.00	308.15	0.00	0.00	0.5905
		9.50	5.25	0.5651
		19.05	10.54	0.5440
		29.35	16.25	0.5258
		37.35	20.67	0.5068

[a] Salinity = m_{salt}(g) / 1000 g of solution

[b] Chlorinity = m_{Cl} / 1000 g of solution (calculated as salinity/1.80655)

[c] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Sea water	Li, Y.-H.; Tsui, T.-F. *J. Geophys. Res.* 1971, *76*, 4203-7.

VARIABLES:	PREPARED BY:
T/K = 273.85 - 303.15 P_1/kPa = 101.325 Chlorinity = 0.0 - 29.0 $^{o}/_{oo}$	Kelly R. Thornton

EXPERIMENTAL VALUES:

t/°C	T/K [a]	Chlorinity/ $^{o}/_{oo}$	$10^2 S$/mol L^{-1} atm [b]
0.7	273.85	0	7.501
4.0	277.15		6.603
10.2	283.35		5.302
20.0	293.15		3.911
30.0	303.15		2.997
10.2	283.35	10.0	4.863
4.0	277.15	20.0	5.526
10.2	283.35		4.482
20.0	293.15		3.359
30.0	303.15		2.614
4.0	277.15	29.0	5.086
10.2	283.35		4.162
20.0	293.15		3.138
30.0	303.15		2.463
4.0	277.15	0.6413 m NaCl	5.547
20.0	293.15		3.358
30.0	303.15		2.618

[a] Calculated by the compiler

[b] S = solubility of CO_2

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Water-saturated CO_2 gas was bubbled overnight through sea water in an equilibration chamber in a constant temperature bath. A sample was removed with an airtight glass syringe and injected into a CO_2-extraction system. Infra-red analysis was done on liberated CO_2. Sea water samples were acidified with 8 M HCl to a pH below 3.

SOURCE AND PURITY OF MATERIALS:

(1) Carbon dioxide. Source not given. Purity of 99.99 ± 0.01 %.

(2) Sea water. Source not given.

ESTIMATED ERROR:

δT/K = ± 0.02
δP_1/mmHg = ± 0.005

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sea water

ORIGINAL MEASUREMENTS:

Weiss, R. F.

Mar. Chem. 1974, *2*, 203-15.

VARIABLES:

T/K = 279.74 - 293.78
P_1/kPa = 101.325
Salinity/ $^{\mathrm{o}}/_{\mathrm{oo}}$ = 0.00 and 35.330

PREPARED BY:

Kelly R. Thornton

EXPERIMENTAL VALUES:

t/°C	T/K [a]	Salinity/ $^{\mathrm{o}}/_{\mathrm{oo}}$	10^2K_o/mol L^{-1} atm [b]
20.61	293.76	0.0	3.848
20.63	293.78		3.843
20.60	293.75		3.867
20.59	293.74		3.834
20.61	293.76		3.840
6.59	279.74	35.330	5.071
6.60	279.75		5.063
6.60	279.75		5.068
6.59	279.74		5.041
20.62	293.77	35.330	3.245
20.63	293.78		3.272
20.63	293.78		3.245
20.63	293.78		3.255
20.63	293.78		3.254
20.63	293.78		3.252

[a] Calculated by the compiler

[b] K_o = solubility of CO_2

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Measurements of CO_2 solubility were carried out by the microgasometric technique used previously to measure He and Ne solubilities (Ref. 1). The amount of degassed water added to the equilibration chamber was reduced to about one third of the total gas volume. Six to ten minutes were allowed for equilibration. The pH of sea water was brought to 2.2 with addition of sulfuric acid, and the salinity was adjusted by gravimetric determination of the amount of H_2O added in the acid solution.

SOURCE AND PURITY OF MATERIALS:

(1) Carbon dioxide. Matheson Gas products. High purity (certified ≥ 99.99 %).

(2) Sea water. Surface sea water collected at La Jolla, California. Salinity increased by ≈ 2 $^{\mathrm{o}}/_{\mathrm{oo}}$, filtered with 0.45 μm filter, poisoned with 1 mg/L $HgCl_2$, salinity determined to 0.004 $^{\mathrm{o}}/_{\mathrm{oo}}$.

ESTIMATED ERROR:

The overall accuracy of solubility measurements estimated as ± 0.2 % by author.

REFERENCES:

1. Weiss, R. F.
   J. Chem. Eng. Data 1971, *16*,
   235 - 41.

COMPONENTS:	EVALUATOR:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Electrolyte (3) Water; H_2O; [7732-18-5]	H. Lawrence Clever Department of Chemistry Emory University Atlanta, GA 30322, USA August 1995

CRITICAL EVALUATION:

AN EVALUATION OF THE SOLUBILITY OF CARBON DIOXIDE IN AQUEOUS ELECTROLYTE SOLUTIONS.

The solubility of a gas in an aqueous electrolyte solution often approximates the behavior pointed out by Sechenov over 100 years ago (1, 2, 4, 5). It obeys the equation, $(1/c_2)\lg (S^0/S) = k_{scc}$, where S^0, S represent the solubility of the gas in pure water and in the aqueous electrolyte solution, respectively, lg is the base 10 logarithm, c_2 is the concentration of the electrolyte, and k_{scc}, the Sechenov salt effect parameter when both the gas and electrolyte concentrations are in volume units.

Other gas and electrolyte measures lead to slightly different values of the salt effect parameter. The commonly used forms are:

$$
\begin{aligned}
k_{scc}/\mathrm{L\ mol^{-1}} &= (1/(c_2/\mathrm{mol\ L^{-1}}))\ \lg\ (c_1^0/\mathrm{mol\ L^{-1}})/(c_1/\mathrm{mol\ L^{-1}}) \\
k_{smm}/\mathrm{kg\ mol^{-1}} &= (1/(m_2/\mathrm{mol\ kg^{-1}}))\ \lg\ (m_1^0/\mathrm{mol\ kg^{-1}})/(m_1/\mathrm{mol\ kg^{-1}}) \\
k_{scx}/\mathrm{L\ mol^{-1}} &= (1/(c_2/\mathrm{mol\ L^{-1}}))\ \lg\ (x_1^0/x_1) \\
k_{cmx}/\mathrm{kg\ mol^{-1}} &= (1/(m_2/\mathrm{mol\ kg^{-1}}))\ \lg\ (x_1^0/x_1)
\end{aligned}
$$

where subscript 1 represents the nonelectrolyte gas, and subscript 2 the electrolyte.

The gas solubility ratio in pure water and electrolyte solution, c_1^0/c_1 will be numerically the same using the Bunsen coefficient ratio, α^0/α, or the Ostwald coefficient ratio, L^0/L, as well as the mol L^{-1} ratio. The molality ratio, m_1^0/m_1, is the same as the Kuenen coefficient ratio, S^0/S, or the solvomolality ratio, A^0/A. The mole fraction ratio, x^0/x, is the same as the inverse Henry's constant ratio, K_H/K_H^0, when the Henry's constant is of the form,$(K_H/\mathrm{kPa}) = (p_1/\mathrm{kPa})/x_1$. The gas mol fractions are usually calculated treating each electrolyte ion as an entity. A more detailed description of these units and the interconversions among them is in the introductory material of Volume 10 of the *Solubility Data Series* (47).

A useful graphical test of salt effect data of either a particular worker or to compare different workers data is to put the Sechenov equation in the form:

$$\lg S = \lg S^0 - k_s\, c_2$$

and plot lg S *vs.* c_2, the linear slope will be the negative of the salt effect parameter in what ever set of units is used for S and c_2. A number of such figures follow in this evaluation.

Many workers use electrolyte ionic strength instead of volume concentration, and the salt effect parameter is given in electrolyte ionic strength. There are valid reasons to do this, and we have used the ionic strength designation for most systems except 1-1 electrolytes where ionic strength and electrolyte concentration or molality is numerically the same. The conversion of molar units to ionic strength basis requires dividing by the small whole number of one for 1-1 electrolytes, three for 1-2 and 2-1 electrolytes, four for 2-2 electrolytes, six for 1-3 and 3-1 electrolytes and and 15 for 2-3 and 3-2 electrolytes. The solubilities in the mixed electrolyte solutions are plotted as a function of ionic strength. The salt effect parameters in ionic strength are symbolized $k_{sI(c)c}$ and $k_{sI(m)m}$ for ionic strength in volume concentration and molality units, respectively.

For electrolytes other than 1 - 1 and for mixtures of electrolytes we have generally used ionic strength in this evaluation. For electrolytes of higher valent ions the equation becomes $\lg S = \lg S^0 - k_{sI(c,m)s}\, I(c,m)_2$, and for mixed electrolytes $\lg S = \lg S^0 - k_{sI(c,m)s}\, I(c,m)_{total}$. Often $k_{sI(c,m)s} = \{k_{sI(c,m)s2} + \cdots + k_{sI(c,m)si}\}$, the sum of the individual salt effect parameters 2 to i. $I(c,m)$ means express ionic strength in either volume concentration or molality depending on the data available. The approach was probably first suggested by van Krevelen and Hoffijzer (23).

The evaluator would be among the first to point out the simple Sechenov approach is not the best way to treat salt effect data. However, it is fast and convenient to use and gives a simple common basis for the comparison of the many data we have here. The user of this evaluation should always consult the original paper, when available, to find what approach the original authors used to explain their data. Some other approaches the user may want to consider are discussed by Markham and Kobe (18, 19), and by the Japanese school of workers (36, 37, 39, 41, 42, 43) who suggest extensions of the Sechenov equation. More recently workers have started to use the Pitzer equation and examples are Rumpf, Maurer and coworkers (56, 59, 60) and He and Morse (57).

Two or more groups of workers have measured the solubility of carbon dioxide in several of the same aqueous electrolyte solutions. Unfortunately often they report values of the solubility of carbon dioxide in water at 298 K which differ by several percent. The difference makes for some difficulty in comparing their results by a plot of lg L *vs.* c_2 as we have used here. There are data on over 100 systems containing either one electrolyte, one electrolyte and a non-aqueous nonelectrolyte or two or more electrolytes with water. In general the data for carbon dioxide solubility in aqueous electrolyte solutions show better consistency than the data for less soluble gases reviewed in previous *Solubility Data Series* volumes.

The term salt effect means to many the effect of a strong electrolyte on a property, solubility in this evaluation. However, nonelectrolytes often have a similar magnitude effect on a property. This review contains weak electrolytes, some nonelectrolytes in combination with electrolytes, some inorganic substances in colloidal form and some miscelle forming electrolytes in addition to strong electrolytes.

The systems are given in the order of the standard arrangement for inorganic compounds used by the U. S. National Institute of Science and Technology. The NBS (NIST) Table of Thermodynamic Properties (48) gives a recent description of the standard order and the table is a good example of its use. The number before each system is the standard order number for the electrolyte atom of largest order number.

9 (1) Carbon dioxide + Hydrofluoric acid [7664-39-3] + Water

Cox and Head (28) measured the solubility of carbon dioxide in 0, 2.5 and 5.0 mol L^{-1} aqueous HF at 293.02, 298.07, 303.02 and 308.00 K. Partial pressures of CO_2 ranged from 94.64 to 107.00 kPa. Results were reported as Henry constants with units mol L^{-1} atm^{-1}. The salt effect parameter is based on two measurements of the solubility at each of the two HF concentrations. There is a small salting in by the HF. The salt effect parameters are in the table below.

Table 1.

T/K	HF Concentration Range, c_2/mol L^{-1}	Salt Effect Parameter k_{scc}/L mol^{-1}	Std. Dev. of Slope	Reference
293.02	2.5, 5.0	-0.013	0.0007	CH (28)
298.07	2.5, 5.0	-0.0096	0.0018	CH (28)
303.02	2.5, 5.0	-0.0081	0.0008	CH (28)

At 308.00 K measurements were made at only one concentration and no calculation of the salt effect parameter was made. The negative sign on the salt effect parameter means salting in. Recall that HF is a weak acid.

10 (1) Carbon dioxide + Hydrochloric acid [7647-01-0] + Water

Geffcken (6) made seven measurements of the solubility of CO_2 in 0 to 2.18 mol L^{-1} aqueous HCl at 288.15 and 298.15 K and atmospheric pressure. Wolf and Krause (12) made several solubility measurements in 0 - 4 vol % HCl at 293 K. Van Slyke, Sendroy, Hastings and Neill (13) made nine measurements of the solubility of CO_2 in 0.01 to 0.300 mol L^{-1} HCl at 311.2 K and atmospheric pressure. Robb and Zimmer (34) made eight measurements of the solubility of CO_2 in 0 to 10 mol L^{-1} HCl at 298.15 K and up to three measurements each at 293.15 and 303.15 K and atmospheric pressure. He and Morse (57) made five measurements of the solubility of CO_2 in 0.01 to 3.0 mol kg^{-1} HCl at temperatures of 273.2, 298.2, 323.2, 348.2 and 363.2 K and a total pressure near one atmosphere. The actual carbon dioxide partial pressures were 0.927, 0.954, 0.865, 0.611 and 0.305 bar, respectively at the five temperatures.

The measurements of Wolf and Krause (12) were considered doubtful and were not used. Salt effect parameters were calculated from the other data and are given in Table 2 (next page). Figure 1 (next page) shows lg α *vs.* m_2 at 298.15 K from the data of Geffcken, Robb and Zimmer, and He and Morse. The data of He and Morse were converted to Bunsen coefficients using their density and partial pressure values and assuming ideal gas behavior. The data of Geffcken and of Robb and Zimmer show a modest salting-out to about 1.25 mol L^{-1}, then a salting-in as the HCl concentration increases. The data of He and Morse show a regular salting-out up to 3.0 mol kg^{-1} (2.82 mol L^{-1}) HCl of a magnitude almost as large as the salting out by sulfuric acid at the same molalities. The differences between the data of Geffcken and Robb and Zimmer and of He and Morse are serious. The evaluator prefers the data of Geffcken and of Robb and Zimmer because the solubility of carbon dioxide in other aqueous strong acid ($HClO_4$ and H_2SO_4) solutions show similar trends of salting out and salting in (Figure 1), but only further experimental studies can resolve the differences.

Table 2.

T/K	HCl Concentration Range, c_2/mol L^{-1}	Salt Effect Parameter k_{scc}/L mol^{-1}	Std. Dev. of Slope	Reference
288.15	0.499 - 2.18	0.013	0.002	Gf (6)
298.15	0.0 - 1.25	0.011	0.003	Gf (6)
	0.0 - 1.26	0.014	0.001	RZ (34)
	0.01 - 2.82	0.026	0.001	HM (57)
[	0.0 - 1.26	0.013	0.002	Comb. Gf & RZ]
311.2	0.01 - 0.300	0.023	0.002	VSHN (13)

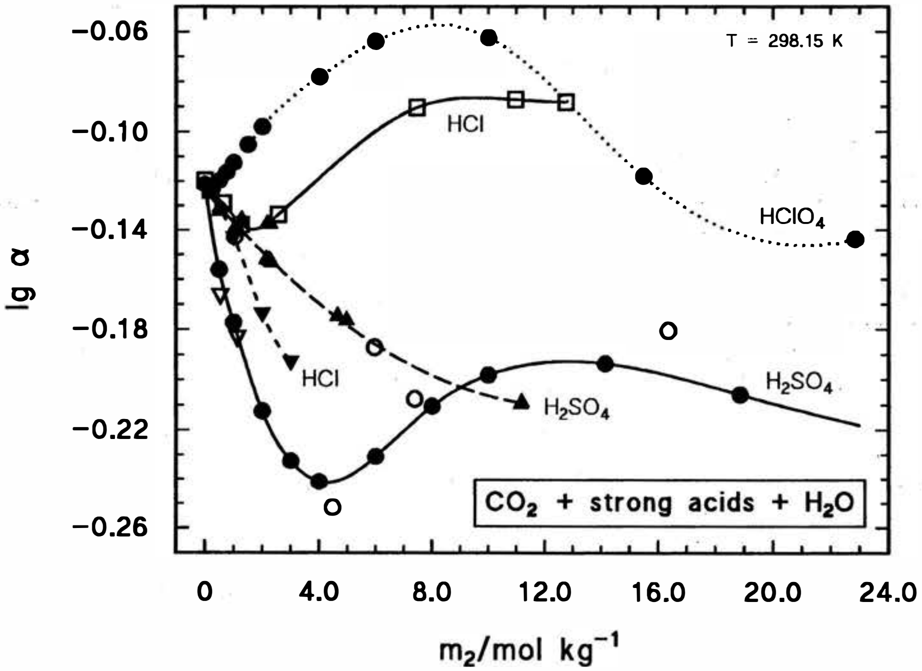

Figure 1. Logarithm of Bunsen coefficient *vs*. acid molality at 298.15 K.
Upper dotted line: Perchloric acid;
Middle solid line: Hydrochloric acid;
Lower solid line: Sulfuric acid;
Upper dashed line: Geffcken (6), Sulfuric acid;
Lower dashed line: He and Morse (57), Hydrochloric acid.

Symbols: ▲ Ref. (6), ∇ Ref. (16), ● Ref. (19),
○ Ref. (25), □ Ref. (34), ▼ Ref. (57).

He and Morse (57) report their results in mol kg^{-1} of HCl and of CO_2. Table 3 (next page) gives values of the salt effect parameters, k_{smm}/kg mol^{-1}, from their data. There is modest salting out over the 0.01 to 3.0 molal HCl range at all temperatures. Until the discrepancy among the results of the three laboratories (6, 34 and 57) is resolved all the data are classed tentative, but use with caution.

Table 3.

T/K	HCl Molality Range, m_2/mol kg^{-1}	Salt Effect Parameter k_{smm}/L mol^{-1}	Std. Dev. of Slope	Reference
273.15	0.01 - 3.00	0.017	0.0015	HM (57)
298.15	0.01 - 3.00	0.016	0.0009	HM (57)
323.15	0.01 - 3.00	0.0090	0.0004	HM (57)
348.15	0.01 - 3.00	0.0060	0.0013	HM (57)
363.15	0.01 - 3.00	0.0059	0.0023	HM (57)

10 (2) Carbon dioxide + Perchloric acid [7601-90-3] + Water

Markham and Kobe (19) measured the solubility of CO_2 at 12 molalities between 0 and 22.84 mol kg^{-1} $HClO_4$ at 298.15 K. The perchloric acid salts in and the Sechenov salt effect shows a definite curvature which is slightly different for concentration (mol L^{-1}) and for molal (mol kg^{-1}) unit gas solubility values (Figure 1). Limiting slopes were determined up to molalities of 4.00 and 6.00 $HClO_4$. Results are in Table 4 below.

Table 4.

T/K	$HClO_4$ Molality Range, m_2/mol kg^{-1}	Salt Effect Parameter k_{smc}/L mol^{-1} or k_{smm}/kg mol^{-1}	Std. Dev. of Slope	Reference
298.15	0 - 6.00	-0.0103 (c)	0.0005	MK (19)
	0 - 6.00	-0.0271 (m)	0.0006	MK (19)
	0 - 4.00	-0.0128 (c)	0.0012	MK (19)
	0 - 4.00	-0.0301 (m)	0.0011	MK (19)

The evaluator has a small preferance for the k_{smm}/mol kg^{-1} values which appear to give a better fit.

14 (1) Carbon dioxide + Sulfuric acid [7664-93-9] + Water

At least seven papers report the solubility of carbon dioxide in aqueous sulfuric acid. Sechenov (2) reports five solubility values for 8.6 to 100 mass % H_2SO_4 at 290 K, Geffcken (6) reports ten solubility values for 1.0 to 7.6 mol L^{-1} acid at 288.15 and 298.15 K, Christoff (7) reports four solubility values for 0 - 95.6 mass % acid at 293.15 K, Wolf and Krause (12) report five solubility values for 0 to 4 volume percent acid at 293.2 K, Kobe and Williams (16) report solubility values over 0 to 10 mass % acid at 298.15 K, Markham and Kobe (19) report twenty solubility values for 0 to 100 mol % acid at 298.15 K and Shchennikova, Devyatykh, and Korshunov (25) report solubility values for 9.25, 30.5, 36.9, 42, 61.6, 77.6, 78.8 and 84.48 mass % acid over the 288 to 350 K temperature interval.

Results of Wolf and Krause (12) were judged doubtful and were not included in the evaluation. The evaluator judges the Markham and Kobe (19) data at 298.15 K to be the most reliable. Their data shows salting out up to 4 mol kg^{-1} acid, salting in between 4 and 14 mol kg^{-1} acid, salting out bewteen about 15 and 38 mol kg^{-1} acid and then an increasing solubility until the composition reaches pure sulfuric acid. Geffcken's data are usually reliable, however, for this system Geffcken's data do not reproduce the minimum at 4 mol kg^{-1} found by Markham and Kobe. Geffcken's data appear to merge with the Markham and Kobe data as they approach the second minimum (Figure 2). The data of Shchennikova *et al.* (25) scatter badly and do not resolve the discrepancy, agreeing sometimes with Markham and Kobe and other times with Geffcken data. The evaluator prefers the data of Markham and Kobe and has drawn the curves in both figures 1 and 2 with respect to their data.

Figure 1 shows lg Bunsen coefficient *vs.* the sulfuric acid molality up to 20 mol kg^{-1} at 298.15 K. The Geffcken data are nearly linear from 0 to 10 mol kg^{-1} acid with a salt effect parameter of k_{smc} = 0.0107. The Markham and Kobe data are linear to only 2 mol kg^{-1} acid with a salt effect parameter of k_{smc} = 0.0284. The Markham and Kobe result is preferred.

Figure 2 (next page) shows the the entire sulfuric acid + water composition range by a plot of lg Bunsen coefficient *vs.* 0 to 1.00 mass fraction acid at 298.15 and 290 ± 2 K. There are enough independent data at the lower temperature that parallel the Markham and Kobe data at 298.15 K to give confidence in the reliability of the Markham and Kobe data.

Markham and Kobe fitted their data over the 0 to 10 mol kg^{-1} sulfuric acid range to the equation:

$$S/S^0 = 0.0885\, m_2 + 1/(1 + 0.2159\, m_2)$$

where S and S^0 represent the carbon dioxide Kuenen coefficient in acid solution and in pure water, respectively and m_2 the sulfuric acid molality up to 10 mol kg^{-1} at 298.15 K. The authors state the maximum error of their equation to be about 1 %.

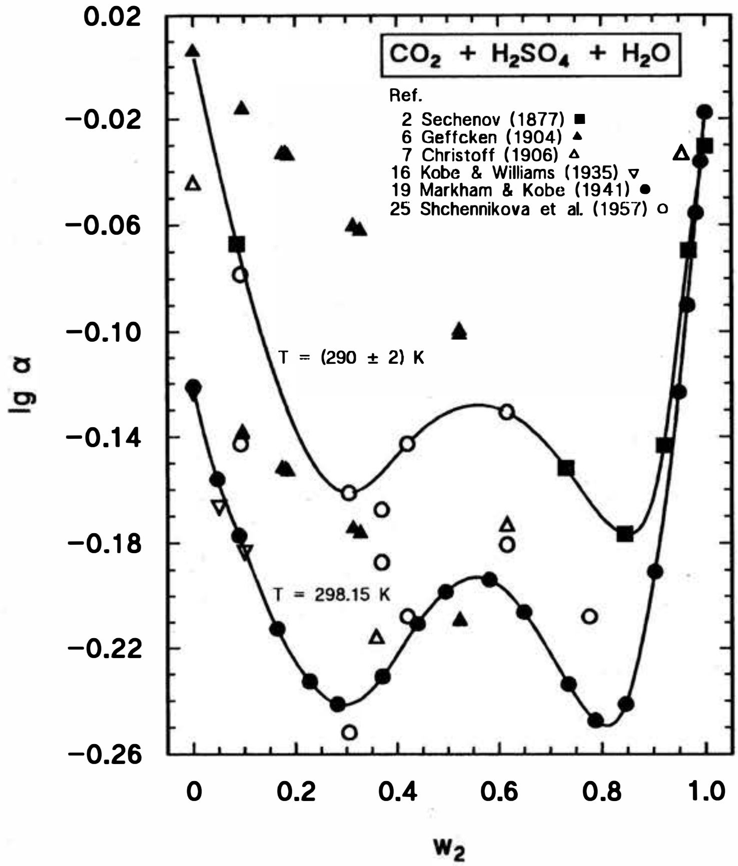

Figure 2. Logarithm of Bunsen coefficient *vs.* mass fraction of sulfuric acid at 298.15 and 290 ± 2 K.

18 (1) Carbon dioxide + Nitric acid; [7697-37-2] + Water

Geffcken (6) reports ten solubility values between 0 and 2.5 mol L^{-1} HNO_3 at both 288.15 and 298.15 K. Onda, Sada, Kobayashi, Kito and Ito (36) report the solubility in water and one solution at 298.15 K. Nitric acid salt in. The salt effect parameters are given below.

Table 5.

T/K	HNO_3 Concentration Range, c_2/mol L^{-1}	Salt Effect Parameter k_{scc}/L mol^{-1}	Std. Dev. of Slope	Reference
288.15	0.472 - 2.54	-0.0075	0.0006	Gf (6)
298.15	0.472 - 2.54	-0.0120	0.0005	Gf (6)
	0, 1.482	-0.0119	-	OSKKI (36)
[	0 - 2.54	-0.0119	0.0004	combined]

The combined value at 298.15 K is a recommended value. The others are tentative.

19 (1) Carbon dioxide + *ortho*-Phosphoric acid [7664-38-2] + Water

Sada, Kito and Ito (39) report six solubility values in 0 - 2.06 mol L^{-1} aqueous phosphoric acid at 298.15 K. A linear regression gives a salt effect parameter k_{scc} = 0.0577 L mol^{-1} with a standard deviation about the slope of 0.0032. Van Slyke, Sendroy, Hastings and Neill (13) measured the solubility of carbon dioxide in 0, 0.150 and 0.300 mol L^{-1} H_3PO_4 at 311.2 K. The salt effect parameter from their data is (0.0376 ± 0.0031) L mol^{-1}. The salt effect parameter is given in the molar concentration unit since it is assumed most of the acid is in an undissociated form. The results are classed as tentative.

18 (2) Carbon dioxide + Ammonium chloride [12125-02-9] + Water

The solubility of carbon dioxide in aqueous ammonium chloride has been measured by Mackenzie (3) at four concentration up to almost 6 mol L^{-1} NH_4Cl at temperatures of 281, 288 and 295 K, by Sechenov (5) at eight concentrations between 0 and 4.8 mol L^{-1} NH_4Cl at 288.35 K, by Findlay and Shen (9) at six concentration bewteen 0 and 3.19 mol L^{-1} NH_4Cl at 298.15 K, by Gerecke (35) five concentration between 0 and 5 mol L^{-1} NH_4Cl at five degree intervals between 288.15 and 333.15 K, by Yasunishi and Yoshida (42) at up to 23 concentration between 0.24 and 5.65 mol L^{-1} NH_4Cl at temperatures of 288.15, 298.15 and 308.15 K and by Burmakina, Efanov and Shnet (45) at 11 concentrations between 0 and 1.0 mol L^{-1} NH_4Cl at 298.15 K. A measurement of Passauer (14) of carbon dioxide in saturated aqueous ammonium chloride at 293.15 K was not used in the evaluation.

Table 6.

T/K	NH_4Cl Concentration Range, c_2/mol L^{-1}	Salt Effect Parameter k_{scc}/L mol^{-1}	Std. Dev. of Slope	Reference
281	1.23 - 2.51	0.0364	0.0062	Mac (3)
288	1.23 - 4.86	0.0124	0.0020	Mac (3)
288.15	0 - 4.2	0.0317	0.0018	YY (42)
	0 - 5.00	0.0319	0.0081	G (35)
288.35	0 - 1.6	0.0316	0.0014	S (5)
295	1.23 - 4.86	0.0217	0.0022	Mac (3)
298.15	0 - 5.65	0.0242	0.0007	YY (42)
	0 - 5.0	0.0266	0.0086	G (35)
	0 - 3.19	0.0289	0.0020	FS (9)
	0 - 1.00	0.0329	0.0131	BES (45)
308.15	0 - 5.0	0.0080	0.0029	G (35)
318.15	0 - 5.0	-0.0069	0.0048	G (35)
328.15	0 - 5.0	-0.0263	0.0114	G (35)

The data of Yasunishi and Yoshida (42) are probably the most reliable. At 298.15 K they report 24 data points over the 0 to 5.65 mol L^{-1} range of NH_4Cl. The data show a definite curvature (see Figure 3, next page) and do not extrapolate to a good value of the solubility of carbon dioxide in water. If one uses the nine data between 0.0 and 1.16 mol L^{-1} one obtains a salt effect parameter of 0.0373 with std. dev. of 0.0012 that extrapolates to the carbon dioxide solubility in water. The Findlay and Shen data show a similar trend. If the data between 0 and 0.944 mol L^{-1} are used the salt effect parameter is 0.0414 with a standard deviation about the slope of 0.0001 and good extraploation to the solubility of carbon dioxide in water. The two papers are good evidence of a larger salting-out in dilute solution than in over the full range of salt concentration. The data of Burmakina *et al.* (45) show a pronounced curvature over even the 0 - 1.00 mol L^{-1} range. Between 0 and 0.005 mol L^{-1} the salt effect parameter is 1.06 and between 0.25 and 1.00 mol L^{-1} it is 0.0392. These are interesting results, but until they are confirmed by other workers they are classed doubtful. Yasunishi and Yoshida (42), Findlay and Shen (9) and Sechenov (5) data are classed as tentative with the Yasunishi and Yoshida data preferred.

The data of Mackenzie (3) is doubtful. It shows more scatter and gives smaller salt effect parameters for a given temperature than the results discussed above. The work of Gerecke (35) is difficult to judge. Here, as with other salts, it shows more scatter and salting in at the higher temperatures which is not confirmed for carbon dioxide by other workers. Gerecke's data should be used with caution.

Rumpf, Nicolaisen and Maurer (60) have measured the solubility of carbon dioxide in 4 and 6 mol kg^{-1} NH_4Cl at six temperatures between 313.14 and 433.10 K and pressures between 0.04 and 9.35 MPa. The results are similar to the results above at lower temperatures and atmospheric pressure. The solubility data were plotted and values of the solubility taken at 5 MPa at four temperatures. Salt effect parameters calculated from the two molalities at 5 MPa are:

T/K	313	353	393	433
k_{smm}/kg mol^{-1}	-0.005	0.005	0.005	0.017

The results appear to be consistent with Figures 1 and 2 of the original paper which show a cross over in solubility between 4 and 6 molal salt at 333 K (a change from salting out at low pressure to salting in at high pressure), and a larger salting out at 433 K than at other temperatures. It would be desirable to have the salting in at higher pressures confirmed by additional experimental work. The authors use of the Pitzer equations to correlate their results is of interest.

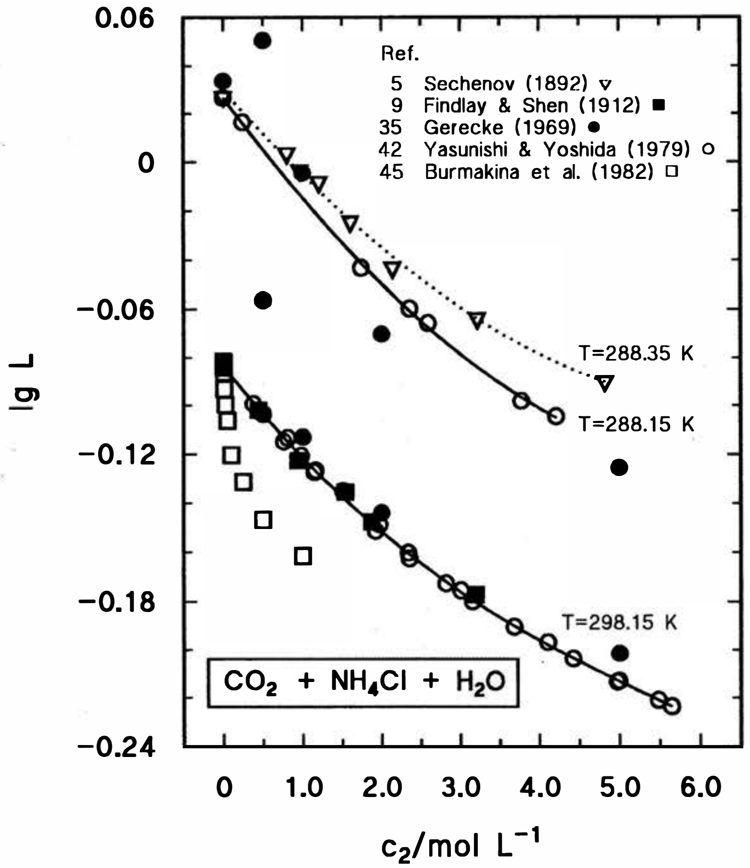

Figure 3. Logarithm of Ostwald coefficient *vs.* ammonium chloride concentration.
Dotted line, data of Sechenov (5); solid lines, data of Yasunishi and Yoshida (42).

18 (3) Carbon dioxide + Ammonium bromide [12124-97-9] + Water

Gerecke (35) measured the solubility of carbon dioxide in aqueous ammonium bromide at four concentrations between 0 and 2.0 mol L^{-1} at five degree intervals between 288.15 and 333.15 K. The results show salting in at 0.5 and 1.0 mol L^{-1} NH_4Br and salting out at 2.0 mol L^{-1} at temperatures of 288.15 to 328.15 K. There are no other data to compare with these data so the effect cannot be confirmed. We suggest caution in using the Gerecke data. No salt effect parameters are given from these data.

18 (4) Carbon dioxide + Ammonium sulfate [7783-20-2] + Water

Sechenov (1) measured the solubility of carbon dioxide in aqueous $(NH_4)_2SO_4$ up to 1.09 mol L^{-1} at 291.53 K, Gerecke (35) from 0 to 2.0 mol L^{-1} salt at five degree intervals from 288.15 to 333.15 K, Yasunishi and Yoshida (42) from 0 to 3.87 mol L^{-1} salt at 288.15, 298.15 and 308.15 K, and Rumpf and Maurer (56) at near 2.0 and 4.0 mol kg^{-1} salt at six temperatures between 333.13 and 433.15 K over a total pressure range of about 0.018 to 9.9 MPa. The Rumpf and Maurer data will be treated separately below.

The data of Yasunishi and Yoshida (42) show a small but well defined curvature on the lg L *vs.* c_2 plot. Thus, the Sechenov approach is probably valid to only about 1 mol L^{-1} (ionic strength 3) of ammonium sulfate. Their data were treated over several concentration ranges in Table 7.

Only the data over the 0 - 1 salt concentration range extrapolate back to the value of the carbon dioxide solubility in pure water. We suspect this is common for many salt solutions, we just do not have reliable data to show the effect for most systems.

Table 7.

T/K	$(NH_4)_2SO_4$ Conc. Range, c_2/mol L^{-1}	Salt Effect Parameter $k_{sI(c)c}$/L mol^{-1}	Std. Dev. of Slope	Reference
288.15	0 - 0.99	0.0629	0.0009	YY (42)
	0 - 3.35	0.0531	0.0013	YY (42)
	0.99- 3.35	0.0506	0.0015	YY (42)
298.15	0 - 0.85	0.0609	0.0015	YY (42)
	0 - 3.36	0.0518	0.0012	YY (42)
	1.24 - 3.36	0.0459	0.0020	YY (42)
308.15	0 - 1.01	0.0577	0.0009	YY (42)
	0 - 3.87	0.0487	0.0014	YY (42)
	1.32 - 3.87	0.0430	0.0015	YY (42)

The ionic salt effect parameters are compared in Table 8 from the work of Yasunishi and Yoshida, of Sechenov and of Gerecke.

Table 8.

T/K	$(NH_4)_2SO_4$ Conc. Range, c_2/mol L^{-1}	Salt Effect Parameter $k_{sI(c)c}$/L mol^{-1}	Std. Dev. of Slope	Reference
288.15	0 - 2.0	0.0541	0.0029	G (35)
	0 - 0.99	0.0629	0.0009	YY (42)
291.53	0 - 1.09	0.0584	0.0013	S (1)
298.15	0 - 2.0	0.0534	0.0033	G (35)
	0 - 0.85	0.0609	0.0015	YY (42)
308.15	0 - 2.0	0.0531	0.0022	G (35)
	0 - 1.01	0.0577	0.0009	YY (42)
318.15	0 - 2.0	0.0513	0.0022	G (35)
328.15	0 - 2.0	0.0530	0.0011	G (35)

The salt effect paramaters in ionic strength of Yasunishi and Yoshida and of Sechenov are classed as tentative. The values from Gerecke show more scatter about the regression line and show little temperature dependence. They are also classed as tentative, but should be used with caution.

Rumpf and Maurer (56) made molal solubility measurements of carbon dioxide at about 2.0 and 4.0 mol kg^{-1} $(NH_4)_2SO_4$ up to a total pressure near 9.5 MPa at six temperatures bewteen 313.15 and 433.15 K. The evaluator has interpolated solubility values at total pressures of 2.0, 5.0 and 8.0 MPa at four temperatures and calculated a salt effect parameter based on the slope between the two ammonium sulfate molalities. The results are shown in Table 9 (next page).

Table 9.

T/K	p_{total}/MPa	k_{smm}/kg mol^{-1}	$k_{sI(m)m}$/kg mol^{-1}
313.15	2.0	0.0654	0.0218
	5.0	0.0666	0.0222
	8.0	0.0702	0.0234
353.15	2.0	0.0579	0.0193
	5.0	0.0651	0.0217
	8.0	0.0645	0.0215
393.15	2.0	0.0732	0.0244
	5.0	0.0699	0.0233
	8.0	0.0708	0.0236
433.15	2.0	0.0888	0.0296
	5.0	0.0852	0.0284
	8.0	0.0792	0.0264

The increasing pressure has a relatively small influence on the salt effect parameter. The salt effect parameter appears to increase with increasing temperature which is contrary to observations at lower temperatures and atmospheric pressure. The salt effect parameters were obtained in an approximate way by the evaluator from the data of Rumpf and Maurer. The authors give a detailed discussion of their results which should be consulted by anyone making use of their data.

18 (5) Carbon dioxide + Ammonium chloride [12125-02-9] + Ammonium sulfate [7783-20-2] + Water

Yasunishi, Tsuji and Sada (43) measured the solubility of carbon dioxide in aqueous mixed electrolyte of NH_4Cl and $(NH_4)_2SO_4$ at 298.15 K. The solutions were:

Mole Fraction NH_4Cl	0.00	0.25	0.50	0.75	1.00
Ionic Strength Fraction NH_4Cl	0.00	0.20	0.25	0.50	1.00
Ionic strength Factor	3	2.5	2.0	1.5	1

The ionic strength factor multiplied by the total concentration converts the value to ionic strength.

The evaluator has treated this paper as an entity to itself. Each data set has been fit to a linear equation lg L *vs.* c_2. The negative of the slope is taken as the salt effect parameter which has been put on an ionic strength basis by dividing by the ionic strength factor given above. Salt effect parameters have been calculated using the values for pure NH_4Cl and pure $(NH_4)_2SO_4$ and the respective ionic strength fractions. Thus, $k_{sI(c)c}$(calc) = (Ionic strength fraction NH_4Cl)(0.0299) + (Ionic strength fraction $(NH_4)_2SO_4$)(0.0536). Results at 298.15 K are in Table 10 below. See also Figure 10B following section 100 (10).

The data for pure ammonium chloride and pure ammonium sulfate are from Yasunishi and Yosihida (42), the present authors have selected 7 of 22 values for ammonium chloride and 7 of 11 values for ammonium sulfate from the earlier paper with no indication as to why this selection was made. Other data from the earlier paper may give different results than observed below.

Table 10.

Total Concentration Range, $(c_2 + c_3)$	Ionic Strength Fraction, NH_4Cl	Salt Effect Parameter, $k_{sI(c)c}$ Experimental	Calculated
0.25 - 2.87	0.0	0.0536	-
0.28 - 2.81	0.20	0.0488	0.0489
0.33 - 2.67	0.25	0.0465	0.0476
0.25 - 2.86	0.50	0.0397	0.0418
0.38 - 2.82	1.00	0.0299	-

The salt effect parameter for NH_4Cl seems large (see Table 6), a value of 0.0258 gives calculated values of 0.0480, 0.0467, and 0.0397, which are in much better agreement with the experimental values.

18 (6) Carbon dioxide + Ammonium nitrate [6484-52-2] + Water

Sechenov (5) measured the solubility of carbon dioxide in aqueous NH_4NO_3 at 0 to 10.13 mol L^{-1} at 288.35 K, Gerecke (35) at 0 to 4 mol L^{-1} at five degree intervals from 288.15 to 328.15 K and Onda, Sada, Kobayashi, Kito and Ito (36) at 0 to 3.63 mol L^{-1} at 298.15 K. A measurement of carbon dioxide solubility in aqueous saturated ammonium nitrate at 293.15 K by Passauer (14) was not used in the evaluation. Evaluation results are in Table 11 below.

Table 11.

T/K	NH_4NO_3 Conc. Range, c_2/mol L^{-1}	Salt Effect Parameter $k_{sl(c)c}$/L mol^{-1}	Std. Dev. of Slope	Reference	
288.15	0 - 4.0	0.0474	0.0017	G	(35)
288.35	0 - 10.13	0.0213	0.0006	S	(5)
298.15	0 - 4.0	0.0488	0.0024	G	(35)
	0 - 3.63	0.0187	0.0025	OSKKI	(36)
308.15	0 - 4.0	0.0526	0.0051	G	(35)
318.15	0 - 4.0	0.0558	0.0090	G	(35)
	0 - 2.0	0.0224	0.0040	G	(35)
328.15	0 - 4.0	0.0570	0.0093	G	(35)
	0 - 2.0	0.0223	0.0026	G	(35)

The values above are classed tentative, but we suggest the values from Gerecke be used with caution. They show high scatter about the regression line and an increase with temperature not ordinarily observed. The value of 0.0187 L mol^{-1} at 298.15 K has been used in later sections to calculate a mixed salt effect parameter with $CaCl_2$ and $BaCl_2$ with fair success.

20 (1) Carbon dioxide + Arsenic trioxide [1327-53-3] + Water
20 (2) Carbon dioxide + Arsenic pentoxide [1303-28-2] + Water
20 (3) Carbon dioxide + Arsenic trioxide + Arsenic pentoxide + Water
20 (4) Carbon dioxide + Arsenic trioxide + Arsenic pentoxide + Hydrochloric acid [7647-01-0] + Water

Robb and Zimmer (34) report carbon dioxide solubility data in the four systems above plus the carbon dioxide + hydrochloric acid + water system discussed earlier (Section 10 (1)). The authors report measurements at 293.15, 298.15 and 303.15 K in three As_2O_3 solutions up to 0.1113 mol L^{-1} and three As_2O_5 solutions up to 0.1330 mol L^{-1}. They also report measurements in one system containing the two oxides and two systems containing the two oxides and HCl.

There are several inconsistencies in the original paper. No meaurements of carbon dioxide solubility in water at 293.15 and 303.15 K are tabulated, but water solubility values at all three temperatures are shown on the figures. Some carbon dioxide solubility values in the mixtures of oxides and HCl are larger than in pure water, but these are ignored in later data treatment. The authors give salt effect parameters with no statement as to the temperature or the effect of temperature.

The following salt effect parameters were determined from the data assuming a water solubility from the small figures in the paper.

Table 12.

	Arsenic Trioxide		Arsenic Pentoxide	
T/K	k_{smc}/kg mol^{-1}	Std Dev Slope	k_{smc}/kg mol^{-1}	Std Dev Slope
293.15	0.207	0.058	0.132	0.014
298.15	0.196	0.014	0.095	0.012
303.15	0.219	0.016	0.148	0.013

The authors reported salt effect parameters of 0.180 for As_2O_3 and 0.129 for As_2O_5. The averages of the evaluator's values are 0.207 and 0.125, respectively, assuming no temperature effect. The difference between molality and concentration in these solutions is negligable. The data are classed as tentative.

20 (5) Carbon dioxide + Arsenic trisulfide [1303-33-9] + Water

Findlay and Creighton (8) measured the solubility of carbon dioxide in four solutions of 0 - 0.0930 mol L^{-1} As_2S_3 at 298.15 K. The gas pressure ranged from 0.1005 to 0.1707 MPa (754 to 1281 mmHg) without appreciable change in solubility. The salt effect parameter is k_{scc} = 0.069 ± 0.005 L mol^{-1}. The salt effect parameter is about the magnitude one would expect for a molecular solute. The enhanced solubility seen in many colloid systems is not observed. The result is classed tentative.

23 (1) Carbon dioxide + *N, N*-Dimethylmethanamine hydrochloride [593-81-7] + Water

Gerecke (35) has measured the solubility of carbon dioxide in the *N, N*-dimethylmethanamine hydrochloride (trimethylamine hydrochloride) at 6 concentrations between 0 and 4 mol L^{-1} at five degree intervals between 288.15 and 333.15 K. Plots of lg L *vs.* c_2 are well defined smooth curves. The first three points (0, 0.25 and 0.50 mol L^{-1} salt) and the entire salt concentration range have been fitted to straight lines. The resulting salt effect parameters are in Table 13 below.

Table 13.

T/K	$C_3H_{10}NCl$ Conc. Range, c_2/mol L^{-1}	Salt Effect Parameter $k_{sl(c)c}$/L mol^{-1}	Std. Dev. of Slope	Reference
288.15	0 - 0.50	0.068	0.013	
	0 - 4.0	0.0210	0.0034	G (35)
298.15	0 - 0.50	0.085	0.032	
	0 - 4.0	0.0154	0.0056	G (35)
308.15	0 - 0.50	0.118	0.048	
	0 - 4.0	0.0194	0.0069	G (35)
318.15	0 - 0.50	0.145	0.0145	
	0 - 4.0	0.0199	0.0084	G (35)
328.15	0 - 0.50	0.182	0.057	
	0 - 4.0	0.0198	0.0107	G (35)

The increase in the salt effect parameter with temperature in the 0 - 0.50 mol L^{-1} salt concentration range is contrary to most other observations, so too is the salt effect parameter for the entire salt concentration range which goes through a minimum value. The values are classed as tentative. The system is briefly mentioned in the carbon dioxide in aqueous nonelectrolytes volume.

23 (2) Carbon dioxide + *N, N, N*-Trimethylmethanaminium iodide [75-58-1] + Water

Gerecke (35) has measured the solubility of carbon dioxide in the *N, N , N*-trimethyl-methanaminium iodide (tetramethylamonium iodide) at concentrations of 0, 0.1 and 0.19 mol L^{-1} at five degree intervals between 288.15 and 333.15 K. At the lower temperatures the solubility data show salting in at 0.10 mol L^{-1} and salting out at 0.19 mol L^{-1} which does not seem likely. Salt effect parameters are calculated and given below at ten degree intervals between 298.15 and 328.15 K, temperatures at which both salt concentrations show salting out.

Table 14.

T/K	$C_4H_{12}NI$ Conc. Range, c_2/mol L^{-1}	Salt Effect Parameter $k_{sl(c)c}$/L mol^{-1}	Std. Dev. of Slope	Reference
298.15	0 - 0.19	0.085	0.038	G (35)
308.15	0 - 0.19	0.167	0.090	G (35)
318.15	0 - 0.19	0.258	0.073	G (35)
328.15	0 - 0.19	0.370	0.115	G (35)

The results above are out of the ordinary in that they increase rapidly with increasing temperature and that they are of an unusually large magnitude for a 1-1 electrolyte. Past experience with inert gases is that tetra alkyl ammonium salts salt-out little or even salt-in. Carbon dioxide interacts with water and that may in some way account for the different behavior. There are no other data to compare with these. They are classed as tentative, but use with caution until confirmed. The system is also briefly discussed in the carbon dioxide in aqueous nonelectrolytes volume.

23 (3) Carbon dioxide + Ammonium citrate [3012-65-5] + Water

Lloyd (33) measured the solubility of carbon dioxide in water and in 0.053 mol L^{-1} aqueous ammonium citrate solutions adjusted to pH of 4, 5, 6 and 7 between 299.8 and 333.2 K. The citrate ion ranged from -1 anion, -2 anion and -3 anion at pH's of 4, 5 and 7, respectively. At 299.8 K carbon dioxide was salted out at pH 4 and 5 and salted in a pH 6 and 7. At 333.2 K carbon dioxide was salted in at all pH's. The evaluator suggests the user refer to the data sheet and original paper. No salt effect parameters were calculated by the evaluator. The data are classed as tentative.

24 (1) Carbon dioxide + Silicic acid [1343-98-2] + Water

Findlay and Creighton (8) and Findlay and Williams (10) report carbon dioxide solubility in this system. Findlay and Creighton report measurements in four solutions from 0 to 0.466 mol L^{-1} H_4SiO_4 at 298.15 K and pressures between 0.0975 and 0.1805 MPa (731 and 1354 mmHg). To the evaluator the change in solubility with pressure appears to be within experimental error. Findlay and Williams report measurements in four solutions from 0 to 0.208 mol L^{-1} acid at 298.15 K and pressures between 0.0.0349 to 0.1020 MPa (262 to 765 mmHg). In this set of experiments there is a definite decrease in Ostwald solubility between the lowest and second lowest (ca. 0.052 MPa) gas pressure. The system "salts-in" slightly. The values in the table below are classed tentative.

Table 15.

T/K	H_4SiO_4 Conc. Range, c_2/mol L^{-1}	Salt Effect Parameter k_{scc}/kg mol^{-1}	Std. Dev. About Slope	Reference
298.15	0.0 - 0.466	-0.0085	0.0035	FC (8)
298.15	0.0 - 0.208	-0.0020	0.0008	FW (10)
298.15	0.0 - 0.466	-0.0087	0.0035	Combined (8)(10)

Suspensions in water of colloidal silica, SiO_2, have negligible effect on the solubility of carbon dioxide (8, 10).

29 (1) Carbon dioxide + Aluminum oxide [1333-84-2] + Water

The solubility of carbon dioxide was measured in three dilute solutions of hydrated aluminum oxide at 293.15, 303.15 and 313.15 K by Shkol'nikova (27). The nature of these solutions is not known. The evaluator has calculated salt effect parameters on the basis of 0.0098, 0.0345 and 0.0414 moles of Al_2O_3 per kilogram of water. Carbon dioxide is salted out with salt effect parameters that have a magnitude about that observed for 1-1 electrolytes.

Table 16.

T/K	Al_2O_3 Molality Range, m_2/mol kg^{-1}	Salt Effect Parameter k_{smc}/kg mol^{-1}	Std. Dev. About Slope	Reference
293.15	0.0098 - 0.0414	0.153	0.086	Sh (27)
303.15	0.0098 - 0.0414	0.103	0.064	Sh (27)
313.15	0.0098 - 0.0414	0.100	0.063	Sh (27)

Measurements in such dilute solutions are difficult. The results are classed tentative, but they should be used with caution.

29 (2) Carbon dioxide + Alumimun chloride [7446-70-0] + Water

Yasunishi and Yoshida (42) measured the solubility of carbon dioxide at six concentrations between 0 and 2.57 mol L^{-1} $AlCl_3$ at 298.15 K. Multiplication by 6 converts the concentrations to ionic strength. The ionic strength basis salt effect parameter is $k_{sI(c)c}$ = 0.0411 L mol^{-1} with a standard error about the slope of 0.0004. The result is classed as tentative. Kobe and Williams (16) made measurements in water and in 25 mass % (2.32 mol L^{-1}) at 298.15 K. The two points give an ionic strength salt effect parameter of 0.0380 which is in reasonable agreement with the Yasunishi and Yoshida result.

29 (3) Carbon dioxide + Aluminum sulfate [10043-01-3] + Water

Yasunishi and Yoshida (42) measured the solubility of carbon dioxide at five concentrations between 0 and 0.85 mol L^{-1} $Al_2(SO_4)_3$ at 298.15 K. Multiplication by 15 converts the concentrations to ionic strength. The ionic strength basis salt effect parameter is $k_{sI(c)c}$ = 0.0504 L mol^{-1} with a standard error about the slope of 0.0008. The result is classed tentative. Kobe and Williams (16) made measurements in water and 20 mass % (0.717 mol L^{-1}) at 298.15 K. The ionic strength salt effect parameter from the two points is 0.0531 which is within reasonable agreement with the Yasunishi and Yoshida result.

33 (1) Carbon dioxide + Zinc chloride [7646-85-7] + Water

Passauer (14) measured the solubility of carbon dioxide in saturated zinc chloride at 293.15 K. No salt effect parameter was calculated because of uncertainty of the solubility of zinc chloride in water. Kobe and Williams (16) measured the solubility of carbon dioxide in 50 mass % (7.34 mol kg^{-1}; 5.74 mol L^{-1}) $ZnCl_2$ at 298.15 K. The salt effect parameters are $k_{sI(m)c}$ = 0.0149 and $k_{sI(c)c}$ = 0.0191. The results are classed tentative.

33 (2) Carbon dioxide + Zinc sulfate [7733-02-0] + Water

Sechenov (5) measured the solubility at five concentrations between 0 and 2.48 mol L^{-1} $ZnSO_4$ at 288.35 K. Multiplication by 4 converts the concentrations to ionic strength. The ionic strength salt effect parameter is $k_{sI(c)c}$ = 0.0691 with a standard deviation about the slope of 0.0009. The result is classed as tentative.

36 (1) Carbon dioxide + Copper (II) sulfate [7758-98-7] + Water

Nahoczky (15) reported a single measurement of the solubility of carbon dioxide in saturated aqueous copper sulfate at 288.15 K. Vázquez, Chenlo and Pereira (61) measured the solubility of carbon dioxide in five solutions between 0 and 1.002 mol L^{-1} $CuSO_4$ at 298.15 K and 0.1013 MPa. Vázquez, Chenlo, Pereira and Peaguda (64) measured the solubility of carbon dioxide in four solutions between 0.251 and 1.002 mol L^{-1} $CuSO_4$ at five degree intervals between 293.1 and 313.1 K at a pressure of 0.1013 MPa.

No salt effect parameter was calculated from Nahoczky's data because of uncertainty in the saturation concentration of the copper sulfate. Ionic strength salt effect parameters were calculated from the Vázquez *et al.* (61, 64) data. It was assumed the salt concentration values valid at 298.1 K could be used at the other temperatures with negligible error. The concentration salt effect parameters will be four times larger than the values in the table below.

Table 17.

T/K	$CuSO_4$ Concentration Range, c_2/mol L^{-1}	Salt Effect Parameter $k_{sI(c)c}$/L mol^{-1}	Std. Dev. About Slope	Reference
293.1	0.251 - 1.002	0.0595	0.0007	VCPP (64)
298.1	0.0 - 1.002	0.0650	0.0029	VCP (61)
	0.251 - 1.002	0.0601	0.0011	VCPP (64)
303.1	0.251 - 1.002	0.0564	0.0038	VCPP (64)
308.1	0.251 - 1.002	0.0585	0.0028	VCPP (64)
313.1	0.251 - 1.002	0.0522	0.0048	VCPP (64)

The Vázquez *et al.* solubilities show curvature on the lg L *vs.* c_2 plot. Much of the curvature comes between 0 and 0.25 mol L^{-1} salt. The temperature coefficient of the salt effect parameters does not decrease smoothly as expected. The data are classed tentative, but use with caution.

41 (1) Carbon dioxide + Ferric oxide [12259-21-1] + Water

The solubility of carbon dioxide was measured in three dilute solutions of hydrated ferric oxide at 293.15, 303.15 and 313.15 K by Shkol'nikova (27). The nature of these solutions is not known. The evaluator has calculated salt effect parameters on the basis of 0.0063, 0.0315 and 0.0505 moles of Fe_2O_3 per kilogram of water. Carbon dioxide is strongly salted in. Salt effect parameters are below.

Table 18.

T/K	Fe_2O_3 Molality Range, m_2/mol kg^{-1}	Salt Effect Parameter k_{smc}/kg mol^{-1}	Std. Dev. About Slope	Reference
293.15	0.0063 - 0.0505	-0.73	0.02	Sh (27)
303.15	0.0063 - 0.0505	-0.83	0.14	Sh (27)
313.15	0.0063 - 0.0505	-0.63	0.15	Sh (27)

Measurements in such dilute solutions are difficult. The results are classed as tentative, but they should be used with caution.

41 (2) Carbon dioxide + Iron hydroxide oxide [20344-49-4], [1309-33-7] + Water

Gatterer (11) measured the solubility of carbon dioxide in six solutions of 0 to 0.322 mol L^{-1} $Fe(OH)_3$ at five degree intervals between temperatures of 278.12 and 298.15 K. The author reported eq L^{-1}, the evaluator has used mol L^{-1}. The carbon dioxide solubility is enhanced by the presence of the colloidal solution. However, the lg L *vs.* c_2 plot is curved with slope decreasing as the iron compound concentration increases. Both Findlay and Creighton (8) and Findlay and Williams (10) report carbon dioxide solubilities in $Fe(OH)_3$ solutions at 298.15 K. The first paper reports solubilities at pressures between 0.0995 and 0.1808 MPa (746 and 1356 mmHg) and the second paper at pressures between 0.0311 and 0.0995 MPa (233 and 746 mmHg). At the higher pressure range the Ostwald solubility appears to be independent of pressure, at the lower pressure range there is a noticible decrease in Ostwald solubility as the pressure increases. The solubility at the common pressure of about 0.0995 MPa differs by 7 to 12 % in the two experiments. These differences may be due to variations in the colloidal nature of these systems.

The evaluator has used only the first three points of Gatterer (0, 0.0237 and 0.0480 mol L^{-1} $Fe(OH)_3$) to determine the initial salt effect parameter. The values are in Table 19. The Findlay and Creighton data over the higher pressure range showed much less salting in than the data at 0.0995 MPa from the Findlay and Williams paper. The nature of these colloidal solutions depends on method of preparation, aging and other treatment. It appears difficult to obtain solutions of the same stoichimetric concentration with reproducucible properties.

Table 19.

T/K	$Fe(OH)_3$ Conc. Range, c_2/mol kg^{-1}	Salt Effect Parameter k_{scc}/kg mol^{-1}	Std. Dev. About Slope	Reference
278.12	0.0 - 0.0480	-0.700	0.011	Ga (11)
283.10	0.0 - 0.0480	-0.813	0.014	Ga (11)
288.11	0.0 - 0.0480	-0.875	0.016	Ga (11)
293.13	0.0 - 0.0480	-0.960	0.003	Ga (11)
298.15	0.0 - 0.0480	-1.071	0.068	Ga (11)
298.15	0.0 - 0.1554	-0.273	0.007	FC (8)
298.15	0.0 - 0.1179	-0.701	0.022	FW (10)

41 (3) Carbon dioxide + Ferrous ammonium sulfate [7783-85-9] + Water

Findlay and Shen (9) measured the solubility of carbon dioxide at four concentrations between 0 and 0.573 mol L^{-1} $(NH_4)_2SO_4FeSO_4$ (dissoloved as the hexahydrate) at 298.15 K. Multiplication by 7 converts the concentration to ionic strength. The electrolyte salts in. The molar salt effect parameter is -0.442 with a stanadard deviation about the slope of 0.004, the ionic strength salt effect parameter is $k_{sI(c)c}$ = -0.0632 L mol^{-1} with a standard error about the slope of 0.0005. The values are classed as tentative.

41 (4) Carbon dioxide + Ferriferrocyanide {other names: Iron(III)hexacyanoferrate(II) and Iron(3+)hexacyanoferrate(4-), also Prussian Blue} [14038-43-8]], [12240-15-2] + Water

Gatterer (11) has measured the solubility of carbon dioxide in six solutions between 0 and 0.0747 mol L^{-1} $Fe_4[Fe(CN)_6]_3$ at five degree intervals between temperatures 278.12 and 298.15 K. The original paper gives the concentrations as equivalents per liter, the equivalent being 1/12 the molecular weight. The solution is described as colloidal. The salt effect parameters are given on a molar basis since the nature of the solution is not known. The solutions show salting in, but the solubility goes through a maximum and then decreases to a value near the value in water at the highest concentration (0.896 eq L^{-1}, 0.0747 mol L^{-1}). The lg *L vs.* c_2 plots are linear over only the first three concentrations, and the salt effect parameters are based on the initial slope defined by those three points (0, 0.0105 and 0.0148 mol L^{-1}).

Table 20.

T/K	$Fe_4[Fe(CN)_6]_3$ Range, c_2/mol kg^{-1}	Salt Effect Parameter k_{scc}/kg mol^{-1}	Std. Dev. About Slope	Reference
278.12	0.0 - 0.0148	-0.526	0.013	Ga (11)
283.10	0.0 - 0.0148	-0.644	0.046	Ga (11)
288.11	0.0 - 0.0148	-0.752	0.023	Ga (11)
293.13	0.0 - 0.0148	-0.841	0.013	Ga (11)
298.15	0.0 - 0.0148	-0.937	0.029	Ga (11)

The results are classed as tentative.

ALKALINE EARTH METAL SALTS

A number of measurements have been made on the solubility of carbon dioxide in aqueous solutions of alkaline earth metal salts. An interesting set of values is the Sechenov salt effect parameters for the alkaline earth chlorides at 298.15 K. Values for $k_{sI(c)c}$ and R_i, the cation crystallographic radii (63), are given below:

	$k_{sI(c)c}$/L mol^{-1}	Cation	$10^{10}R_i$/m	Coordination number
$MgCl_2$	0.0581 ± 0.0005	Mg^{2+}	0.72	6
$CaCl_2$	0.0626 ± 0.0008	Ca^{2+}	1.12	8
$SrCl_2$	0.065 ± 0.004	Sr^{2+}	1.26	8
$BaCl_2$	0.0715 ± 0.0006	Ba^{2+}	1.42	8

Thus, salting out of carbon dioxide by the alkaline earth chlorides increases as the size of the divalent alkaline earth cation increases. These and other salt effect parameters are evaluated below.

93 (1) Carbon dioxide + Magnesium chloride [7786-30-3] + Water

The system was studied by Yasunishi and Yoshida (42) at 288.15, 298.15 and 308.15 K, by Kobe and Williams (16) in water and 30 mass % (3.92 mol L^{-1}) $MgCl_2$, and in saturated aqueous $MgCl_2$ by Nahoczky (15) at 288.15 K and by Passauer (14) at 293.15 K. In addition He and Morse (57) at 273.15, 298.15, 323.15, 348.15 and 363.15 K using molality units. The work from references (42) and (16) is considered the most useful, but the two data sets are treated separately because one is in mol L^{-1} units and the other in mol kg^{-1} units. The ionic strength salt effect parameters from the data of Yasunishi and Yoshida (42) are:

T/K	288.15	298.15	308.15
$k_{sI(c)c}$/L mol^{-1}	0.0637	0.0581	0.0547
Std. dev. slope	0.0019	0.0005	0.0008

The salt effect parameters, which decrease with increasing temperature as expected, are classed as tentative. The two points of Kobe and Williams (16) give a salt effect parameter of 0.0595 at 298.15 K which agrees well with the Yasunishi and Yoshida (42) result. The saturated solution data were not treated because of uncertainty in the saturated $MgCl_2$ concentration.

The salt effect parameters from the data of He and Morse are in Table 21 next page.

Table 21.

T/K	$MgCl_2$ Molality Range, m_2/mol kg^{-1}	Salt Effect Parameter $k_{sI(m)m}$/kg mol^{-1}	Std. Dev. of slope	Reference
273.15	0.1 - 5.0	0.0565	0.0017	HM (57)
298.15	0.1 - 5.0	0.0455	0.0043	HM (57)
323.15	0.2 - 5.0	0.0236	0.0032	HM (57)
348.15	0.1 - 5.0	0.0090	0.0007	HM (57)
363.15	0.1 - 5.0	0.0094	0.0002	HM (57)

The He and Morse data show somewhat more scatter than do the Yasunishi and Yoshida data. The values at 348.15 and 363.15 do not seem to carry the same temperature dependence as the lower temperature values. The data set is classed tentative until more information becomes available.

93 (2) Carbon dioxide + Magnesium sulfate [7487-88-9] + Water

The system was studied by Sechenov (5) at 288.35 K, Markham and Kobe (18) at 273.35, 298.15 and 313.15 K, Gerecke (35) at 5 degree intervals bewteen 288.15 and 333.15 K, Yasunishi and Yoshida (42) at 298.15 K, Nahoczky (15) in aqueous saturated magnesium sulfate and He and Morse (57) at five temperatures bewteen 273.15 and 363.15 K. The ionic strength salt effect parameters from the first four workers are given in Table 22.

The value in [ ] at 298.15 K is a recommended value from the combined data of Markham and Kobe and of Yasunishi and Yoshida. The values of Gerecke show fair standard deviation of the slope, but they show very little change with temperature, thus they are classed doubtful. The other values are classed tentative. The concentration range can be changed to an ionic strength range by multiplication by four.

Table 22.

T/K	$MgSO_4$ Concentration Range, c_2/mol L^{-1}	Salt Effect Parameter $k_{sI(c)c}$/L mol^{-1}	Std. Dev. of slope	Reference
273.35	0.0 - 1.96	0.0788	0.0009	MK (18)
288.15	0.0 - 2.0	0.0717	0.0038	G (35)
288.35	0.0 - 2.617	0.0701	0.0005	S (5)
298.15	0.0 - 1.96	0.0673	0.0007	MK (18)
	0.0 - 2.0	0.0718	0.0020	G (35)
	0.118 - 2.274	0.0669	0.0007	YY (42)
[298.15	0.0 - 2.27	0.0671	0.0004	MK & YY]
313.15	0.0 - 2.7	0.0625	0.0011	MK (18)
	0.0 - 2.0	0.0729	0.0028	G (35)
323.15	0.0 - 2.0	0.0724	0.0032	G (35)
328.15	0.0 - 2.0	0.0724	0.0042	G (35)

The data of He and Morse (57) are reported as molal values for both salt and gas. They report CO_2 solubility values up to 4.0 molal $MgSO_4$, but the lg m_1 *vs.* m_2 lines do not extrapolate well to the solubility value in water. Use of only the first three data point extrapolate better, but the standard deviation about the slope is little changed except for the 273 K slope. The salt effect parameters are in Table 23 (next page).

93 (3) Carbon dioxide + Magnesium nitrate [10377-60-3] + Water

Solubility data are reported on the system by Markham and Kobe (18) at 273.35, 298.15 and 313.15 K and by Yasunishi and Yoshida (42) at 298.15 K. The salt effect parameters from the slope of lg L *vs.* I_2 plots are given in Table 24 (next page). The individual values are classed as tentative, but the combined data of the two papers at 298.15 K given in [ ] in Table 24 is classed as recommended. Multiplication of the concenration range by three will give the ionic strength range.

Table 23.

T/K	$MgSO_4$ Molality Range, m_2/mol kg^{-1}	Salt Effect Parameter $k_{\mathrm{sl(m)m}}$/kg mol^{-1}	Std. Dev. of slope	Reference
273.15	0.10 - 1.00	0.0521	0.0018	HM (57)
298.15	0.1 - 1.0	0.0305	0.0068	HM (57)
323.15	0.1 - 1.00	0.0205	0.0031	HM (57)
348.15	0.1 - 2.0	0.0129	0.0009	HM (57)
363.15	0.1 - 2.0	0.0111	0.00003	HM (57)

Table 24.

T/K	$Mg(NO_3)_2$ Conc. Range, c_2/mol L^{-1}	Salt Effect Parameter $k_{\mathrm{sl(c)c}}$/L mol^{-1}	Std. Dev. of slope	Reference
273.35	0.0 - 2.70	0.0599	0.0007	MK (18)
298.15	0.0 - 2.70	0.0459	0.0003	MK (18)
	0.203 - 3.372	0.0468	0.0003	YY (42)
[298.15	0.0 - 3.37	0.0465	0.0003	MK & YY]
313.15	0.0 - 2.70	0.0415	0.0003	MK (18)

94 (1) Carbon dioxide + Calcium chloride [10043-52-4] + Water

Eight papers report the solubility of carbon dioxide in aqueous calcium chloride solution at atmospheric pressure and four papers report the solubility at pressures of 48 to over 3000 bars. The low and high pressure values will be treated separately.

Mackenzie (3), Sechenov (5), Onda, Sada, Kobayashi, Kito and Ito (36), Yasunishi and Yoshida (42), Wolf and Krause (12), Passauer (14), Kobe and Williams (16) and Eremina, Efanov and Sorokina (53) report the atmospheric pressure experimental measurements. The Wolf and Krause data were not used because the gas was a carbon dioxide/air mixture. The Passauer data was a single point in saturated salt solution and was not used because of uncertainty in the concentration of calcium chloride in saturated solution. Eremina et al. made 11 to 12 solubility measurements over the 0 to 0.025 mol L^{-1} $CaCl_2$ range. Their data show linear segments ranging in slopes from -2.2 to -3.4 which the evaluator judges to be doubtful. Measurements in such dilute solutions are difficult and subject to large error [(49) and this volume preliminary material]. The large salt effect parameters from their work are classed doubtful unless confirmed by future work. The Kobe and Williams measurements were in water and in 40 mass % $CaCl_2$ (5.02 mol L^{-1}). A salt effect parameter was calculated from the two solubilities. It and other values are in Table 25 (next page).

The data at 288.35/289.4 and 298.15 K are shown on a logarithm of Bunsen coefficient *vs.* calcium chloride ionic strength plot in Figure 4 (next page). The data of He and Morse were included after conversion of their values to Bunsen coefficient and calcium chloride concentration ionic strength using the author's density and partial pressure data, and assuming ideal gas behavior and Henry's law. The 288.35 K line was drawn with respect to the data of Sechenov (5) and the 298.15 K line with respect to the data of Yasunishi and Yoshida (42). The curvature of the 298.15 K line at ionic strength greater than about 6 mol L^{-1} appears to be confirmed by the points of Onda *et al.* (36) and Kobe and Williams (16), but not the final value of He and Morse (57). The differences in the curves at 288.35 and 298.15 K can be resolved only with further experimental work.

Mackenzie's results are classed doubtful. The salt effect parameters from his solubility values are smaller than those reported by other workers, they show more scatter about the slope and they do not show a regular change with temperature.

Sechenov's value at 288.35 K is classed tentative. Yashunishi and Yoshida's measured the solubility of carbon dioxide up to 4.53 mol L^{-1} calcium chloride at 298.15 K. Above about 2 mol L^{-1} calcium chloride there is a definite curvature to the lg L *vs.* c_2 data. Thus, we have fitted the salt effect parameter to the near linear part of the data. The data of Onda *et al.* go to 2.17 mol L^{-1} calcium chloride. Both data sets are classed tentative. The combined result given in [ ] (Table 25) uses four data points from Yasunishi and Yoshida and eight data points from Onda *et al.* It is the recommended value at 298.15 K.

Yashunishi and Yoshida's data at 308.15 K and the resulting salt effect parameter are classed as tentative.

Table 25.

T/K	$CaCl_2$ Conc. Range, c_2/mol L^{-1}	Salt Effect Parameter $k_{sI(c)c}$/L mol^{-1}	Std. Dev. of slope	Reference
281	0.41 - 1.62	0.0452	0.0048	Mac (3)
288.35	0 - 4.34	0.0700	0.0013	S (5)
289.4	0.41 - 1.62	0.0449	0.0004	Mac (3)
295	0.41 - 1.62	0.0398	0.0044	Mac (3)
298.15	0.18 - 2.17	0.0616	0.0004	OSKKI (36)
	0.23 - 4.53	0.0521	0.0024	YY (42)
	0.23 - 2.0	0.0606	0.0013	YY (42)
	0.0, 5.02	0.0476	-	KW (16)
	0.0 - 0.025	1.01	0.21	EES (53)
[298.15	0.18 - 2.17	0.0626	0.0005	OSKKI & YY]
303	0.41 - 1.62	0.0433	0.0068	Mac (3)
308.15	0.30 - 2.14	0.0548	0.0009	YY (42)
313.15	0.0 - 0.025	0.724	0.154	EES (53)

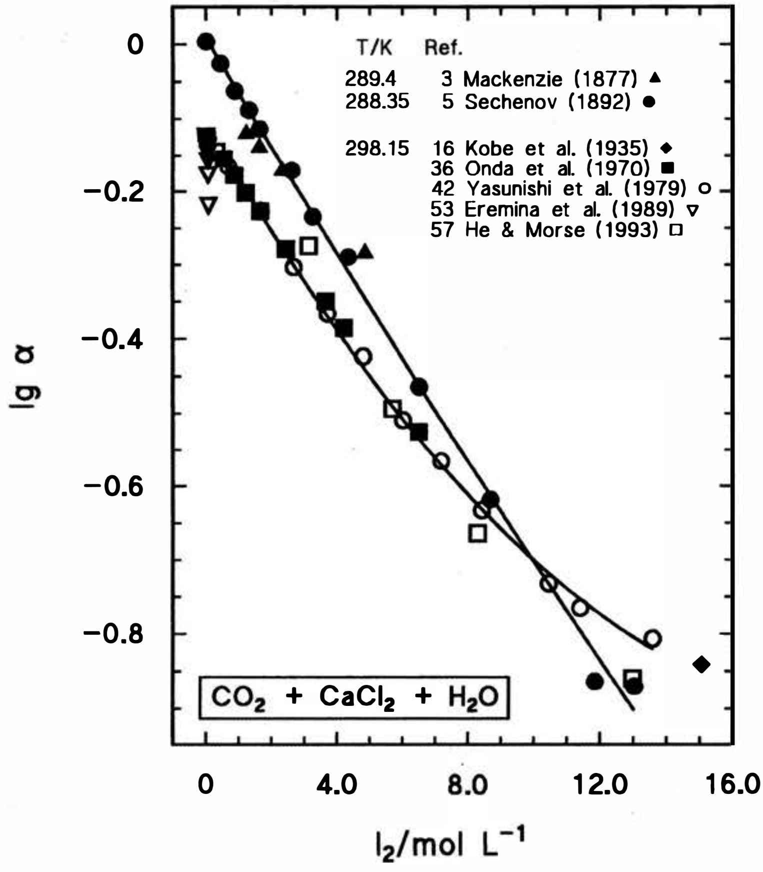

Figure 4. Logarithm of Bunsen coefficient *vs.* calcium chloride ionic strength.

The data of He and Morse (57) were measured under somewhat different conditions. They report both the salt and gas in molal units. They used different carbon dioxide pressures at each temperature. The temperatures and pressures of their measurements are (temperature, K)/(pressure/bar): 273.15/0.954, 298.15/0.930, 323.15/0.843, 348.15/0.595 and 363.15/0.297. The measurements are reported for the gas solubility up to 5.0 molal $CaCl_2$, but better straight lines that extrapolate to the water solubility value are obtained if the 5.0 molal value is omitted. The salt effect parameters from their data are below.

Table 26.

T/K	$CaCl_2$ Molality Range, m_2/mol kg^{-1}	Salt Effect Parameter $k_{sI(m)m}$/kg mol^{-1}	Std. Dev. of slope	Reference
273.15	0.10 - 4.00	0.0527	0.0018	HM (57)
298.15	0.1 - 4.0	0.0559	0.0009	HM (57)
323.15	0.1 - 2.71	0.0446	0.0025	HM (57)
348.15	0.1 - 3.0	0.0075	0.0011	HM (57)
363.15	0.1 - 3.0	0.0057	0.0003	HM (57)

There are several inconsistencies in the salt effect parameters. The 273.15 K value is suspected to be low, and the 348.15 and 363.15 K values do not seem to carry on the expected temperature dependence of the lower temperature values. The values are classed as tentative, but use with caution. The evaluator does not believe there is much change with pressure, see the pressure dependent data in Table 27.

Table 27.

T/K	$CaCl_2$ Conc. Range, c_2/mol L^{-1} (m_2/mol kg^{-1})	Total Pressure p_t/bar	Salt Effect Parameter $k_{sI(c)m}$/L mol^{-1} or $k_{sI(m)x}$/kg mol^{-1}	Std. Dev. of slope	Reference
293.15	0 - 3.44	48	0.0532	0.0008	MS (38)
323.15	0 - 1.94	48	0.0536	0.0008	MS (38)
349	0 - 3.91(m)	48	0.0365 (m)	0.0013	PS (22)
		300	0.0478	0.0013	
		600	0.0499	0.0015	
363.15	0 - 2.10	48	0.0528	0.0012	MS (38)
373.15	0 - 1.98	48	0.0522	0.0034	MK (40)
374.2	0 - 3.91(m)	48	0.0562 (m)	0.0028	PS (22)
		300	0.0488	0.0014	
		600	0.0505	0.0019	
393/ 394	0 - 3.91(m)	48	0.0541 (m)	0.0038	PS (22)
		300	0.0504	0.0026	
		600	0.0513	0.0036	
423.15	0 - 2.60	48	0.0487	0.0039	MK (40)

The papers of Malinin and Savelyeva (38) and Malinin and Kurovskaya (40) report the solubility of carbon dioxide in aqueous calcium chloride at temperarures of 293.15, 323.15, 353.15, 373.15 and 423.15 K at a pressure of 47.95 bars. The calcium chloride concentration ranges from 0.0 to as high as 6.95 mol L^{-1}. All of the data sets show a definite similar curvature in the lg m_1 *vs.* c_2 plots. They appear nearly linear up to about 2 mol L^{-1} $CaCl_2$ and this range is used to obtain a limiting salt effect parameter. The salt effect parameters are given as $k_{sI(c)m}$ values with the $CaCl_2$ ionic strength in mol L^{-1} and the solubility in mol kg^{-1}. The evaluator calculated approximate molal carbon dioxide solubilities at 293.15 K assuming the solution densities were the same as the aqueous $CaCl_2$ densities at this temperature. All of the values are classed as tentative.

Prutton and Savage (22) measured the mole fraction solubility of carbon dioxide in water and in 10.1, 20.2 and 30.2 mass percent (0, 1.01, 2.28, and 3.91 molal) $CaCl_2$ at temperatures of 349, 374, and 393/94 K over a pressure range of 15.2 to 703 bar. The evaluator interpolated mole fraction solubility values at pressures of 47.3, 300 and 600 bar. The slopes of lg x_1 *vs.* m_2 were determined by a linear regression at each of the temperatures. The negative of the slopes was converted to an ionic strength scale in molality to give $k_{sI(m)x}$/kg mol^{-1} values. The salt effect parameter at 349 K and 47.3 bar appears to be too small and is classed doubtful, the other values are classed tentative.

Plyasunova and Shmulovich (55) measured the solubility of carbon dioxide at 773 K in 10 and 20 mass % $CaCl_2$ at pressures of 1000, 2000 and 3000 bar. The evaluator calculated molalities of both CO_2 and $CaCl_2$ from the mass % data and estimated salt effect parameters from the carbon dioxide solubility at the two salt concentrations. The results are:

p_{total}/MPa	100	200	300
k_{smm}/kg mol^{-1}	0.291	0.056	0.024
$k_{sI(m)m}$/kg mol^{-1}	0.097	0.019	0.008

The change of the salt effect parameter with pressure is much larger than at pressures below 10 MPa where little pressure dependence is noted. There are no other data to compare with these and they are classed as tentative.

All of the high pressure salt effect parameters are given in the table above. The results of Malinin and coworkers and of Prutton and Savage cannot be directly compared nor can either set be compared with the atmospheric results without knowledge of the solution density. They appear to be of similar magnitude. There appears to be little effect of pressure on the salting out parameter as one increases the pressure from about 50 to over 600 bars. At 100 to 300 MPa the salt effect parameters decrease (55).

94 (2) Carbon dioxide + Ammonium nitrate [6484-52-2] + Calcium chloride [10043-52-4] + Water

Onda, Sada, Kobayashi, Kito and Ito (36, 37) have measured the solubility of carbon dioxide in aqueous calcium chloride and in aqueous ammonium nitrate + calcium chloride where the salt mol ratio is 1 mole calcium chloride to 3 moles ammonium nitrate (ionic strength ratio 1:1). At 298.15 K and atmospheric pressure the salt effect parameter for the mixed aqueous electrolyte is $k_{sI(c)c}$ = 0.0372 L mol^{-1} with a standard deviation about the slope of 0.0010 for the total ionic strength range of 1.66 - 6.33.

If the salts act independently the predicted salt effect parameter would be the average of the calcium chloride and the ammonium nitrate ionic strength salt effect parametrs 0.5(0.0187) + 0.5(0.0616) = 0.0402. The fact that the calculated value is 8 % larger than the experimental value indicates the possibility of some specific interaction between the salts or salts and solvent.

94 (3) Carbon dioxide + Calcium chloride [10043-52-4] + Methanol [67-56-1] + Water

Sada, Kito and Ito (41) measured the solubility of carbon dioxide in methanol-water mixed solutions of calcium chloride at atmospheric pressure at 298.15 K. For comparison with aqueous calcium chloride solutions we used the data of Onda, Sada, Kobayashi, Kito and Ito (36). The ionic strength salt effect parameters are summarized below.

Table 28.

T/K	Calcium chloride Ionic strength Range, I_2/mol L^{-1}	Methanol Mole Fraction	Salt Effect Parameter $k_{sI(c)c}$/L mol^{-1}	Std. Dev. of slope
298.15	0.54 - 6.51	0.0	0.0616	0.0004
	0.0 - 2.10	0.280	0.0607	0.0007
	0.0 - 2.25	0.389	0.0585	0.0010
	0.0 - 2.19	0.587	0.0635	0.0017
	0.0 - 2.60	0.800	0.0669	0.0003
	0.0 - 2.89	1.000	0.0721	0.0013

The results indicate a minimum in the salting out effect someplace in the methanol mole fraction range between 0.280 and 0.587, probably near mole fraction 0.4 (see also Figure 5 following section 98 (2)). The salt effect parameters are classed as tentative.

94 (4) Carbon dioxide + Calcium nitrate [10124-37-5] + Water

Onda, Sada, Kobayashi, Kito and Ito (36) and Yashunishi and Yoshida (42) have measured the solubility of carbon dioxide in aqueous calcium nitrate solutions at 298.15 K and atmospheric pressure. Their results compare well and an ionic strength salt effect parameter from their combined data is recommended. The concentration range can be made the ionic strength range of 0.69 - 10.74 by multiplying by three.

Table 29.

T/K	$Ca(NO_3)_2$ Conc. Range, c_2/mol L^{-1}	Salt Effect Parameter $k_{sI(c)c}$/L mol^{-1}	Std. Dev. of slope	Reference
298.15	0.30 - 2.11	0.0504	0.0004	OSKKI (36)
	0.23 - 3.58	0.0503	0.0006	YY (42)
[	0.23 - 3.58	0.0504	0.0005	OSKKI & YY]

95 (1) Carbon dioxide + Strontium chloride [10476-85-4] + Water

Mackenzie (3) measured the solubility of carbon dioxide in aqueous strontium chloride at atmospheric pressure and temperatures of 281, 289.4, 295 and 303 K. His data are the only results we are aware of with this salt. Mackenzie's data often show more scatter than more modern data, however, these data are consistent for the system and are classed as tentative. Note that at 303 K there is considerable improvement in the standard deviation about the slope when the value at 0.868 mol L^{-1} $SrCl_2$ is omitted. The ionic strength salt effect parameters are in the table below. The concentration range can be converted to an ionic strength range by multiplication by three.

Table 30.

T/K	$SrCl_2$ Conc. Range, c_2/mol L^{-1}	Salt Effect Parameter $k_{sI(c)c}$/L mol^{-1}	Std. Dev. of slope	Reference
281	0.65 - 2.64	0.0750	0.0043	Mac (3)
289.4	0.65 - 2.64	0.0720	0.0007	Mac (3)
295	0.65 - 2.64	0.0667	0.0033	Mac (3)
303	0.65 - 2.64	0.0643	0.0093	Mac (3)
		0.0590^a	0.0043	Mac (3)

^{a} solubility value at 0.868 mol L^{-1} $SrCl_2$ was omitted from fit.

96 (1) Carbon dioxide + Barium chloride [10361-37-2] + Water

The solubility of carbon dioxide in aqueous barium chloride (usually dissolved as the dihydrate) at atmospheric pressure is reported by Mackenzie (3) at 281, 285.7, 288, 289.4, 295 and 303 K, by Sechenov (4) at 288.35 K, by Findlay and Shen (9) at 298.15 K, by Onda, Sada, Kobayashi, Kito and Ito (36) at 298.15 K, by Yasunishi and Yoshida (42) at 298.15 K and by Eremina, Efanov and Sorokina (53) at 298.15 and 313.15 K.

The data of Mackenzie are not consistently reliable and the measurements of Sechenov include only one barium chloride solution, thus both data sets are classed as doubtful. Eremina et al. (53) measured ten solubilities over the 0.0 to 0.050 mol L^{-1} $BaCl_2$. Measurements in such dilute solutions are difficult and subject to large error [(49) and this volume preliminary material]. The salt effect parameters from their data in the table below are classed as doubtful until confirmed by future new work. The data from the other three papers are classed as tentative. The result at 298.15 K from the combined data of references (36) and (42) is the preferred tentative salt effect parameter. Results are summarized in Table 31 (next page).

96 (2) Carbon dioxide + Ammonium nitrate [6484-52-2] + Barium chloride [10361-37-2] + Water

Onda, Sada, Kobayashi, Kito and Ito (36, 37) have measured the solubility of carbon dioxide in aqueous barium chloride and in six aqueous mixtures of ammonium nitrate and barium chloride in the ratio of 1 mol $BaCl_2$ to 2.60 mole NH_4NO_3 (ionic strength ratio 3.00 $BaCl_2$ to 2.60 NH_4NO_3). The ionic strength salt effect parameter is, $k_{sI(c)c}$ = 0.0441 with a standard deviation about the slope of 0.0006 for the 0.33 to 1.69 ionic strength range at 298.15 K.

If the two salts act independently one would predict from the salt effect parameters of $BaCl_2$ and NH_4NO_3 a salt effect parameter of [3(0.0715) + 2.60(0.0187)]/5.60 = 0.0470 which is 6.6 % larger than the experimental value. The result suggests the possibility of a specific interaction in the system.

Table 31.

T/K	$BaCl_2$ Conc. Range, c_2/mol L^{-1}	Salt Effect Parameter $k_{\mathrm{sl(c)c}}$/L mol^{-1}	Std. Dev. of slope	Reference
281	0.38 - 1.54	-		Mac (3)
285.7	0.766	-		Mac (3)
288	0.1.541	-		Mac (3)
288.35	0 - 1.59	0.068		S (4)
289.4	0.38 - 0.766	-		Mac (3)
295	0.38 - 1.54	0.069	0.006	Mac (3)
298.15	0.115 - 0.408	0.0747	0.0037	FS (9)
	0.155 - 1.564	0.0703	0.0006	YY (42)
	0.371 - 1.082	0.0715	0.0030	OSKKI (36)
	0.0 - 0.050	0.124	0.045	EES (53)
[298.15	0.155 - 1.564	0.0715	0.0006	YY & OSKKI]
303	0.38 - 1.54	0.0740	0.0023	Mac (3)
313	0.0 - 0.050	0.041	0.056	EES (53)

98 (1) Carbon dioxide + Lithium chloride [7447-41-8] + Water

The solubility of carbon dioxide in aqueous lithium chloride solutions is reported in four papers. Sechenov (5) reports the solubility in seven solutions between 0 and 11.83 mol L^{-1} LiCl at 288.35 K and atmospheric pressure, Gerecke (35) reports the solubility in five solutions between 0 and 3.75 mol L^{-1} LiCl at five degree intervals between temperatures of 288.15 and 333.15 K. Onda, Sada, Kobayashi, Kito and Ito (36) report the solubility in six solutions between 0 and 5.05 mol L^{-1} LiCl at 298.15 K. Sada, Kito and Ito (41) report the solubility in four solutions between 0 and 1.18 mol L^{-1} LiCl at 298.15 K.

The results of Sechenov, of Onda *et al.* and of Sada *et al.* give good straight lines on lg L *vs.* c_2 plots and the slopes show fair agreement. Their results are classed tentative. The data of Gerecke presents problems. At the lower temperatures the solubility of carbon dioxide is greater than in water at the concentrations of 0.43, 0.77 and 1.42 mol L^{-1} LiCl, at the higher temperatures the solubility is greater than in water in the first two solutions. Thus, the initial salt effect is a salting in. There is no hint of any such behavior in the other three papers. If the water value is excluded from the fitted straight line the Gerecke data gives satisfactory slopes for salting out, but the salt effect parameters increases with increasing temperature which has not been confirmed in the work of others. Note that the salt effect parameters from Gerecke's data extrapolate to a solubility in pure water that is 27 % larger than the actual solubility. Gerecke's results are classed doubtful, use with caution. Salt effect parameters are in the table below.

Table 32.

T/K	LiCl Concentration Range, c_2/mol L^{-1}	Salt Effect Parameter k_{scc}/L mol^{-1}	Std. Dev. of Slope	Reference
288.15	0.43 - 3.75	0.0673	0.0018	G (35)
288.35	0 - 11.38	0.0779	0.0002	S (5)
298.15	0.43 - 3.75	0.0666	0.0015	G (35)
	0 - 5.05	0.0749	0.0014	OSKKI (36)
	0 - 1.18	0.0824	0.0012	SKI (41)
308.15	0.43 - 3.75	0.0736	0.0041	G (35)
318.15	0.43 - 3.75	0.0821	0.0051	G (35)
328.15	0.43 - 3.75	0.1026	0.0031	G (35)

98 (2) Carbon dioxide + Lithium chloride [7447-41-8] + Methanol [67-56-1] + Water

Sada, Kito and Ito (41) measured the solubility of carbon dioxide in methanol-water mixed solvent at four concentrations between 0 and as much as 2.29 mol L^{-1} LiCl at 298.15 K. The salt effect parameters for the four mixed solvents, pure water and pure methanol are in the table below.

Table 33.

T/K	Lithium Chloride Concentration Range, c_2/mol L^{-1}	Methanol Mole Fraction x_3	Salt Effect Parameter k_{scc}/L mol^{-1}	Std. Dev. of Slope
298.15	0 - 1.19	0	0.0824	0.0012
	0 - 1.39	0.280	0.0992	0.0032
	0 - 1.13	0.389	0.1066	0.0019
	0 - 2.23	0.587	0.1068	0.0005
	0 - 2.29	0.800	0.1165	0.0019
	0 - 2.26	1.000	0.1243	0.0017

The salting out increases as the mole fraction of methanol increases, but it is not a regular increase, there may be a point of inflection near the 0.389 to 0.587 mole fraction methanol range. Compare the behavior here with the system where calcium chloride (Section 94 (3)) is the electrolyte. See also Figure 5.

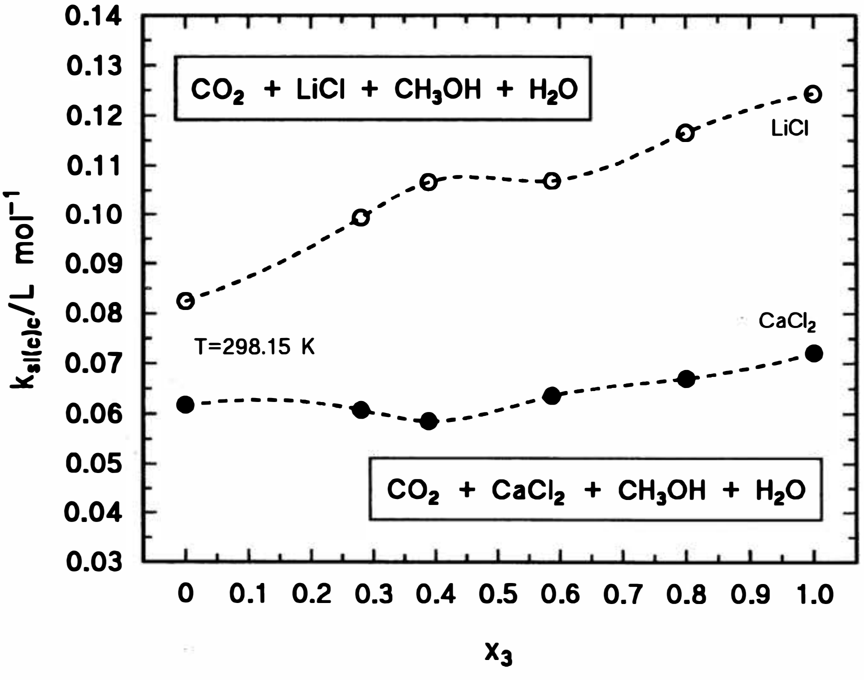

Figure 5. CO$_2$ + (LiCl, CaCl$_2$) + CH$_3$OH + H$_2$O. Salt effect parameter *vs.* mole fraction of methanol. Symbols: ○ LiCl, Ref. (41); ● CaCl$_2$, Ref. (41)

98 (3) Carbon dioxide + Lithium bromide [7550-35-8] + Water

Gerecke (35) measured the solubility of carbon dioxide in five solutions of 0 to 1.45 mol L^{-1} LiBr at five degree intervals at temperatures between 288.15 and 333.15 K. There are no other data on the system. The data show similarities to Gerecke's results in the aqueous LiCl solutions. The solubilities at the first two concentrations (0.2 and 0.4 mol L^{-1}) are larger than in water. The value of the solubility in water fits the lg L *vs.* c_2 poorly. Omitting the solubility in water value improves the fit, but the scatter is still greater than average. Several values are given in Table 34 (next page) to show trends in the data.

Table 34.

T/K	LiBr Concentration Range, c_2/mol L^{-1}	Salt Effect Parameter k_{scc}/L mol^{-1}	Std. Dev. of Slope	Reference
288.15	0.20 - 1.45	0.112	0.002	G (35)
298.15	0.20 - 1.45	0.121	0.011	G (35)
308.15	0.20 - 1.45	0.109	0.009	G (35)
318.15	0.20 - 1.45	0.097	0.009	G (35)

Note that the values above extrapolate to solubility in water values that are too large by 13 to 19 %. The data are classed tentative, but use with caution.

98 (4) Carbon dioxide + Lithium sulfate [10377-48-7] + Water

Lagarote (20) measured the solubility of carbon dioxide in seven solutions between 0 to 2.29 mol L^{-1} Li_2SO_4 at 290.15 K. Gerecke (35) measured the solubility of carbon dioxide in five solutions from 0 to 2 mol L^{-1} Li_2SO_4 at five degree intervals between temperatures of 288.15 and 333.15 K. The salt effect parameters in Table 35 have been calculated on an ionic strength basis. For the molar salt effect parameters multiply the values by 3. Agreement betwen the two workers is poor with the Lagarote salt effect parameter being ca. 10 % larger than the Gerecke value at either 288.15 or 298.15 K.

Table 35.

T/K	Li_2SO_4 Conc. Range, c_2/mol L^{-1}	Salt Effect Parameter $k_{sI(c)c}$/L mol^{-1}	Std. Dev. of Slope	Reference
288.15	0 - 2.0	0.0890	0.0018	G (35)
290.15	0 - 2.29	0.1036	0.0009	L (20)
298.15	0 - 2.0	0.0936	0.0042	G (35)
308.15	0 - 2.0	0.0933	0.0083	G (35)
318.15	0 - 2.0	0.0949	0.0111	G (35)
328.15	0 - 2.0	0.0954	0.0370	G (35)

The Gerecke salt effect parameters show little change with temperature. The lg L *vs.* c_2 plots reproduce the Gerecke solubility in water poorly being low by 2.5 to 10 % except the 328.15 value which is low by 18.5 %. The standard error of the slope increases at the higher temperatures. The Lagarote line reproduces the water solubility to better than 0.2 %. There is no sure way to decide between the results from the data of Lagarote and of Gerecke until future work resolves the nearly 10 % difference in salt effect parameters. The evaluator has a preferance for the data of Lagarote. The Gerecke data are classed as tentative, use with caution.

99 (1) Carbon dioxide + Sodium fluoride [7681-49-4] + Water

Gerecke (35) measured the solubility of carbon dioxide in water and in 0.5 mol L^{-1} NaF at five degree intervals between temperatures of 288.15 and 333.15 K. Salt effect parameters based on only the two experimental points are given in the table below.

Table 36.

T/K	NaF Concentration Range, c_2/mol L^{-1}	Salt Effect Parameter k_{scc}/L mol^{-1}	Std. Dev. of Slope	Reference
288.15	0, 0.5	0.185	-	G (35)
298.15	0, 0.5	0.230	-	G (35)
308.15	0, 0.5	0.327	-	G (35)
318.15	0, 0.5	0.400	-	G (35)
328.15	0, 0.5	0.471	-	G (35)

The results show a strong salting out and a large positive coefficient of temperature. Both properties are unusual for a 1-1 electrolyte. The evaluator knows of no other system showing this behavior. The results are classed as tentative, but use with extreme caution until confirmed by other workers.

99 (2) Carbon dioxide + Sodium chloride [7647-14-5] + Water

The papers on the solubility of carbon dioxide in aqueous sodium chloride are divided into three parts. *i*) Measurements at or near atmospheric pressure in which both NaCl and CO_2 are reported in mol L^{-1} or other volume units, *ii*) measurements at or near atmospheric pressure in which both NaCl and CO_2 are reported in mol kg^{-1} or other mass units, and *iii*) measurements at high pressures regardless of the units used for NaCl and CO_2.

i) Mackenzie (3) measured the solubility of carbon dioxide in four solutions between 1.23 and 4.86 mol L^{-1} NaCl at temperatures of 281, 288 and 295 K; Sechenov (4, 5) measured the solubility of carbon dioxide in ten solutions between 0 and 5.40 mol L^{-1} NaCl at 288.35 K; Nahoczky (15) and Passauer (14) measured the solubility of carbon dioxide in water and in saturated NaCl solution at 288/293 K; Kobe and Williams (16) measured the solubility of carbon dioxide in four solutions between 0 and 5.07 mol L^{-1} at 298.15 K; Rosenthal (24b) measured the solubility of carbon dioxide in four solutions between 0 and 5.06 mol L^{-1} NaCl at 293.15 K; Yeh and Peterson (31) measured the solubility in two solutions at 0 and 0.155 mol L^{-1} NaCl at four temperatures between 298.15 and 318.15 K; Gerecke (35) measured the solubility of carbon dioxide in five solutions between 0 and 4.3 mol L^{-1} at five degree intervals between 288.15 and 333.15 K; Onda, Sada, Kobayashi, Kito and Ito (36) measured the solubility of carbon dioxide in nine solutions between 0 and 3.01 mol L^{-1} NaCl at 298.15 K; Yasunishi and Yoshida (42) measured the solubility of carbon dioxide in eight or more solutions between about 0.45 and up to 5.10 mol L^{-1} NaCl at temperatures of 288.15, 298.15 and 308.15 K; and Burmakina, Efanov and Shnet (45) measured the solubility of carbon dioxide at 298.15 K in nine solutions between 0 and 0.200 mol L^{-1} NaCl. Vázquez, Chenlo and Pereira (61) measured the solubility of carbon dioxide at 298.15 K and 0.1013 MPa in five solutions between 0 and 2.738 mol L^{-1} NaCl. Vázquez, Chenlo, Pereira and Peaguda (64) measured the solubility of carbon dioxide at 5 degree intervals from 293.1 to 308.1 K and 0.1013 MPa in four solutions from 0.684 to 2.738 mol L^{-1} NaCl. Wolf and Krause (12) made seven measurements up to saturated NaCl at 293 K. Their data were not used because the gas was a carbon dioxide/air mixture.

Table 37.

T/K	NaCl Concentration Range, c_2/mol L^{-1}	Salt Effect Parameter k_{scc}/L mol^{-1}	Std. Dev. of Slope	Reference
279.6	1.23 - 4.86	0.1004	0.0092	Mac (3)
288.15	1.23 - 4.86	0.0971	0.0057	Mac (3)
	0 - 4.3	0.0858	0.063	G (35)
	0.48 - 4.72	0.1010	0.0011	YY (42)
	0, 5.45 (est)	0.0840	-	N (15)
288.35	0 - 5.4	0.1038	0.0012	S (4, 5)
293.15	0 - 5.06	0.1022	0.0020	R (24b)
	0 - 4.3	0.0912	0.036	G (35)
	0.68 - 2.74	0.0961	0.0023	VCPP (64)
295.15	1.23 - 4.86	0.0897	0.0029	Mac (3)
298.15	0 - 5.07	0.1000	0.0013	KW (16)
	0 - 4.3	0.0889	0.0024	G (35)
	0 - 3.01	0.1005	0.0011	OSKKI (36)
	0.46 - 5.10	0.0979	0.0007	YY (42)
	0 - 0.200	0.116	0.017	BES (45)
	0 - 2.74	0.0998	0.0008	VCP (61)
	0.68 - 2.74	0.1013	0.0013	VCPP (64)
[298.15	0 - 5.10	0.0995	0.0007	(16)(36)(42)(61)]
303.15	0 - 4.3	0.0851	0.0030	G (35)
	0.68 - 2.74	0.0871	0.0043	VCPP (64)
308.15	0 - 4.3	0.0859	0.0035	G (35)
	0.45 - 4.86	0.0931	0.0004	YY (42)
	0.68 - 2.74	0.0926	0.0027	VCPP (64)
313.15	0 - 4.3	0.0836	0.0063	G (35)
318.15	0 - 4.3	0.0798	0.0075	G (35)
323.15	0 - 4.3	0.0782	0.0078	G (35)
328.15	0 - 4.3	0.0833	0.0122	G (35)
333.15	0 - 4.3	0.0814	0.0110	G (35)

The value of 0.0995 L mol^{-1} at 298.15 K from the combined data of Kobe and Williams (16), Onda *et al.*(36), Yasunishi and Yoshida (42), and Vázquez *et al.* (61) is the only recommended value in Table 37. All of the other data in Table 37 are classed as tentative, but the evaluator prefers the data of Yasunishi and Yoshida as a consistent set of data over a 20 degree temperature interval. The data of Vázquez *et al.* (61, 64) arrived too late to process with the other data. Their data appear to agree well with the earlier data for this system.

The mass percent data of Kobe and Williams (16) were converted to mol L^{-1} NaCl using density data from the *International Critical Tables*. The solubility of NaCl at 288.15 was estimated to be 6.20 mol kg^{-1} or 5.45 mol L^{-1} in the calculation from the data of Nahoczky (15).

In addition to the data in Table 37, salt effect parameters were calculated from the data of Yeh and Peterson (31). They report solubilities for water and for 0.9 mass % NaCl which the evaluator calculated to be 0.155 mol L^{-1} NaCl. The salt effect parameters from the two measurements ranged from 0.199 to 0.186 which is about two times the magnitude of the salt effect parameter values in Table 37. We have no confirming evidence this is a real effect in dilute solutions, so we class the result doubtful unless confirmed by future work. Burmakina *et al.* (45) made nine measurements in the 0 - 0.200 mol L^{-1} NaCl range. Measurements in the very dilute solutions are difficult and subject to large error [(49) and this volume introductory material]. They did obtain a somewhat larger salt effect parameter with a relatively large standard error of the slope. This may be an important observation, but until it is confirmed by other workers it also is classified as doubtful.

Figure 6 shows logarithm of Ostwald coefficient *vs.* sodium chloride concentration (ionic strength) at 288.15 and 298.15 K. The experimental values come from papers published over the last 117 years and show a linear relationship to over 5 mol L^{-1} sodium chloride. The data of He and Morse (57) were converted from molal to volume units assuming ideal gas behavior and Henry's law using density and partial pressure data from their paper. Their results show considerable scatter. This is not surprising in that they made the 298.15 K measurements at a carbon dioxide partial pressure of 0.039 atm and reported the measured solubilities to only two significant figures.

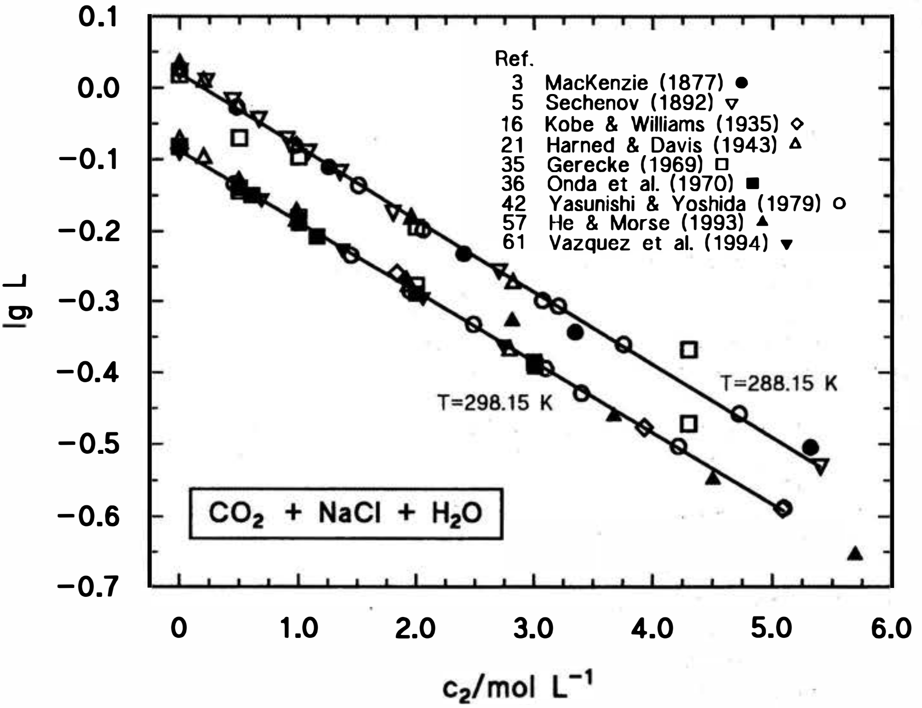

Figure 6. Logarithm of Ostwald coefficient *vs.* sodium chloride concentration.
The Sechenov data (Ref. 5, symbol ▽) are at 288.35 K.

ii) The data of He and Morse (57) are reported in molality for both NaCl and CO_2. They measured the solubility of carbon dioxide in five to seven solutions between 0.1 or 0.5 to 6.14 mol kg^{-1} NaCl at five temperatures between 273.15 and 363.15 K and carbon dioxide partial pressure between 0.0395 and 0.979 bar (a different pressure at each temperarure, see Table 38 next page). The salt effect parameters are in Table 38 (next page).

Table 38.

T/K	p_1/bar	NaCl Molality Range, m_2/mol kg^{-1}	Salt Effect Parameter k_{smm}/kg mol^{-1}	Std. Dev. of Slope	Reference
273.15	0.979	0.5 - 6.0	0.0835	0.0017	HM (57)
298.15	0.0395	0.5 - 6.14	0.0853	0.0029	HM (57)
323.15	0.865	0.5 - 6.14	0.0598	0.0032	HM (57)
348.15	0.611	0.1 - 6.0	0.0204	0.0008	HM (57)
363.15	0.305	0.1 - 6.0	0.0195	0.0010	HM (57)

The salt effect parameters from the data of He and Morse are classed as tentative, but there are several concerns about the results. It is unlikely that the 273.15 K value is smaller than the 298.15 K value. The sharp decrease in salt effect parameter magnitude between 323.15 and 363.15 K needs confirmation. There are nonelectrolyte and salt solutions that show a change from salting out to salting in at about this temperature range, but we have seen no indication of this behavior for carbon dioxide and any salt in this review.

iii) There are several papers that report the solubility of carbon dioxide in aqueous NaCl solution at elevated temperatures and pressures. Ellis and Golding (30) measured the solubility of carbon dioxide in four solutions between 0 and 2.0 mol L^{-1} NaCl at temperatures between 445 and 607 K and partial pressures between 1.59 and 9.31 MPa CO_2; Takenouchi and Kennedy (32) measured the solubility of carbon dioxide at 0, 1.09 and 4.28 mol kg^{-1} NaCl at 50 degree intervals between 423.15 and 723.15 K and total pressures between 10.0 and 140.0 MPa; Malinin and Savelyeva (38) measured the solubility of carbon dioxide in up to seven solutions of 0 to 4.46 mol L^{-1} NaCl at temperatures of 298.15, 323.15 and 358.15 K and a total pressure of 4.795 MPa; Malinin and Kurovskaya (40) measured the solubility of carbon dioxide in up to seven solutions between 0 and 5.92 mol L^{-1} NaCl at temperatures of 298.15, 373.15 and 423.15 K and a total pressure of 4.80 MPa; Cramer (46) measured the solubility of carbon dioxide in 0, 0.49 and 1.86 mol L^{-1} NaCl at temperatures between 298.15 and 511.8 K and pressures between 0.8 and 6.2 MPa; and Nighswander, Kalogerakis, and Mehrotra (52) measured the solubility of carbon dioxide in water and in 1 weight percent (0.173 mol kg^{-1}) NaCl at temperatures of about 353.65, 393.15, 433 and 470 K and pressures between about 2.1 and 10.2 MPa. Rumpf, Nicolaisen, Öcal and Maurer (59) measured the solubility of carbon dioxide in 4 and 6 mol kg^{-1} NaCl between 313 and 433 K and up to 10 MPa total pressure. There is also a 1981 Ph.D. Thesis of Drummond (44) that contains additional data.

All of the papers above contain useful information on the solubility of carbon dioxide as a function of temperature and pressure. However, not all of the experimental studies above are suitable for the evaluation of the effect of electrolyte ionic strength (salt effect parameter) on the carbon dioxide solubility. The paper of Nighswander, Kalogerakis and Mehrotra (52) reports carbon dioxide solubility in water and one mass percent (0.173 mol kg^{-1}) NaCl. The two solubility values over such a small molality range do not lead to reliable salt effect parameters and the paper was not used further. The paper of Takenouchi and Kennedy (32) presented problems. The evaluator converted mass percent data to molality values and made estimates of the salt effect parameter, k_{smm}/kg mol^{-1} at 423, 523 and 623 K. The salt effect parameters ranged from 0.023 to 0.26 and showed a high scatter. The data were not treated further. We agree with Dr. R. Crovetto (private communication) who questioned the data treatment in the Drummond (44) thesis for the solubility of carbon dioxide in water because no equation of state could be used with the data as presented.

The evaluator has made calculations from graphically smoothed data from Ellis and Golding (30) and of Cramer (46) under several conditions of temperature and pressure. The salt effect parameters obtained are of larger magnitude and show more scatter about the regression line than other values. From Ellis and Golding at 450 K and 1.59 MPa k_{scm}/L mol^{-1} = 0.105 ± 0.005, at 500 K and 4.5 MPa 0.091 ± 0.011, at 540 K and 6.5 MPa 0.128 ± 0.021 and at 580 K and 6.5 MPa 0.153 ± 0.028. From Cramer (46) at 300 K and 1.0 MPa k_{scx}/L mol^{-1} = 0.115 ± 0.037, at 420 K and 2.0 MPa 0.135 and at 500 K and 6 MPa 0.145.

The most self consistent high temperature and pressure carbon dioxide solubility data appear to be the data of Malinin and Savelyeva (38) and of Malinin and Kurovskaya (40). Most of the plots of lg m_1 *vs.* c_2 showed a slight concave curveture. A straight line through the data extrapolates to a carbon dioxide solubility in water that is too small by 2.5 to 5.0 % when the full NaCl concentration range of 0 to >5.0 mol L^{-1} is used. When the NaCl concentration range is 0 to about 2.0 the line extrapolates satisfactorily to the carbon dioxide solubility in water. Salt effect parameters from several NaCl concentration ranges from the Malinin *et al.* data at 47.95 and 48.0 MPa are in Table 39 (next page).

Table 39.

T/K	NaCl Conc. Range, c_2/mol L^{-1}	Salt Effect Parameter k_{scm}/L mol^{-1}	Std. Dev. of Slope	Reference
298.15	0 - 2.60	0.0918	0.0011	MS (38)
	0 - 5.04	0.0808	0.0034	MK (40)
	0 - 2.1	0.0922	0.0012	(38 & 40)
	4.04, 5,04	0.0697		MK (40)
323.15	0 - 2.74	0.0791	0.0026	MS (38)
	0 - 1.79	0.0845	0.0019	MS (38)
358.15	0 - 4.46	0.0691	0.0026	MS (38)
	0 - 2.2	0.0780	0.0032	MS (38)
373.15	0 - 5.92	0.0616	0.0032	MK (40)
	0 - 2.0	0.0814	0.0031	MK (40)
	3.98 - 5.92	0.0477		MK (40)
423.15	0 - 5.65	0.0622	0.0042	MK (40)
	0 - 2.52	0.0743	0.0043	MK (40)
	2.52, 5.65	0.054		MK (40)

The evaluator prefers the values from treatment of the 0 - 2 mol L^{-1} NaCl range. There are inconsistencies in the data at the 373 and 423 K temperatures that require further study.

The data of Rumpf et al. (59) was treated graphically to obtain smoothed solubility values at 2, 5 and 8 MPa total pressure. The solubility values in 4 and 6 mol kg^{-1} were used to calculate a k_{smm} salt effect parameter. The results based on just the two solubility values are in Table 40.

Table 40.

T/K	k_{smm}/kg mol^{-1}		
	at 2 MPa	at 5 MPa	at 8 MPa
313	0.052	0.059	-
353	0.055	0.047	0.046
393	0.031	0.046	0.037
433	0.035	0.034	0.037

The Malinin and Kurovskaya values at the high concentrations of NaCl can be compared with the Rumpf et al. values remembering that $k_{scm} = 1.15\ k_{smm}$. The values are of similar magnitude which gives increased confidence in the reliability of the two sets of data.

99 (3) Carbon dioxide + Hydrochloric acid [7647-01-0] + Sodium chloride [7647-14-5] + Water

Van Slyke, Sendroy, Hastings and Neill (13) measured the solubility of carbon dioxide in solutions of 0.01 mol L^{-1} HCl and 0, 0.150 and 0.300 mol L^{-1} NaCl at 311.2 K. The effect of the HCl was considered negligible and the system treated as if only NaCl were present. The NaCl salt effect parameter is k_{scc} = (0.0931 ± 0.0036) L mol^{-1} which agrees well with the value from Yasunishi and Yoshida (42) at 308.15 K. The result is classed tentative. Kobe and Williams (16) made measurements in water and in a mixture which was 2 mass % HCl (0.703 mol kg^{-1}) and 20 mass % NaCl (4.388 mol kg^{-1}) at 298.15 K. The ionic strength salt effect parameter in molality units is 0.0725. It is classed tentative.

99 (4) Carbon dioxide + Nitric acid [7697-37-2] + Sodium chloride [7647-14-5] + Water

Onda, Sada, Kobayashi, Kito and Ito (37) measured the solubility of carbon dioxide in aqueous mixed electrolyte of ionic strength ratio NaCl/HNO_3 0.3988/0.6012 and 0.6458/0.3542 at 298.15 K. Plots of lg L vs. I_{total} were reasonably linear (std error about slope of 0.0014 for both mixtures). The ionic strength salt effect parameters are in Table 41 (next page).

Table 41.

Ionic Strength Ratio NaCl/HNO_3	Ionic Strength Range I_{tot}/mol L^{-1}	Salt Effect Parameter [a], $k_{sI(c)c}$/L mol^{-1}	Salt Effect Parameter, Calculated	Difference
0.40/0.60	0, 1.40, 2.95	0.0289	0.0399	38 %
0.65/0.35	0 - 2.16	0.0587	0.0644	9.7 %

[a] Std dev about slope 0.0014 and 0.0014.

The calculated values use the single salt effect parameters of 0.0004 for HNO_3 and 0.0995 for NaCl. The difference indicates some specific interaction or solution structural change. The effect is definitely not additive. See Figure 11A following section 100 (10).

99 (5) Carbon dioxide + Ammonium chloride [12125-02-9] + Sodium chloride [7647-14-5] + Water

Yasunishi, Tsuji and Sada (43) measured the solubility of carbon dioxide in the mixed electrolyte of 0.0, 0.25, 0.50, 0.75 and 1.00 mole fraction NaCl at 298.15 K. There were eight or nine solutions at each mole fraction. The NH_4Cl values were a selection of the 23 solubility values of Yasunishi and Yoshida (42) and the NaCl values were from the same source (42). The ionic strength salt effect parameters are in Table 42.

The experimental and the calculated salt effect parameters agree well assuming additivity of the salt effects. See also Figure 11A following section 100 (10).

Table 42.

Ionic Strength Ratio NaCl/NH_4Cl	Ionic Strength Range I_{tot}/mol L^{-1}	Salt Effect Parameter [a], $k_{sI(c)c}$/L mol^{-1}	Salt Effect Parameter, Calculated	Difference
0.00/1.00	0 - 5.48	0.0252	-	
0.25/0.75	0 - 5.05	0.0424	0.0436	2.8 %
0.50/0.50	0 - 5.18	0.0588	0.0620	5.4 %
0.75/0.25	0 - 5.28	0.0786	0.0803	2.2 %
1.00/0.00	0 - 5.10	0.0987	-	

[a] Std. dev. about slopes are 0.0015, 0.0011, 0.0011, 0.0011 and 0.0009, respectively.

99 (6) Carbon dioxide + Ammonium nitrate [6484-52-2] + Sodium chloride [7647-14-5] + Water

Onda, Sada, Kobayashi, Kito and Ito (37) measured the solubility of carbon dioxide in mixed electrolyte of 0.335, 0.500 and 0.635 mole fraction NaCl at 298.15 K. There were five to seven solutions at each mole fraction. To test the additivity of the salt effects salt effect parameters of 0.0995 and 0.0187 were used for NaCl and NH_4NO_3, respectively.

Table 43.

Ionic Strength Ratio NaCl/NH_4NO_3	Ionic Strength Range I_{tot}/mol L^{-1}	Salt Effect Parameter [a], $k_{sI(c)c}$/L mol^{-1}	Salt Effect Parameter, Calculated	Difference
0.335/0.665	0 - 2.97	0.0412	0.0458	11 %
0.50/0.50	0 - 2.78	0.0551	0.0591	7.3 %
0.635/0.365	0 - 3.05	0.0657	0.0701	6.7 %

[a] Std. dev. about slope of 0.0006, 0.0009 and 0.0016, respectively.

The salt effects are not additive. All results are classed as tentative. See also Figure 11B following section 100 (10).

99 (7) Carbon dioxide + Magnesium sulfate [7487-88-9] + Sodium chloride [7647-14-5] + Water

Yasunishi, Tsuji and Sada (43) measured the solubility of carbon dioxide in mixed electrolyte of 0.0, 0.25, 0.50, 0.75 and 1.00 mole faction NaCl [0.0, 0.077, 0.260, 0.428 and 1.00 ionic strength fraction NaCl] at 298.15 K. Six solutions were measured at each mole fraction. The results are in the Table 44 (next page).

Table 44.

Ionic Strength Ratio $NaCl/MgSO_4$	Ionic Strength Range I_{tot}/mol L^{-1}	Salt Effect Parameter [a], $k_{\mathrm{sI(c)c}}$/L mol^{-1}	Salt Effect Parameter, Calculated	Difference
0.00/1.00	0 - 9.10	0.0665	-	
0.077/0.923	0 - 6.68	0.0683	0.0691	1.2 %
0.260/0.740	0 - 5.46	0.0726	0.0755	4.0 %
0.428/0.572	0 - 3.81	0.0804	0.0863	1.1 %
1.00/0.00	0 - 2.49	0.1010	-	

[a] Std. dev. of slopes are 0.0007, 0.0007, 0.0005, 0.0011, 0.0018, respectively.

The electrolytes act with near additively. The results are classed tentative. See also Figure 11B following section 100 (10).

99 (8) Carbon dioxide + Calcium chloride [10043-52-4] + Sodium chloride [7647-14-5] + Water

Malinin and Savelyeva (38) measured the solubility of carbon dioxide in water and in one mixture of $CaCl_2$ and NaCl at a total ionic strength of 2.65 at 298.15 K and 47.95 bar. The solubility in water and in the one solution gives salt effect parameters $k_{\mathrm{sI(c)m}} = 0.032$ and $k_{\mathrm{sI(c)c}} = 0.040$. The results are classed tentative.

99 (9) Carbon dioxide + Calcium sulfate [7778-18-9]] + Sodium chloride [7647-14-5] + Water

He and Morse (57) measured the solubility of carbon dioxide in six solutions of 0.1 to 6.0 mol kg^{-1} NaCl and 0.01 mol kg^{-1} $CaSO_4$ at temperatures of 273.15, 298.15, 323.15, 348.15 and 363.15 K. In other mixed electrolyte studies the electrolytes have been at some constant ionic strength ratio. In this study the calcium sulfate is near its saturation value at 0.01 mol kg^{-1} (ionic strength 0.04) in all solutions.

The data were treated to obtain $k_{\mathrm{sI(m)m}}$/kg mol^{-1} values in the table below.

Table 45.

T/K	p_1/bar	Ionic Strength Range, I_2/mol kg^{-1}	Salt Effect Parameter $k_{\mathrm{sI(m)m}}$/kg mol^{-1}	Std. Dev. of Slope	Reference
273.15	0.979	0.14 - 6.04	0.0866	0.0083	HM (57)
298.15	0.954	0.14 - 6.04	0.0852	0.0024	HM (57)
323.15	0.865	0.14 - 6.04	0.0623	0.0007	HM (57)
348.15	0.611	0.14 - 6.04	0.0286	0.0020	HM (57)
363.15	0.305	0.14 - 6.04	0.0227	0.0011	HM (57)

The results parallel within 0.1 to 4.2 % the results for sodium chloride alone at the first three temperatures. At 348 and 363 K the calcium sulfate containing solutions show higher salt effect parameters by 40 and 16 %, respectively. The results are not reliable enough to draw conclusions about the effect of the calcium sulfate in the mixed electrolyte.

99 (10) Carbon dioxide + Ammonium nitrate [6484-52-2] + Barium chloride [10361-37-2] + Sodium chloride [7647-14-5] + Water

Onda, Sada, Kobayashi, Kito and Ito (37) measured the solubility of carbon dioxide in five solutions of a mixed elctrolyte of $NH_4NO_3/BaCl_2/NaCl$ of mole ratio 3/1/3 which is ionic strength ratio 1/1/1. A plot of lg L *vs.* I_2 over the 0 - 0.633 ionic strength range gives the salt effect parameter of $k_{\mathrm{sI(c)c}} = 0.0612$ with a standard error about the regression line of 0.0010. A calculated salt effect parameter obtained by summing one third values of each pure elctrolyte salt effect parameter gives 0.0632 which is 3.3 % larger than the experimental value. The result is classed as tentative.

99 (11) Carbon dioxide + Sodium chloride [7647-14-5] + Glucose [50-99-7] + Water

Yuan and Yang (58) measured the solubility of carbon dioxide in six solutions of 0 to 3.00 mol kg^{-1} sodium chloride in a 15 mass % glucose- water mixture at ten degree intervals between 278.15 and 318.15 K. The salt effect parameters on a molality basis are in Table 46 (next page).

Table 46.

T/K	NaCl Concentration Range, m_2/mol kg^{-1}	Salt Effect Parameter k_{smm}/kg mol^{-1}	Std. Dev. about Slope	Reference
278.15	0 - 3.00	0.086	0.007	YuYa (58)
288.15	0 - 3.00	0.064	0.011	YuYa (58)
298.15	0 - 3.00	0.063	0.009	YuYa (58)
308.15	0 - 3.00	0.048	0.008	YuYa (58)
318.15	0 - 3.00	0.042	0.004	YuYa (58)

The data show more than an average amount of scatter on the lg m_1 *vs.* m_2 plot. Our values of the salt effect parameter differ from the author's values especially at temperatures of 288 and 308 K. The results show smaller magnitude salt effect parameters in the glucose solution than in pure water. The data are classed as tentative.

99 (12) Carbon dioxide + Sodium chlorate [7775-09-9] + Water

Sechenov (5) measured the solubility of carbon dioxide at four concencentrations between 0 and 6.57 mol L^{-1} $NaClO_3$ at 288.35 K. The salt effect parameter is k_{scc} = 0.0874 L mol^{-1} with a standard error of the slope of 0.0020. The value is classed tentative.

99 (13) Carbon dioxide + Sodium perchlorate [7601-89-0] + Water

Gerecke (35) measured the solubility of carbon dioxide at five concentrations between 0 and 1.6 mol L^{-1} $NaClO_4$ at five degree intervals between the temperatures of 288.15 and 333.15 K. The salt effect prameters are below.

Table 47.

T/K	$NaClO_4$ Concentration Range, c_2/mol L^{-1}	Salt Effect Parameter k_{scc}/L mol^{-1}	Std. Dev. of Slope	Reference
288.15	0 - 1.6	0.103	0.006	G (35)
298.15	0 - 1.6	0.110	0.012	G (35)
308.15	0 - 1.6	0.125	0.015	G (35)
318.15	0 - 1.6	0.156	0.022	G (35)
328.15	0 - 1.6	0.190	0.022	G (35)

It is important to point out that the trend more commonly seen for inorganic gases that do not have a special interaction with water in aqueous electrolytes is a small salt effect parameter that decreases with increasing temperature. The relatively large salt effect parameter that increases with temperature is unusual. The results are classed as tentative, but use with caution until confirmed by other workers.

99 (14) Carbon dioxide + Sodium bromide [7647-15-6] + Water

Sechenov (5) measured the solubility of carbon dioxide at four concentrations between 0 and 6.71 mol L^{-1} NaBr at 288.35 K. Rosenthal (24b) measured the solubility at five concentrations between 0 and 7.08 mol L^{-1} at 293.15 K. Gerecke (35) measured the solubility at five concentrations between 0 and 4.50 mol L^{-1} at five degree intervals between temperatures of 288.15 and 333.15 K. Salt effect parameters from these papers are compared in Table 48 (next page). Vázquez, Chenlo, Pereira and Peaguda (64) measured the solubility at seven concentrations between 0.389 and 2.721 mol L^{-1} NaBr at 298.1 K and 0.1013 MPa. In an earlier paper (61) they reported the solubility of carbon dioxide in water at the same conditions of temperature and pressure. Their (61, 64) values of the salt effect parameter fitted with and without the solubility in water are in Table 48.

This is one of only a few systems for which the salt effect parameters from the data of Gerecke show the expected magnitude and temperature coefficient. However, the data do show more scatter than the data of Sechenov and of Rosenthal. The data of Vázquez *et al.* (61, 64) show a definite curvature on a lg L *vs.* c_2 plot with much of the curvature between 0 and 0.4 mol L^{-1} NaBr. At 298.15 K the solubility values of Vázquez *et al.* are significantly lower than the values of Gerecke for a given NaBr concentration. [See also Figure 10 following section 100 (7)]. All of the results are classed tentative with a slight preferance for the values of Sechenov and of Rosenthal at 288.5 and 293.15 K, respectively. At 298.15 K we cannot make a choice between the data of Gerecke and of Vázquez *et al.*, both data sets should be used with caution.

Table 48.

T/K	NaBr Concentration Range, c_2/mol L^{-1}	Salt Effect Parameter k_{scc}/L mol^{-1}	Std. Dev. of Slope	Reference
288.15	0 - 4.50	0.0875	0.0059	G (35)
288.35	0 - 6.71	0.0981	0.0005	S (5)
293.15	0 - 7.08	0.0874	0.0006	R (24b)
	0 - 4.50	0.0831	0.0044	G (35)
298.15	0 - 4.50	0.0779	0.0041	G (35)
	0 - 2.72	0.0905	0.0043	VCPP (64)
	0.39 - 2.72	0.0842	0.0029	VCPP (64)
308.15	0 - 4.50	0.0709	0.0025	G (35)
318.15	0 - 4.50	0.0680	0.0010	G (35)
328.15	0 - 4.50	0.0520	0.0037	G (35)

99 (15) Carbon dioxide + Sodium iodide [7681-82-5] + Water

Rosenthal (24b) measured the solubility of carbon dioxide at four concentrations between 0 and 6.01 mol L^{-1} NaI at 293.15 K. Gerecke (35) measured the solubility at five concentrations bewteen 0 and 4.0 mol L^{-1} at five degree intervals between temperatures of 288.15 and 333.15 K. Salt effect parameters from their data are in the table below.

Table 49.

T/K	NaI Concentration Range, c_2/mol L^{-1}	Salt Effect Parameter k_{scc}/L mol^{-1}	Std. Dev. of Slope	Reference
288.15	0 - 4.00	0.0792	0.0033	G (35)
293.15	0 - 6.01	0.0726	0.0023	R (24b)
	0 - 4.00	0.0779	0.0025	G (35)
298.15	0 - 4.00	0.0774	0.0017	G (35)
308.15	0 - 4.00	0.0750	0.0046	G (35)
318.15	0 - 4.00	0.0577	0.0101	G (35)
328.15	0 - 4.00	0.0400	0.0161	G (35)

The results are classed as tentative. There seems little reason to pick one result over the other at 293.15 K. The difference could be due to the smaller NaI concentration range used by Gerecke since with some systems the slope decreases at the higher concnetrations (ionic strengths). Gerecke's results at 318.15 and 328.15 K scatter badly and these two results should be used with caution.

99 (16) Carbon dioxide + Sodium hydrogen sulfite [7631-90-5] + Water

Onda, Sada, Kobayashi, Kito and Ito (36) measured the solubility of carbon dioxide at four concentrations between 0 and 2.02 mol L^{-1} $NaHSO_3$ at 298.15 K. The salt is not 100 per cent dissociated so the molar concentration salt effect parameter is reported. It is k_{scc} = 0.1434 L mol^{-1} with a standard deviation of the slope of 0.0031. The result is classed as tentative. If the salt was 100 % dissociated the ionic strength salt effect parameter, $k_{sI(c)c}$, would be the value above divided by 3.

99 (17) Carbon dioxide + Sodium sulfate [7757-82-6] + Water

The evaluation of the solubility of carbon dioxide in aqueous solutions of sodium sulfate is divided into three parts. *i*) Papers reporting measurements at or near atmospheric pressure in which both Na_2SO_4 and CO_2 are reported in mol L^{-1} or other volume units; *ii*) papers reporting measuremnts at or near atmospheric pressure in which both Na_2SO_4 and CO_2 are reported in mol kg^{-1} or other mass units; and *iii*) papers which report measurements at high pressures and temperatures regardless of the units used for Na_2SO_4 and CO_2.

i) Sechenov (5) reported the solubility of carbon dioxide in eight solutions from 0 to 2.00 mol L^{-1} sodium sulfate at 288.35 K, Markham and Kobe (18) reported the solubility of carbon dioxide in five solutions from 0 to 1.435 mol L^{-1} sodium sufate at 298.15 and 313.15 K, Shchennikova, Devyatykh and Korshunov (26) reported the solubility of carbon dioxide in six solutions of 0.20 to 1.68 mol L^{-1} sodium sulfate at one to five temperatures between 298.15 and 348.15 K, Gerecke (35) measured the solubility of carbon dioxide in four solutions between 0 and 1.0 mol L^{-1} sodium sulfate at five degree intervals between 288.15 and 333.15 K, Onda, Sada, Kobayashi, Kito and Ito (36) reported the solubility of carbon dioxide in four solutions from 0 to 1.44 mol L^{-1} sodium sulfate at 298.15 K and Yasunishi and Yoshida (42) reported the solubility of carbon dioxide in up to fifteen solutions from 0 to 2.21 mol L^{-1} sodium sulfate at 288.15, 298.15 and 308.15 K. The concentrations have been changed to ionic strength by multiplying by 3. The ionic strength salt effect parameters from the papers are given in the table below.

Table 50.

T/K	Na_2SO_4 Conc. Range, c_2/mol L^{-1}	Salt Effect Parameter $k_{sI(c)c}$/L mol^{-1}	Std. Dev. of Slope	Reference
288.15	0 - 1.00	0.0829	0.0102	G (35)
	0 - 1.06	0.1072	0.0049	YY (42)
288.35	0 - 2.00	0.1063	0.0004	S (5)
298.15	0.2 - 1.68	0.1001	0.0062	SDK (26)
	0 - 1.00	0.0836	0.0132	G (35)
	0 - 1.435	0.0991	0.0006	MK (18)
	0 - 1.44	0.0982	0.0009	OSKKI (36)
	0 - 2.21	0.0981	0.0004	YY (42)
[	0 - 2.2	0.0983	0.0005	(18)(36)(42) combined]
308.15	0 - 1.00	0.0826	0.0188	G (35)
	0 - 1.76	0.0894	0.0009	YY (42)
313.15	0 - 1.435	0.0913	0.0004	MK (18)
318.15	0 - 1.00	0.0869	0.0195	G (35)
323.15	0.42 - 1.68	0.1108	0.0057	SDK (26)
328.15	0 - 1.00	0.0904	0.0199	G (35)

Shchennikova, Devyatykh and Korshunov (26) reported salt effect parameters from their smoothed data on a natural logarithm mol fraction basis. The evaluator converted their values to our $k_{sI(c)x}$/L mol^{-1} values. The results are:

T/K	298	303	313	323	338
$k_{sI(c)x}$	0.094	0.097	0.104	0.124	0.221

The values at 298 and 303 K seem reasonable, but the steady increase in salt effect parameter with temperture is contrary to our experience and the values at the higher temperatures are classed doubtful.

Gerecke's (35) data give smaller slopes than other data, show more scatter about the regression line and extrapolate to a carbon dioxide in water value that is 5 to 8.5 % low. The data are classed doubtful.

The combined data of Markham and Kobe (18), Onda et al. (36) and of Yasunishi and Yoshida (42) give a recommended salt effect parameter at 298.15 K of 0.0983 ± 0.0005 L mol^{-1}.

Figure 7 (next page) shows logarithm of Bunsen coefficient *vs.* the sodium sulfate ionic strength at 288.15 and 298.15 K and one atm. The data are best fitted by a straight line. The data of He and Morse were converted from their molality values to Bunsen coefficients and concentration ionic strength using their density and partial pressure values and assuming ideal gas behavior and Henry's law. Their results at 298.15 K deviate considerably from the other 298.15 K values.

ii) He and Morse (57) report the molality solubility of carbon dioxide in 4 or 5 solutions ranging from 0.01 up to 3.00 mol kg^{-1} sodium sulfate at temperatures of 273.15, 298.15, 323.15, 348.15 and 363.15 K and carbon dioxide partial pressures of 0.305 to 0.979 bar. In addition Markham and Kobe (18) and Gerecke (35) report their data so values of the salt effect parameter, $k_{sI(m)m}$, can be obtained. Salt effect parameters from these data are given in Table 51 (next page).

Agreement in Table 51 is not good. The evalator prefers the values from the data of Markham and Kobe since their results agree well with other reliable workers when mol L^{-1} units are used.

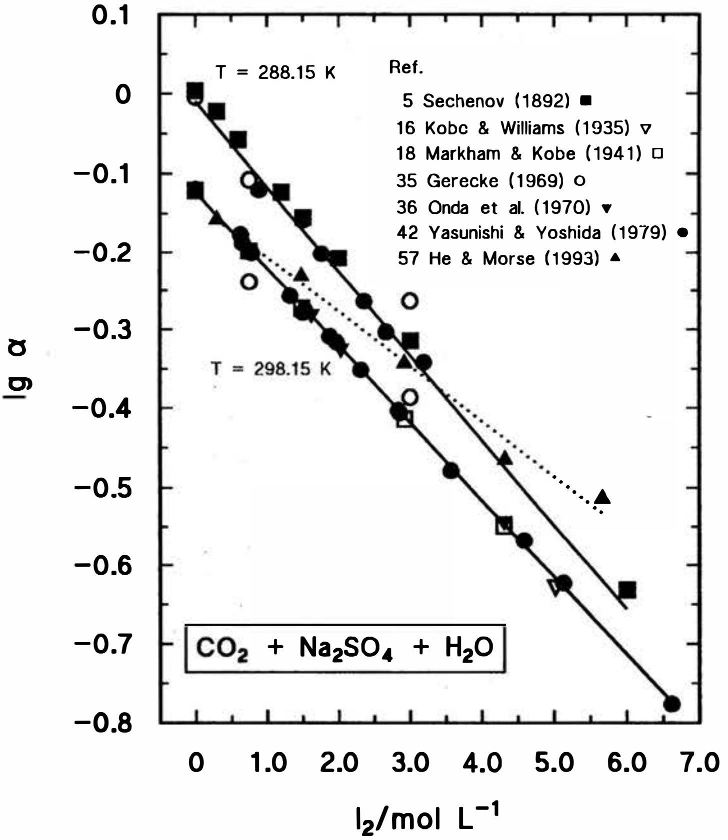

Figure 7. Logarithm of Bunsen coefficient *vs.* sodium sulfate ionic strength.

Table 51.

T/K	p_1/bar	Na_2SO_4 Molal Range m_2/mol kg^{-1}	Salt Effect Parameter $k_{sI(m)m}$/kg mol^{-1}	Std. Dev. of slope	Reference
273.15	0.979	0.01 - 0.3	0.0663	0.0129	HM (57)
	0.979	0.01 - 0.1	0.106	0.065	HM (57)
298.15	0.954	0.1 - 2.0	0.0619	0.0047	HM (57)
	0.954	0.1 - 1.0	0.0654	0.0033	HM (57)
		0 - 1.5	0.0911	0.0016	MK (18)
		0 - 1.05	0.0754	0.0132	G (35)
313.15		0 - 1.5	0.0835	0.0011	MK (18)
		0 - 1.05	0.0776	0.0199	G (35)
323.15	0.865	0.1 - 3.0	0.0287	0.0044	HM (57)
	0.865	0.1 - 1.0	0.0466	-	HM (57)
348.15	0.611	0.1 - 3.0	0.0134	0.0028	HM (57)
	0.611	0.1 - 1.0	0.0295	0.0027	HM (57)
363.15	0.305	0.1 - 3.0	0.0223	0.0006	HM (57)

iii) Corti, Krenzer, de Pablo and Prausnitz (54) measured the solubility of carbon dioxide in solutions of 0.95 to 2.72 mol kg^{-1} sodium sulfate at temperatures of 323.15 and 348.15 K and total pressures between 37.9 and 145.1 bar. Rumpf and Maurer (56) measured the solubility of carbon dioxide in two solutions of about 1 and 2 mol kg^{-1} sodium sulfate at seven temperatures between 313 and 433 K over a total pressure interval of 0.019 to 9.71 MPa.

The evaluator has interpolated data from both papers at several temperatures and pressures. There are really solubility measurements at only two molalities of sodium sulfate. Therefore any salt effect parameters derived from these data are of limited value. The values obtained this way are in the table below.

Table 52.

T/K	p_{total}/MPa	k_{smm}/kg mol^{-1}	$k_{\text{sI(m)m}}$/kg mol^{-1}	Reference
313.15	2.0	0.202	0.067	RM (56)
	5.0	0.230	0.077	
	8.0	0.232	0.077	
323.15	10.0	0.225	0.075	CKPP (54)
348.15	10.0	0.202	0.067	CKPP (54)
353.15	2.0	0.202	0.067	RM (56)
	5.0	0.202	0.067	
	8.0	0.208	0.069	
393.15	2.0	0.156	0.052	RM (56)
	5.0	0.158	0.053	
	8.0	0.168	0.056	
433.15	2.0	0.123	0.041	RM (56)
	5.0	0.165	0.055	
	8.0	0.163	0.054	

The data in these two papers deserve better treatment than we have time to give them in this brief review. The salt effect parameters above should be used between 1.0 and 2.0 molal (3.0 and 6.0 ionic strength) sodium sulfate. The results indicate only a small effect of pressure on salting out and a slight decrease in the salting out as temperature increases.

99 (18) Carbon dioxide + Sulfuric acid [7664-93-9] + Sodium sulfate [7757-82-6] + Water

Kobe and Kenton (17) measured the solubility of carbon dioxide in one solution which was 0.90 molal H_2SO_4 and 1.76 molal Na_2SO_4 at 298.15 K. The total ionic strength is 7.98 mol kg^{-1}. The evaluator used the solubility of carbon dioxide in water from Markham and Kobe (18) to calculate an ionic strength salt effect parameter of 0.0609. The value is less than the contribution of sodium sulfate alone in a solution to which it contributes 0.662 fraction ionic strength. The sulfuric acid is contributing an apparent salting in effct. The result is classed tentatve. Kobe and Williams (16) measured the solubility in water and in a solution that was 5 volume % H_2SO_4 and 20 mass % Na_2SO_4. The solubility values are classed tentative, but no effort was made to calculate a solubility parameter.

Shchennikova, Devyatykh and Korshuhov (26) measured the solubility of carbon dioxide in solutions which ranged between 0.2 to 1.3 mol L^{-1} sodium sulfate and 0.24 to 5.66 mol L^{-1} (2.3 to 42 mass %) sulfuric acid at temperatures between 298.15 and 348.15 K. In all 11 solutions were studied. Assuming 100 % dissociation of both salt and acid the total ionic strength ranged from 1.31 to 18.84 mol L^{-1}. All eleven solutions were studied at 298.15 K and only up to three solutions studied at the other temperatures. At 298.15 K the five data points between ionic strength 3.6 and 6.9 fitted well a Sechenov plot with a salt effect parameter of $k_{\text{sI(c)c}}$ = 0.0993, but the linear portion extrapolated to a water solubility value that was twice its normal value. The salt effect parameter was only 0.016 over the 0 to 3.6 ionic strength range and about 0.01 over the 11.8 to 18.8 ionic strength range. This is a complex system that deserves further analysis.

99 (19) Carbon dioxide + Ammonium sulfate [7783-20-2] + Sodium sulfate [7757-82-6] + Water

Rumpf and Maurer (56) measured the solubility of carbon dioxide in a solution that was 1 molal in $(NH_4)_2SO_4$ and 1 molal in Na_2SO_4 at six temperatures between 313 and 433 K over a total pressure range of 0.0084 to 9.67 MPa. Thus, the total ionic strength is about 6 mol kg^{-1}. Since we have only a single concentration it is not possible to calculate a salt effect parameter. The solubility data are probably quite good and are classed as tentative.

99 (20) Carbon dioxide + Ammonium nitrate [6484-52-2] + Sodium sulfate [7757-82-6] + Water

Onda, Sada, Kobayashi, Kito and Ito (37) measured the solubility of carbon dioxide in seven solutions of 0 to 2.81 mol L^{-1} total ionic strength in which the ionic strength ratio of ammonium nitrate and sodium sulfate was 1 at 298.15 K. The salt effect parameter is $k_{\text{sI(c)c}}$ = (0.0557 ± 0.0009) L mol^{-1}. The value is 4.8 % less than one would calculate from the pure salt parameters. The value is classed as tentative.

99 (21) Carbon dioxide + Sodium chloride [7647-14-5] + Sodium sulfate [7757-82-6] + Water

Yasunishi, Tsuji and Sada (43) measured the solubility of carbon dioxide in six solutions with a total concentration of 0 to 2.49 mol L^{-1} NaCl + Na_2SO_4 with NaCl salt mole fraction of 0, 0.25, 0.50, 0.75 and 1.00 at 298.15 K. The ionic strength fractions are NaCl/Na_2SO_4 = 0/1.0, 0.10/0.90, 0.25/0.75, 0.50/0.50 and 1.0/0. The ionic strength salt effect parameters are in the table below.

Table 53.

Ionic Strength Ratio NaCl/Na_2SO_4	Ionic Strength Range I_2/mol L^{-1}	Salt Effect Parameter $k_{\mathrm{sI(c)c}}$/L mol^{-1}	Std. Dev. about slope	Calc. Salt Effect Par.	Difference %
0/1.0	0 - 6.62	0.0988	0.0006	-	
0.10/0.90	0 - 4.36	0.0947	0.0013	0.0990	4.5
0.25/0.75	0 - 4.12	0.0950	0.0010	0.0993	4.5
0.50/0.50	0 - 3.11	0.0985	0.0018	0.0998	1.3
1.0/0	0 - 2.49	0.1007	0.0017	-	

The experimental result ranges from 4.5 to 1.3 % less than the result calculated assuming indepenedent action of the electrolytes. The results are classed as tentative. See Figure 11A following section 100 (10).

99 (22) Carbon dioxide + Ammonium chloride [12125-02-9] + Sodium chloride [7647-14-5] + Sodium sulfate [7757-82-6] + Water

Yasunishi, Tsuji and Sada (43) measured the solubility of carbon dioxide in six solutions of five different mole ratios of the three salts; NH_4Cl/NaCl/Na_2SO_4 = 0/0.50/0.50, 0.125/0.50/0.375, 0.25/0.50/0.25, 0.325/0.500/0.125, and 0.50/0.50/0 at 298.15 K. Each was fitted to a lg *L vs.* c_2 line to obtain the salt effect parameters below. The calculated ionic strength salt effect parameters are based on the values for each salt in pure water. There is a small departure from additivity for the mixed electrolyte solutions.

Table 54.

Ionic Strength Ratio NH_4Cl/NaCl/Na_2SO_4	Ionic Strength Range I_2/mol L^{-1}	Salt Effect Parameter $k_{\mathrm{sI(c)c}}$/L mol^{-1}	Std. Dev. about slope	Calc. Salt Effect Par.	Difference %
0/0.250/0.750	0 - 4.12	0.0950	0.0010	0.0985	3.7
0.071/0.286/0.643	0 - 3.46	0.0901	0.0009	0.0933	3.6
0.167/0.333/0.500	0 - 3.73	0.0844	0.0012	0.0863	2.3
0.300/0.400/0.300	0 - 3.19	0.0724	0.0012	0.0765	5.7
0.500/0.500/0	0 - 3.45	0.0621	0.0015	0.0619	-0.3

99 (23) Carbon dioxide + Sodium thiosulfate [7772-98-7] + Water

Both Passauer (14) and Nahoczky (15) measured the solubility of carbon dioxide in saturated aqueous sodium thiosulfate, the first at 293 K the second at 288 K. The solubility measurements are classed tentative, but no salt effect parameters were calculated from the data because of uncertainty in the solubility of sodium thiosulfate and concern about the reliablity of a salt effect parameter based on just one salt concentration.

99 (24) Carbon dioxide + Sodium nitrate [7631-99-4] + Water

The system was studied by Sechenov (5) at 288.35 K, Markham and Kobe (18) at 273.35 and 298.15 K, Yasunishi and Yoshida (42) at 288.15, 298.15 K and 308.15 K and by Gerecke (35) at five degree intervals between 288.15 and 333.15 K. In general the results accord well. Gerecke's results show by far the most scatter and largest standard deviation of the slope of lg *L vs.* c_2 plots.. Salt effect parameters are in Table 55 (next page).

Gerecke (35) reports values at 293, 303, 313, 318 and 328 K in addition to his values above. His solubility values scatter much more than the data of the other workers and a simple straight line slope does not show the expected variation with temperature. The data are classed doubtful.

The values in [ ] in Table 55 (next page) are combined data sets and are recomended. The recommended salt effect parameters are (0.0874 ± 0.0010) at 288.2 K and (0.0777 ± 0.0.0002) at 298.15 K.

Table 55.

T/K	Concentration Range, c_2/mol L^{-1}	Salt Effect Parameter k_{scc}/L mol^{-1}	Reference
273.35	0 - 6.300	0.0989	MK (18)
288.15	0 - 4	0.0677	G (35)
	0.382 - 5.929	0.0847	YY (42)
288.35	0 - 7.356	0.0891	S (5)
[288.2	0 - 7.356	0.0874	(5) & (42)]
298.15	0 - 6.300	0.0770	MK (18)
	0 - 4	0.0677	G (35)
	0.382 - 7.256	0.0781	YY (42)
[298.15	0 - 7.256	0.0777	(18) & (42)]
308.15	0 - 4	0.0649	G (35)
	0.346 - 5.186	0.0723	YY (42)
323.15	0 - 4	0.0647	G (35)
333.15	0 - 4	0.0649	G (35)

99 (25) Carbon dioxide + Phosphoric acid [7664-38-2] + Sodium dihydrogen phosphate [7558-80-7] + Water

Van Slyke, Sendroy, Hastings and Neill (13) measured the solubility of carbon dioxide in 0.150 and 0.300 mol L^{-1} H_3PO_4 and in mixtures of 0.0375 to 0.300 mol L^{-1} NaH_2PO_4 and 0.011 to 0.030 mol L^{-1} H_3PO_4 at 311.2 K. The solubility was corrected for the effect of phosphoric acid, which changed the solubility 0.3 % or less, and the corrected solubility treated as if only the sodium salt was present. The salt effect parameter for the NaH_2PO_4 alone was k_{scc} = (0.184 ± 0.005) L mol^{-1}. See section 19 (1) for the result for phosphoric acid.

99 (26) Carbon dioxide + Sodium formate [141-53-7] + Water
99 (27) Carbon dioxide + Sodium acetate [127-09-3] + Water

Gerecke (35) reports carbon dioxide solubility data between 0 and 4 mol L^{-1} sodium formate and 0 and 2 mol L^{-1} sodium acetate at five degree intervals between 288.15 and 333.15 K. The solubility of carbon dioxide in sodium formate shows salting in at concentration of 0.1, 0.2 and 0.5 mol L^{-1}, salting out at 1 and 2 mol L^{-1} and salting in at 4 mol L^{-1}. A similar variation is observed in the sodium acetate solutions.

Both formate and acetate ions are the anions of weak acids and thus themselves bases. We would expect an apparent salting in because of the reaction of the basic anions with the acidic carbon dioxide. Reactions

$$CO_2(aq) + H_2O + HCOO^-(aq) = HCO_3^-(aq) + HCOOH(aq)$$
$$CO_2(aq) + H_2O + 2\ HCOO^-(aq) = CO_3^{2-}(aq) + 2\ HCOOH(aq)$$

contribute to the effect. We have not tried to analyze the data beyond the suggestion of an acid base interaction being responsible for the apparent salting in.

99 (28) Carbon dioxide + Sodium phenoxide [139-02-6] + Water

Kimura and Takeuchi (29) report the solubility of carbon dioxide in aqueous sodium phenoxide as functions of temperature, pressure and electrolyte concentration. The data show the effect of an acid base reaction between the acidic carbon dioxide and the basic phenoxide anion. At 293.15 K there is strong salting in at all concentrations between 0.805 and 3.04 mol L^{-1} sodium phenoxide which is described by a salt effect parameter of -0.237, at 323.15 the salt effect parameter is -0.40. The salt effect parameters were calculated for the solubility values at 0.98/0.99 atm partial pressure carbon dioxide. The values are classed tentative.

99 (29) Carbon dioxide + Sodium 4-[{4-(dimethylamino)pheynl}azo]benzenesulfonic acid salt (Methyl orange) [547-58-0] + Water

Findlay and Shen (9) measured the solubility of carbon dioxide in dilute solutions of methyl orange at 298.15 K. The evaluator treated the solubility data at 122 - 124 kPa and obtained a salt effect parameter of -3.00 L mol^{-1} for the 0.0101 to 0.0281 mol L^{-1} methyl orange solutions with a standard deviation of the slope of 0.15. The methyl orange salts-in strongly. The result is classed tentative, but use with caution.

99 (30) Carbon dioxide + Lactic acid [50-21-5] + Sodium lactate [920-49-0] + Water

Van Slyke, Sendroy, Hastings and Neill (13) measured the solubility of carbon dioxide in 0.100 to 0.300 mol L^{-1} lactic acid and in mixtures of 0.150 and 0.300 mol L^{-1} sodium lactate and 0.100 to 0.300 mol L^{-1} lactic acid at 311.2 K. The effect for the lactic acid is scattered and small. Its molar parameter is $k_{scc} = (0.006 \pm 0.006)$ L mol^{-1}. The lactic acid was assumed to have a negligible effect in the mixture and the data were treated as if sodium lactate alone was present. The resulting salt effect parameter is $k_{scc} = (0.125 \pm 0.006)$ mol L^{-1}. The sodium lactate salts out and the result is classed tentative.

99 (31) Carbon dioxide + Sodium monododecyl sulfuric acid ester (or SDS); [151-21-3] + Water
99 (32) Carbon dioxide + Sodium 1-heptylsulfonate (or SHSo); [22767-50-6] + Water
99 (33) Carbon dioxide + Sodium perfluoro-octanoate (or SPFO); [335-95-5] + Water
23 (4) Carbon dioxide + N,N,N-Trimethyl-1-hexadecanaminium bromide (or CTAB); [57-09-0] + Water

NOTE: This sytem belongs with the carbon number, 23. It is better considered here with other micelle forming solutions.

Ownby, Prapaitrakul and King (50) measured the solubility of carbon dioxide in the four systems listed above at either 298.2 or 299.2 K over a small pressure range. The solutions appear to obey Henry's law. At salt concentrations above the critical micelle concentration (CMC) the carbon dioxide is salted in, below the CMC the gas is salted out. The salt CMC's are: SDS 0.0081; SPFO 0.032; CTAB 0.00092; and SHSo 0.28 mol kg^{-1}. Only the sodium 1-heptyl sulfonate (SHSo) has a large enough CMC to see the salting out effect (Figure 8). Both the salting out and salting in parameter are given for the SHSo, and only salting in parameters are given for the other salts in the table below.

Table 56.

Salt	Molality Range, m_2/mol kg^{-1}	Salt Effect Parameter k_{smm}/kg mol^{-1}	Std Dev of Slope
SHSo	0.0 - 0.4	0.091	0.004
	0.6 - 1.2	-0.060	0.003
SDS	0.0 - 0.6	-0.116	0.006
SPFO	0.0 - 0.6	-0.164	0.007
CTAB	0.0 - 0.4	-0.179	0.008

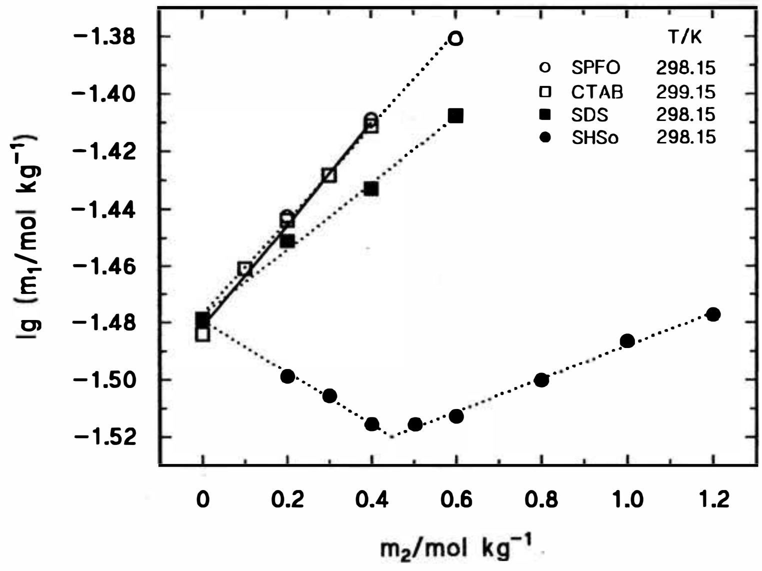

Figure 8. Logarithm of carbon dioxide molality *vs.* salt molality. The four salts are sodium perfluoro-octanoate (SPFO), cetyltrimethylammonium bromide (CTAB), sodium dodecyl sulfate (SDS), and sodium 1-heptylsulfonate (SHSo). These salts are micelle forming substances. The carbon dioxide is "salted in" above the CMC (critical micelle concentration). Only one of the four salts (SHSo) has a large enough CMC to show the effect of salting out below the CMC salting in above the CMC.

99 (34) Carbon dioxide + Sodium trifluoroacetate [2923-18-4] + Water

Castellani and Berchiesi (62) report one solubility measurement of carbon dioxide in 19.0 mol kg^{-1} sodium trifluoroacetate at 294.65 K and 0.936 atm of 0.0077 mol L^{-1}. The evaluator estimated a solubility of carbon dioxide in water under these conditions of 0.0353 mol L^{-1}. The two values give a salt effect parameter of k_{smc} = 0.035. The value is classed tentative, but use with caution.

100 (1) Carbon dioxide + Potassium chloride [7447-40-7] + Water

The system has been studied by Sechenov (5) at 288.35 K, by Geffcken (6) at 288.15 and 298.15 K, by Findlay and Shen (9) at 298.15 K, by Passauer (14) at 293.15 K, by Markham and Kobe (18) at 273.35, 298.15 and 313.15 K, Gerecke (35) at five degree intervals between 288.15 and 333.15 K, by Yasunishi and Yoshida (42) at 298.15 and 308.15 K, by Burmakina, Efanov, and Shnet (45) at 298.15 K and by He and Morse (57) at five temperatures between 273.15 and 363.15 K. Each workers data have been fitted to a linear lg L *vs.* c_2 line with the exception of He and Morse whose data was fitted to a linear lg m_1 *vs.* m_2 line and Passauer (14), whose measurement in saturated aqueous potassium chloride, was not used. The concentration results are below.

Table 57.

T/K	KCl Concentration Range, c_2/mol L^{-1}	Salt Effect Parameter k_{scc}/L mol^{-1}	Standard Deviation of Slope	Reference
273.35	0 - 3	0.0768	0.0017	MK (18)
288.15	0.423 - 1.058	0.0731	0.0022	Gf (6)
	0 - 1	0.0817	0.0012	G (35)
288.35	0.0 - 2.564	0.0935	0.0041	S (5)
298.15	0.423 - 1.058	0.0705	0.0029	Gf (6)
	0.247 - 1.000	0.0680	0.0052	FS (9)
	0.0 - 3.558	0.0622	0.0015	MK (18)
	0.0 - 2.0	0.0650	0.0029	G (35)
	0.498 - 4.131	0.0569	0.0015	YY (42)
	0 - 0.200	0.0755	0.0119	BES (45)
[298.15	0.0 - 2.0	0.0664	0.0009	all except (45)]
308.15	0 - 2	0.0694	0.0135	G (35)
	0.420 - 4.110	0.0567	0.0011	YY (42)
313.15	0 - 3	0.0597	0.0043	MK (18)
	0 - 2	0.0755	0.0134	G (35)
323.15	0 - 2	0.0776	0.0135	G (35)
333.15	0 - 2	0.0854	0.0214	G (35)

The value at 298.15 in [ ] is based on the 21 values from all papers between 0.0 and 2.0 mol L^{-1} KCl. It is the only recommended value. A plot of all the data to 4.3 mol L^{-1} KCl shows a small curvature at concentrations above 2.0 mol L^{-1} KCl. Gerecke's value at 4.3 mol L^{-1} is off from the pattern of the other data and is rejected. Burmakina *et al.* (45) made nine measurments in the 0 - 0.200 mol L^{-1} KCl range. Measurements in dilute solutions are difficult and subject to large error [(49) and this volume preliminary material]. Their data scatters badly and their results were not included in the general average of 298.15 K data. The data of He and Morse (57) are treated separately below.

Table 58.

T/K	p_1/bar	KCl Molality Range, m_2/mol kg^{-1}	Salt Effect Parameter k_{smm}/kg mol^{-1}	Standard Deviation of Slope	Reference
273.35	1.049	0.1 - 3.51	0.0403	0.0037	HM (57)
298.15	0.954	0.1 - 4.0	0.0375	0.0072	HM (57)
323.15	0.865	0.1 - 5.0	0.0248	0.0015	HM (57)
348.15	0.611	0.1 - 5.0	0.0174	0.0019	HM (57)
363.15	0.305	0.1 - 5.0	0.0170	0.0013	HM (57)

The values appear to be slightly lower than expected from the other data on the system. They are classed as tentative.

Figure 9 shows logarithm of Bunsen coefficient *vs.* the potassium chloride concentration (ionic strength) at 288 and 298 K. Only the data of Gerecke (35) deviates significantly from the other data. The data of He and Morse (57), calculated as Bunsen coefficients from the author's data assuming ideal gas and Henry's law behavior, show more scatter than the other data.

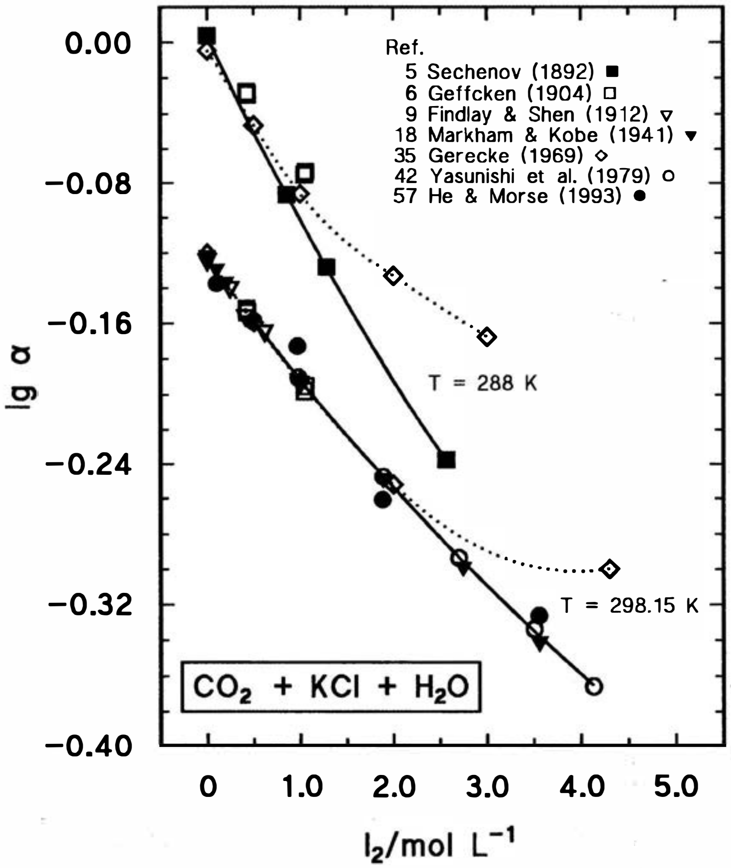

Figure 9. Logarithm of Bunsen coefficient *vs.* potassium chloride concentration (ionic strength).

100 (2) Carbon dioxide + Hydrochloric acid [7647-01-0] + Potassium chloride [7447-40-7] + Water

Van Slyke, Sendroy, Hastings and Neill (13) measured the solubility of carbon dioxide in solutions that were 0.01 mol L^{-1} in HCl and 0 to 0.300 mol L^{-1} in KCl at 311.2 K. The very small concentration of HCl was assumed to have a negligible effect on salting out and the data were treated as if KCl alone was present. The result for the KCl is k_{scc} = (0.0691 ± 0.0032) mol L^{-1} and it is classed tentative.

100 (3) Carbon dioxide + Calcium chloride [10043-52-4] + Potassium chloride [7447-40-7] + Water

Yasunishi, Tsuji and Sada (43) studied this system at 298.15 K and mole ratios of KCl/$CaCl_2$ of 0.0/1.00, 0.25/0.75, 0.50/0.50, 0.75/0.25 and 1.00/0.0. As an ionic strength ratio the values are 0.0/1.00, 0.10/0.90, 0.25/0.75, 0.50/0.50 and 1.0/0. The resulting salt effect parameters assuming a linear lg L *vs.* I_2 are shown in Table 59 (next page). The calculated values assume the pure KCl and pure $CaCl_2$ salt effect parameters are additive as the sum of the products of ionic strength fraction times the salt effect parameter for each electrolyte. See also Figure 11B following section 100 (10).

The pure KCl and $CaCl_2$ values in Table 59 do not agree well with values given earlier. Another problem is that the regression lines give solubility in water values that range from 1.4 to 4.1 % low. In spite of these problems, the pure salt effect parameters have been used to calculate the salt effect parameters for the mixtures and the results appear satisfactory. The data deserve a more detailed treatment than we can give it here. They are classed as tentative.

Table 59.

Ionic Strength Ratio $KCl/CaCl_2$	Concentration Range c_2/mol L^{-1}	Salt Effect Parameter $k_{\mathrm{sl(c)c}}$/L mol^{-1}	Salt Effect Parameter Calculated	Difference %
1.00/0.00	0.498 - 3.505	0.0605	-	-
0.50/0.50	0.429 - 3.501	0.0586	0.0588	0.3
0.25/0.75	0.512 - 3.401	0.0594	0.0580	2.3
0.10/0.90	0.426 - 3.233	0.0572	0.0574	0.4
0.00/1.00	0.558 - 3.801	0.0571	-	-

100 (4) Carbon dioxide + Sodium chloride [7647-14-5] + Potassium chloride [7447-40-7] + Water

Yasunishi, Tsuji and Sada (43) studied this system at 298.15 K and mole ratios of (same as ionic strength ratios) NaCl/KCl of 0.0/1.0, 0.25/0.75, 0.50/0.50, 0.75/0.25 and 1.0/0.0. The resulting salt effect parameters assuming a linear lg L *vs.* I_2 are below. The calculated values assume the pure NaCl and pure KCl salt effect parameters are additive as the sum of the products of mol fraction times the salt effect parameter for each electrolyte.

Table 60.

Ionic Strength Ratio NaCl/KCl	Concentration Range c_2/mol L^{-1}	Salt Effect Parameter $k_{\mathrm{sl(c)c}}$/L mol^{-1}	Salt Effect Parameter Calculated	Difference %
1.00/0.00	0.498 - 3.505	0.0986	-	-
0.75/0.25	0.545 - 4.311	0.0873	0.0882	1.0
0.50/0.50	0.479 - 4.396	0.0766	0.0778	1.6
0.25/0.75	0.537 - 4.125	0.0677	0.0673	-0.6
0.00/1.00	0.498 - 4.131	0.0569	-	-

The mixed electrolyte systems appear to have no specific interaction within experimental error. The data are classed tentative. See Figure 11A following section 100 (10).

100 (5) Carbon dioxide + Calcium chloride [10043-52-4] + Sodium chloride [7647-14-5] + Potassium chloride [7447-40-7] + Water

The system was studied by Yasunishi, Tsuji and Sada (43) at 298.15 K and several ratios of $CaCl_2/NaCl/KCl$. The salt effect parameters are in the table below.

Table 61.

Ionic Strength Ratio $CaCl_2/NaCl/KCl$	Concentration Range c_2/mol L^{-1}	Salt Effect Parameter $k_{\mathrm{sl(c)c}}$/L mol^{-1}	Salt Effect Parameter Calculated	Difference %
0.00/0.50/0.50	0.479 - 4.396	0.0766	0.0778	1.6
0.50/0.167/0.333	0.386 - 2.762	0.0643	0.0669	4.0
0.75/0.00/0.25	0.512 - 3.401	0.0580	0.0561	3.3

The calculated salt effect parameter is probably within experimental error of the measured parameter. The values are classed tentative.

100 (6) Carbon dioxide + Potassium bromide [7758-02-3] + Water

Three laboratories report data on the system. Sechenov (5) studied the system at 288.35 K, Geffcken (6) at 288.15 and 298.15 K and Gerecke (35) at ten temperatures between 288.15 and 333.15 K.

The data of both Sechenov and Geffcken at 288 K are linear in lg L *vs.* c_2, but the slopes do not agree well. Gerecke's data shows salting in at 4 mol L^{-1} KBr at temperatures of 298 K and above. Plots of Gerecke's data as lg L *vs.* c_2 are linear to either 0 - 1 or 0 - 2 mol L^{-1} KBr. The slopes do not agree with the values of Sechenov and Geffcken. The salt effect parameter is not a regular increase or decrease with increasing temperature. Gerecke's data are classed doubtful.

The salt effect parameters of Sechenov and Geffcken and a sampling of Gerecke's values are below. Geffcken's values are preferred, but use with caution.

Table 62.

T/K	KBr Concentration Range, c_2/mol L^{-1}	Salt Effect Parameter k_{scc}/L mol^{-1}	Standard Deviation of Slope	Reference
288.15	0.550 - 1.064	0.0635	0.0012	Gf (6)
	0.0 - 2.0	0.0499	0.0044	G (35)
288.35	0.0 - 4.228	0.0567	0.0017	S (5)
298.15	0.550 - 1.064	0.0672	0.0030	Gf (6)
	0.0 - 4.0	0.0074	0.0146	G (35)
	0.0 - 2.0	0.0394	0.0080	G (35)
	0.0 - 1.0	0.0602	0.0022	G (35)
303.15	0.0 - 1.0	0.0506	0.0016	G (35)
313.15	0.0 - 1.0	0.117	0.037	G (35)
323.15	0.0 - 1.0	0.150	0.002	G (35)
333.15	0.0 - 1.0	0.136	0.048	G (35)

100 (7) Carbon dioxide + Potassium iodide [7681-11-0] + Water

In addition to the same three workers (5, 6, 35) that report on the KBr systems, Onda Sada, Kobayashi, Kito and Ito (36) report carbon dioxide solubility meausrements at 0, 1 and 2 mol L^{-1} KI at 298.15 K and 0.1013 MPa, Passauer (14) reports a measurement in saturated aqueous KI at 293.15 K, and Vázquez, Chenlo, Pereira and Peaguda (64) report seven measurements between 0.241 and 1.687 mol L^{-1} KI at 298.1 K and 0.1013 MPa. In an earlier paper (61) they report the solubility in water at the same temperature and pressure. Passauer's value was not used. At 298.15 K there is fair agreement among the results of Geffcken (6), Gerecke (35) and Onda *et al.* (36) to 2 mol L^{-1} KI. The results are classed tentative. The data of Vázquez *et al.* (64) are about 7 % smaller than the other data for any given KI concentration and their data are classed doubtful. Their data shows a definite curvature which is emphasized more when the water value is used. See also Figure 10 (next page). The salt effect parameters are below.

Table 63.

T/K	KI Concentration Range, c_2/mol L^{-1}	Salt Effect Parameter k_{scc}/L mol^{-1}	Standard Deviation of Slope	Reference
288.15	0.559 - 1.119	0.0624	0.0029	Gf (6)
288.35	0.0 - 5.767	0.0516	0.0027	S (5)
298.15	0.559 - 1.119	0.0540	0.0006	Gf (6)
	0.0 - 4.0	0.0208	0.0057	G (35)
	0.0 - 2.0	0.0453	0.0013	G (35)
	0.0 - 1.0	0.0483	0.0017	G (35)
	0.0 - 2.002	0.0520	0.0036	OSK (36)
	0.0 - 1.69	0.0505	0.0081	VCPP (64)
	0.24 - 1.69	0.0375	0.0040	VCPP (64)
	0.0 - 1.0	0.0541	0.0023	(6, 35, 36)
313.15	0.0 - 2.0	0.0581	0.0082	G (35)
323.15	0.0 - 2.0	0.0659	0.0083	G (35)
333.15	0.0 - 2.0	0.0830	0.0119	G (35)

Sechenov's data at 288.35 K are classed tentative although the salt effect parameter is smaller than expected from other data at 288 and 298 K. Gerecke's data at the higher temperatures shows a salting out effect that increases with temperature. This is contrary to normal expectations and the data should be used with caution.

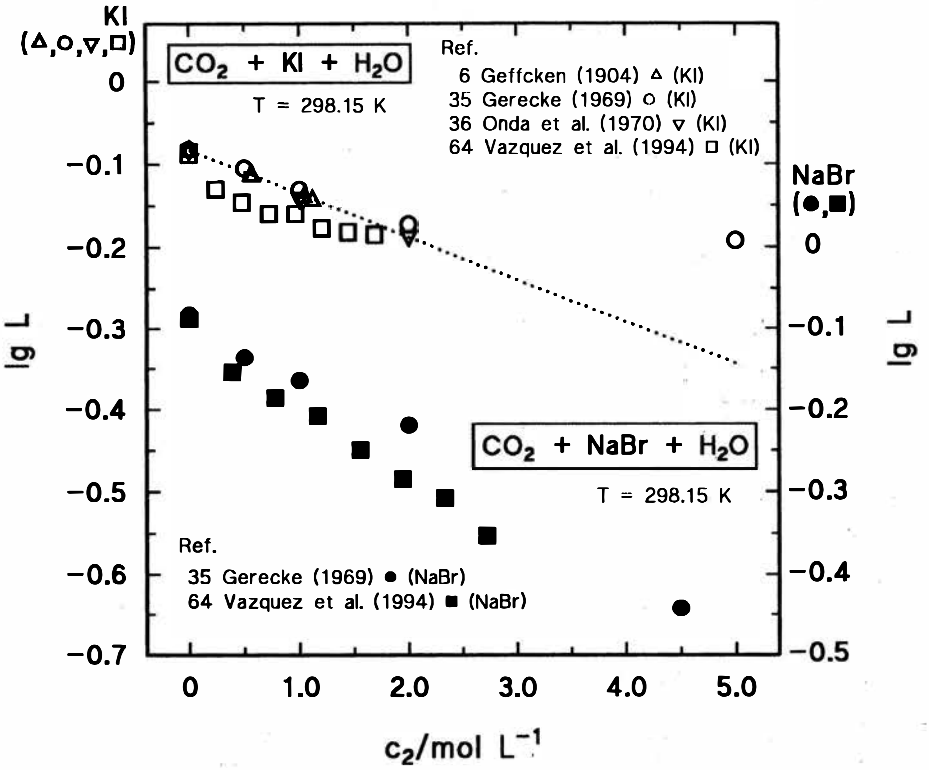

Figure 10. Logarithm of Ostwald coefficient *vs.* potassium iodide and sodium bromide concentrations.

100 (8) Carbon dioxide + Potassium sulfate [7778-80-5] + Water

Yasunishi and Yoshida (42) measured the solubility of carbon dioxide at four concentrations of potassium sulfate between 0.093 and 0.454 mol L^{-1} (0.279 and 1.362 ionic strength) at 298.15 K. The salt effect parameter as a function of ionic strength is $k_{sI(c)c}$ = (0.0777 ± 0.0003) L mol^{-1} and it is classed as tentative. Passauer (14) reports the carbon dioxide solubility in saturated aqueous potassium sulfate at 293.15 K. No salt effect parameter was calculated from his measuremnet.

He and Morse (57) measured the solubility of carbon dioxide in 0.01 to as high as 0.9 mol kg^{1} K_2SO_4 at five temperatures between 273.15 and 363.15 K. The carbon dioxide partial pressure was different at each temperature. They reported both salt and gas in molality. Ionic strength salt effect parameters in molality units from their data are in the table below. The values are classed tentative. Multiplication by three will put the salt effect parameters on a molal basis.

Table 64.

T/K	p_1/bar	K_2SO_4 Molal Range, m_2/mol kg^{-1}	Salt Effect Parameter $k_{sI(m)m}$/kg mol^{-1}	Standard Deviation of Slope	Reference
273.15	1.049	0.01 - 0.4	0.0734	0.0071	HM (57)
298.15	0.954	0.1 - 0.6	0.0568	0.0051	HM (57)
323.15	0.865	0.02 - 0.81	0.0377	0.0028	HM (57)
348.15	0.611	0.1 - 0.9	0.0260	0.0031	HM (57)
363.15	0.305	0.1 - 0.9	0.0226	0.0024	HM (57)

100 (9) Carbon dioxide + Potassium nitrate [7757-79-1] + Water

A number of workers have studied this system. Sechenov (4) at 288.35 K, Geffcken (6) at 288.15 and 298.15 K, Markham and Kobe (18) at 273.35, 298.15 and 313.15 K, Gerecke (35) at five degree intervals between 288.15 and 328.15 K and Yasunishi and Yoshida (42) at 298.15 and 308.15 K. The salt effect parameters obtained by finding the slope of lg *L vs.* c_2 plots of each workers data at each temperature are given in Table 65 (next page). The data are classed tentative, but the Markham and Kobe data are preferred.

Table 65.

T/K	Concentration Range, c_2/mol L^{-1}	Salt Effect Parameter k_{scc}/L mol^{-1}	Reference
273.35	0.0 - 0.961	0.0682	MK (18)
288.15	0.536 - 1.033	0.0527	Gf (6)
	0.0 - 2.0	0.0425	G (35)
288.35	0.0 - 2.325	0.0486	S (4)
293.15	0.0 - 2.0	0.0412	G (35)
298.15	0.536 - 1.033	0.0435	Gf (6)
	0.0 - 2.664	0.0429	MK (18)
	0.0 - 2.0	0.0389	G (35)
	0.275 - 1.768	0.0419	YY (42)
303.15	0.0 - 2.0	0.0365	G (35)
308.15	0.0 - 2.0	0.0365	G (35)
	0.275 - 1.768	0.0392	YY (42)
313.15	0.0 - 2.664	0.0372	MK (18)
	0.0 - 2.0	0.0379	G (35)
318.15	0.0 - 2.0	0.0348	G (35)
323.15	0.0 - 2.0	0.0348	G (35)
328.15	0.0 - 2.0	0.0361	G (35)

100 (10) Carbon dioxide + Sodium chloride [7647-14-5] + Potassium nitrate [7757-79-1] + Water

Yasunishi, Tsuji and Sada (43) have studied this system at 298.15 K. They report the solubility of carbon dioxide in aqueous NaCl, KNO_3, and three mixed electrolyte solutions of mole fraction ratio NaCl/KNO_3 0.25/0.75, 0.50/0.50 and 0.75/0.25. The salt effect parameters for the five solutions are given in Table 66 on the next page.

The calculated salt effect parameters assume the two electrolytes act independently. It is probably true within the experimental error of these experiments. The values are classed tentative. See Figure 11A.

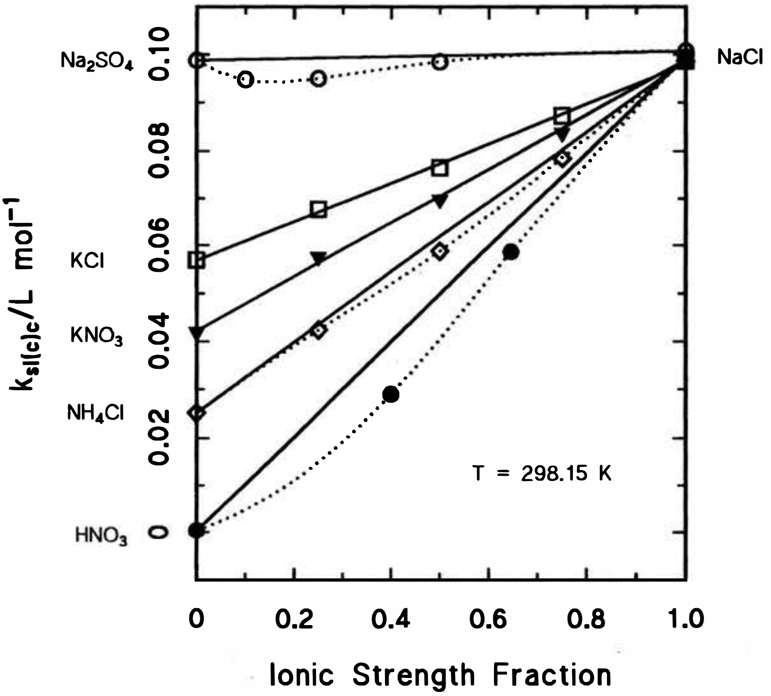

Figure 11A. CO_2 + Binary salts + H_2O. A test of the additivity of salt effect parameters as a function of ionic strength fraction, 298.15 K.

In Figure 11 A systems from top to bottom are:

99 (21) $CO_2 + Na_2SO_4 + NaCl + H_2O$
100 (4) $CO_2 + KCl + NaCl + H_2O$
100 (10) $CO_2 + KNO_3 + NaCl + H_2O$
99 (5) $CO_2 + NH_4Cl + NaCl + H_2O$
99 (4) $CO_2 + HNO_3 + NaCl + H_2O$

Table 66.

Ionic Strength Ratio $NaCl/KNO_3$	Concentration Range c_2/mol L^{-1}	Salt Effect Parameter k_{scc}/L mol^{-1}	Salt Effect Parameter Calculated	Difference %
0.00/1.00	0.288 - 1.630	0.0419	-	-
0.25/0.75	0.298 - 1.664	0.0576	0.0564	2.1
0.50/0.50	0.289 - 2.173	0.0698	0.0708	1.4
0.75/0.25	0.264 - 1.723	0.0838	0.0853	1.8
1.00/0.00	0.455 - 3.400	0.0997	-	-

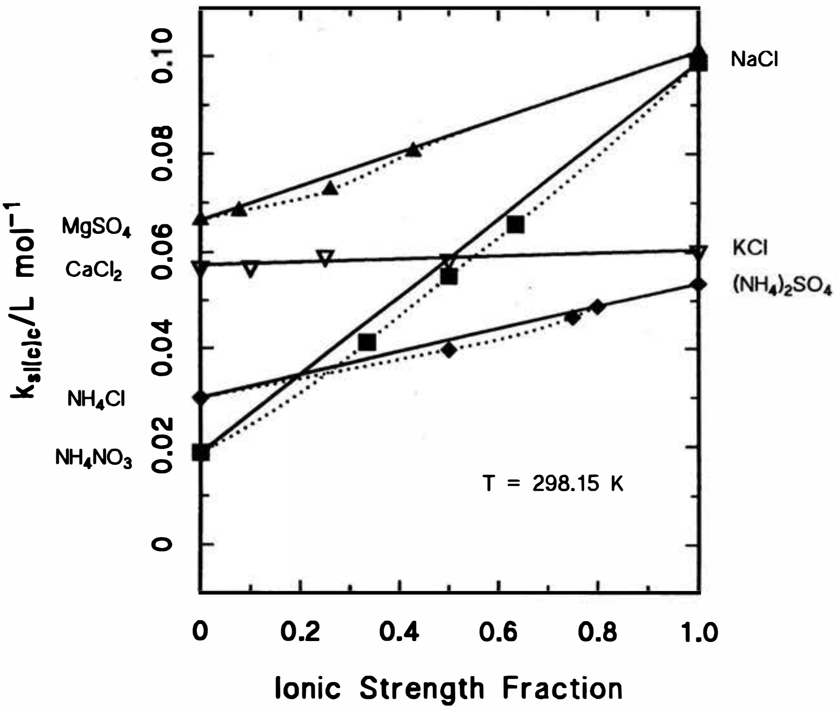

Figure 11B. CO_2 + Binary salts + H_2O. A test of the additivity of salt effect parameters as a function of ionic strength fraction, 298.15 K.

Systems from right top to bottom:

99 (7) $CO_2 + MgSO_4 + NaCl + H_2O$
99 (6) $CO_2 + NH_4NO_3 + NaCl + H_2O$
100 (3) $CO_2 + CaCl_2 + KCl + H_2O$
18 (5) $CO_2 + NH_4Cl + (NH_4)_2SO_4 + H_2O$

100 (11) Carbon dioxide + Magnesium sulfate [7487-88-9] + Sodium chloride [7647-14-5] + Potassium nitrate [7757-79-1] + Water

The system was studied by Yasunishi, Tsuji and Sada (43) at 298.15 K. The results are in Table 67 (next page).

Table 67.

Ionic Strength Ratio $MgSO_4/NaCl/KNO_3$	Ionic Strength Range I_2/mol L^{-1}	Salt Effect Parameter $k_{sI(c)c}$/L mol^{-1}	Salt Effect Parameter Calculated	Difference %
0.80/0.20/0.0	0 - 5.46	0.0725	0.0736	1.5
0.571/0.286/0.143	0 - 3.96	0.0667	0.0729	9.3
0.0/0.50/0.50	0 - 2.17	0.0707	0.0712	0.70

The results indicate additivity of salt effects when two salts are present, but some specific effect when three salts are present. The standard errors about the regression line are 0.0004, 0.0005 and 0.0014, respectively for the three values in the order they appear in the table above. The results are classed as tentative.

100 (12) Carbon dioxide + Potassium dihydrogen phosphate [7778-77-0] + Water

Gerecke (35) studied the system at five degree intervals between 288.15 and 333.15 K at electrolyte concentrations of 0, 0.25, 0.5 and 1 mol L^{-1}. We did not try to calculate an ionic strength for the KH_2PO_4 electrolyte. The CO_2 solubility at 1.0 mol L^{-1} electrolyte shows a lower solubility than expected from the behavior shown at lower electrolyte concentrations. Salt effect parameters based on the solubilities at 0.0, 0.25 and 0.50 mol L^{-1} are given below:

T/K	288.15	298.15	313.15	323.15	333.15
k_{scc}/L mol^{-1}	0.192	0.175	0.206	0.204	0.239
Std. dev. slope	0.013	0.010	0.009	0.035	0.008

The salt effect parameter shows several unusual effects. It is larger than seen for other electrolytes. There is no indication of an acid-base interaction between the carbon dioxide and the anions present in solution. If the electrolyte is mainly K^+, H^+ and HPO_4^{2-} the salt effect parameters need be divided by 3 to put them on an ionic strength basis. The values would then be consistent with values for other electrolytes. The temperature coefficient of the salt effect parameter is doubtful until confirmed by other work.

100 (13) Carbon dioxide + Phosphoric acid [7664-38-2] + Potassium dihydrogenphosphate [7778-77-0] + Water

Van Slyke, Sendroy, Hastings and Neill (13) measured the solubility of carbon dioxide in 0.150 and 0.300 mol L^{-1} H_3PO_4 and in mixtures of 0 to 0.300 mol L^{-1} KH_2PO_4 and 0.015 to 0.030 mol L^{-1} H_3PO_4 at 311.2 K. The phosphoric acid data were analysed separately, see section 19 (1). In the mixed system the solubility was corrected assuming the phosphoric acid acted independently. The correction was 0.3 % or less. The corrected solubility was treated as if the potassium dihydrogen phosphate was present alone. The resulting salt effect parameter is k_{scc} = (0.151 ± 0.003) mol L^{-1}. See section 99 (25) for the treatment of the sodium salt system.

100 (14) Carbon dioxide + β-D-Fructofuranosyl-α-D-glucopyranoside (sucrose) [57-50-1] + Potassium dihydrogenphosphate [7778-77-0] + Water

de Molineri, de Cozzitorti, Sosa and Katz (51) measured the solubility of carbon dioxide in five sucrose solutions from 5 to 15 mass fraction sucrose each containing 0 to 15 mass fraction potassium dihydrogen phopsphate at temperatures of 288.15, 298.15 and 308.15 K. The evaluator calculated the salt effect parameters in Table 68 (next page). The lg *L vs. m_3* plots showed a small concave curvature and extrapolated to a carbon dioxide solubility in the aqueous sucrose solutions that was usually about 1 % low.

There are small, but consistent increases in the salt effect parameter with increasing temperature, and decreases in the parameter with increasing sucrose content. It is interesting to compare these results with the results of the aqueous KH_2PO_4, System 100 (12) above. The results from the aqueous sucrose solutions would represent the sucrose + water system, but no calculations were made for the system.

100 (15) Carbon dioxide + Potassium hydrogen oxalate [127-95-7] + Water

Van Slyke, Sendroy, Hastings and Neill (13) measured the solubility of carbon dioxide in 0.300 and 0.600 mol L^{-1} KHC_2O_4 at 311.2 K. The molar salt effect parameter is k_{scc} = (0.0683 ± 0.0003) mol L^{-1} and is classed tentative.

Table 68.

T/K	Sucrose 10^2w_2	KH_2PO_4 Molality Range, m_3/mol kg^{-1}	Salt Effect Parameter k_{smc}/kg mol^{-1}	Std. Dev. of slope
288.15	5	0 - 1.378	0.1299	0.0029
298.15	5	0 - 1.378	0.1305	0.0028
308.15	5	0 - 1.378	0.1310	0.0034
288.15	7.5	0 - 1.422	0.1263	0.0034
298.15	7.5	0 - 1.422	0.1284	0.0026
308.15	7.5	0 - 1.422	0.1285	0.0033
288.15	10	0 - 1.469	0.1257	0.0027
298.15	10	0 - 1.469	0.1269	0.0026
308.15	10	0 - 1.469	0.1270	0.0034
288.15	12.5	0 - 1.520	0.1245	0.0030
298.15	12.5	0 - 1.520	0.1257	0.0026
308.15	12.5	0 - 1.520	0.1263	0.0035
288.15	15	0 - 1.575	0.1236	0.0028
298.15	15	0 - 1.575	0.1259	0.0028
308.15	15	0 - 1.575	0.1263	0.0035

100 (16) Carbon dioxide + Lactic acid [50-21-5] + Potassium lactate [996-31-6] + Water

Van Slyke, Sendroy, Hastings and Neill (13) measured the solubility of carbon dioxide in 0.150 and 0.300 mol L^{-1} lactic acid and in mixtures of 0.150 and 0.300 mol L^{-1} potassium lactate and 0.100 to 0.300 mol L^{-1} lactic acid at 311.2 K. The lactic acid alone shows a small and scattered effect (see section 99 (30)) and is considered to contribute negligible effect in the mixture. The data were treated as if potassium lactate alone was present. The result is k_{scc} = (0.0959 ± 0.0004) mol L^{-1}. The value is classed tentative.

100 (17) Carbon dioxide + Potassium thiocyanate [333-20-0] + Water

The system was studied by Sechenov (5) at 288.35 K in water and three aqueous solutions to over 10 mol L^{-1} KSCN. The salt effect parameter, k_{scc} = (0.041 ± 0.03) L mol^{-1}, is classed tentative.

100 (18) Carbon dioxide + Potassium aluminum sulfate [10043-67-1] + Water

Only Rosenthal (24b) reports measurements on this system, and he reports on only one dilute solution at 293.15 K. The salt effect parameter has been calculated on both a concentration and ionic strength basis. The values are: k_{scc} = 0.84 and $k_{sI(c)c}$ = 0.094. The values are classed as tentative. Ionic strength was calculated assuming 100 % dissociation into potassium, aluminum and sulfate ions.

101 (1) Carbon dioxide + Rubidium chloride [7791-11-9] + Water
102 (1) Carbon dioxide + Cesium chloride [7647-17-8] + Water

Geffcken (6) measured the solubility of carbon dioxide in both RbCl and CsCl aqueous solutions at temperatures of 288.15 and 298.15 K. Gerecke (35) measured the solubility of carbon dioxide in aqueous solutions of CsCl at temperatures of 288.15, 293.15, 298.15 and 303.15 K at concentrations up to 2 mol L^{-1}. The salt effect parameters from these data are:

Table 69.

T/K	Electrolyte	No. of Detn.	Concentration Range c_2/L mol^{-1}	Salt Effect Parameter k_{scc}/L mol^{-1}	Reference
288.15	RbCl	4	0 - 1.012	0.060	Gf (6)
298.15	RbCl	4	0 - 0.55	0.058	Gf (6)
288.15	CsCl	2	0 - 0.55	0.045	Gf (6)
		4	0 - 2	0.036	G (35)
293.15	CsCl	4	0 - 2	0.030	G (35)
298.15	CsCl	2	0 - 0.55	0.044	Gf (6)
		4	0 - 2	0.032	G (35)
303.15	CsCl	4	0 - 2	0.031	G (35)

The CsCl salt effect parameters at 288.15 and 298.15 K from the two papers show fair agreement considering the small effect and the fact that all the Geffcken (6) measurements were made at low electrolyte concentrations. The evaluator has a slight preference for the results of Gerecke (35) except for the 293 K value which appears to be too small.

MISCELLANEOUS

The papers of Passauer (14), Nahoczky (15) and Kobe and Williams (16) contain a number of measurements in just one electrolyte solution for each system studied. A number of these have already been cited under the appropriate system. Other systems, for which these papers are the only data, are listed below.

Both Passauer (14) and Nahoczky (15) made measurements in water and in electrolyte solutions at or near saturation. They did not give an electrolyte saturation concentration, although Nahoczky (15) did give the saturated solution density. The evaluator did calculate a few salt effect parameters based on the carbon dioxide solubility in water and in the saturated salt solution using handbook values of the salt solubility. The values appear reasonable and it would seem that the data have some value. The systems not referenced earlier are listed below. However, no salt effect parameters are given because of uncertainty in the electrolyte solubility and a hesitation not to give salt effect parameters based on only one salt concentration.

The work of Kobe and Williams (16) is more complete. They did not work at electrolyte saturation, and they give the salt mass % composition. Salt effect parameters were calculated using *International Critical Table* densities except for mixed electrolyte solutions.

Passauer (14). Solubilities measured at or near salt saturation at 293 K and one atm.

33 (3) Carbon dioxide + Zinc iodide [10139-47-6] + Water
37 (1) Carbon dioxide + Silver nitrate [[7761-88-8] + Water
41 (5) Carbon dioxide + Iron (II) chloride [7758-94-3] + Water
96 (3) Carbon dioxide + Barium iodidie [13718-50-8] + Water
99 (35) Carbon dioxide + Sodium nitrite [7632-00-0] + Water
99 (36) Carbon dioxide + Sodium hydrogen carbonate [144-55-8] + Water
99 (37) Carbon dioxide + Sodium dichromate [10588-01-9] + Water

Nahoczky (15). Solubilities measured at or near salt saturation at 288 K and one atm.
Solution densities were given.

48 (1) Carbon dioxide + Manganese sulfate [7785-87-7] + Water
52 (1) Carbon dioxide + Ammonium molybdate [12027-67-7]
93 (4) Carbon dioxide + 1/5 ethanol [64-17-5] + Magnesium sulfate [7487-88-9] + Water
99 (38) Carbon dioxide + 1/2 Magnesium chloride [7786-30-3] + 1/2 Sodium chloride [7647-14-5] + Water
99 (39) Carbon dioxide + 1/2 Magnesium sulfate [7487-88-9] + 1/2 Sodium chloride [7647-14-5] + Water
99 (40) Carbon dioxide + 1/3 Manganese sulfate [7785-87-7] + 1/3 Magnesium chloride [7786-30-3]
+ Sodium chloride [7647-14-5] + Water
99 (41) Carbon dioxide + 1/3 Manganese sulfate [7785-87-7] + 1/3 Magnesium sulfate [7487-88-9]
+ 1/3 Sodium chloride [7647-14-5] + Water
99 (42) Carbon dioxide + 1/2 Glycerine [56-81-5] + Sodium thiosulfate [7772-98-7] + Water
99 (43) Carbon dioxide + 1/2 Magnesium sulfate [7487-88-9] + 1/2 Sodium thiosulfate [7772-98-7] + Water
100 (19) Carbon dioxide + Potassium oxalate [583-52-8] + Water
100 (20) Carbon dioxide + Potassium ferrocyanide [13746-66-2] + Water
100 (21) Carbon dioxide + Potassium dichromate [7778-50-9] + Water

Kobe and Williams (16). Solubilities measured at one stated concentration at 298.15 K and one atm pressure.

99 (44) Carbon dioxide + Sulfuric acid [7664-93-9] + Sodium chloride [7647-14-5] + Water

The aqueous solution was 5 mass % H_2SO_4 (0.680 mol kg^{-1}) and 20 mass % NaCl (4.562 mol kg^{-1}). The molal ionic strength salt effect parameter assuming complete dissociation of the acid is $k_{sI(m)c}$ = 0.0605.

99 (45) Carbon dioxide + *ortho*-Phosphoric acid [7664-38-2] + Trisodium phosphate [7601-54-9] + Water

The aqueous solution was 7 mass % (0.861 mol kg^{-1}) H_3PO_4 and 10 mass % (0.735 mol kg^{-1}) Na_3PO_4. The molal salt effect parameter is k_{smc} = 0.293.

99 (46) Carbon dioxide + Aerosol OT [577-11-7] + Water
99 (47) Carbon dioxide + Teepol CH 53 [50642-03-0] + Water

Gjaldbæk (24a) measured the solubility of carbon dioxide in Aerosol OT, and Rosenthal (24b) in a single dilute Teepol - water mixture. The values are classed tentative as there are no other data with which to compare them.

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COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Hydrofluoric acid; HF; [7664-39-3]

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

ORIGINAL MEASUREMENTS:

Cox, J. D.; Head, A. J.

Trans. Faraday Soc. 1962, *58*, 1839-45.

VARIABLES:

$T/K = 293.02 - 308.00$
$P_1/kPa = 94.638 - 107.810$
$c_2/mol\ L^{-1} = 0 - 5.0$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	$c_2/mol\ L^{-1}$	P_1/atm	P_1/kPa [a]	$K_H/mol\ L^{-1}\ atm^{-1}$ [b]
19.87	293.02	0	1.0092	102.257	0.0398_6
			1.0406	105.439	0.0394_2
24.92	298.07		1.0279	104.152	0.0345_7
			1.0303	104.395	0.0344_0
29.87	303.02		1.0640	107.810	0.0304_0
			0.9581	97.079	0.0304_0
19.87	293.02	2.5	1.0561	107.009	0.0404_9
			1.0344	104.811	0.0398_9
24.92	298.07		0.9975	101.072	0.0358_6
			1.0550	106.898	0.0357_0
29.87	303.02		0.9874	100.048	0.0319_3
			1.0348	104.851	0.0320_3
34.85	308.00		0.9713	98.417	0.0280_0
			0.9991	101.234	0.0281_6
19.87	293.02	5.0	0.9973	101.051	0.0431_4
			1.0085	102.186	0.0430_4
24.92	298.07		1.0167	103.017	0.0379_8
			0.9340	94.638	0.0372_9
			1.0295	104.314	0.0383_1
29.87	303.02		1.0106	102.399	0.0333_6
			0.9597	97.242	0.0336_5

[a] Added by the compiler.

[b] Henry's law constant K_H is defined as the amount of CO_2 (mol) dissolved in 1 L of solvent under a partial pressure of 1 atm of CO_2.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the experimental method was to transfer a known amount of CO_2 into a gold-plated copper cylinder containing a known volume of solvent, to stir at constant temperature until equilibrium had been attained, and to measure the equilibrium pressure with the aid of a sensitive diaphragm. The latter was used as a null-detector, the pressure within the solubility vessel being balanced against an external pressure of N_2.

The details are given in the source, and also in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Prepared by vaporizing the commercial solid CO_2 and passing the gas through anhydrous $Mg(ClO_4)_2$.

(2) Not specified.

(3) Not specified.

ESTIMATED ERROR:

$\delta T/K = \pm 0.01$ (authors)
$\delta P/mmHg = \pm 0.1$ (authors)
$\delta K_H/K_H = \pm 0.01$ (authors)

REFERENCES:

1. Ambrose, D. *Trans. Faraday Soc.* 1956, *52*, 772.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Hydrochloric acid; HCl; [7647-01-0]

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

ORIGINAL MEASUREMENTS:

Geffcken, G.

Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1904, *49*, 257-302.

VARIABLES:

$T/K = 288.15$ and 298.15

$c_2/\text{mol dm}^{-3} = 0 - 2.180$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	$c_2/\text{mol dm}^{-3}$	L [a]
288.15	0	1.070
	0.499	1.041
	0.511	1.042
	1.212	1.020
	1.249	1.023
	2.080	0.9864
	2.180	1.009
298.15	0	0.8255
	0.499	0.8047
	0.511	0.8074
	1.212	0.7973
	1.249	0.7984
	2.080	0.7951
	2.180	0.7951

[a] L = Ostwald coefficient ($\text{cm}^3\ \text{cm}^{-3}$)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method using simple absorption pipet and buret. Diagram and detailed description given in original paper.

SOURCE AND PURITY OF MATERIALS:

(1) Obtained by the sublimation of solid carbon dioxide. Dried.

(2) Not specified.

(3) Degassed.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta L = \pm 1$ %.

(estimated by compiler)

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Hydrochloric acid; HCl; [7647-01-0]

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

ORIGINAL MEASUREMENTS:

Van Slyke, D. D.; Sendroy, J., Jr.; Hastings, A. B.; Neill, J. M.

J. Biol. Chem. 1928, *78*, 765-99.

VARIABLES:

$T/K = 311.2$
$c_2/\text{mol L}^{-1} = 0.01 - 0.300$
P = "atmospheric"

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	Method [b]	p_1/mmHg [c]	$c_2/\text{mol L}^{-1}$	α [d]	S_1 [e]
38.0	311.2	T	715.1	0.01	0.5452	0.5468
		B	700.8		0.5450	0.5466
		T	712.0		0.5444	0.5460
		B	721.8		0.5453	0.5469
		T	723.0		0.5453	0.5469
		B	719.3		0.5459	0.5475
				0.01	0.5452*	0.5468*
		B	721.8	0.256	0.5384	0.5427
		B	723.7	0.300	0.5364	0.5407

[a] Calculated by the compiler.

[b] B: saturation by bubbling; T: saturation in rotating tonometer.

[c] 1 mmHg = 133.322 Pa = 1.33322×10^{-3} bar

[d] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

[e] S_1 = Kuenen coefficient [cm^3 (STP) g^{-1} atm^{-1}]

* Average of six measurements.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two procedures were used for saturating solutions with CO_2:

Saturation by bubbling (B). The solution was placed in the saturating tube, the lower end of which was connected through a wash bottle with a Kipp CO_2 generator. The tube and wash bottle were immersed in a constant temperature bath. CO_2 gas was bubbled through it rapidly for 30 minutes. The wash bottle was replaced by a mercury reservoir and the free gas was driven completely out of the saturating tube by admitting mercury underneath the solution. The CO_2 contents of the solutions were determined in the manometric gas apparatus (Refs 1 and 2).

Saturation in rotating tonometer (T). The technique used was that described by Austin *et al.* (Ref. 3).

Both procedures gave identical results with solutions of acids.

SOURCE AND PURITY OF MATERIALS:

(1) From a Kipp CO_2 generator.

(2) Not specified.

(3) Distilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$
$\delta\alpha/\alpha = \pm 0.005$

REFERENCES:

1. Van Slyke, D. D.; Neill, J. M. *J. Biol. Chem.* 1924, *61*, 523.
2. Van Slyke, D. D.; Sendroy, J., Jr. *J. Biol. Chem.* 1927, *73*, 127.
3. Austin, J. H.; Cullen, G. E.; Hastings, A. B.; McLean, F. C.; Peters, J. P.; Van Slyke, D. D. *J. Biol. Chem.* 1922, *54*, 121.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Hydrochloric acid; HCl; [7647-01-0]

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

ORIGINAL MEASUREMENTS:

He, S.; Morse, J.W.

Geochim. Cosmochim. Acta 1993, *57*, 3533-54.

VARIABLES:

T/K = 273.15 - 363.15
P/MPa = 0.1032
m_2/mol kg^{-1} = 0.01 - 3.00

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

T/K [a]	m_2/mol kg^{-1} [b]	ρ/g cm^{-3} [c]	$10^2 p_1$/atm [d]	$10^3 m_1$/mol kg^{-1} [e]	γ_1 [f]
273.15	0.01	1.0011	96.6	74.9	1.01
	0.10	1.0027		74.2	1.02
	1.00	1.0189		70.7	1.07
	2.00	1.0358		68.7	1.10
	3.00	1.0520		66.6	1.13
298.15	0.01	0.9977	94.2	31.9	1.01
	0.10	0.9992		31.8	1.01
	1.00	1.0144		30.9	1.04
	2.00	1.0303		29.4	1.09
	3.00	1.0452		28.6	1.12
323.15	0.01	0.9888	85.4	16.6	1.00
	0.10	0.9903		16.6	1.01
	1.00	1.0050		16.3	1.02
	2.00	1.0204		16.0	1.04
	3.00	1.0347		15.6	1.06
348.15	0.01	0.9760	60.3	8.1	1.00
	0.10	0.9775		8.0	1.01
	1.00	0.9924		7.9	1.02
	2.00	1.0079		7.9	1.03
	3.00	1.0244		7.7	1.05
363.15	0.01	0.9656	30.1	3.5	1.00
	0.10	0.9724		3.4	1.00
	1.00	0.9896		3.4	1.01
	2.00	0.9975		3.4	1.02
	3.00	1.0214		3.3	1.03

[a] Calculated by compiler
[c] ρ = density of solvent
[e] m_1 = molality of CO_2
[b] m_2 = molality of HCl
[d] p_1 = partial pressure of CO_2
[f] γ_1 = activity coefficient of CO_2

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Either pure CO_2 gas or CO_2-N_2 mixtures were used in the experiments to maintain a constant $P(CO_2)$. The CO_2-N_2 mixtures were made by pumping predetermined amounts of CO_2 and N_2 into a gas tank and their composition was verified by gas chromatography.
CO_2 or CO_2-N_2 gas mixtures were equilibrated with the aqueous solutions in a series of stirred water-jacketed reaction vessels with condensers. The gas was premoistured by first passing it through distilled water at the temperature of experiment. Fine bubbles were obtained by using gas-dispersion tubes. The bubbling rate was 90 to 95 mL min^{-1}.
The mole fraction of CO_2 in the CO_2-N_2 mixture was determined using a Hewlett Packard (5790A) gas chromatograph.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial; purity 99.9 %.

(2) Hydrochloric acid solutions were prepared by diluting concentrated HCl and standardizing the solution by titration. HCl was analytical reagent-grade which met ACS specifications.

(3) 18 MΩ water obtained from a Milli-Q Super-Q water system.

ESTIMATED ERROR:

δT/K = ± 0.1
$\delta m_1/m_1$ = ± 0.012
$\delta \gamma_1/\gamma_1$ = ± 0.04

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Perchloric acid; $HClO_4$; [7601-90-3]

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

ORIGINAL MEASUREMENTS:

Markham, A.A.; Kobe, K.A.

J. Am. Chem. Soc. 1941, *63*, 1165-6.

VARIABLES:

$T/K = 298.15$
$P/kPa = 101.325$
$10^2x_2 = 0 - 29.15$

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

T/K	m_2/mol kg^{-1}	10^2x_2	α [a]	S [b]
298.15	0.0	0.0000	0.7565	0.7587
	0.25	0.4484	0.753	0.764
	0.50	0.8928	0.759	0.778
	0.75	1.3332	0.765	0.793
	0.100	1.7679	0.772	0.809
	1.50	2.6313	0.785	0.840
	2.00	3.4779	0.798	0.865
	4.00	6.7220	0.835	0.984
	6.00	9.7551	0.863	1.091
	10.00	15.266	0.866	1.239
	15.47	21.79	0.762	1.264
	22.84	29.15	0.718	1.426

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[b] S = Kuenen coefficient [cm^3 (STP) $g^{-1}(H_2O)$ atm^{-1}].

The authors fitted their data up to 6 molal with the equation:

$$S_m/S_o = 0.107\ m_2 + 1/(1 + 0.04282\ m_2)$$

Maximum error of the equation was about 1 %.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which the gas is agitated with a measured quantity of gas-free liquid and the decrease in volume of solution-saturated gas is measured in a burette over mercury. The pressure was adjusted to yield one atmosphere partial pressure of carbon dioxide. The volume of gas was reduced to 0°C by the ideal gas law. Experiments were conducted to show that the agitation did not cause supersaturation.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial cylinder, 99.8 % pure.

(2) Baker, cp analyzed (ACS).

(3) Distilled.

ESTIMATED ERROR:

$\delta T/K = \pm\ 0.03$ (authors),
$\delta\alpha/\alpha$, $\delta S/S = \pm\ 0.002$ (authors).

REFERENCES:

1. Markham, A.A.; Kobe, K.A. *J. Am. Chem. Soc.* 1941, *63*, 449-54.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sulfuric acid; H_2SO_4; [7664-93-9]

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

ORIGINAL MEASUREMENTS:

Setschenow, J.

Akad. Nauk SSSR, Bull. Acad. Imp. Sci., St. Petersbourg 1877, *22* [Ser. No. 6], 102-7.

VARIABLES:

T/K = 290.15
P_1/kPa = 85.9 - 129.5
$10^2 w_2$ = 8.58 - 100

PREPARED BY:

Pirketta Scharlin
H.L. Clever

EXPERIMENTAL VALUES:

t = 17.0 °C

T/K [a]	P_1/mmHg	P_1/kPa [a]	Solvent	$10^2 w_2$ [a,b]	c_2/mol L^{-1} [a]	α [c]
290.15			H_2O	0	0	0.9519
290.15	670.76	89.42	1 mol acid	8.58	0.924	0.857
	815.35	108.70	58 mol H_2O			0.857
290.15	686.46	91.52	1 mol acid	73.1	12.3	0.706
	750.77	100.09	2 mol H_2O			0.703
	953.59	127.13				0.705
290.15	699.33	93.24	1 mol acid	84.5	15.3	0.665
	752.67	100.35	1 mol H_2O			0.666
	971.05	129.46				0.667
290.15	680.67	90.75	92 g acid	92.0	17.1	0.719
	862.15	114.94	8 g H_2O			0.718
290.15	658.51	87.79	92 g acid	96.8	18.1	0.851
	708.26	94.43	3 g H_2O			0.852
	917.47	122.32				0.852
290.15	656.39	87.51	H_2SO_4	100	18.7	0.932
	774.56	103.27				0.932
290.15	644.20	85.89	H_2SO_4	100	18.7	0.929
	797.77	106.36				0.936

[a] Calculated by the compiler.
Concentration estimated from 25 °C Handbook data.
[b] w_2 = mass fraction of H_2SO_4 in solvent.
[c] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Setchenow based his apparatus on those of Fernet (1857) and of Meyer (1857). The manometer was based on ideas he learned from Regnault in 1861. The one meter manometer had three branches, two for measuring the pressure and one a mercuty reservoir. The manometer was connected to the absorption cell by a flexible silver capillary. The absorption cell was of two bulbs with a mark in the constricting connection. CO_2 gas was generated, saturated with water vapor and filled the bulbs and manometer to a known pressure less than atmospheric. The liquid was degassed by heating and then passed by the pressure difference into the lower bulb to the mark of known volume. The system was sealed, turned 90 degrees and shaken until equilibrium was established. The gas volume absorbed was reduced to 0 °C and one meter Hg pressure. The Bunsen cofficient was calculated.

SOURCE AND PURITY OF MATERIALS:

(1) Apparently generated from limestone and sulfuric acid. Dried.

(2) Not specified.

(3) Not specified, assumed to be distilled.

ESTIMATED ERROR:

The author makes a qualitative statement that the results are good to the second decimal.

REFERENCES:

1. These data appear also in Setchenow, J. *Mosk. Obsh. Spyt. Prirody. Nouv. Mem. Soc. Imp.Nat. Moscow,* 1889, *15*, 203-74.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sulfuric acid; H_2SO_4; [7664-93-9]

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

ORIGINAL MEASUREMENTS:

Geffcken, G.

Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1904, *49*, 257-302.

VARIABLES:

T/K = 288.15 and 298.15

c_2/mol dm^{-3} = 0 - 7.600

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	c_2/mol dm^{-3}	L [a]
288.15	0	1.070
	1.024	1.016
	1.034	1.016
	1.990	0.9772
	2.078	0.9775
	2.134	0.9756
	3.912	0.9175
	4.176	0.9143
	7.580	0.8354
	7.600	0.8385
298.15	0	0.8255
	1.024	0.7923
	1.034	0.7936
	1.990	0.7693
	2.078	0.7685
	2.134	0.7672
	3.912	0.7302
	4.176	0.7273
	7.580	0.6736
	7.600	0.6747

[a] L = Ostwald coefficient (cm^3 cm^{-3})

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method using simple absorption pipet and buret. Diagram and detailed description given in original paper.

SOURCE AND PURITY OF MATERIALS:

(1) Obtained by the sublimation of solid carbon dioxide. Dried.

(2) Not specified.

(3) Degassed.

ESTIMATED ERROR:

δT/K = ± 0.1; δL = ± 1 %.

(estimated by compiler)

REFERENCES:

COMPONENTS: (1) Carbon dioxide; CO_2; [124-38-9] (2) Sulfuric acid; H_2SO_4; [7664-93-9] (3) Water; H_2O; [7732-18-5]	**ORIGINAL MEASUREMENTS:** Christoff, A. *Z. Phys. Chem., Stoechiom. Verwandtschaftsl.* 1906, *55*, 622-34.
VARIABLES: T/K = 293.15 p_1/kPa = atmospheric $10^2 w_2$ = 0 - 95.6	**PREPARED BY:** H.L. Clever

EXPERIMENTAL VALUES:

t/°C	T/K	$10^2 w_2$ [a]	m_2/mol kg^{-1} [b]	L/cm^3 cm^{-3} [c]
20	293.15	0.0	0.0	0.9674
		35.82	5.69	0.6521
		61.62	16.37	0.7191
		95.6	222	0.9924

[a] w_2 = mass fraction of sulfuric acid

[b] m_2 = molality; calculated by the compiler.

[c] L = Ostwald coefficient

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was an Ostwald type [1] with a lead capillary tube through which the gas flows to the absorption flask, gas buret, and gasometer.

The acid solution was degassed by boiling under reflux. The author estimates a one percent change in the acid concentration due to the degassing procedure. The absorption flask was filled with solvent, the gas was introduced, and the system shaken until equilibrium was reached.

SOURCE AND PURITY OF MATERIALS:

(1) No information.

(2) Merck. Relative density 1.271, 1.523, and 1.839 for the 35.82, 61.62, and 95.6 mass % acid, respectively.

(3) Distilled.

ESTIMATED ERROR:

δT/K = ± 0.02 for solvent
± 0.5 for gas

Barometric fluctuations were stated to be negligible.

REFERENCES:

1. Ostwald, W.
Lehrbuch der allgem. Chemie (2. Aufl.), *1*, 615.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sulfuric acid; H_2SO_4; [7664-93-9]

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

ORIGINAL MEASUREMENTS:

Markham, A.A.; Kobe, K.A.

J. Am. Chem. Soc. 1941, *63*, 1165-6.

VARIABLES:

$T/K = 298.15$

$P/kPa = 101.325$

$10^2 x_2 = 0 - 100$

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

T/K	$m_2/\text{mol kg}^{-1}$	$10^2 x_2$	α [a]	S [b]
298.15	0.0	0.0000	0.7565	0.7587
	0.5	0.8928	0.6983	0.7127
	1.0	1.7679	0.6650	0.6911
	2.0	3.4779	0.6132	0.6610
	3.0	5.1277	0.5854	0.6546
	4.0	6.7220	0.5740	0.6659
	6.0	9.7551	0.5878	0.7332
	8.0	12.597	0.6159	0.8238
	10.0	15.266	0.6337	0.9053
	14.15	20.32	0.6404	1.0372
	18.86	25.37	0.6225	1.1453
	28.29	33.77	0.5840	1.3386
	37.72	40.48	0.5659	1.5573
	56.58	50.49	0.5741	2.1232
	94.30	62.95	0.645	-
	188.6	77.26	0.753	-
	282.9	83.60	0.813	-
	565.8	91.07	0.880	-
	1131.6	95.32	0.920	-
	-	100	0.960	-

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[b] S = Kuenen coefficient [cm^3 (STP) $g^{-1}(H_2O)$ atm^{-1}].

The authors fitted their data up to 10 molal with the equation:

$$S_m/S_0 = 0.0885\ m_2 + 1/(1 + 0.2159\ m_2)$$

Maximum error of the equation was about 1 %.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which the gas is agitated with a measured quantity of gas-free liquid and the decrease in volume of solution-saturated gas is measured in a burette over mercury. The pressure was adjusted to yield one atmosphere partial pressure of carbon dioxide. The volume of gas was reduced to 0°C by the ideal gas law. Experiments were conducted to show that the agitation did not cause super-saturation.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial cylinder, 99.8 % pure.

(2) Baker, cp analyzed (ACS).

(3) Distilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.03$ (authors),

$\delta\alpha/\alpha$, $\delta S/S = \pm 0.002$ (authors).

REFERENCES:

1. Markham, A.A.; Kobe, K.A. *J. Am. Chem. Soc.* 1941, *63*, 449-54.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sulfuric acid; H_2SO_4; [7664-93-9]

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

ORIGINAL MEASUREMENTS:

Shchennikova, M.K.; Devyatykh, G.G.; Korshunov, I.A.
Zh. Prikl. Khim. (Leningrad) 1957, *30*, 833-8; * *J. Appl. Chem. USSR* (Engl. Transl.) 1957, *30*(6), 881-6.

VARIABLES:

T/K = 288.15-350.15
$10^2 w_2$ = 9.25-84.48
P_1/kPa = 101.325

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

t/°C	T/K [a]	$10^2 w_2$ [b]	$10^4 x_1$	α [c]	L [a,d]
19	292.15	9.25	6.78	0.82	0.88
			7.00	0.85	0.91
25	298.15		5.94	0.72	0.79
27	300.15		5.57	0.67	0.74
38	311.15		4.36	0.525	0.598
			4.41	0.531	0.605
45	318.15		3.65	0.438	0.510
50	323.15		3.47	0.415	0.491
			3.44	0.412	0.487
56	329.15		2.98	0.355	0.428
			2.89	0.345	0.416
60	333.15		2.83	0.337	0.411
			2.76	0.329	0.401
18.5	291.65	30.5	6.22	0.71	0.76
19	292.15		6.10	0.69	0.74
26	299.15		4.95	0.56	0.61
			4.88	0.55	0.60
41	314.15		3.77	0.423	0.486
52	325.15		2.96	0.329	0.392
64	337.15		2.33	0.258	0.318
77	350.15		1.99	0.219	0.281
19.5	292.65	36.9	6.20	0.68	0.73
			6.49	0.71	0.76
24	297.15		5.88	0.65	0.71
33	306.15		4.54	0.497	0.557
20	293.15	42	6.70	0.72	0.77
			6.52	0.70	0.75
24.5	297.65		5.83	0.62	0.68
26	299.15		5.60	0.60	0.66
30	303.15		5.41	0.58	0.64
			5.34	0.57	0.63
31	334.15		5.39	0.57	0.70
40	313.15		4.43	0.47	0.54
			4.38	0.464	0.532
			4.43	0.470	0.539

(continued)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Isotopic dilution method, with C^{14} radioactive carbon isotope as a tracer. Experimental procedure described in detail in the original source.

SOURCE AND PURITY OF MATERIALS:

(1) Not specified.

(2) Chemically pure.

(3) Redistilled.

The purity of the H_2SO_4-H_2O-solutions was verified polarographically.

ESTIMATED ERROR:

Not given.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sulfuric acid; H_2SO_4; [7664-93-9]

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

ORIGINAL MEASUREMENTS:

Shchennikova, M.K.; Devyatykh, G.G.; Korshunov, I.A.
Zh. Prikl. Khim. (Leningrad) 1957, *30*, 833-8; * *J. Appl. Chem. USSR* (Engl. Transl.) 1957, *30*(6), 881-6.

EXPERIMENTAL VALUES: (continued)

$t/°C$	T/K [a]	10^2w_2 [b]	10^4x_1	α [c]	L [a,d]
44	317.15	42	4.13	0.436	0.506
50	323.15		3.55	0.374	0.442
54	327.15		3.33	0.350	0.419
70	343.15		2.38	0.248	0.312
76	349.15		2.08	0.216	0.276
15	288.15	61.6	9.12	0.85	0.90
			9.27	0.87	0.92
			8.78	0.82	0.87
17	290.15		8.20	0.76	0.81
			8.08	0.75	0.80
18	291.15		8.17	0.76	0.81
			7.91	0.74	0.79
			7.86	0.73	0.78
			7.87	0.73	0.78
21	294.15		7.38	0.69	0.74
25	298.15		7.58	0.70	0.76
			7.34	0.68	0.74
			7.37	0.68	0.74
			7.53	0.70	0.76
			7.75	0.72	0.79
			6.88	0.64	0.70
			6.80	0.63	0.69
			6.90	0.64	0.70
			6.74	0.63	0.69
			6.82	0.63	0.69
			6.79	0.63	0.69
			6.90	0.64	0.70
			7.30	0.68	0.74
26	299.15		6.72	0.62	0.68
31	304.15		6.20	0.57	0.64
37	310.15		5.82	0.54	0.61
51.5	324.65		4.47	0.409	0.486
61	334.15		3.66	0.333	0.407
75	348.15		2.70	0.243	0.310
21	294.15	77.6	8.09	0.62	0.67
25	298.15		8.11	0.62	0.68
26	299.15		8.05	0.62	0.68
42	315.15		6.43	0.488	0.563
46	319.15		6.23	0.473	0.553
32	305.15	78.8	6.58	0.497	0.555
40	313.15		6.34	0.473	0.542
50	323.15		5.98	0.444	0.525
60	333.15		4.78	0.352	0.429
20	293.15	84.48	9.33	0.63	0.68

---

[a] Calculated by the compiler.

[b] w_2 = Mass fraction of sulfuric acid in the solvent.

[c] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[d] L = Ostwald coefficient [cm^3 cm^{-3}].

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]
(2) Nitric acid; HNO_3; [7697-37-2]
(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Geffcken, G.
Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1904, *49*, 257-302.

VARIABLES:

T/K = 288.15 and 298.15
c_2/mol dm^{-3} = 0 - 2.539

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	c_2/mol dm^{-3}	L [a]	T/K	c_2/mol dm^{-3}	L [a]
288.15	0	1.070	298.15	0	0.8255
	0.472	1.073		0.472	0.8382
	0.475	1.075		0.475	0.8366
	0.557	1.069		0.557	0.8387
	0.704	1.080		0.704	0.8447
	1.382	1.093		1.382	0.8620
	1.387	1.093		1.387	0.8622
	1.860	1.105		1.860	0.8752
	2.519	1.109		2.519	0.8839
	2.539	1.111		2.539	0.8865

[a] L = Ostwald coefficient (cm^3 cm^{-3})

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method using simple absorption pipet and buret. Diagram and detailed description given in original paper.

SOURCE AND PURITY OF MATERIALS:

(1) Obtained by the sublimation of solid carbon dioxide. Dried.
(2) Not specified.
(3) Degassed.

ESTIMATED ERROR: δT/K = ± 0.1; δL = ± 1 % (estimated by compiler)

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]
(2) Nitric acid; HNO_3; [7697-37-2]
(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Onda, K.; Sada, E; Kobayashi, T.; Kito, S.; Ito, K.
J. Chem. Eng. Jpn 1970, *3*, 18-24.

VARIABLES:

T/K = 298.15
P/kPa = 101.325; c_2/mol dm^{-3} = 1.482

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

T/K	c_2/mol dm^{-3}	α [a]	L [b,c]
298.15	0	0.7595	0.8290
	1.482	0.7910	0.8634

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]
[b] L = Ostwald coefficient [cm^3 cm^{-3}]
[c] Calculated by the compiler. P = 1 atm = 101.325 kPa = 1.01325 bar

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solution was made up by weight. Concentration of solution was verified by measuring the density. (Density was not reported in paper.) A measured volume of gas was brought into contact with a measured quantity of gas-free solvent. Equilibrium was established by agitation using a magnetic stirrer. The volume of remaining gas was measured. The amount of gas absorbed was estimated from change in volume of gas. Details in original paper.

SOURCE AND PURITY OF MATERIALS:

(1) From commercial cylinder. Purity 99.8 %.

(2) Analytical grade.

(3) Distilled and degassed.

ESTIMATED ERROR: (by compiler)

δT/K = ± 0.2; $\delta\alpha$ = ± 2 %

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Phosphoric acid; H_3PO_4; [7664-38-2]

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

ORIGINAL MEASUREMENTS:

Sada, E; Kito, S.; Ito, Y.

J. Chem. Eng. Jpn. 1974, *7*, 57-9.

VARIABLES:

T/K = 298.15

P/kPa = 101.325

c_2/mol L^{-1} = 0 - 2.0573

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	c_2/mol L^{-1}	α [a]
298.15	0.0000	0.7597
	0.7013	0.6714
	1.0923	0.6405
	1.6024	0.6076
	1.7412	0.5958
	2.0573	0.5731

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

P = 1 atm = 101.325 kPa = 1.01325 bar

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Equilibrium established between a measured volume of gas and a measured volume of gas-free liquid in a cell fitted with a magnetic stirrer. Amount of gas absorbed estimated from change in volume of gas. Concentration of acid determined by titration. Details in source and Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Showa Denko Co. sample, purity better than 99.8 mole %.

(2) Reagent grade of guaranteed purity.

(3) Distilled and degassed.

ESTIMATED ERROR:

δT/K = ± 0.2; $\delta\alpha$ = ± 2 %

(Estimated by the compiler.)

REFERENCES:

1. Onda, K.; Sada, E; Kobayashi, T.; Kito, S.; Ito, K.

J. Chem. Eng. Jpn. 1970, *3*, 18-24.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Ammonium chloride; NH_4Cl; [12125-02-9]

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

ORIGINAL MEASUREMENTS:

Setchenow, J. [Sechenov, I.M.]

Ann. Chim. Phys. [6] 1892, *25*, 226-70.

VARIABLES:

$T/K = 288.35$
$c_2/\text{mol dm}^{-3} = 0 - 4.823$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	Dilution x	$c_2/\text{mol dm}^{-3}$ [a]	α [b]	$k_{scc}/\text{dm}^3\ \text{mol}^{-1}$ [a,c]
15.2	288.35	∞	0	1.009	-
		6	0.8039	0.956	0.0292
		5	0.9646	0.941	0.0314
		4	1.206	0.930	0.0294
		3	1.608	0.896	0.0321
		2	2.412	0.858	0.0292
		1.5	3.215	0.819	0.0282
		1	4.823	0.7705	0.0243

[a] Calculated by the compiler.

[b] α = Bunsen coefficient [cm^3 (STP) $\text{cm}^{-3}\ \text{atm}^{-1}$].

[c] k_{scc} = Setchenow salt effect parameter; $k_{scc} = (1/c_2)\ \lg(\alpha^\circ/\alpha)$.

Initial solution: 25.80 g NH_4Cl + 80.92 cm^3 water to make 100 cm^3 of solution.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Setchenow (Ref. 1) based his apparatus on those of Fernet (1857) and of Meyer (1857). The manometer was based on ideas he learned from Regnault in 1861. The one meter manometer had three branches, two for measuring the pressure and one a mercury reservoir. The manometer was connected to the absorption cell by a flexible silver capillary. The absorption cell was of two bulbs with a mark in the constricting connection. CO_2 gas was generated, saturated with water vapor and filled the bulbs and manometer to a known pressure less than atmospheric. The liquid was degassed by heating and then passed by the pressure difference into the lower bulb to the mark of known volume. The system was sealed, turned 90 degrees and shaken until equilibrium was established. The gas volume absorbed was reduced to 0 °C and one meter Hg pressure. The Bunsen coefficient was calculated.

SOURCE AND PURITY OF MATERIALS:

(1) Apparently generated from limestone and sulfuric acid. Dried.

(2) Not specified.

(3) Not specified, assumed to be distilled.

ESTIMATED ERROR:

The author makes a qualitative statement that the results are good to the second decimal.

REFERENCES:

1. Setchenow, J.

Akad. Nauk. SSSR Mem. Acad. imp. Sci. St. Petersburg 1887, *35*, [Ser. No. 7], 1-59.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Ammonium chloride; NH_4Cl; [12125-02-9] (3) Water; H_2O; [7732-18-5]	Findlay, A; Shen, B. *J. Chem. Soc.* 1912, *101*, 1459-68.
VARIABLES: $T/K = 298.15$ $10^2\gamma_2/g\ cm^{-3} = 2.35 - 17.09$	PREPARED BY: C. L. Young

EXPERIMENTAL VALUES:

T/K	$10^2\gamma_2/g\ cm^{-3}$ [a]	$\rho/g\ cm^{-3}$	S [b]	10^4x_1 (p = 1 atm) [c]
298.15	2.35	1.005	0.791	5.92
	5.05	1.013	0.754	5.70
	8.24	1.022	0.732	5.61
	10.02	1.027	0.712	5.49
	17.09	1.045	0.665	5.29

---

[a] γ = mass concentration of salt

[b] $$S = \frac{\text{concentration of gas in liquid phase}}{\text{concentration of gas in gaseous phase}}$$

Solubility was stated to be independent of pressure (over 1-2 atm pressure range); value quoted is the mean.

[c] Calculated by compiler assuming $V_{m,1} = 24.3 \times 10^{-3}\ m^3\ mol^{-1}$ at 1 atm.

Solubility in water: Ostwald coefficient $L = 0.825\ cm^3\ cm^{-3}$.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas buret and absorption pipet. Manometer tube was of such length as to allow measurements up to 2×10^5 Pa (about 2 atm).

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.95 mole %.

(2) No details given.

(3) No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta S = \pm 1$ %.

(estimated by compiler)

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Ammonium chloride; NH_4Cl; [12125-02-9]

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

VARIABLES:

T/K = 288.15 - 333.15
P/kPa = 101.325
c_2/mol dm^{-3} = 0 - 5

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

$t/^{\circ}C$	T/K	c_2/mol dm^{-3}	α [a]	S [b]
15	288.15	0	0.990	-
		0.5	1.03	1.052
		1	0.907	0.942
		2	0.780	0.843
		5	0.686	-
20	293.15	0	0.860	-
		0.5	0.887	0.906
		1	0.800	0.831
		2	0.724	0.784
		5	0.629	-
25	298.15	0	0.758	0.5173
		0.5	0.804	0.8215
		1	0.706	0.7345
		2	0.658	0.7135
		5	0.576	-
30	303.15	0	0.671	-
		0.5	0.713	0.729
		1	0.639	0.665
		2	0.648	0.704
		5	0.5675	0.711

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which a measured volume of gas-free liquid is stirred in the presence of the gas, and its decrease in volume is measured in a burette over mercury. The volume of liquid was measured at the experimental temperature. For calculation of the Kuenen coefficient, the density of the solution was obtained from Landolt-Börnstein extant 1969. The molar concentration of salt in the liquid was standardized at 20°C. These data are analyzed and discussed further in Ref.1.

SOURCE AND PURITY OF MATERIALS:

(1) VEB Leuna Works; 99.8 vol %; the impurity was mostly water (author).

(2) DDR pro analysis grade by DDR Standard TGL 5021.

(3) Double distilled.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Gerecke, J.; Bittrich, H.J. *Wiss. Z. Tech. Hochsch. Chem. "Carl Schorlemmer" Leuna-Merseburg* 1971, *13*(2), 115-22.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Ammonium chloride; NH_4Cl; [12125-02-9]

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

EXPERIMENTAL VALUES:
(continued)

t/°C	T/K	c_2/mol dm^{-3}	α [a]	S [b]
35	308.15	0	0.605	-
		0.5	0.612	0.627
		1	0.5815	0.607
		2	0.607	0.660
		5	0.5515	-
40	313.15	0	0.546	-
		0.5	0.554	0.568
		1	0.507	0.5285
		2	0.597	0.650
		5	0.543	-
45	318.15	0	0.482	-
		0.5	0.465	0.478
		1	0.466	0.487
		2	0.519	0.565
		5	0.5065	-
50	323.15	0	0.436	-
		0.5	0.413	0.4245
		1	0.425	0.445
		2	0.5165	0.5635
		5	0.503	0.635
55	328.15	0	0.392	-
		0.5	0.335	0.346
		1	0.3795	0.3985
		2	0.463	0.5065
		5	0.484	-
60	333.15	0	0.372	-
		0.5	0.3185	0.328
		1	0.357	0.375
		2	0.445	0.4875
		5	0.483	-

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

[b] S = Kuenen coefficient [cm^3 (STP) g^{-1} (H_2O) atm^{-1}].

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Ammonium chloride; NH_4Cl; [12125-02-9]

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

ORIGINAL MEASUREMENTS:

Yasunishi, A.; Yoshida, F.

J. Chem. Eng. Data 1979, *24*, 11-14.

VARIABLES:

T/K = 288.15 - 308.15

P/kPa = 101.325

c_2/mol L^{-1} = 0 - 5.645

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	c_2/mol L^{-1}	L [a]	T/K	c_2/mol L^{-1}	L [a]
288.15	0	1.0634	298.15	2.816	0.6721
	0.244	1.0386		3.006	0.6677
	1.724	0.9055		3.152	0.6610
	2.356	0.8716		3.682	0.6452
	2.590	0.8599		4.104	0.6358
	3.772	0.7980		4.421	0.6258
	4.209	0.7863		4.973	0.6121
				4.995	0.6126
298.15	0	0.8264		5.480	0.6015
	0.375	0.7958		5.645	0.5979
	0.476	0.7892			
	0.501	0.7880	308.15	0	0.6675
	0.760	0.7678		0.590	0.6313
	0.811	0.7704		1.165	0.6030
	0.980	0.7576		1.541	0.5903
	1.147	0.7460		2.179	0.5660
	1.163	0.7472		2.285	0.5547
	1.508	0.7328		3.129	0.5358
	1.923	0.7059		4.012	0.5142
	1.973	0.7102		4.147	0.5160
	2.338	0.6915		4.475	0.5069
	2.353	0.6879		4.477	0.4976

[a] L = Ostwald coefficient (cm^3 cm^{-3})

P = 1 atm = 101.325 kPa = 1.01325 bar

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Density and composition of solution determined after absorption. Details in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) High purity grade sample, purity 99.96 mole %.

(2,3) Guaranteed reagent, solution degassed by boiling.

ESTIMATED ERROR:

δT/K = ± 0.05; δL = ± 1 %.

REFERENCES:

1. Tokunaga, J.
J. Chem. Eng. Data 1975, *20*, 41.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Ammonium chloride; NH_4Cl; [12125-02-9]

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

ORIGINAL MEASUREMENTS:

Burmakina, G.V.; Efanov, L.N.; Shnet, M.A.

Zh. Fiz. Khim. 1982, *56*, 1159-61; *Russ. J. Phys. Chem. (Engl. Transl.)* 1982, *56*, 705-7.

VARIABLES:

$T/K = 298.15$
$p/MPa = 0.1$
$10^3c_2/mol\ L^{-1} = 0 - 1000$

PREPARED BY:

Yu. P. Yampol'skii

EXPERIMENTAL VALUES:

Solubility of carbon dioxide in aqueous solutions of NH_4Cl at 298.15 K. [a]

T/K	$10^3c_2/mol\ L^{-1}$ [b]	$10^3c_1/mol\ L^{-1}$ [c]
298.15	0	33.90
	1	33.85
	2	33.70
	5	33.50
	10	33.00
	25	32.50
	50	32.00
	100	31.00
	250	30.20
	500	29.15
	1000	28.15

[a] Data taken from a graph by compiler.

[b] c_2 = concentration of NH_4Cl

[c] c_1 = concentration of CO_2

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Attainment of the equilibrium was checked by the constancy of CO_2 content in 3-5 subsequent samples of gas after saturation of the solution. The concentration of carbon dioxide was determined by titration.

SOURCE AND PURITY OF MATERIALS:

(1) Source not given. Before contacting with water solutions CO_2 was allowed to pass through the vessels with $NaHCO_3$, glass beads, glass wool and distilled water.

(2) Nothing specified.

(3) Distilled.

ESTIMATED ERROR:

$\delta c_1/c_1 = \pm\ 0.06 - 0.2\ \%$
$\delta T/K = \pm\ 0.05$

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Ammonium chloride; NH_4Cl; [12125-02-9]

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

ORIGINAL MEASUREMENTS:

Rumpf, B.; Nicolaisen, H.; Maurer, G.

Ber. Bunsenges. Phys. Chem. 1994, *98*, 1077-81.

VARIABLES:

T/K = 313.14 - 433.10
p/MPa = 0.482 - 9.692
m_2/mol kg^{-1} = near 4.00 and 6.00

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

The authors used Pitzer's semiempirical model to correlate the data. The model has been described in detail in Ref. 1. The dissociation of CO_2 can be neglected at the concentrations here. The system was treated as containing a non-dissociating gas, G and a completely dissociating electrolyte, MX. A temperature dependent interaction parameter, $B^o_{CO_2,NH_4Cl}$, and a temperature independent interaction parameter, $\Gamma_{CO_2,NH_4Cl,NH_4Cl}$, were derived from the experimental data.

For the $CO_2 + NH_4Cl + H_2O$ system the values are:

$$B^o_{CO_2,NH_4Cl} = 0.2834 - 123.27(T/K)^{-1} + 1551.29(T/K)^{-2} + 3543\cdot 10^3(T/K)^{-3}$$

and $\Gamma_{CO_2,NH_4Cl,NH_4Cl} = -0.0010$.

The interaction parameters were also predicted from earlier measurements on the solubility of CO_2 in aqueous solutions of Na_2SO_4, $(NH_4)_2SO_4$ (Ref 1.) and NaCl (Ref. 2). The predicted values are:

$$B^o_{CO_2,NH_4Cl} = 0.4206 - 187.48(T/K)^{-1} + 691.287(T/K)^{-2} + 6312\cdot 10^3(T/K)^{-3}$$

and $\Gamma_{CO_2,NH_4Cl,NH_4Cl} = -0.0035$.

(continued on the next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The experimental equipment has been described in Ref. 1. It consists of a high pressure optical cell, thermostat, magnetic stirrer, thermocouples and Pt resistance thermometer, pressure transducers and tanks for aqueous solutions, rinse water and solute gas.

The thermostated about 30 mL high pressure optical cell is filled with carbon dioxide. Pressure and temperature of the gas are measured after equilibration. A known amount of aqueous solvent is added which is slightly greater than that needed to completely dissolve the gas. The pressure in the cell is reduced stepwise by removing very small amounts of the liquid until the first stable bubble appears.
The mass of carbon dioxide is calculated from the Bender equation (3). The volume of the cell is known within 0.06 mL. The solvent density is from the literature.

SOURCE AND PURITY OF MATERIALS:

(1) Carbon dioxide. Messer Griesheim, Ludwigshafen, > 99.995 mol %, used as received.

(2) Ammonium chloride. Riedel de Haen AG, Seelze, > 99.5 mass %. Degassed and dried under vacuum.

(3) Water. Deionized and degassed by vacuum distillation.

ESTIMATED ERROR:

δT/K = ± 0.1
$\delta p/p$ < ± 0.04 (at p up to 6 MPa)
$\delta p/p$ < ± 0.05 (at higher pressures)

REFERENCES:

1. Rumpf, B.; Maurer, G. *Ber. Bunsenges. Phys. Chem.* 1993, *97*, 85-97.
2. Rumpf, B.; Nicolaisen, H.; Öcal, C. Maurer, G. *J. Solution Chem.* 1994, *23*, 431-48.
3. Bender, E. 5th Proc. Symp. Thermophys. Prop., ASME, NY, 1970, 227-35.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Ammonium chloride; NH_4Cl; [12125-02-9]

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

ORIGINAL MEASUREMENTS:

Rumpf, B.; Nicolaisen, H.; Maurer, G.

Ber. Bunsenges. Phys. Chem. 1994, *98*, 1077-81.

EXPERIMENTAL VALUES: (continued)

Solubility of carbon dioxide in aqueous ammonium chloride.

m_2 = 3.994 mol kg^{-1} [a]			m_2 = 5.992 mol kg^{-1} [a]		
T/K	p/MPa	m_1/mol kg^{-1} [b]	T/K	p/MPa	m_1/mol kg^{-1} [b]
313.33	0.482	0.0980	313.15	0.606	0.1263
313.22	1.157	0.2358	313.14	1.231	0.2553
313.21	2.648	0.5086	313.14	2.847	0.5461
313.21	4.320	0.7600	313.14	4.674	0.8162
313.22	5.523	0.9050	313.16	4.666	0.8171
313.21	7.354	1.0744	313.16	6.521	1.0255
313.33	8.823	1.1519			
333.12	0.689	0.0973	333.14	0.756	0.1043
333.10	2.173	0.2918	333.15	2.305	0.3151
333.11	3.897	0.4878	333.16	4.145	0.5265
333.11	3.920	0.4906	333.12	6.507	0.7406
333.11	5.997	0.6879	333.13	8.949	0.9010
333.08	8.803	0.8856			
353.13	0.0426	0.0	353.11	0.0398	0.0
353.08	1.018	0.0995	353.10	1.078	0.1070
353.10	2.504	0.2502	353.11	2.688	0.2684
353.11	5.547	0.5034	353.12	6.121	0.5404
353.13	9.692	0.7583	353.11	9.139	0.7232
393.00	0.173	0.0	393.05	0.1606	0.0
393.09	1.970	0.1273	393.04	1.543	0.0977
393.07	3.433	0.2275	393.06	3.817	0.2450
393.13	6.487	0.4064	393.06	6.355	0.3932
393.12	8.458	0.5112	393.07	9.346	0.5398
413.05	0.314	0.0	413.05	0.294	0.0
413.09	1.921	0.1005	413.07	1.901	0.0979
413.06	4.413	0.2525	413.05	3.947	0.2170
413.05	7.276	0.4036	413.06	7.401	0.3936
413.08	9.276	0.5046	413.05	9.468	0.4909
433.08	0.537	0.0	433.09	0.5039	0.0
433.07	2.137	0.0998	433.06	2.266	0.0990
433.07	2.212	0.0999	433.04	4.153	0.2000
433.04	4.937	0.2510	433.07	4.148	0.1991
433.10	6.676	0.3498	433.09	6.051	0.2955
433.08	8.792	0.4516	433.06	8.205	0.3937
			433.08	9.245	0.4421

---

[a] m_2 = molality of NH_4Cl

[b] m_1 = solubility of CO_2

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Ammonium bromide; NH_4Br; [12124-97-9]

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

VARIABLES:

$T/K = 288.15 - 333.15$
$P/kPa = 101.325$
$c_2/mol\ dm^{-3} = 0 - 2$

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

$t/^{\circ}C$	T/K	$c_2/mol\ dm^{-3}$	α [a]	S [b]
15	288.15	0	0.990	-
		0.5	1.23	1.26
		1	1.003	1.050
		2	0.964	1.062
20	293.15	0	0.860	-
		0.5	1.11	1.135
		1	0.881	0.924
		2	0.830	0.913
25	298.15	0	0.758	-
		0.5	1.00	1.026
		1	0.784	0.823
		2	0.728	0.802
30	303.15	0	0.671	-
		0.5	0.887	0.916
		1	0.705	0.7415
		2	0.657	0.725
35	308.15	0	0.605	-
		0.5	0.813	0.8355
		1	0.634	0.668
		2	0.588	0.651

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AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which a measured volume of gas-free liquid is stirred in the presence of the gas, and its decrease in volume is measured in a burette over mercury. The volume of liquid was measured at the experimental temperature. For calculation of the Kuenen coefficient, the density of the solution was obtained from Landolt-Börnstein extant 1969. The molar concentration of salt in the liquid was standardized at 20°C. These data are analyzed and discussed further in Ref.1.

SOURCE AND PURITY OF MATERIALS:

(1) VEB Leuna Works; 99.8 vol %; the impurity was mostly water (author).

(2) DDR pro analysis grade by DDR Standard TGL 5021.

(3) Double distilled.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Gerecke, J.; Bittrich, H.J. *Wiss. Z. Tech. Hochsch. Chem. "Carl Schorlemmer" Leuna-Merseburg* 1971, *13*(2), 115-22.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Ammonium bromide; NH_4Br; [12124-97-9] (3) Water; H_2O; [7732-18-5]	Gerecke, J. *Diss. Dr. rer. Nat.* 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

EXPERIMENTAL VALUES:

(continued)

$t/^{\circ}C$	T/K	c_2/mol dm^{-3}	α [a]	S [b]
40	313.15	0	0.546	-
		0.5	0.7115	0.732
		1	0.553	0.583
		2	0.525	0.5825
45	318.15	0	0.482	-
		0.5	0.638	0.6575
		1	0.495	0.5225
		2	0.473	0.526
50	323.15	0	0.436	-
		0.5	0.600	0.619
		1	0.469	0.496
		2	0.422	0.4685
55	328.15	0	0.392	-
		0.5	0.551	0.569
		1	0.406	0.432
		2	0.3899	0.434
60	333.15	0	0.372	-
		0.5	0.482	0.498
		1	0.362	0.384
		2	0.356	0.397

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

[b] S = Kuenen coefficient [cm^3 (STP) g^{-1} (H_2O) atm^{-1}].

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Ammonium sulfate; $(NH_4)_2SO_4$; [7783-20-2]

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

ORIGINAL MEASUREMENTS:

Setchenow, J. [Sechenov, I.M.]

Akad. Nauk. SSSR, Mem. Acad. Imp. Sci., St. Petersbourg 1877, *35*, 1-59.

VARIABLES:

T/K = 291.53
c_2/mol dm^{-3} = 0 - 1.093

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

t/°C	T/K [a]	Dilution x	c_2/mol dm^{-3} [a]	α [b]	k_{scc}/dm^3 mol^{-1} [a,c]
18.38	291.53	∞	0	0.896	-
		2	0.5464	0.711	0.184
				0.713	0.182
		1	1.093	0.570	0.180
				0.580	0.172

[a] Calculated by the compiler.

[b] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[c] k_{scc} = Setchenow salt effect parameter; $k_{scc} = (1/c_2)\ \lg(\alpha^o/\alpha)$.

Initial solution: 14.44 g $(NH_4)_2SO_4$ + water to make 100 cm^3 of solution.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Setchenow (Ref. 1) based his apparatus on those of Fernet (1857) and of Meyer (1857). The manometer was based on ideas he learned from Regnault in 1861. The one meter manometer had three branches, two for measuring the pressure and one a mercury reservoir. The manometer was connected to the absorption cell by a flexible silver capillary. The absorption cell was of two bulbs with a mark in the constricting connection. CO_2 gas was generated, saturated with water vapor and filled the bulbs and manometer to a known pressure less than atmospheric. The liquid was degassed by heating and then passed by the pressure difference into the lower bulb to the mark of known volume. The system was sealed, turned 90 degrees and shaken until equilibrium was established. The gas volume absorbed was reduced to 0 °C and one meter Hg pressure. The Bunsen coefficient was calculated.

SOURCE AND PURITY OF MATERIALS:

(1) Apparently generated from limestone and sulfuric acid. Dried.

(2) Not specified.

(3) Not specified, assumed to be distilled.

ESTIMATED ERROR:

The author makes a qualitative statement that the results are good to the second decimal.

REFERENCES:

1. Setchenow, J.

Akad. Nauk. SSSR Mem. Acad. imp. Sci. St. Petersburg 1887, *35*, [Ser. No. 7], 1-59.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Ammonium sulfate; $(NH_4)_2SO_4$; [7783-20-2]

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

VARIABLES:

T/K = 288.15 - 333.15
P/kPa = 101.325
c_2/mol dm^{-3} = 0 - 2

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

$t/^{\circ}C$	T/K	c_2/mol dm^{-3}	α [a]	S [b]
15	288.15	0	0.990	-
		0.25	0.915	0.928
		0.5	0.825	0.850
		1	0.648	0.688
		2	0.477	0.548
20	293.15	0	0.860	-
		0.25	0.811	0.823
		0.5	0.738	0.761
		1	0.574	0.611
		2	0.424	0.4875
25	298.15	0	0.758	0.5173
		0.25	0.718	0.7295
		0.5	0.669	0.690
		1	0.515	0.549
		2	0.374	0.431
30	303.15	0	0.671	-
		0.25	0.634	0.645
		0.5	0.579	0.598
		1	0.465	0.4965
		2	0.331	0.383

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which a measured volume of gas-free liquid is stirred in the presence of the gas, and its decrease in volume is measured in a burette over mercury. The volume of liquid was measured at the experimental temperature. For calculation of the Kuenen coefficient, the density of the solution was obtained from Landolt-Börnstein extant 1969. The molar concentration of salt in the liquid was standardized at 20°C.

These data are analyzed and discussed further in Ref.1.

SOURCE AND PURITY OF MATERIALS:

(1) VEB Leuna Works; 99.8 vol %; the impurity was mostly water (author).

(2) DDR pro analysis grade by DDR Standard TGL 5021.

(3) Double distilled.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Gerecke, J.; Bittrich, H.J. *Wiss. Z. Tech. Hochsch. Chem. "Carl Schorlemmer" Leuna-Merseburg* 1971, *13*(2), 115-22.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Ammonium sulfate; $(NH_4)_2SO_4$; [7783-20-2]

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

EXPERIMENTAL VALUES:
(continued)

$t/^\circ C$	T/K	$c_2/\text{mol dm}^{-3}$	α [a]	S [b]
35	308.15	0	0.605	-
		0.25	0.564	0.574
		0.5	0.516	0.533
		1	0.409	0.4375
		2	0.296	0.3425
40	313.15	0	0.546	-
		0.25	0.502	0.512
		0.5	0.461	0.477
		1	0.362	0.388
		2	0.262	0.3035
45	318.15	0	0.482	-
		0.25	0.448	0.4575
		0.5	0.409	0.4245
		1	0.327	0.351
		2	0.241	0.2793
50	323.15	0	0.436	-
		0.25	0.396	0.405
		0.5	0.368	0.383
		1	0.299	0.3215
		2	0.215	0.250
55	328.15	0	0.392	-
		0.25	0.356	0.3645
		0.5	0.334	0.348
		1	0.272	0.2927
		2	0.189	0.220
60	333.15	0	0.372	-
		0.25	0.323	0.331
		0.5	0.308	0.321
		1	0.252	0.273
		2	0.175	0.2043

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

[b] S = Kuenen coefficient [cm^3 (STP) g^{-1} (H_2O) atm^{-1}].

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Ammonium sulfate; $(NH_4)_2SO_4$; [7783-20-2]

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

ORIGINAL MEASUREMENTS:

Yasunishi, A.; Yoshida, F.

J. Chem. Eng. Data 1979, *24*, 11-14.

VARIABLES:

T/K = 288.15 - 308.15
P/kPa = 101.325
c_2/mol L^{-1} = 0 - 3.867

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	c_2/mol L^{-1}	L [a]	T/K	c_2/mol L^{-1}	L [a]
288.15	0	1.0634	298.15	2.089	0.3622
	0.322	0.9174		2.486	0.3161
	0.690	0.7830		2.873	0.2802
	0.993	0.6903		3.351	0.2465
	1.442	0.5764		3.358	0.2495
	1.838	0.4930			
	2.360	0.4085	308.15	0	0.6675
	2.766	0.3575		0.276	0.5974
	3.106	0.3228		0.611	0.5196
	3.349	0.3042		1.011	0.4468
				1.324	0.3961
298.15	0	0.8264		1.669	0.3508
	0.253	0.7378		1.965	0.3145
	0.519	0.6572		2.090	0.3009
	0.845	0.5794		2.703	0.2507
	1.235	0.4978		2.825	0.2415
	1.474	0.4529		3.195	0.2198
	1.836	0.3952		3.867	0.1865

[a] L = Ostwald coefficient (cm^3 cm^{-3})

P = 1 atm = 101.325 kPa = 1.01325 bar

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Density and composition of solution determined after absorption. Details in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) High purity grade sample, purity 99.96 mole %.

(2,3) Guaranteed reagent, solution degassed by boiling.

ESTIMATED ERROR:

δT/K = ± 0.05; δL = ± 1 %.

REFERENCES:

1. Tokunaga, J. *J. Chem. Eng. Data* 1975, *20*, 41.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Ammonium sulfate; $(NH_4)_2SO_4$; [7783-20-2]

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

ORIGINAL MEASUREMENTS:

Rumpf, B.; Maurer, G.

Ber. Bunsenges. Phys. Chem. 1993, *97*, 85-97.

VARIABLES:

T/K = 313.13 - 433.18
p/MPa = 0.0181 - 9.868
m_2/mol kg^{-1} = near 2.00 and 4.00

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

The authors used Pitzer's semiempirical model to correlate the data. The dissociation of the carbon dioxide can be neglected at the concentrations here. The system was treated as containing a non-dissociating gas, G and a completely dissociating electrolyte, MX. A temperature dependent interaction parameter, $B^o_{CO_2,(NH_4)_2SO_4}$, and a temperature independent interaction parameter, $\Gamma_{CO_2,(NH_4)_2SO_4,(NH_4)_2SO_4}$, were derived from the experimental data.

For the $CO_2 + (NH_4)_2SO_4 + H_2O$ system the values are:

$$B^o_{CO_2,(NH_4)_2SO_4} = 0.7790 - 446.7(T/K)^{-1} + 78900(T/K)^{-2}$$

which gives values:

T/K	313.15	353.15	393.15	433.15
$B^o_{CO_2,(NH_4)_2SO_4}$	0.1571	0.1467	0.1533	0.1683

and $\Gamma_{CO_2,(NH_4)_2SO_4,(NH_4)_2SO_4} = -0.0083$.

(continued on the next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is a modification of one used in earlier work (1). It consists of a high pressure optical cell, thermostat, magnetic stirrer, thermocouples and Pt resistance thermometer, pressure transducers and tanks for aqueous solutions, rinse water and solute gas.
The thermostated about 30 mL high pressure optical cell is filled with carbon dioxide. Pressure and temperature of the gas are measured after equilibration. A known amount of aqueous solvent is added which is slightly greater than that needed to completely dissolve the gas. The pressure in the cell is reduced stepwise by removing very small amounts of the liquid until the first stable bubble appears.
The mass of carbon dioxide is calculated from the Bender equation (2). The volume of the cell is known within 0.06 mL. The solvent density is from the literature.

SOURCE AND PURITY OF MATERIALS:

(1) Carbon dioxide. Messer Griesheim, Ludwigshafen, > 99.995 mol %, used as received.

(2) Ammonium sulfate. Merck GmbH, Darmstadt, > 99.5 mass %. Degassed and dried under vacuum.

(3) Water. Deionized and degassed by vacuum distillation.

ESTIMATED ERROR:

δT/K = ± 0.1
$\delta m_2/m_2$ = ± 0.003
$\delta m_1/m_1$ = ± 0.01 to 0.03

REFERENCES:

1. Rumpf, B.; Maurer, G. *Fluid Phase Equilib.* 1992, *81*, 241-60.
2. Bender, E. 5th Proc. Symp. Thermophys. Prop., ASME, NY, 1970, 227-35.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Ammonium sulfate; $(NH_4)_2SO_4$; [7783-20-2]

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

ORIGINAL MEASUREMENTS:

Rumpf, B.; Maurer, G.

Ber. Bunsenges. Phys. Chem. 1993, *97*, 85-97.

EXPERIMENTAL VALUES: (continued)

Solubility of carbon dioxide in aqueous ammonium sulfate.

T/K	p/MPa	m_2/mol kg^{-1}	m_1/mol kg^{-1}
313.15	0.4060	2.015	0.0537
313.15	0.626	2.015	0.0808
313.14	1.594	2.015	0.1992
313.14	2.545	2.015	0.3075
313.15	3.607	2.015	0.4104
313.13	4.783	2.015	0.5130
313.13	6.370	2.015	0.6210
313.13	8.104	2.015	0.7073
313.16	8.968	2.015	0.7272
313.16	0.707	3.989	0.0646
313.14	1.138	3.989	0.1061
313.15	2.235	3.989	0.2005
313.14	3.619	3.989	0.3009
313.14	5.294	3.989	0.4021
313.13	7.716	3.989	0.5022
313.15	8.966	3.989	0.5453
333.13	0.0185	2.000	0.0
333.15	0.518	2.015	0.0494
333.16	1.086	2.015	0.0988
333.15	2.297	2.015	0.2008
333.13	3.618	2.015	0.3016
333.15	5.075	2.015	0.3984
333.14	6.876	2.015	0.4993
333.13	7.965	2.015	0.5511
333.14	9.346	2.015	0.5983
333.13	0.0181	3.934	0.0
333.15	0.796	3.989	0.0584
333.13	1.420	3.989	0.1006
333.15	3.114	3.989	0.2009
333.15	5.138	3.989	0.3013
333.16	7.789	3.989	0.4032
333.18	9.395	3.989	0.4482
353.10	0.0445	1.999	0.0
353.15	0.715	2.015	0.0495
353.19	1.437	2.015	0.1002
353.15	2.992	2.015	0.2008
353.15	4.720	2.015	0.3025
353.15	6.775	2.015	0.4023
353.15	7.991	2.015	0.4524
353.15	9.343	2.015	0.5012
353.15	0.0420	3.934	0.0
353.16	0.885	3.989	0.0517
353.14	1.848	3.989	0.1012
353.14	4.096	3.989	0.2013
353.15	5.428	3.989	0.2518
353.14	6.879	3.989	0.3022
353.14	8.540	3.989	0.3534
353.14	9.512	3.989	0.3785

(continued on the next page)

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9]	Rumpf, B.; Maurer, G.
(2) Ammonium sulfate; $(NH_4)_2SO_4$; [7783-20-2]	*Ber. Bunsenges. Phys. Chem.* 1993, *97*, 85-97.
(3) Water; H_2O; [7732-18-5]	

EXPERIMENTAL VALUES: (continued)

T/K	p/MPa	m_2/mol kg^{-1}	m_1/mol kg^{-1}
393.16	0.1778	2.005	0.0
393.16	1.057	2.005	0.0506
393.16	1.770	2.005	0.0875
393.16	2.080	2.015	0.1005
393.18	2.768	2.005	0.1377
393.16	4.185	2.015	0.2007
393.16	4.950	2.005	0.2397
393.16	6.456	2.005	0.3010
393.16	7.483	2.005	0.3375
393.15	7.739	2.005	0.3485
393.16	8.848	2.005	0.3907
393.16	0.1705	3.989	0.0
393.09	1.363	3.989	0.0496
393.15	2.757	3.989	0.1009
393.14	4.198	3.989	0.1516
393.15	5.905	3.989	0.2030
393.15	7.743	3.989	0.2531
393.14	9.764	3.989	0.3042
413.11	0.337	1.982	0.0
413.15	1.291	2.005	0.0499
413.15	1.808	2.005	0.0754
413.15	2.327	2.005	0.1006
413.16	4.526	2.005	0.2005
413.15	6.905	2.005	0.3013
413.16	6.975	2.005	0.3012
413.15	8.397	2.005	0.3519
413.15	9.868	2.005	0.4021
413.20	0.317	4.013	0.0
413.21	1.627	4.013	0.0489
413.11	3.214	3.989	0.1004
413.08	4.747	3.989	0.1499
413.14	6.621	3.989	0.2016
413.21	8.294	4.013	0.2413
413.08	8.580	3.989	0.2498
413.20	9.047	4.013	0.2592
433.15	0.572	2.005	0.0
433.14	1.594	2.005	0.0508
433.14	2.689	2.005	0.1006
433.12	3.827	2.005	0.1513
433.14	5.010	2.005	0.2012
433.10	6.297	2.005	0.2521
433.14	7.580	2.005	0.3014
433.12	9.011	2.005	0.3539
433.14	9.751	2.005	0.3782
433.15	0.546	4.013	0.0
433.15	1.986	4.013	0.0462
433.14	3.470	4.013	0.0921
433.16	5.036	4.013	0.1382
433.15	6.350	4.013	0.1751
433.16	7.361	4.013	0.2009
433.18	8.312	4.013	0.2256
433.10	9.372	4.013	0.2510

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]
(2) Ammonium chloride; NH_4Cl; [12125-02-9]
(3) Ammonium sulfate; $(NH_4)_2SO_4$; [7783-20-2]
(4) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Yasunishi, A.; Tsuji, M.; Sada, E.

Adv. Chem. Ser. 1979, *177*, 189-203.

VARIABLES:

T/K = 298.15
P/kPa = 101.325
(c_2+c_3)/mol dm^{-1} = 0 - 2.873

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T = 298.15 K;
P = 101.325 kPa

x_2 in mixed salt	(c_2+c_3) /mol dm^{-3}	L [a]
0	0	0.8264
	0.253	0.7378
	0.519	0.6572
	0.845	0.5794
	1.235	0.4978
	1.836	0.3952
	2.486	0.3161
	2.873	0.2802
0.25	0.282	0.7505
	0.573	0.6785
	0.998	0.5961
	1.396	0.5322
	1.946	0.4580
	2.433	0.4015
	2.806	0.3687
0.50	0.333	0.7568
	0.658	0.6997
	1.021	0.6460
	1.330	0.5959
	2.014	0.5223
	2.673	0.4578
0.75	0.254	0.7905
	0.601	0.7451
	1.018	0.6978
	1.414	0.6594
	1.985	0.6133
	2.400	0.5800
	2.861	0.5524
1.00	0.375	0.7958
	0.811	0.7704
	1.147	0.7460
	1.508	0.7328
	1.973	0.7102
	2.338	0.6915
	2.816	0.6721

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[a] L = Ostwald coefficient [cm^3 cm^{-3}]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Partial pressure determined from total pressure and vapor pressure of solution. The vapor pressure of the mixed salt solution estimated by the method of Robinson and Bower (1) from corresponding data for each component salt solution. Apparatus s6milar to that described in Ref. 2.

SOURCE AND PURITY OF MATERIALS:

(1) Extra pure grade, purity 99.96 mole %.

(2,3) Reagent grade.

(4) Deionized.

ESTIMATED ERROR:

δT/K = ± 0.05; δL = ± 1 %

REFERENCES:

1. Robinson, R.A.; Bower, V.E. *J. Res. Nat. Bur. Stand.* 1965, *69A*, 365.
2. Tokunaga, J. *J. Chem. Eng. Data* 1975, *20*, 41.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Ammonium nitrate; NH_4NO_3; [6484-52-2]

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

ORIGINAL MEASUREMENTS:

Setchenow, J. [Sechenov, I.M.]

Ann. Chim. Phys. [6] 1892, *25*, 226-70.

VARIABLES:

$T/K = 288.35$

$c_2/\text{mol dm}^{-3} = 0 - 10.125$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	Dilution x	$c_2/\text{mol dm}^{-3}$ [a]	α [b]	$k_{scc}/\text{dm}^3\ \text{mol}^{-1}$ [a,c]
15.2	288.35	∞	0	1.009	-
		128	0.0791	1.010	-0.00544
		64	0.1582	1.006	0.00817
		16	0.6328	0.989	0.0137
		8	1.266	0.962	0.0164
		4	2.531	0.911	0.0175
		2	5.062	0.812	0.0186
		1	10.125	0.612	0.0214

[a] Calculated by the compiler.

[b] α = Bunsen coefficient [cm^3 (STP) $\text{cm}^{-3}\ \text{atm}^{-1}$].

[c] k_{scc} = Setchenow salt effect parameter; $k_{scc} = (1/c_2)\ \lg(\alpha^{\circ}/\alpha)$.

Initial solution: 81.04 g NH_4NO_3 + 48.0 cm^3 water to make 100 cm^3 of solution.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Setchenow (Ref. 1) based his apparatus on those of Fernet (1857) and of Meyer (1857). The manometer was based on ideas he learned from Regnault in 1861. The one meter manometer had three branches, two for measuring the pressure and one a mercury reservoir. The manometer was connected to the absorption cell by a flexible silver capillary. The absorption cell was of two bulbs with a mark in the constricting connection. CO_2 gas was generated, saturated with water vapor and filled the bulbs and manometer to a known pressure less than atmospheric. The liquid was degassed by heating and then passed by the pressure difference into the lower bulb to the mark of known volume. The system was sealed, turned 90 degrees and shaken until equilibrium was established. The gas volume absorbed was reduced to 0 °C and one meter Hg pressure. The Bunsen coefficient was calculated.

SOURCE AND PURITY OF MATERIALS:

(1) Apparently generated from limestone and sulfuric acid. Dried.

(2) Not specified.

(3) Not specified, assumed to be distilled.

ESTIMATED ERROR:

The author makes a qualitative statement that the results are good to the second decimal.

REFERENCES:

1. Setchenow, J.

Akad. Nauk. SSSR Mem. Acad. imp. Sci. St. Petersburg 1887, *35*, [Ser. No. 7], 1-59.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Ammonium nitrate; NH_4NO_3; [6484-52-2]

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

VARIABLES:

T/K = 288.15 - 328.15
P/kPa = 101.325
c_2/mol dm^{-3} = 0 - 4

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

$t/^{\circ}C$	T/K	c_2/mol dm^{-3}	α [a]	S [b]
15	288.15	0	0.990	-
		0.25	0.969	-
		0.5	0.953	0.977
		1	0.907	0.944
		2	0.787	0.872
		4	0.648	0.809
20	293.15	0	0.860	-
		0.25	0.858	-
		0.5	0.847	0.860
		1	0.799	0.834
		2	0.693	0.769
		4	0.562	0.691
25	298.15	0	0.758	-
		0.25	0.747	-
		0.5	0.737	0.758
		1	0.711	0.743
		2	0.618	0.688
		4	0.490	0.615
30	303.15	0	0.671	-
		0.25	0.662	-
		0.5	0.646	0.665
		1	0.634	0.663
		2	0.560	0.625
		4	0.434	0.545

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which a measured volume of gas-free liquid is stirred in the presence of the gas, and its decrease in volume is measured in a burette over mercury. The volume of liquid was measured at the experimental temperature. For calculation of the Kuenen coefficient, the density of the solution was obtained from Landolt-Börnstein extant 1969. The molar concentration of salt in the liquid was standardized at 20°C. These data are analyzed and discussed further in Ref.1.

SOURCE AND PURITY OF MATERIALS:

(1) VEB Leuna Works; 99.8 vol %; the impurity was mostly water (author).

(2) DDR pro analysis grade by DDR Standard TGL 5021.

(3) Double distilled.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Gerecke, J.; Bittrich, H.J. *Wiss. Z. Tech. Hochsch. Chem. "Carl Schorlemmer" Leuna-Merseburg* 1971, *13*(2), 115-22.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Ammonium nitrate; NH_4NO_3; [6484-52-2] (3) Water; H_2O; [7732-18-5]	Gerecke, J. *Diss. Dr. rer. Nat.* 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

EXPERIMENTAL VALUES:
(continued)

t/°C	T/K	c_2/mol dm^{-3}	α [a]	S [b]
35	308.15	0	0.605	-
		0.25	0.587	-
		0.5	0.564	0.581
		1	0.564	0.591
		2	0.509	0.568
		4	0.367	0.462
40	313.15	0	0.546	-
		0.25	0.525	-
		0.5	0.506	0.522
		1	0.496	0.511
		2	0.462	0.517
		4	0.321	0.406
45	318.15	0	0.482	-
		0.25	0.471	-
		0.5	0.454	0.469
		1	0.453	0.477
		2	0.431	0.483
		4	0.281	0.356
50	323.15	0	0.436	-
		0.25	0.430	-
		0.5	0.418	0.432
		1	0.407	0.419
		2	0.390	0.438
		4	0.248	0.314
55	328.15	0	0.392	-
		0.25	0.389	-
		0.5	0.379	0.392
		1	0.367	0.387
		2	0.355	0.395
		4	0.228	0.290

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

[b] S = Kuenen coefficient [cm^3 (STP) g^{-1} (H_2O) atm^{-1}].

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Ammonium nitrate; NH_4NO_3; [6484-52-2]

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

ORIGINAL MEASUREMENTS:

Onda, K.; Sada, E; Kobayashi, T.; Kito, S.; Ito, K.

J. Chem. Eng. Jpn 1970, *3*, 18-24.

VARIABLES:

$T/K = 298.15$
$P/kPa = 101.325$
$c_2/mol\ L^{-1} = 0 - 3.632$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	$c_2/mol\ L^{-1}$	α [a]
298.15	0	0.7595
	1.777	0.7214
	2.015	0.6974
	2.615	0.6906
	2.644	0.6917
	3.372	0.6640
	3.632	0.6616

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

$P = 1\ atm = 101.325\ kPa = 1.01325\ bar$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solutions made up by weight and density measured but not reported in paper. Equilibrium established between a measured volume of gas and a measured amount of gas-free liquid in a cell fitted with a magnetic stirrer. Amount of gas absorbed estimated from change in volume of gas. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial sample, minimum purity 99.8 mole %.

(2) Analytical grade.

(3) Distilled and degassed.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta\alpha = \pm 2$ %

(Estimated by the compiler.)

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Arsenic trioxide; As_2O_3; [1327-53-3]

(3) Arsenic pentoxide; As_2O_5; [1303-28-2]

(4) Hydrochloric acid; HCl; [7647-01-0]

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

ORIGINAL MEASUREMENTS:

Robb, R. A.; Zimmer, M. F.

J. Chem. Eng. Data 1968, *13*, 200-3.

VARIABLES:

T/K = 293.15 - 303.15

P/kPa = 40.0 - 112.0

m_i/mol kg^{-1} = 0 - 12.754

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

t/°C	T/K [a]	m_2/mol kg^{-1}	m_3/mol kg^{-1}	m_4/mol kg^{-1}	α [b]
20	293.15	0.0344	0	0	0.880
		0.0649	0	0	0.855
		0.1113	0	0	0.835
		0	0.0262	0	0.866
		0	0.0509	0	0.865
		0	0.1330	0	0.841
		0.0329	0.0273	0	0.864
		0	0	0.6370	0.854
		0	0	10.971	0.938
		0	0	12.754	0.924
		0.0305	0.0307	0.1271	1.029
		0.0465	0.0159	0.0625	0.854
25	298.15	0	0	0	0.758 [c]
		0.0344	0	0	0.749
		0.0649	0	0	0.735
		0.1113	0	0	0.720
		0.1113	0	0	0.724
		0	0.0262	0	0.756
		0	0.0509	0	0.748
		0	0.1330	0	0.737
		0.0329	0.0273	0	0.744

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method. The apparatus is described in detail in the source. The CO_2 was purified in the line and sublimed into the system. Mercury levels were read with a cathetometer to ± 0.05 mm. Atmospheric pressures were read to ± 0.1 mm with a mercury barometer and were corrected to 0 °C. The volumes determined were reproducible to ± 0.02 mL.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial. Purity 99.9 %.

(2,3) Fisher Certified Reagents. Purity better than 99.3 %.

(4) Purified. Source not specified.

(5) Conductivity water, distilled from a quartz still. Conductivity less than 1 x 10^{-7} Ω^{-1} m^{-1}.

ESTIMATED ERROR:

δT/K = ± 0.05 (authors)

$\delta\alpha$ = ± 1.1 % (authors)

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Arsenic trioxide; As_2O_3; [1327-53-3]

(3) Arsenic pentoxide; As_2O_5; [1303-28-2]

(4) Hydrochloric acid; HCl; [7647-01-0]

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

ORIGINAL MEASUREMENTS:

Robb, R. A.; Zimmer, M. F.

J. Chem. Eng. Data 1968, *13*, 200-3.

EXPERIMENTAL VALUES: (continued)

t/°C	T/K [a]	m_2/mol kg^{-1}	m_3/mol kg^{-1}	m_4/mol kg^{-1}	α [b]
25	298.15	0	0	0.1866	0.752
		0	0	0.6370	0.743
		0	0	1.261	0.728
		0	0	2.562	0.735
		0	0	7.459	0.812
		0	0	10.971	0.818
		0	0	12.754	0.816
		0.0305	0.0307	0.1271	0.789
		0.0465	0.0159	0.0625	0.732
27.3	300.45	0	0	0	0.743
30	303.15	0.0344	0	0	0.662
		0.0649	0	0	0.651
		0.1113	0	0	0.635
		0.1113	0	0	0.633
		0	0.0262	0	0.663
		0	0.0509	0	0.655
		0	0.1330	0	0.640
		0.0329	0.0273	0	0.649
		0	0	0.6370	0.647
		0.0305	0.0307	0.1271	0.653
		0.0465	0.0159	0.0625	0.650

---

[a] Added by the compiler.

[b] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

[c] Average of five determinations. Standard deviation s_α = 0.005.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Arsenic trisufide (colloidal); As_2S_3; [1303-33-9]

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

ORIGINAL MEASUREMENTS:

Findlay, A.; Creighton, H.J.M.

J. Chem. Soc. 1910, *97*, 536-61.

VARIABLES:

$T/\mathrm{K} = 298.15$

$p_1/\mathrm{kPa} = 100.5 - 170.8$

$10^2\gamma_2/\mathrm{g\ cm^{-3}} = 0.392 - 2.289$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	$10^2\gamma_2/\mathrm{g\ cm^{-3}}$ [a]	$\rho/\mathrm{g\ cm^{-3}}$	p_1/bar	S [b]	p_1/bar	S [b]
298.15	0.392	0.997	1.008	0.816	1.188	0.817
			1.268	0.814	1.396	0.816
			1.563	0.818	1.679	0.820
	1.410	1.003	1.008	0.810	1.135	0.810
			1.296	0.812	1.443	0.810
			1.516	0.812	1.708	0.811
	2.289	1.007	1.005	0.806	1.137	0.806
			1.251	0.806	1.337	0.806
			1.424	0.806	1.615	0.806

[a] γ_2 = mass concentration of arsenic trisulfide

[b] $$S = \frac{\text{concentration of gas in liquid phase}}{\text{concentration of gas in gaseous phase}}$$

Solubility in water: Ostwald coefficient $L = 0.817\ \mathrm{cm^3\ cm^{-3}}$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas burette and absorption pipette similar to that of Geffcken (Ref. 1) except that the manometer tube was longer. Concentration of As_2S_3 determined by precipitation with hydrochloric acid, drying at 80 °C and weighing.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.42 mole %.

(2) Prepared by passing hydrogen sulfide into arsenic trioxide solution. Hydrogen bubbled through colloidal solution, filtered and partially degassed.

(3) Nothing specified.

ESTIMATED ERROR:

$\delta T/\mathrm{K} = \pm 0.1$; $\delta S = \pm 0.25$ %

REFERENCES:

1. Geffcken, G.
Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1904, *49*, 257-302.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) *N,N*-Dimethylmethanamine hydrochloride; (trimethylamine hydrochloride); $C_3H_{10}NCl$; [593-81-7]

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

VARIABLES:

T/K = 288.15 - 333.15
P/kPa = 101.325
c_2/mol dm^{-3} = 0 - 4

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

t/°C	T/K	c_2/mol dm^{-3}	α [a]	t/°C	T/K	c_2/mol dm^{-3}	α [a]
15	288.15	0	0.990	40	313.15	0	0.546
		0.25	0.940			0.25	0.478
		0.5	0.916			0.5	0.461
		1	0.881			1	0.455
		2	0.842			2	0.437
		4	0.799			4	0.419
20	293.15	0	0.860	45	318.15	0	0.482
		0.25	0.810			0.25	0.419
		0.5	0.792			0.5	0.408
		1	0.761			1	0.396
		2	0.728			2	0.385
		4	0.710			4	0.373
25	298.15	0	0.758	50	323.15	0	0.436
		0.25	0.699			0.25	0.373
		0.5	0.687			0.5	0.367
		1	0.669			1	0.344
		2	0.637			2	0.339
		4	0.636			4	0.329
30	303.15	0	0.671	55	328.15	0	0.392
		0.25	0.621			0.25	0.330
		0.5	0.603			0.5	0.318
		1	0.584			1	0.308
		2	0.561			2	0.304
		4	0.549			4	0.297
35	308.15	0	0.605	60	333.15	0	0.372
		0.25	0.539			0.25	0.296
		0.5	0.528			0.5	0.288
		1	0.515			1	0.282
		2	0.492			2	0.274
		4	0.479			4	0.268

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which a measured volume of gas-free liquid is stirred in the presence of the gas, and its decrease in volume is measured in a burette over mercury. The volume of liquid was measured at the experimental temperature. The molar concentration of salt in the liquid was standardized at 20 °C.

These data are analyzed and discussed further in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) VEB Leuna Works; 99.8 vol %; the impurity was mostly water (author)

(2) DDR pro analysis grade by DDR Standard TGL 5021.

(3) Double distilled.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Gerecke, J.; Bittrich, H.J.

Wiss. Z. Tech. Hochsch. Chem. "Carl Schorlemmer" Leuna-Merseburg 1971, *13*(2), 115-22.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Methanaminium, *N,N,N*-trimethyl iodide; (tetramethyl ammonium iodide); $C_4H_{12}NI$; [75-58-1]

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

VARIABLES:

$T/\text{K} = 288.15 - 333.15$
$P/\text{kPa} = 101.325$
$c_2/\text{mol dm}^{-3} = 0 - 0.19$

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

$t/°\text{C}$	T/K	$c_2/\text{mol dm}^{-3}$	α [a]	$t/°\text{C}$	T/K	$c_2/\text{mol dm}^{-3}$	α [a]
15	288.15	0	0.990	40	313.15	0	0.546
		0.1	0.998			0.1	0.507
		0.19	0.980			0.19	0.496
20	293.15	0	0.860	45	318.15	0	0.482
		0.1	0.872			0.1	0.442
		0.19	0.847			0.19	0.431
25	298.15	0	0.758	50	323.15	0	0.436
		0.1	0.754			0.1	0.390
		0.19	0.730			0.19	0.379
30	303.15	0	0.671	55	328.15	0	0.392
		0.1	0.652			0.1	0.345
		0.19	0.644			0.19	0.334
35	308.15	0	0.605	60	333.15	0	0.372
		0.1	0.563			0.1	0.309
		0.19	0.563				

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which a measured volume of gas-free liquid is stirred in the presence of the gas, and its decrease in volume is measured in a burette over mercury. The volume of liquid was measured at the experimental temperature. The molar concentration of salt in the liquid was standardized at 20 °C.

These data are analyzed and discussed further in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) VEB Leuna Works; 99.8 vol %; the impurity was mostly water (author)

(2) DDR pro analysis grade by DDR Standard TGL 5021.

(3) Double distilled.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Gerecke, J.; Bittrich, H.J.
Wiss. Z. Tech. Hochsch. Chem. "Carl Schorlemmer" Leuna-Merseburg 1971, *13*(2), 115-22.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Diammonium salt of 2-hydroxy-1,2,3-propanetricarboxylic acid; $(NH_4)_2C_6H_6O_7$; [3012-65-5]

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

ORIGINAL MEASUREMENTS:

Lloyd, R.

AEC Accession No. 8890, Rep. No. WAPD-TM-511, <u>1965</u>, 10 pp.

Chem. Abstr. <u>1966</u>, *65*, 12910a.

EXPERIMENTAL VALUES:

Solubility of carbon dioxide in water and 0.053 mol L^{-1} ammonium citrate [a]

						c_1/mmol L^{-1} [d]		
t/°F	T/K [b]	p_3/atm	p_1/atm	c_2/mol L^{-1}	pH [c]	Total	Fixed	Unfixed
80	299.82		0.966	0	4.2	31.2	0	31.2
		0.034	0.926	0.053	4	20.4	4.2	16.2
					5	26.0	4.7	21.3
					6	40.0	5.1	34.9
					7	58.5	5.8	52.7
100	310.93		0.935	0	4.2	23.2	0	23.2
		0.065	0.895	0.053	5	20.7	5.2	15.5
120	322.04		0.884	0	4.2	17.8	0	17.8
		0.116	0.844	0.053	5	18.6	5.1	13.5
140	333.15		0.804	0	4.2	13.3	0	13.3
		0.196	0.764	0.053	4	15.8	4.0	11.8
					5	17.5	4.4	13.1
					6	23.8	5.0	18.8
					7	35.7	6.0	29.7

[a] The common name of the electrolyte is diammonium citrate.

[b] Added by the compiler. The Kelvin temperatures are not intended to represent an accuracy, but to reproduce the Fahrenheit temperatures.

[c] The pH given for water (c_2/mol L^{-1} = 0) means pH of water saturated with carbon dioxide. According to the author the measurements showed that saturating water with CO_2 under the ambient barometric pressure in the temperature range of 80 to 140 °F yielded a pH of 4.2 ± 0.1.

The ammonium citrate solutions of certain pH's were prepared as follows:
At pH 4 the solution was prepared from an equimolar mixture of citric acid and diammonium citrate to contain 11.1 g/L of monoammonium citrate, and its pH was adjusted upward to pH 4 by adding ammonia.
At pH 5 the solution was primarily diammonium citrate and was prepard by dissolving 12 g of diammonium citrate per liter.
At pH 6 and at pH 7 ammonia was added to the pH 5 solution. At pH 7 the salt was in the form of triammonium citrate.
All solutions were initially prepared to contain 12 g diammonium citrate per liter (0.053 mol L^{-1}).

[d] The values for the solubility of CO_2 in water are at a total pressure of 1 atm (101.3 kPa). The carbon dioxide in ammonium citrate solutions was measured at a barometric pressure of 730 mmHg (0.960 atm or 97.3 kPa).

The author distinguished between fixed CO_2, assumed to be in the form of bicarbonate and carbonate ion, and unfixed CO_2, assumed to be in the form of $CO_2(aq)$ and $H_2CO_3(aq)$.

Continued on the next page.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Diammonium salt of 2-hydroxy-1,2,3-propanetricarboxylic acid; $(NH_4)_2C_6H_6O_7$; [3012-65-5]

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

ORIGINAL MEASUREMENTS:

Lloyd, R.

AEC Accession No. 8890, Rep. No. WAPD-TM-511, 1965, 10 pp.

Chem. Abstr. 1966, *65*, 12910a.

VARIABLES:

$T/K = 299.8 - 333.2$
$p/kPa = 101.3, 97.3$
$c_2/mol\ L^{-1} = 0$ and 0.053

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES: (continued)

The author found that the fixed dissolved carbon dioxide did not vary with temperature while the unfixed dissolved carbon dioxide decreased as temperature increased. He summarized these results in the following table.

Solution	Fixed CO_2 c/mmol L^{-1}	Unfixed CO_2, c/mmol (L atm)$^{-1}$ 299.8 K (80 °F)	333.2 K (140 °F)
NH_4-citr. pH 4	4.1	17.5	15.5
NH_4-citr. pH 5	4.9	23.0	17.1
NH_4-citr. pH 6	5.1	37.7	24.6
NH_4-citr. pH 7	5.9	54.6	38.9
Water	0	32.3	16.5

The carbon dioxide solubilities in water correspond to mole fraction solubilities of 5.83×10^{-4} and 3.02×10^{-4} at one atm assuming the density of water and the CO_2 saturated solutions have the same value.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two 100 mL samples of the solvent were saturated with carbon dioxide by passing pure cylinder CO_2 through the solutions for 30 minutes. One sample was used to determine total CO_2. It was treated with ammonia and barium chloride to precipitate the total CO_2 as barium carbonate which was recovered and treated with acid to liberate the CO_2. The other sample was stripped of unfixed CO_2 by heating strongly under reduced pressure until the solution volume was reduced in half. The fixed CO_2 remaining was treated with ammonia and barium chloride and the barium carbonate recovered and treated with acid to recover the CO_2. The Unfixed CO_2 = Total CO_2 - Fixed CO_2.

Compiler's note: The 30 minute saturation time seems too short to attain saturation.

SOURCE AND PURITY OF MATERIALS:

(1) Carbon dioxide. Described as pure cylinder gas, source not given.

(2) Diammonium citrate. Nothing specified.

(3) Water. Nothing specified.

ESTIMATED ERROR:

Temperature: Nothing specified.
Solubility: Nothing specified.

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) *N,N,N*-Trimethyl-1-hexadecanaminium bromide; (cetyltrimethylammonium bromide); $C_{19}H_{42}N.Br$; [57-09-0] (3) Water; H_2O; [7732-18-5]	Ownby, D. W.; Prapaitrakul, W.; King, A. D. Jr. *J. Colloid Interface Sci.* 1988, *125*, 526-33.
VARIABLES: $T/K = 298.15$ $m_2/\text{mol kg}^{-1} = 0.0 - 0.4$	PREPARED BY: H. L. Clever

EXPERIMENTAL VALUES:

Solubility of carbon dioxide in aqueous cetyltrimethylammonium bromide.

$t/°C$	T/K [a]	$m_2/\text{mol kg}^{-1}$ [b]	$10^2 m_1/\text{mol kg}^{-1}$ [c]
25	298.15	0.0	3.28
		0.1	3.46
		0.2	3.60
		0.3	3.73
		0.4	3.88

---

[a] Added by the compiler.

[b] m_2 = molality of cetyltrimethylammonium bromide.

[c] m_1 = solubility of carbon dioxide.

The measurements are made at several pressures up to 10 - 15 atm (1 - 1.5 MPa). The solubility values have been corrected to 1 atm (0.103 MPa) partial pressure of CO_2. See method below.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus and method are described in earlier papers (1, 2). Solubility is determined in a thermostated, magnetic stirred cylindrical brass bomb with an observation window. The solution is prepared and put in a glass liner in the bomb. The system is sealed, evacuated to a pressure just above water vapor pressure, and outgassed with stirring for several hours. The gas is added to a known pressure and equilibrated with stirring for a minimum of five hours. Stirring is stopped, the solution is allowed to become still. The gas is vented leaving the supersaturated solution under a gaseous pressure of atmospheric pressure for a fixed time of 30 to 60 seconds. The rate of gas loss during the still condition is measured to use in a later correction. The gas is stirred and collected. The total volume of gas is measured along with ambient pressure and temperature.

SOURCE AND PURITY OF MATERIALS:

(1) Carbon dioxide. Matheson Gas Products. Commercial grade, stated to be 99.5 % min purity.

(2) Cetyltrimethylammonium bromide. Lancaster Synthesis Ltd. Stated to be 98.0 %.

(3) Water. Nothing specified, but have used doubly distilled water in earlier work.

ESTIMATED ERROR:

$\delta T/K$ not specified.
$\delta m_1/\text{mol kg}^{-1} = 0.02 \times 10^{-2}$

REFERENCES:

1. Matheson, I.B.C.; King, A.D. Jr. *J. Colloid Interface Sci.* 1978, *66*, 464.
2. Bolden, P.L.; Hoskins, J.C.; King, A.D. Jr. *J. Colloid Interface Sci.* 1983, *91*, 454.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Silicic acid (colloidal); [1343-98-2] (3) Water; H_2O; [7732-18-5]	Findlay, A.; Creighton, H.J.M. *J. Chem. Soc.* 1910, *97*, 536-61.
VARIABLES: $T/K = 298.15$ $p_1/kPa = 97.5 - 180.5$ $10^2\gamma_2/g\ cm^{-3} = 1.40 - 2.80$	PREPARED BY: Pirketta Scharlin

EXPERIMENTAL VALUES:

T/K	$10^2\gamma_2/g\ cm^{-3}$ [a]	$\rho/g\ cm^{-3}$	p_1/bar	S [b]	p_1/bar	S [b]
298.15	1.40	1.000	0.975	0.822	1.418	0.816
			1.105	0.819	1.590	0.816
			1.248	0.816	1.805	0.816
298.15	2.20	1.002	0.976	0.828	1.384	0.820
			1.115	0.822	1.571	0.820
			1.251	0.820	1.780	0.820
298.15	2.80	1.003	0.975	0.831	1.400	0.823
			1.164	0.825	1.604	0.824
			1.280	0.824	1.773	0.825

[a] γ_2 = mass concentration SiO_2 in the solvent

[b] $$S = \frac{\text{concentration of gas in liquid phase}}{\text{concentration of gas in gaseous phase}}$$

Solubility in water: Ostwald coefficient $L = 0.817\ cm^3\ cm^{-3}$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Gas burette and absorption pipette similar to that of Geffcken (Ref. 1) except that the manometer tube was longer.	(1) Purity 99.42 mole %. (2,3) Solutions of silicic acid were prepared by dissolving pure silica in potassium hydroxide and adding excess of hydrochloric acid. The liquid was then dialysed, first against tap water and then against distilled water, until free from chloride.
	ESTIMATED ERROR: $\delta T/K = \pm 0.1$; $\delta S = \pm 0.25$ %
	REFERENCES: Geffcken, G. *Z. Phys. Chem., Stoechiom. Verwandtschaftsl.* 1904, *49*, 257-302.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Silicic acid (colloidal); [1343-98-2]

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

ORIGINAL MEASUREMENTS:

Findlay, A.; Williams, T.

J. Chem. Soc. 1913, *103*, 636-45.

VARIABLES:

$T/K = 298.15$

$p_1/kPa = 34.9 - 102.0$

$10^2\gamma_2/g\ cm^{-3} = 0.45 - 1.25$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	$10^2\gamma_2/g\ cm^{-3}$ [a]	$\rho/g\ cm^{-3}$	p_1/bar	S [b]	p_1/bar	S [b]
298.15	0.45	0.996	0.356	0.816	0.641	0.813
			0.876	0.816	1.016	0.818
298.15	0.95	0.999	0.349	0.836	0.513	0.823
			0.641	0.823	0.869	0.816
			1.008	0.822		
298.15	1.25	1.000	0.353	0.842	0.512	0.826
			0.636	0.826	0.876	0.820
			1.020	0.824		

[a] γ_2 = mass concentration SiO_2

[b] $$S = \frac{\text{concentration of gas in liquid phase}}{\text{concentration of gas in gaseous phase}}$$

Solubility in water: Ostwald coefficient $L = 0.816\ cm^3\ cm^{-3}$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric static method. Care was taken to reduce dead space because of the small amounts of gas absorbed. Apparatus similar to that described in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) No details given.

(2) Solutions prepared by adding excess hydrochloric acid to solutions of sodium silicate and dialysing the liquid.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta S = \pm 1$ %

(estimated by compiler)

REFERENCES:

1. Findlay, A.; Creighton, H.J.M. *J. Chem. Soc.* 1910, *97*, 536-61.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Hydrated aluminium oxide; $Al_2O_3 \cdot xH_2O$; [1333-84-2]

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

ORIGINAL MEASUREMENTS:

Shkol'nikova, R.I.

Uch. Zap. Leningr. Gos. Unov., Ser. Khim. Nauk. 1959, Nr. 18, 64-86.

Chem. Abstr. 1961, *55*, 25443b.

VARIABLES:

$T/K = 293.15 - 313.15$
$P/kPa = 101.325$
$10^2w_2 = 0 - 0.42$

PREPARED BY:

H.L. Clever
A.L. Cramer

EXPERIMENTAL VALUES:

T/K	10^2w_2 [a]	$10^3\alpha$ [b]
293.15	0.1	770.0
303.15		593.2
313.15		470.1
293.15	0.35	698.0
303.15		551.9
313.15		438.0
293.15	0.42	641.1
303.15		523.0
313.15		416.1

[a] w_2 = mass fraction of component 2.
[b] α =Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

The enthalpy of solution of CO_2 from the temperature coefficient of the Bunsen coefficient is 23.640 kJ mol^{-1} (5650 cal mol^{-1}) in water and 18.828 kJ mol^{-1} (4500 cal mol^{-1}), 17.782 kJ mol^{-1} (4250 cal mol^{-1}), and 16.527 kJ mol^{-1} (3950 cal mol^{-1}) for the 0.1 , 0.35 and 0.42 mass % $Al_2O_3 \cdot xH_2O$ solution, respectively.

The values for the solubility of CO_2 in water were not given in the paper.

$Al_2O_3 \cdot xH_2O$ is described as a sol (colloidal).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus and procedure of Lannung were modified (Ref. 1).

SOURCE AND PURITY OF MATERIALS:

(1) Source not given. Stated to be 99.98 %.

(2) No information.

(3) No information.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Lannung, A.

J. Am. Chem. Soc. 1930, *52*, 68.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Aluminium chloride; $AlCl_3$; [7446-70-0] (3) Water; H_2O; [7732-18-5]	Yasunishi, A.; Yoshida, F. *J. Chem. Eng. Data* 1979, *24*, 11-14.
VARIABLES:	**PREPARED BY:**
T/K = 298.15 P/kPa = 101.325 $c_2/mol\ L^{-1}$ = 0 - 2.570	C. L. Young

EXPERIMENTAL VALUES:

T/K	$c_2/mol\ L^{-1}$	L [a]
298.15	0	0.8264
	0.411	0.6582
	0.936	0.4888
	1.370	0.3854
	1.868	0.2917
	2.570	0.1907

[a] L = Ostwald coefficient ($cm^3\ cm^{-3}$)
P = 1 atm = 101.325 kPa = 1.01325 bar

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Aluminium sulfate; $Al_2(SO_4)_3$; [10043-01-3] (3) Water; H_2O; [7732-18-5]	Yasunishi, A.; Yoshida, F. *J. Chem. Eng. Data* 1979, *24*, 11-14.
VARIABLES:	**PREPARED BY:**
T/K = 298.15 P/kPa = 101.325 $c_2/mol\ L^{-1}$ = 0 - 0.850	C. L. Young

EXPERIMENTAL VALUES:

T/K	$c_2/mol\ L^{-1}$	L [a]
298.15	0	0.8264
	0.186	0.6117
	0.392	0.4327
	0.628	0.2753
	0.850	0.1913

[a] L = Ostwald coefficient ($cm^3\ cm^{-3}$)
P = 1 atm = 101.325 kPa = 1.01325 bar

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Density and composition of solution determined after absorption. Details in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) High purity grade sample, purity 99.96 mole %.

(2,3) Guaranteed reagent, solution degassed by boiling.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta L = \pm 1$ %.

REFERENCES:

1. Tokunaga, J. *J. Chem. Eng. Data* 1975, *20*, 41.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Zinc sulfate; $ZnSO_4$; [7733-02-0] (3) Water; H_2O; [7732-18-5]	Setchenow, J. [Sechenov, I.M.] *Ann. Chim. Phys.* [6] 1892, *25*, 226-70.
VARIABLES: T/K = 288.35 c_2/mol dm^{-3} = 0 - 2.478	PREPARED BY: Pirketta Scharlin

EXPERIMENTAL VALUES:

t/°C	T/K [a]	Dilution x	c_2/mol dm^{-3} [a]	α [b]	k_{scc}/dm^3 mol^{-1} [a,c]
15.2	288.35	∞	0	1.009	-
		12	0.2065	0.903	0.233
		6	0.4130	0.783	0.267
		2	1.239	0.474	0.265
		1	2.478	0.209	0.276

[a] Calculated by the compiler.

[b] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[c] k_{scc} = Setchenow salt effect parameter; $k_{scc} = (1/c_2)\ \lg(\alpha^o/\alpha)$.

Initial solution: 40.00 g $ZnSO_4$ + water to make 100 cm^3 of solution.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Setchenow (Ref. 1) based his apparatus on those of Fernet (1857) and of Meyer (1857). The manometer was based on ideas he learned from Regnault in 1861. The one meter manometer had three branches, two for measuring the pressure and one a mercury reservoir. The manometer was connected to the absorption cell by a flexible silver capillary. The absorption cell was of two bulbs with a mark in the constricting connection. CO_2 gas was generated, saturated with water vapor and filled the bulbs and manometer to a known pressure less than atmospheric. The liquid was degassed by heating and then passed by the pressure difference into the lower bulb to the mark of known volume. The system was sealed, turned 90 degrees and shaken until equilibrium was established. The gas volume absorbed was reduced to 0 °C and one meter Hg pressure. The Bunsen coefficient was calculated.

SOURCE AND PURITY OF MATERIALS:

(1) Apparently generated from limestone and sulfuric acid. Dried.

(2) Not specified.

(3) Not specified, assumed to be distilled.

ESTIMATED ERROR:

The author makes a qualitative statement that the results are good to the second decimal.

REFERENCES:

1. Setchenow, J.

Akad. Nauk. SSSR Mem. Acad. imp. Sci. St. Petersburg 1887, *35*, [Ser. No. 7], 1-59.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Copper sulfate; $CuSO_4$; [7758-98-7]

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

ORIGINAL MEASUREMENTS:

Vázquez, G.; Chenlo, F.; Pereira, G.

Afinidad 1994, *51*, (No. 453) 369-74.

VARIABLES:

$T/K = 298.1$
$P_1/\text{bar} = 1.013$
$\gamma_2/\text{g L}^{-1} = 0 - 160$

PREPARED BY:

Pirketta Scharlin
Rosa Crovetto

EXPERIMENTAL VALUES:

T/K	$\gamma_2/\text{g L}^{-1}$ [a]	$c_2/\text{mol L}^{-1}$ [b]	$\rho/\text{kg m}^{-3}$ [c]	$c_1/\text{mol dm}^{-3}$ [d]	L [e]
298.1	0	0	997.0	0.0333	0.814
	40	0.251	1040.1	0.0275	0.673
	80	0.501	1079.9	0.0238	0.582
	120	0.752	1118.4	0.0208	0.509
	160	1.002	1156.2	0.0181	0.443

[a] γ_2 = mass concentration of $CuSO_4$
[b] c_2 = concentration of $CuSO_4$; calculated by compiler
[c] ρ = density of aqueous $CuSO_4$ solution
[d] c_1 = solubility of CO_2
[e] L = Ostwald coefficient [cm^3 cm^{-3}]; calculated by compiler (PS) (ideal gas behavior assumed)

The authors also report values for viscosity μ:

$\gamma_2/\text{g L}^{-1}$	0	40	80	120	160
$\mu/\text{mPa s}$	0.890	1.028	1.217	1.431	1.664

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is a combination of previous designs (Refs 1 and 2). It was modified to achieve a more accurate determination of the volume of the absorbent liquid. The apparatus measures the volume of absorbed gas as the volume of mercury that must be supplied to the system in order to restore the initial pressure.
The raw solubility data obtained are gas/liquid volume ratios.
A detailed description of apparatus, method and procedure is given in Ref. 3.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial, purity 99.5 mole %.

(2) No details given.

(3) Distilled and degassed.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$
$\delta P/\text{bar} = \pm 0.001$
$\delta c_1/c_1 < \pm 1$ % [estimated by compiler (PS) on the basis of the information in Ref. 3]

REFERENCES:

1. Alvarez, J.R.; Fernández, A.; Coll, A. *Ing. Quím.* 1984, *16*, 67.
2. Haimour, N. *J. Chem. Eng. Data* 1990, *35*, 177.
3. Vázquez, G.; Chenlo, F.; Pereira, G.; Peaguda, J. *J. Chem. Eng. Data* 1994, *39*, 639.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Copper sulfate; $CuSO_4$; [7758-98-7]

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

ORIGINAL MEASUREMENTS:

Vázquez, G.; Chenlo, F.; Pereira, G.; Peaguda, J.

An. Quim. 1994, *90*, 324-28.

VARIABLES:

$T/K = 293.1 - 313.1$
$P_1/bar = 1.013$
$m_2/mol\ kg^{-1} = 0.250 - 1.006$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

T/K	$\gamma_2/g\ L^{-1}$ [a]	$\rho/kg\ m^{-3}$ [b]	$m_2/mol\ kg^{-1}$ [c]	$c_1/mol\ dm^{-3}$ [d]	L [e]
293.1			0.250	0.0310	0.746
			0.502	0.0269	0.646
			0.753	0.0236	0.567
			1.006	0.0205	0.494
298.1	40	1041	0.250	0.0275	0.672
	80	1079	0.502	0.0237	0.580
	120	1118	0.753	0.0208	0.510
	160	1156	1.006	0.0181	0.443
303.1			0.250	0.0241	0.600
			0.502	0.0204	0.508
			0.753	0.0183	0.456
			1.006	0.0162	0.403
308.1			0.250	0.0209	0.529
			0.502	0.0178	0.450
			0.753	0.0157	0.397
			1.006	0.0139	0.352
313.1			0.250	0.0186	0.478
			0.502	0.0158	0.405
			0.753	0.0142	0.364
			1.006	0.0129	0.332

[a] γ_2 = mass concentration of $CuSO_4$
[b] ρ = density of aqueous $CuSO_4$ solution
[c] m_2 = molality of $CuSO_4$; calculated by compiler
[d] c_1 = solubility of CO_2
[e] L = Ostwald coefficient [$cm^3\ cm^{-3}$]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is a combination of previous designs (Refs 1 and 2). It was modified to achieve a more accurate determination of the volume of the absorbent liquid. The apparatus measures the volume of absorbed gas as the volume of mercury that must be supplied to the system in order to restore the initial pressure.
The raw solubility data obtained are gas/liquid volume ratios.
A detailed description of apparatus, method and procedure is given in Ref. 3.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial, purity 99.95 mole %.

(2) Merck. Grade not given.

(3) Distilled and degassed.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$
$\delta P/bar = \pm 0.001$
$\delta c_1/c_1 < \pm 1\ \%$ (estimated by compiler on the basis of the information in Ref. 3)

REFERENCES:

1. Alvarez, J.R.; Fernández, A.; Coll, A. *Ing. Quím.* 1984, *16*, 67.
2. Haimour, N. *J. Chem. Eng. Data* 1990, *35*, 177.
3. Vázquez, G.; Chenlo, F.; Pereira, G.; Peaguda, J. *J. Chem. Eng. Data* 1994, *39*, 639.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Hydrated ferric oxide; $Fe_2O_3 \cdot xH_2O$; [12259-21-1]

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

ORIGINAL MEASUREMENTS:

Shkol'nikova, R.I.

Uch. Zap. Leningr. Gos. Unov., Ser. Khim. Nauk. 1959, Nr. 18, 64-86.

Chem. Abstr. 1961, *55*, 25443b.

VARIABLES:

T/K = 293.15 - 313.15
P/kPa = 101.325
10^2w_2 = 0 - 0.8

PREPARED BY:

H.L. Clever
A.L. Cramer

EXPERIMENTAL VALUES:

T/K	10^2w_2 [a]	$10^3\alpha$ [b]
293.15	0.1	763.1
303.15		592.0
313.15		469.1
293.15	0.5	797.0
303.15		616.0
313.15		482.0
293.15	0.82	809.0
303.15		635.0
313.15		495.0

[a] w_2 = mass fraction of component 2.
[b] α =Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

The enthalpy of solution of CO_2 from the temperature coefficient of the Bunsen coefficient is 23.640 kJ mol^{-1} (5650 cal mol^{-1}) in water and 18.577 kJ mol^{-1} (4440 cal mol^{-1}), 18.912 kJ mol^{-1} (4520 cal mol^{-1}), and 18.326 kJ mol^{-1} (4380 cal mol^{-1}) for the 0.1 , 0.5 and 0.8 mass % $Fe_2O_3 \cdot xH_2O$ solution, respectively.

The values for the solubility of CO_2 in water were not given in the paper.

$Fe_2O_3 \cdot xH_2O$ is described as a sol (colloidal).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus and procedure of Lannung were modified (Ref. 1).

SOURCE AND PURITY OF MATERIALS:

(1) Source not given. Stated to be 99.98 %.

(2) No information.

(3) No information.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Lannung, A.

J. Am. Chem. Soc. 1930, *52*, 68.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Ferric hydroxide (colloidal); $Fe(OH)_3$; [1309-33-7]

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

ORIGINAL MEASUREMENTS:

Findlay, A.; Creighton, H.J.M.

J. Chem. Soc. 1910, *97*, 536-61.

VARIABLES:

$T/K = 298.15$

$p_1/kPa = 99.5 - 180.8$

$10^2\gamma_2/g\ cm^{-3} = 0.569 - 1.661$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	$10^2\gamma_2/g\ cm^{-3}$ [a]	$\rho/g\ cm^{-3}$	p_1/bar	S [b]	p_1/bar	S [b]
298.15	0.569	1.000	1.000	0.848	1.128	0.843
			1.237	0.841	1.353	0.842
			1.528	0.845	1.808	0.846
298.15	0.854	1.003	1.000	0.862	1.129	0.858
			1.231	0.856	1.387	0.857
			1.645	0.860	1.763	0.861
298.15	1.277	1.005	0.995	0.886	1.121	0.881
			1.313	0.880	1.428	0.878
			1.511	0.878	1.675	0.887
298.15	1.661	1.009	0.996	0.904	1.108	0.901
			1.224	0.896	1.336	0.900
			1.533	0.900	1.689	0.902

[a] γ_2 = mass concentration of ferric hydroxide

[b] $$S = \frac{\text{concentration of gas in liquid phase}}{\text{concentration of gas in gaseous phase}}$$

Solubility in water: Ostwald coefficient $L = 0.817\ cm^3\ cm^{-3}$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas burette and absorption pipette similar to that of Geffcken (Ref. 1) except that the manometer tube was longer to give higher pressures. Concentration of ferrous hydroxide determined by precipitation with ammonium sulfate.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.42 mole %.

(2) Ferric hydroxide solution was prepared by the method of Noyes (Ref. 2.) and dialysed.

(3) Nothing specified.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta S = \pm 0.25$ %

REFERENCES:

1. Geffcken, G. *Z. Phys. Chem., Stoechiom. Verwandtschaftsl.* 1904, *49*, 257-302.

2. Noyes, A. A. *J. Am. Chem. Soc.* 1905, *37*, 94.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Ferric hydroxide (colloidal); (Iron hydroxide); $Fe(OH)_3$; [1309-33-7]

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

ORIGINAL MEASUREMENTS:

Findlay, A.; Williams, T.

J. Chem. Soc. 1913, *103*, 636-45.

VARIABLES:

$T/K = 298.15$

$p_1/kPa = 31.1 - 99.5$

$10^2\gamma_2/g\ cm^{-3} = 0.63$ and 1.26

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	$10^2\gamma_2/g\ cm^{-3}$ [a]	$\rho/g\ cm^{-3}$	p_1/bar	S [b]	p_1/bar	S [b]
298.15	0.63	1.003	0.333	1.044	0.475	0.984
			0.588	0.954	0.819	0.920
			0.995	0.904		
298.15	1.26	1.006	0.311	1.286	0.437	1.165
			0.545	1.107	0.783	1.029
			0.987	0.989		

[a] γ_2 = mass concentration ferric hydroxide

[b] $$S = \frac{\text{concentration of gas in liquid phase}}{\text{concentration of gas in gaseous phase}}$$

Solubility in water: Ostwald coefficient $L = 0.816\ cm^3\ cm^{-3}$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric static method. Care was taken to reduce dead space because of the small amounts of gas absorbed. Apparatus similar to that described in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) No details given.

(2) Prepared by method of Noyes (Ref. 2).

(3) Nothing specified

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta S = \pm 1\ \%$

(estimated by compiler)

REFERENCES:

1. Findlay, A.; Creighton, H.J.M. *J. Chem. Soc.* 1910, *97*, 536-61.
2. Noyes, A. A. *J. Am. Chem. Soc.* 1905, *37*, 94.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Ferric hydroxide (colloidal); $Fe(OH)_3$; [1309-33-7]

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

ORIGINAL MEASUREMENTS:

Gatterer, A.

J. Chem. Soc. (London) 1926, *129*, 299-316.

VARIABLES:

$T/K = 278.12 - 298.15$
$c_2/\text{mol L}^{-1} = 0 - 0.967$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	$c_2/\text{mol L}^{-1}$ [b]	L [c]
4.97	278.12	0	1.446
		0.071	1.471
		0.144	1.503
		0.293	1.534
		0.513	1.584
		0.967	1.680
9.95	283.10	0	1.240
		0.071	1.267
		0.144	1.297
		0.293	1.326
		0.513	1.379
		0.967	1.470
14.96	288.11	0	1.070
		0.071	1.095
		0.144	1.123
14.96	288.11	0.293	1.154
		0.513	1.204
		0.967	1.291
19.98	293.13	0	0.936
		0.071	0.9610
		0.144	0.9870
		0.293	1.016
		0.513	1.066
		0.967	1.149
25.00	298.15	0	0.826
		0.071	0.8533
		0.144	0.8764
		0.293	0.9063
		0.513	0.9526
		0.967	1.032

[a] Calculated by the compiler.

[b] c_2 means the concentration of entities 1/3 $Fe(OH)_3$. $c_2 = c\{1/3\ Fe(OH)_3\}$
$M\{1/3\ Fe(OH)_3\} = 35.621\ \text{g mol}^{-1}$

Author: "Although it is uncertain whether the colloids in question have definite chemical formulæ, yet for the sake of clearness the gram-equivalent of ferric hydroxide was taken as 1/3 $Fe(OH)_3$ = 35.621."

[c] L = Ostwald coefficient (cm^3/cm^{-3}). The values represented in table are mean values of measurements.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method of Ostwald was employed. [1] The solutions were freed from air by boiling in a vacuum and, without contact with air, transferred to the vacuum mixing vessel at 25 °C. The gas was saturated with water vapor at the same temperature. Five measurements were made with a given solution at five different temperatures, the process being repeated after an interval of several hours to check the former result.

SOURCE AND PURITY OF MATERIALS:

(1) Carefully washed. Purity of CO_2 was confirmed by the value obtained for its solubility in distilled water.

(2) A solution of pure ferric hydroxide in acetic acid was diluted and boiled until the ratio of acetic acid to ferric hydroxide became 1:30 - 1:60. The solution was then evaporated under reduced pressure.

(3) Not specified.

ESTIMATED ERROR:

$\delta L/L = \pm 0.004$ (by author)

REFERENCES:

1. Ostwald, W.; Luther, R. *Handbuch der Physicochemischen Messungen*, 3rd ed., 1910, p. 246.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Ferrous ammonium sulfate; $(NH_4)_2SO_4\ FeSO_4.6H_2O$; [7783-85-9]

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

ORIGINAL MEASUREMENTS:

Findlay, A; Shen, B.

J. Chem. Soc. 1912, *101*, 1459-68.

VARIABLES:

$T/K = 298.15$

$10^2\gamma_2/g\ cm^{-3} = 9.51 - 22.47$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	$10^2\gamma_2/g\ cm^{-3}$ [a]	$\rho/g\ cm^{-3}$	S [b]	10^4x_1 (p = 1 atm) [c]
298.15	9.51	1.052	0.641	4.94
	10.26	1.057	0.629	4.86
	22.47	1.124	0.460	3.75

[a] γ = mass concentration of salt

[b] $$S = \frac{\text{concentration of gas in liquid phase}}{\text{concentration of gas in gaseous phase}}$$

Solubility was stated to be independent of pressure (over 1-2 atm pressure range); value quoted is the mean.

[c] Calculated by compiler assuming $V_{m,1} = 24.3 \times 10^{-3}\ m^3\ mol^{-1}$ at 1 atm.

Solubility in water: Ostwald coefficient $L = 0.825\ cm^3\ cm^{-3}$.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas buret and absorption pipet. Manometer tube was of such length as to allow measurements up to 2 x 10^5 Pa (about 2 atm).

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.95 mole %.

(2) No details given.

(3) No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta S = \pm 1$ %.

(estimated by compiler)

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Ferriferrocyanide (colloidal); (Prussian blue); [14038-43-8]; [12240-15-2]

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

ORIGINAL MEASUREMENTS:

Gatterer, A.

J. Chem. Soc. (London) 1926, *129*, 299-316.

VARIABLES:

$T/\mathrm{K} = 278.12 - 298.15$

$c_2/\mathrm{mol\ L^{-1}} = 0 - 0.896$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/°\mathrm{C}$	T/K [a]	$c_2/\mathrm{mol\ L^{-1}}$ [b]	L [c]
4.97	278.12	0	1.446
		0.126	1.465
		0.178	1.472
		0.37	1.478
		0.51	1.464
		0.896	1.453
9.95	283.10	0	1.240
		0.126	1.258
		0.178	1.268
		0.37	1.277
		0.51	1.264
		0.896	1.255
14.96	288.11	0	1.070
		0.126	1.089
		0.178	1.098
14.96	288.11	0.37	1.106
		0.51	1.093
		0.896	1.087
19.98	293.13	0	0.936
		0.126	0.9549
		0.178	0.9633
		0.37	0.9684
		0.51	0.9613
		0.896	0.9512
25.00	298.15	0	0.826
		0.126	0.8443
		0.178	0.8530
		0.37	0.8577
		0.51	0.8505
		0.896	0.8421

[a] Calculated by the compiler.

[b] c_2 means the concentration of entities $1/12\ Fe_4[Fe(CN)_6]_3$.
$c_2 = c\{1/12\ Fe_4[Fe(CN)_6]_3\}$; $M\{1/12\ Fe_4[Fe(CN)_6]_3\} = 71.603\ \mathrm{g\ mol^{-1}}$

Author: "Although it is uncertain whether the colloids in question have definite chemical formulæ, yet for the sake of clearness the gram-equivalent of Prussian blue was taken as $1/12\ Fe_4[Fe(CN)_6]_3 = 71.603$."

[c] L = Ostwald coefficient ($\mathrm{cm^3/cm^{-3}}$). The values represented in table are mean values of measurements.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method of Ostwald was employed. [1] The solutions were freed from air by boiling in a vacuum and, without contact with air, transferred to the vacuum mixing vessel at 25 °C. The gas was saturated with water vapor at the same temperature. Five measurements were made with a given solution at five different temperatures, the process being repeated after an interval of several hours to check the former result.

SOURCE AND PURITY OF MATERIALS:

(1) Carefully washed. Purity of CO_2 was confirmed by the value obtained for its solubility in distilled water.

(2) Prepared by mixing sodium ferrocyanide and ferric chloride, washed, redissolved, concentrated.

(3) Not specified.

ESTIMATED ERROR:

$\delta L/L = \pm\ 0.004$ (by author)

REFERENCES:

1. Ostwald-Luther, "Handbuch der Physicochemischen Messungen" 1910, 3rd ed., p. 246.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Magnesium chloride; $MgCl_2$; [7786-30-3]

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

ORIGINAL MEASUREMENTS:

Yasunishi, A.; Yoshida, F.

J. Chem. Eng. Data 1979, *24*, 11-14.

VARIABLES:

$T/K = 288.15 - 308.15$
$P/kPa = 101.325$
$c_2/mol\ L^{-1} = 0 - 3.955$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	$c_2/mol\ L^{-1}$	L [a]	T/K	$c_2/mol\ L^{-1}$	L [a]
288.15	0	1.0634	298.15	2.392	0.3045
	0.356	0.9098		2.797	0.2643
	0.767	0.7642		3.141	0.2314
	1.215	0.6262		3.609	0.1879
	1.588	0.5374		3.955	0.1648
	2.141	0.4286			
	2.568	0.3631	308.15	0	0.6675
	2.921	0.3121		0.146	0.6241
	3.572	0.2332		0.411	0.5685
	3.766	0.1876		0.514	0.5428
				0.973	0.4486
298.15	0	0.8264		1.218	0.4048
	0.363	0.7023		1.810	0.3216
	0.738	0.6038		2.172	0.2805
	1.252	0.4813		2.511	0.2468
	1.633	0.4112		3.253	0.1965
	2.018	0.3537		3.743	0.1604

[a] L = Ostwald coefficient ($cm^3\ cm^{-3}$)

P = 1 atm = 101.325 kPa = 1.01325 bar

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Density and composition of solution determined after absorption. Details in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) High purity grade sample, purity 99.96 mole %.

(2,3) Guaranteed reagent, solution degassed by boiling.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta L = \pm 1$ %.

REFERENCES:

1. Tokunaga, J. *J. Chem. Eng. Data* 1975, *20*, 41.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Magnesium chloride; $MgCl_2$; [7786-30-3]

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

ORIGINAL MEASUREMENTS:

He, S.; Morse, J.W.

Geochim. Cosmochim. Acta 1993, *57*, 3533-54.

VARIABLES:

$T/K = 273.15 - 363.15$
$P/MPa = 0.1032$
$m_2/mol\ kg^{-1} = 0.1 - 5.021$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

T/K [a]	$m_2/mol\ kg^{-1}$ [b]	$\rho/g\ cm^{-3}$ [c]	$10^2 p_1/atm$ [d]	$10^3 m_1/mol\ kg^{-1}$ [e]	γ_1 [f]
273.15	0.1	1.0090	96.6	70.3	1.07
	1.0	1.0732		49.2	1.53
	2.0	1.1430		35.7	2.11
	3.0	1.1980		24.9	3.03
	4.0	1.2530		15.6	4.83
	5.0	1.3014		10.2	7.52
298.15	0.1	1.0056	94.2	30.0	1.07
	1.0	1.0680		21.8	1.47
	2.0	1.1342		17.1	2.25
	3.0	1.1917		9.9	3.24
	5.0	1.2948		6.7	4.83
323.15	0.215	1.0049	85.4	15.8	1.06
	1.128	1.0669		15.5	1.23
	1.831	1.1119		10.9	1.52
	3.024	1.1827		9.6	1.73
	4.021	1.1368		8.7	1.91
	5.021	1.2862		7.5	2.22
348.15	0.1	0.9842	60.3	7.7	1.05
	1.0	1.0460		7.3	1.11
	2.0	1.1109		6.6	1.23
	3.0	1.1701		6.3	1.28
	5.0	1.2742		5.7	1.42
363.15	0.1	0.9751	30.1	3.3	1.04
	1.0	1.0376		3.1	1.10
	2.0	1.1307		2.9	1.23
	3.0	1.1629		2.7	1.27
	5.0	1.2676		2.4	1.40

[a] Calculated by compiler
[b] m_2 = molality of $MgCl_2$
[c] ρ = density of solvent
[d] p_1 = partial pressure of CO_2
[e] m_1 = molality of CO_2
[f] γ_1 = activity coefficient of CO_2

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Either pure CO_2 gas or CO_2-N_2 mixtures were used in the experiments to maintain a constant $P(CO_2)$. The CO_2-N_2 mixtures were made by pumping predetermined amounts of CO_2 and N_2 into a gas tank and their composition was verified by gas chromatography.
CO_2 or CO_2-N_2 gas mixtures were equilibrated with the aqueous solutions in a series of stirred water-jacketed reaction vessels with condensers. The gas was premoistured by first passing it through distilled water at the temperature of experiment. Fine bubbles were obtained by using gas-dispersion tubes. The bubbling rate was 90 to 95 mL min^{-1}.
The mole fraction of CO_2 in the CO_2-N_2 mixture was determined using a Hewlett Packard (5790A) gas chromatograph.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial; purity 99.9 %.

(2) Source not mentioned. Analytical reagent-grade which met ACS specifications. $MgCl_2 \cdot 6H_2O$ was weighed and dissolved in water. The concentration of $MgCl_2$ in solutions was determined by analyzing Cl^- concentration via $AgNO_3$ titration in stock solutions.

(3) 18 MΩ water obtained from a Milli-Q Super-Q water system.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$
$\delta m_1/m_1 = \pm 0.012$
$\delta \gamma_1/\gamma_1 = \pm 0.04$

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Magnesium sulfate; $MgSO_4$; [7487-88-9]

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

ORIGINAL MEASUREMENTS:

Setchenow, J. [Sechenov, I.M.]

Ann. Chim. Phys. [6] 1892, *25*, 226-70.

VARIABLES:

$T/K = 288.35$

$c_2/\text{mol dm}^{-3} = 0 - 2.617$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	Dilution x	$c_2/\text{mol dm}^{-3}$ [a]	α [b]	$k_{scc}/\text{dm}^3\ \text{mol}^{-1}$ [a,c]
15.2	288.35	∞	0	1.009	-
		12	0.218	0.901	0.225
		8	0.327	0.822	0.272
		4	0.654	0.669	0.273
		2	1.309	0.441	0.275
		1	2.617	0.188	0.279

[a] Calculated by the compiler.

[b] α = Bunsen coefficient [cm^3 (STP) $\text{cm}^{-3}\ \text{atm}^{-1}$].

[c] k_{scc} = Setchenow salt effect parameter; $k_{scc} = (1/c_2)\ \lg(\alpha^\circ/\alpha)$.

Initial solution: 31.50 g $MgSO_4$ + water to make 100 cm^3 of solution.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Setchenow (Ref. 1) based his apparatus on those of Fernet (1857) and of Meyer (1857). The manometer was based on ideas he learned from Regnault in 1861. The one meter manometer had three branches, two for measuring the pressure and one a mercury reservoir. The manometer was connected to the absorption cell by a flexible silver capillary. The absorption cell was of two bulbs with a mark in the constricting connection. CO_2 gas was generated, saturated with water vapor and filled the bulbs and manometer to a known pressure less than atmospheric. The liquid was degassed by heating and then passed by the pressure difference into the lower bulb to the mark of known volume. The system was sealed, turned 90 degrees and shaken until equilibrium was established. The gas volume absorbed was reduced to 0 °C and one meter Hg pressure. The Bunsen coefficient was calculated.

SOURCE AND PURITY OF MATERIALS:

(1) Apparently generated from limestone and sulfuric acid. Dried.

(2) Not specified.

(3) Not specified, assumed to be distilled.

ESTIMATED ERROR:

The author makes a qualitative statement that the results are good to the second decimal.

REFERENCES:

1. Setchenow, J.

Akad. Nauk. SSSR Mem. Acad. imp. Sci. St. Petersburg 1887, *35*, [Ser. No. 7], 1-59.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Magnesium sulfate; $MgSO_4$; [7487-88-9]

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

ORIGINAL MEASUREMENTS:

Markham, A.A.; Kobe, K.A.

J. Am. Chem. Soc. 1941, *63*, 449-54.

VARIABLES:

$T/K = 273.35 - 313.15$

$P/kPa = 101.325$

$m_2/mol\ kg^{-1} = 0 - 2$

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

$t/^{o}C$	T/K	$m_2/mol\ kg^{-1}$	α [a]	S [b]
0.2	273.35	0.0	1.7023	1.7025
		0.5	1.1988	1.1986
		1	0.8448	0.8470
		2	0.4128	0.4201
25	298.15	0.0	0.7565	0.7587
		0.5	0.5580	0.5606
		1	0.4147	0.4186
		2	0.2250	0.2306
40	313.15	0.0	0.5133	0.5173
		0.5	0.3814	0.3852
		1	0.2948	0.2992
		2	0.1658	0.1708

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[b] S = Kuenen coefficient [cm^3 (STP) $g^{-1}(H_2O)$ atm^{-1}].

The authors fitted their data to equations:

$S_m/S_o = am_2 + 1/(1 + bm_2)$, as follows:

$t/^{o}C$	a	b
0.2	-0.0852	0.701
25	-0.0808	0.575
40	-0.0736	0.545

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which the gas is agitated with a measured quantity of gas-free liquid and the decrease in volume of solution-saturated gas is measured in a burette over mercury. The pressure was adjusted to yield one atmosphere partial pressure of carbon dioxide. The volume of gas was reduced to 0°C by the ideal gas law. Experiments were conducted to show that the agitation did not cause supersaturation.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial cylinder, 99.8 % pure.

(2) Analytical grade.

(3) Distilled and degassed.

ESTIMATED ERROR:

$\delta T/K$ = <± 0.1 at 0.2°C, ± 0.03 at other temperatures (authors),

$\delta\alpha/\alpha$, $\delta S/S$ = ± 0.002 (authors).

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Magnesium sulfate; $MgSO_4$; [7487-88-9]

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

VARIABLES:

$T/\mathrm{K} = 288.15 - 333.15$
$P/\mathrm{kPa} = 101.325$
$c_2/\mathrm{mol\ dm^{-3}} = 0 - 2$

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

$t/°\mathrm{C}$	T/K	$c_2/\mathrm{mol\ dm^{-3}}$	α [a]	S [b]
15	288.15	0	0.990	-
		0.25	0.845	0.850
		0.5	0.717	0.722
		1	0.565	0.569
		2	0.260	0.266
20	293.15	0	0.860	-
		0.25	0.752	0.7575
		0.5	0.617	0.621
		1	0.481	0.4863
		2	0.255	0.261
25	298.15	0	0.758	-
		0.25	0.661	0.667
		0.5	0.552	0.557
		1	0.416	0.421
		2	0.203	0.2083
30	303.15	0	0.671	-
		0.25	0.597	0.602
		0.5	0.488	0.493
		1	0.373	0.378
		2	0.175	0.180

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which a measured volume of gas-free liquid is stirred in the presence of the gas, and its decrease in volume is measured in a burette over mercury. The volume of liquid was measured at the experimental temperature. For calculation of the Kuenen coefficient, the density of the solution was obtained from Landolt-Börnstein extant 1969. The molar concentration of salt in the liquid was standardized at 20°C. These data are analyzed and discussed further in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) VEB Leuna Works; 99.8 vol %; the impurity was mostly water (author).

(2) DDR pro analysis grade by DDR Standard TGL 5021.

(3) Double distilled.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Gerecke, J.; Bittrich, H.J. *Wiss. Z. Tech. Hochsch. Chem. "Carl Schorlemmer" Leuna-Merseburg* 1971, *13*(2), 115-22.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Magnesium sulfate; $MgSO_4$; [7487-88-9] (3) Water; H_2O; [7732-18-5]	Gerecke, J. *Diss. Dr. rer. Nat.* 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

EXPERIMENTAL VALUES:

(continued)

t/°C	T/K	c_2/mol dm^{-3}	α [a]	S [b]
35	308.15	0	0.605	-
		0.25	0.522	0.5275
		0.5	0.432	0.437
		1	0.337	0.342
		2	0.160	0.1646
40	313.15	0	0.546	-
		0.25	0.461	0.467
		0.5	0.379	0.384
		1	0.297	0.302
		2	0.140	0.1444
45	318.15	0	0.482	-
		0.25	0.414	0.420
		0.5	0.339	0.344
		1	0.270	0.275
		2	0.126	0.1302
50	323.15	0	0.436	-
		0.25	0.374	0.379
		0.5	0.305	0.310
		1	0.243	0.2475
		2	0.113	0.117
55	328.15	0	0.392	-
		0.25	0.334	0.339
		0.5	0.273	0.2775
		1	0.223	0.2275
		2	0.101	0.1048
60	333.15	0	0.372	-
		0.5	0.203	0.2073
		1	0.093	0.096

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[b] S = Kuenen coefficient [cm^3 (STP) g^{-1} (H_2O) atm^{-1}].

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Magnesium sulfate; $MgSO_4$; [7487-88-9]

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

ORIGINAL MEASUREMENTS:

Yasunishi, A.; Yoshida, F.

J. Chem. Eng. Data 1979, *24*, 11-14.

VARIABLES:

$T/K = 298.15$
$P/kPa = 101.325$
$c_2/mol\ L^{-1} = 0 - 2.274$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	$c_2/mol\ L^{-1}$	L [a]
298.15	0	0.8264
	0.118	0.7634
	0.418	0.6480
	0.724	0.5355
	1.020	0.4513
	1.375	0.3636
	1.643	0.3047
	2.013	0.2382
	2.274	0.2049

[a] L = Ostwald coefficient ($cm^3\ cm^{-3}$)

P = 1 atm = 101.325 kPa = 1.01325 bar

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Density and composition of solution determined after absorption. Details in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) High purity grade sample, purity 99.96 mole %.

(2,3) Guaranteed reagent, solution degassed by boiling.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta L = \pm 1$ %.

REFERENCES:

1. Tokunaga, J. *J. Chem. Eng. Data* 1975, *20*, 41.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Magnesium sulfate; $MgSO_4$; [7487-88-9]

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

ORIGINAL MEASUREMENTS:

He, S.; Morse, J.W.

Geochim. Cosmochim. Acta 1993, *57*, 3533-54.

VARIABLES:

$T/K = 273.15 - 363.15$

$P/MPa = 0.1032$

$m_2/mol\ kg^{-1} = 0.099 - 4.003$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

T/K [a]	$m_2/mol\ kg^{-1}$ [b]	$\rho/g\ cm^{-3}$ [c]	$10^2 p_1/atm$ [d]	$10^3 m_1/mol\ kg^{-1}$ [e]	γ_1 [f]
273.15	0.106	1.0150	96.6	69.8	1.08
	0.498	1.0632		58.6	1.29
	1.000	1.1200		45.5	1.65
	1.493	1.1705		30.4	2.47
	1.796	1.1989		22.4	3.37
298.15	0.1	1.0101	94.2	30.5	1.05
	0.5	1.0565		27.4	1.17
	1.0	1.1114		23.7	1.36
	1.5	1.1628		15.8	2.03
	2.2	1.2288		12.5	2.56
323.15	0.099	1.0005	85.4	15.8	1.05
	0.507	1.0461		14.3	1.16
	1.004	1.0996		13.3	1.25
	2.011	1.2005		9.2	2.02
	2.973	1.2879		5.1	2.35
	4.003	1.3717		3.9	4.28
348.15	0.1	0.9875	60.3	7.9	1.03
	1.0	1.0859		7.0	1.15
	2.0	1.1872		6.3	1.27
	3.0	1.2801		5.6	1.43
	4.0	1.3646		4.9	1.64
363.15	0.1	0.9783	30.1	3.4	1.02
	1.0	1.0778		3.1	1.11
	2.0	1.1801		2.8	1.24
	3.0	1.2735		2.5	1.37
	4.0	1.3581		2.2	1.53

[a] Calculated by compiler

[b] m_2 = molality of $MgSO_4$

[c] ρ = density of solvent

[d] p_1 = partial pressure of CO_2

[e] m_1 = molality of CO_2

[f] γ_1 = activity coefficient of CO_2

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Either pure CO_2 gas or CO_2-N_2 mixtures were used in the experiments to maintain a constant $P(CO_2)$. The CO_2-N_2 mixtures were made by pumping predetermined amounts of CO_2 and N_2 into a gas tank and their composition was verified by gas chromatography.

CO_2 or CO_2-N_2 gas mixtures were equilibrated with the aqueous solutions in a series of stirred water-jacketed reaction vessels with condensers. The gas was premoistured by first passing it through distilled water at the temperature of experiment. Fine bubbles were obtained by using gas-dispersion tubes. The bubbling rate was 90 to 95 mL min^{-1}.

The mole fraction of CO_2 in the CO_2-N_2 mixture was determined using a Hewlett Packard (5790A) gas chromatograph.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial; purity 99.9 %.

(2) Source not mentioned.
Analytical reagent-grade which met ACS specifications.
Vacuum-dried before use.

(3) 18 MΩ water obtained from a Milli-Q Super-Q water system.

ESTIMATED ERROR:

$\delta T/K = \pm\ 0.1$

$\delta m_1/m_1 = \pm\ 0.012$

$\delta \gamma_1/\gamma_1 = \pm\ 0.04$

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Magnesium nitrate; $Mg(NO_3)_2$; [10377-60-3]

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

ORIGINAL MEASUREMENTS:

Markham, A.A.; Kobe, K.A.

J. Am. Chem. Soc. 1941, *63*, 449-54.

VARIABLES:

T/K = 273.35 - 313.15
P/kPa = 101.325
m_2/mol kg^{-1} = 0 - 3

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

t/°C	T/K	m_2/mol kg^{-1}	α [a]	S [b]
0.2	273.35	0.0	1.7023	1.7025
		0.5	1.3928	1.4172
		1	1.1439	1.1863
		2	0.7849	0.8488
		3	0.5612	0.6326
25	298.15	0.0	0.7565	0.7587
		0.5	0.6476	0.6627
		1	0.5588	0.5840
		2	0.4200	0.4587
		3	0.3225	0.3683
40	313.15	0.0	0.5133	0.5173
		0.5	0.4460	0.4590
		1	0.3900	0.4102
		2	0.3015	0.3316
		3	0.2375	0.2736

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[b] S = Kuenen coefficient [cm^3 (STP) g^{-1}(H_2O) atm^{-1}].

The authors fitted their data to equations:

$S_m/S_o = am_2 + 1/(1 + bm_2)$, as follows:

t/°C	a	b
0.2	-0.0361	0.366
25	-0.0268	0.257
40	-0.0211	0.230

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which the gas is agitated with a measured quantity of gas-free liquid and the decrease in volume of solution-saturated gas is measured in a burette over mercury. The pressure was adjusted to yield one atmosphere partial pressure of carbon dioxide. The volume of gas was reduced to 0°C by the ideal gas law. Experiments were conducted to show that the agitation did not cause supersaturation.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial cylinder, 99.8 % pure.

(2) Analytical grade.

(3) Distilled and degassed.

ESTIMATED ERROR:

δT/K = <± 0.1 at 0.2°C, ± 0.03 at other temperatures (authors),
$\delta\alpha/\alpha$, $\delta S/S$ = ± 0.002 (authors).

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Magnesium nitrate; $Mg(NO_3)_2$; [10377-60-3]

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

ORIGINAL MEASUREMENTS:

Yasunishi, A.; Yoshida, F.

J. Chem. Eng. Data 1979, *24*, 11-14.

VARIABLES:

$T/K = 298.15$
$P/kPa = 101.325$
$c_2/mol\ L^{-1} = 0 - 3.372$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	$c_2/mol\ L^{-1}$	L [a]
298.15	0	0.8264
	0.203	0.7771
	0.364	0.7435
	0.415	0.7328
	0.636	0.6873
	1.003	0.6129
	1.007	0.6112
	1.076	0.5975
	1.158	0.5805
	1.170	0.5767
	1.350	0.5463
	1.746	0.4801
	1.925	0.4508
	2.186	0.4186
	2.587	0.3656
	2.930	0.3253
	3.372	0.2796

[a] L = Ostwald coefficient ($cm^3\ cm^{-3}$)

P = 1 atm = 101.325 kPa = 1.01325 bar

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Density and composition of solution determined after absorption. Details in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) High purity grade sample, purity 99.96 mole %.

(2,3) Guaranteed reagent, solution degassed by boiling.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta L = \pm 1$ %.

REFERENCES:

1. Tokunaga, J. *J. Chem. Eng. Data* 1975, *20*, 41.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Calcium chloride; $CaCl_2$; [10043-52-4]

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

ORIGINAL MEASUREMENTS:

Setchenow, J. [Sechenov, I.M.]

Ann. Chim. Phys. [6] 1892, *25*, 226-70.

VARIABLES:

$T/K = 288.35$
$c_2/\text{mol dm}^{-3} = 0 - 4.343$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	Dilution x	$c_2/\text{mol dm}^{-3}$ [a]	α [b]	$k_{scc}/\text{dm}^3\text{ mol}^{-1}$ [a,c]
15.2	288.35	∞	0	1.009	-
		30	0.1448	0.943	0.203
		15	0.2895	0.867	0.228
		10	0.4343	0.817	0.211
		8	0.5429	0.770	0.216
		5	0.8686	0.675	0.201
		4	1.086	0.583	0.219
		3	1.448	0.514	0.202
		2	2.171	0.344	0.215
		1.5	2.895	0.241	0.215
		1.1	3.948	0.137	0.220
		1	4.343	0.135	0.201

[a] Calculated by the compiler.

[b] α = Bunsen coefficient [cm^3 (STP) $\text{cm}^{-3}\text{ atm}^{-1}$].

[c] k_{scc} = Setchenow salt effect parameter; $k_{scc} = (1/c_2)\ \lg(\alpha^{o}/\alpha)$.

Initial solution: 48.20 g $CaCl_2$ + water to make 100 cm^3 of solution.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Setchenow (Ref. 1) based his apparatus on those of Fernet (1857) and of Meyer (1857). The manometer was based on ideas he learned from Regnault in 1861. The one meter manometer had three branches, two for measuring the pressure and one a mercury reservoir. The manometer was connected to the absorption cell by a flexible silver capillary. The absorption cell was of two bulbs with a mark in the constricting connection. CO_2 gas was generated, saturated with water vapor and filled the bulbs and manometer to a known pressure less than atmospheric. The liquid was degassed by heating and then passed by the pressure difference into the lower bulb to the mark of known volume. The system was sealed, turned 90 degrees and shaken until equilibrium was established. The gas volume absorbed was reduced to 0 °C and one meter Hg pressure. The Bunsen coefficient was calculated.

SOURCE AND PURITY OF MATERIALS:

(1) Apparently generated from limestone and sulfuric acid. Dried.

(2) Not specified.

(3) Not specified, assumed to be distilled.

ESTIMATED ERROR:

The author makes a qualitative statement that the results are good to the second decimal.

REFERENCES:

1. Setchenow, J.

Akad. Nauk. SSSR Mem. Acad. imp. Sci. St. Petersburg 1887, *35*, [Ser. No. 7], 1-59.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Calcium chloride; $CaCl_2$; [10043-52-4]

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

ORIGINAL MEASUREMENTS:

Prutton, C.F.; Savage, R.L.

J. Am. Chem. Soc. 1945, *67*, 1550-4.

VARIABLES:

$T/\text{K} = 348.65 - 394.15$
$P/\text{MPa} = 1.52 - 88.6$
$10^2 w_2 = 10.1 - 30.2$

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

$t/^\circ\text{C}$	T/K	$10^2 w_2$ [a]	P/atm	$10^3 x_1$ [b]
75.5	348.65	10.1	16	2.6
			16	2.7
			62	8.1
			63	8.3
			162	13.3
			163	13.3
			310	15.4
			328	15.8
			426	17.0
			446	16.8
			585	18.4
			620	19.2
76	349.15	20.2	22	2.2
			23	2.2
			73	5.8
			73	6.0
			165	8.8
			166	8.6
			282	9.7
			290	9.8

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Salt solution and gas were charged to a 300-ml copper-lined vessel supported in a heater, and were equilibrated by rocking. Temperature was measured by a copper constantan thermocouple placed in a well in the vessel; pressure was measured by a Crosby deadweight balance. Samples were with drawn from the bottom of the vessel into a glass trap; the gas evolved from the sample was measured in a water-jacketed buret over mercury at atmospheric pressure, and the solution residue was weighed. Correction was made for the volume of gas still disvolved in the solution. The total volume was reduced to STP and the number of moles was obtained from the molar volume of carbon dioxide, taken as 22,264 cm^3. Measurements on a charge of solution were made first at the maximum pressure, after which the pressure was reduced by venting gas. Equilibration and sampling was repeated for measurements at lower pressures.

SOURCE AND PURITY OF MATERIALS:

(1) Ohio Chemical Co., medicinal.

(2) Baker, cp.

(3) No details.

ESTIMATED ERROR:

$\delta x_1/x_1$ (mean) = < ± 0.03 (authors),
$\delta T/\text{K} = \pm 1$ (authors),
$\Delta P/P = \pm 0.0025$ or $\Delta P/\text{MPa} < 0.007$, whichever is larger (authors).

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Calcium chloride; $CaCl_2$; [10043-52-4]

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

ORIGINAL MEASUREMENTS:

Prutton, C.F.; Savage, R.L.

J. Am. Chem. Soc. 1945, *67*, 1550-4.

EXPERIMENTAL VALUES: (continued)

$t/°C$	T/K	10^2w_2 [a]	P/atm	10^3x_1 [b]
76	349.15	20.2	454	10.7
			460	10.8
			572	11.7
			600	11.8
76	349.15	30.2	15	0.9
			73	3.6
			74	3.7
			161	5.2
			163	5.1
			314	6.0
			319	6.1
			431	6.7
			455	6.6
			525	7.0
			554	7.0
			625	6.9
101	374.15	0	57	10.8
			107	15.0
			109	15.3
			210	20.5
			212	20.7
			283	22.5
			290	22.1
			320	23.3
			325	23.1
			443	25.3
			452	25.1
			518	26.6
			558	27.8
			615	28.2
101	374.15	10.1	17	2.1
			17	2.2
			56	8.1
			120	11.2
			120	11.3
			213	13.5
			213	14.0
			286	14.7
			286	15.2
			347	16.2
			352	15.9
			380	16.5
			394	16.8
			500	17.4
			575	18.5
			618	18.6
101	374.15	20.2	23	1.7
			23	1.8
			88	5.9
			91	5.8

(continued next page)

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Calcium chloride; $CaCl_2$; [10043-52-4]

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

ORIGINAL MEASUREMENTS:

Prutton, C.F.; Savage, R.L.

J. Am. Chem. Soc. 1945, *67*, 1550-4.

EXPERIMENTAL VALUES: (continued)

$t/^{\circ}C$	T/K	10^2w_2 [a]	P/atm	10^3x_1 [b]
101	374.15	20.2	142	7.4
			142	7.4
			169	8.4
			170	8.3
			290	9.7
			292	9.9
			566	11.6
			574	11.8
			648	12.3
101	374.15	30.2	74	3.1
			76	3.3
			151	4.7
			154	4.9
			234	5.4
			238	5.2
			261	5.8
			388	6.4
			389	6.4
			402	6.3
			525	7.0
			630	7.1
120	393.15	0.0	23	3.8
			23	4.0
			68	10.0
			69	10.5
			186	19.3
			187	20.0
			353	24.8
			360	25.0
			562	28.8
			570	29.0
			646	29.9
			694	30.0
121	394.15	10.1	21	2.7
			21	2.7
			76	6.1
			77	6.9
			149	11.3
			153	11.1
			297	14.8
			300	14.8
			437	16.8
			460	16.7
			585	18.4
			621	18.1
			703	19.3
121	394.15	20.2	25	1.7
			25	1.9
			63	3.9
			63	3.9

(continued next page)

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Calcium chloride; $CaCl_2$; [10043-52-4] (3) Water; H_2O; [7732-18-5]	Prutton, C.F.; Savage, R.L. *J. Am. Chem. Soc.* 1945, *67*, 1550-4.

EXPERIMENTAL VALUES: (continued)

$t/^\circ C$	T/K	$10^2 w_2$ [a]	P/atm	$10^3 x_1$ [b]
121	394.15	20.2	150	7.3
			150	7.3
			280	9.4
			282	9.4
			464	11.0
			491	11.0
			506	11.3
			602	11.7
			636	11.5
			659	11.5
121	394.15	30.2	83	3.1
			85	3.1
			148	4.5
			150	4.5
			296	5.8
			302	5.8
			450	6.3
			468	6.1
			494	6.5
			510	6.9
			665	7.4
120	393.15	10.1 [c]	28	3.0
			28	3.0
			73	7.1
			74	8.2
			155	11.6
			156	12.4
			309	15.3
			318	15.9
			480	17.9
			492	18.4
			643	19.5
			655	19.8
			830	22.0
			874	21.2

[a] w_2 = mass fraction of $CaCl_2$

[b] Based on moles of H_2O, $CaCl_2$ and CO_2

[c] Solid $CaCO_3$ was also present during this set of measurements.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Calcium chloride; $CaCl_2$; [10043-52-4] (3) Water; H_2O; [7732-18-5]	Onda, K.; Sada, E; Kobayashi, T.; Kito, S.; Ito, K. *J. Chem. Eng. Jpn* 1970, *3*, 18-24.
VARIABLES:	PREPARED BY:
$T/K = 298.15$ $P/kPa = 101.325$ $c_2/mol\ L^{-1} = 0 - 2.169$	C. L. Young

EXPERIMENTAL VALUES:

T/K	$c_2/mol\ L^{-1}$	α [a]
298.15	0	0.7595
	0.178	0.7003
	0.287	0.6646
	0.403	0.6279
	0.551	0.5920
	0.812	0.5267
	1.220	0.4471
	1.404	0.4120
	2.169	0.2986

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

P = 1 atm = 101.325 kPa = 1.01325 bar

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Solutions made up by weight and density measured but not reported in paper. Equilibrium established between a measured volume of gas and a measured amount of gas-free liquid in a cell fitted with a magnetic stirrer. Amount of gas absorbed estimated from change in volume of gas. Details in source.	(1) Commercial sample, minimum purity 99.8 mole %. (2) Analytical grade. (3) Distilled and degassed.
	ESTIMATED ERROR:
	$\delta T/K = \pm 0.2$; $\delta\alpha = \pm 2$ % (Estimated by the compiler.)
	REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Calcium chloride; $CaCl_2$; [10043-52-4]

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

ORIGINAL MEASUREMENTS:

Malinin, S. D.; Savelyeva, N. I.

**Geokhimiya* 1972, (6), 643-53;
Geochem. Int. 1972, *9*, 410-8.

VARIABLES:

T/K = 293.15 - 353.15
P/bar = 47.95
c_2/mol L^{-1} = 0 - 3.854

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	c_2/mol L^{-1}	C_1 [a]	S_1 [b]
293.15	47.95	0.00	52.84	52.84
		0.437	41.37	
			42.20+	
		0.879	33.59+	
		1.349	26.80	
			26.71	
		2.341	16.84+	
			16.81+	
		3.443	10.49	
			10.47	
323.15	47.95	0.00	32.86	32.86
		0.437	26.39	27.63
		0.5531	24.84+	26.33
			24.82+	
		1.349	17.14	19.68
		1.935	13.19	16.01
			13.19	
		2.354	11.07	13.96
353.15	47.95	0.00	23.92	23.92
		0.1554	22.01	22.46
			22.15	
		0.8766	15.33+	16.86
			15.36+	
		1.173	13.84+	15.37
			30.60+	
		1.283	12.88+	14.70
			12.68+	
		2.099	9.05	11.16
		3.854	4.58	6.69

+ Equilibrium state approached from supersaturation

[a] Solubility of CO_2: $C_1 = m_1$ (in grams) / 1 kg of solution

[b] Solubility of CO_2: $S_1 = m_1$ (in grams) / 1 kg of water

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Flow system with about 0.25 L of solution in 0.5 L stainless steel cell. After equilibrium established, liquid sampled and carbon dioxide absorbed in potassium hydroxide. Gain in weight of absorption train used to estimate amount of carbon dioxide. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) GOST 8050-64 sample.

(2) Analytical reagent grade sample.

(3) No details given.

ESTIMATED ERROR:

δT/K = ± 0.1; δC_1, δS_1 = ± 0.5 %;
δP/bar = ± 0.1

(estimated by compiler)

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Calcium chloride; $CaCl_2$; [10043-52-4]

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

ORIGINAL MEASUREMENTS:

Malinin, S. D.; Kurovskaya, N. A.

**Geokhimiya* 1975, (4), 547-50;
Geochem. Int. 1975, *12*, 199-201.

VARIABLES:

T/K = 373.15 and 423.15
P/bar = 47.95
c_2/mol L^{-1} = 0 - 6.9474

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	c_2/mol L^{-1}	S_1 [a]
373.15	47.95	0.00	19.44
			19.43+
			19.35
		1.0451	12.81
			12.79
		1.9764	9.531
			9.528
		2.9874	7.115
		4.8211	4.593
		6.0313	3.568+
			3.524+
423.15	47.95	0.00	15.21
			15.32
		0.8818	10.62
		2.5960	6.336
			6.248
		4.8672	3.680
		6.9474	2.642
			2.544

\+ Equilibrium state approached from supersaturation
[a] Solubility of CO_2: $S_1 = m_1$ (in grams) / 1 kg water

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Flow system with about 0.25 L of solution in 0.5 L stainless steel cell. After equilibrium established, liquid sampled and carbon dioxide absorbed in potassium hydroxide. Gain in weight of absorption train used to estimate amount of carbon dioxide. Details in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

δT/K = ± 0.1; δS_1 = ± 1 %;
δP/bar = ± 0.5
(estimated by compiler)

REFERENCES:

1. Malinin, S. D.; Savelyeva, N. I.
**Geokhimiya* 1972, (6), 643-53;
Geochem. Int. 1972, *9*, 410-8.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Calcium chloride; $CaCl_2$; [10043-52-4]

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

ORIGINAL MEASUREMENTS:

Yasunishi, A.; Yoshida, F.

J. Chem. Eng. Data 1979, *24*, 11-14.

VARIABLES:

$T/K = 298.15$ and 308.15
$P/kPa = 101.325$
$c_2/mol\ L^{-1} = 0 - 4.528$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	$c_2/mol\ L^{-1}$	L [a]
298.15	0	0.8264
	0.227	0.7458
	0.558	0.6477
	0.893	0.5434
	1.237	0.4701
	1.601	0.4118
	2.008	0.3380
	2.396	0.2969
	2.809	0.2544
	3.486	0.2026
	3.801	0.1876
	4.528	0.1705
308.15	0	0.6675
	0.295	0.5786
	0.807	0.4742
	0.809	0.4708
	1.283	0.4010
	2.137	0.2864

[a] L = Ostwald coefficient ($cm^3\ cm^{-3}$)

P = 1 atm = 101.325 kPa = 1.01325 bar

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Density and composition of solution determined after absorption. Details in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) High purity grade sample, purity 99.96 mole %.

(2,3) Guaranteed reagent, solution degassed by boiling.

ESTIMATED ERROR:

$\delta T/K = \pm\ 0.05$; $\delta L = \pm\ 1\ \%$.

REFERENCES:

1. Tokunaga, J.
J. Chem. Eng. Data 1975, *20*, 41.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Calcium chloride; $CaCl_2$ [10043-54-2] (3) Water; H_2O; [7732-18-5]	Eremina, A.O.; Efanov, L.N.; Sorokina, N.A. **Zh. Fiz. Khim.* 1989, *63*, 2491-94; *Russ. J. Phys. Chem. (Engl. Transl.)* 1989, *63*, 1361-63.
VARIABLES: T/K = 298.15 and 313.15 p/MPa = 0.1 10^3c_2/mol L^{-1} = 0 - 25	PREPARED BY: Yu. P. Yampol'skii

EXPERIMENTAL VALUES:

Solubility of carbon dioxide in aqueous solutions of calcium chloride. [a]

T/K	10^3c_2/mol L^{-1} [b]	10^3c_1/mol L^{-1} [c]
298.15	0	33.90
	2.5	33.54
	5	33.25
	7.5	32.92
	10	32.58
	12.5	33.00
	13.5	32.96
	15	32.75
	16.25	32.07
	17.5	31.37
	20	29.98
	25	27.19
313.15	0	22.69
	2.5	22.43
	5	22.20
	7.5	21.95
	10	21.69
	12.5	22.00
	15	22.11
	16.25	21.78
	17.5	21.41
	20	20.68
	25	19.21

[a] Data taken from a graph by compiler.
[b] c_2 = concentration of $CaCl_2$
[c] c_1 = solubility of CO_2

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Attainment of the equilibrium was checked by the constancy of CO_2 content in 3-5 subsequent samples of gas after saturation of the solution. The concentration of carbon dioxide was determined by titration. Detailed description of the technique is given in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Source not given. Before contacting with water solutions CO_2 was allowed to pass through the vessels with $NaHCO_3$, glass beads, glass wool and distilled water.

(2) Nothing specified.

(3) Distilled.

ESTIMATED ERROR:

$\delta c_1/c_1$ = ± 0.06 - 0.2 %
δT/K = ± 0.05

REFERENCES:

1. Burmakina, G.V.; Efanov, L.N.; Shnet, M.A. **Zh. Fiz. Khim.* 1982, *56*, 1159; *Russ. J. Phys. Chem. (Engl. Transl.)* 1982, *56*, 705.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Calcium chloride; $CaCl_2$; [10043-52-4]

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

ORIGINAL MEASUREMENTS:

Plyasunova, N.V.; Shmulovich, K.I.

**Dokl. Akad. Nauk SSSR* 1991, *319*, 738-42.

Chem. Abstr. 1991, *115*, 260106 d.

VARIABLES:

$T/K = 773$
$p/MPa = 100 - 300$
$10^2w_2 = 10$ and 20

PREPARED BY:

Yu. P. Yampol'skii

EXPERIMENTAL VALUES:

Solubility of carbon dioxide in aqueous solutions of $CaCl_2$ at 773 K. [a]

10^2w_2 [b]	p/kbar	10^2w_1 [c]
10	1	12
	2	30
	3	36
20	1	5
	2	23
	3	30

[a] Data taken from a graph by compiler.

[b] w_2 = mass fraction of $CaCl_2$

[c] w_1 = mass fraction of CO_2

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Phase equilibria were studied by means of the method described in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Nothing specified.

(2) $CaCl_2 \cdot 6H_2O$ served as a source of solutions. Purity not specified.

(3) Not specified.

ESTIMATED ERROR:

$\delta T/K = \pm 5$
$\delta p/bar = \pm 50$

REFERENCES:

1. Sterner, S.M.; Bodnar, R.J. *Geochim. Cosmochim. Acta* 1984, *48*, 2659-68.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Calcium chloride; $CaCl_2$; [10043-52-4]

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

ORIGINAL MEASUREMENTS:

He, S.; Morse, J.W.

Geochim. Cosmochim. Acta 1993, *57*, 3533-54.

VARIABLES:

T/K = 273.15 - 363.15
P/MPa = 0.1032
m_2/mol kg^{-1} = 0.1 - 5.004

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

T/K [a]	m_2/mol kg^{-1} [b]	ρ/g cm^{-3} [c]	$10^2 p_1$/atm [d]	$10^3 m_1$/mol kg^{-1} [e]	γ_1 [f]
273.15	0.104	1.0214	96.6	69.7	1.08
	1.021	1.0908		53.7	1.40
	2.036	1.1696		34.6	2.18
	2.998	1.2263		25.7	2.93
	4.027	1.2991		16.9	4.45
	5.001	1.3505		10.4	7.25
298.15	0.102	1.0118	94.2	30.1	1.07
	1.001	1.1603		21.4	1.50
	2.002	1.1607		14.2	2.25
	3.001	1.2290		9.9	3.25
	5.004	1.3449		6.7	4.80
323.15	0.105	1.0143	85.4	14.1	1.05
	0.976	1.0809		10.2	1.25
	1.849	1.1435		7.9	1.69
	2.706	1.2008		6.3	1.85
	4.958	1.3321		4.2	2.56
348.15	0.101	0.9957	60.3	7.7	1.04
	0.999	1.0639		7.5	1.08
	2.001	1.1345		6.9	1.17
	3.001	1.2000		6.7	1.20
	5.001	1.3127		5.8	1.38
363.15	0.1	0.9915	30.1	6.6	1.04
	1.0	1.0567		6.4	1.07
	2.0	1.1245		6.1	1.14
	3.0	1.1874		5.9	1.17
	5.0	1.2987		5.6	1.22

[a] Calculated by compiler
[b] m_2 = molality of $CaCl_2$
[c] ρ = density of solvent
[d] p_1 = partial pressure of CO_2
[e] m_1 = molality of CO_2
[f] γ_1 = activity coefficient of CO_2

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Either pure CO_2 gas or CO_2-N_2 mixtures were used in the experiments to maintain a constant $P(CO_2)$. The CO_2-N_2 mixtures were made by pumping predetermined amounts of CO_2 and N_2 into a gas tank and their composition was verified by gas chromatography.
CO_2 or CO_2-N_2 gas mixtures were equilibrated with the aqueous solutions in a series of stirred water-jacketed reaction vessels with condensers. The gas was premoistured by first passing it through distilled water at the temperature of experiment. Fine bubbles were obtained by using gas-dispersion tubes. The bubbling rate was 90 to 95 mL min^{-1}.
The mole fraction of CO_2 in the CO_2-N_2 mixture was determined using a Hewlett Packard (5790A) gas chromatograph.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial; purity 99.9 %.

(2) Source not mentioned. Analytical reagent-grade which met ACS specifications. $CaCl_2 \cdot 2H_2O$ was weighed and dissolved in water. The concentration of $CaCl_2$ in solutions was determined by analyzing Cl^- concentration via $AgNO_3$ titration in stock solutions.

(3) 18 MΩ water obtained from a Milli-Q Super-Q water system.

ESTIMATED ERROR:

δT/K = ± 0.1
$\delta m_1/m_1$ = ± 0.012
$\delta \gamma_1/\gamma_1$ = ± 0.04

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Calcium chloride; $CaCl_2$; [10043-52-4]

(3) Ammonium nitrate; NH_4NO_3; [6484-52-2]

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

ORIGINAL MEASUREMENTS:

Onda, K.; Sada, E; Kobayashi, T.; Kito, S.; Ito, K.

J. Chem. Eng. Jpn 1970, *3*, 137-42.

VARIABLES:

$T/K = 298.15$
$P/kPa = 101.325$
$c_2/mol\ L^{-1} = 0 - 1.055$
$c_3/mol\ L^{-1} = 0 - 3.166$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	$c_2/mol\ L^{-1}$ [a]	$c_3/mol\ L^{-1}$ [a]	$I/mol\ L^{-1}$ [b]	α [b]
298.15	0	0	0	0.7595
	0.276	0.828	1.655	0.6528
	0.559	1.676	3.351	0.5628
	0.699	2.096	4.191	0.5331
	0.899	2.697	5.394	0.4744
	1.055	3.166	6.331	0.4365

[a] Calculated from ionic strength and statement in paper that ratio of ionic strength of calcium chloride to ammonium nitrate was 1:1.

[b] Quoted in original paper.
I = ionic strength; α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

P = 1 atm = 101.325 kPa = 1.01325 bar

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Concentrated solutions prepared by weighting, less concentrated solutions prepared by dilution. Equilibrium established between a measured volume of gas and a measured amount of gas-free liquid in a cell fitted with a magnetic stirrer. Amount of gas absorbed estimated from change in volume of gas. Details in source and Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial sample, purity 99.8 mole %.

(2) Analytical grade sample.

(3) No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta\alpha = \pm 2$ %

(Estimated by the compiler.)

REFERENCES:

1. Onda, K.; Sada, E; Kobayashi, T.; Kito, S.; Ito, K.

J. Chem. Eng. Jpn 1970, *3*, 18.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]
(2) Calcium chloride; $CaCl_2$; [10043-52-4]
(3) Methanol; CH_4O; [67-56-1]
(4) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sada, E.; Kito, S.; Ito, Y.
Adv. Chem. Ser. 1976, *No. 155* *(Thermodynamic Behavior of Electrolytes in Mixed Solvents Symp.,* 1975 Furter, W.F., Editor) 374-80.

VARIABLES:

$T/\text{K} = 298.15$
$p_1/\text{kPa} = 101.325$
$c_2/\text{mol dm}^{-3} = 0 - 0.9623$
$x_3 = 0.280 - 1.0$

PREPARED BY:

H.L. Clever

EXPERIMENTAL VALUES:

T/K	x_3	$c_2/\text{mol dm}^{-3}$	$I/\text{mol dm}^{-3}$	$\rho/\text{g cm}^{-3}$	α [a]
298.15	0.280	0	0	-	0.9695
		0.2024	0.6072	0.9472	0.8885
		0.3051	0.9154	0.9565	0.8486
		0.4837	1.4510	0.9721	0.7897
		0.6990	2.0969	0.9912	0.7228
	0.389	0	0	-	1.1775
		0.2130	0.6389	0.9260	1.0707
		0.2659	0.7978	0.9308	1.0546
		0.3208	0.9624	0.9358	1.0249
		0.5983	1.7948	0.9610	0.9180
		0.7502	2.2506	0.9743	0.8694
	0.587	0	0	-	1.8161
		0.2340	0.7021	0.8857	1.6361
		0.3151	0.9454	0.8931	1.5963
		0.7292	2.1877	0.9330	1.3187
	0.800	0	0	-	2.7813
		0.3257	0.9771	0.8562	2.3869
		0.5850	1.7551	0.8827	2.1193
		0.8667	2.6001	0.9112	1.8634
	1.0	0	0	-	3.9003
		0.2935	0.8805	-	3.3315
		0.6643	1.9928	0.8637	2.7794
		0.9623	2.8868	0.8952	2.4118

[a] Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Full descriptions of the apparatus and the mode of operation are given elsewhere (Ref. 1). The principle of the method is that a known volume of gas in liquid-saturated vapor state is brought into contact with a measured amount of gas-free liquid. Equilibrium is established by agitation, and the volume of gas remaining is measured. After correction for the solvent vapor pressure, the change in the gas volume gives the solubility. The vapor pressures of the salt solutions at 20 °C were calculated by use of Raoult's law.

The gas free solution was prepared by mixing methanol, water and calcium chloride, each of which was separately degassed or desorbed.

The compiler calculated the calcium chloride molar concentrations from the ionic strength given in the paper. The methanol mole fraction refers to the salt free liquid. The salt effect in water is in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Source not given, commercial cylinder. Purity of > 99.8 % confirmed by gas chromatography.

(2,3) From Nakarai Chemicals Ltd. (Tokyo). Used without further purification.

(4) Distilled.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.01$ (compiler)
Mole fraction of salt free solvent reproducible to 0.001.

REFERENCES:

1. Onda, K.; Sada, E.; Kobayashi, T.; Kito, S.; Ito, K.

J. Chem. Eng. Jpn. 1970, *3*, 18.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Calcium nitrate; $Ca(NO_3)_2$; [10124-37-5] (3) Water; H_2O; [7732-18-5]	Onda, K.; Sada, E; Kobayashi, T.; Kito, S.; Ito, K. *J. Chem. Eng. Jpn* <u>1970</u>, *3*, 18-24.
VARIABLES:	PREPARED BY:
T/K = 298.15 P/kPa = 101.325 c_2/mol L^{-1} = 0 - 2.110	C. L. Young

EXPERIMENTAL VALUES:

T/K	c_2/mol L^{-1}	α [a]
298.15	0	0.7595
	0.304	0.6847
	0.701	0.5993
	1.340	0.4810
	1.619	0.4356
	2.110	0.3647

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

P = 1 atm = 101.325 kPa = 1.01325 bar

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solutions made up by weight and density measured but not reported in paper. Equilibrium established between a measured volume of gas and a measured amount of gas-free liquid in a cell fitted with a magnetic stirrer. Amount of gas absorbed estimated from change in volume of gas. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial sample, minimum purity 99.8 mole %.

(2) Analytical grade.

(3) Distilled and degassed.

ESTIMATED ERROR:

δT/K = ± 0.2; $\delta\alpha$ = ± 2 %

(Estimated by the compiler.)

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Calcium nitrate; $Ca(NO_3)_2$; [10124-37-5] (3) Water; H_2O; [7732-18-5]	Yasunishi, A.; Yoshida, F. *J. Chem. Eng. Data* 1979, *24*, 11-14.
VARIABLES: $T/K = 298.15$ $P/kPa = 101.325$ $c_2/mol\ L^{-1} = 0 - 3.581$	PREPARED BY: C. L. Young

EXPERIMENTAL VALUES:

T/K	$c_2/mol\ L^{-1}$	L [a]
298.15	0	0.8264
	0.232	0.7630
	0.510	0.7027
	0.801	0.6363
	1.158	0.5584
	1.476	0.5014
	1.788	0.4460
	2.062	0.4067
	2.504	0.3430
	3.581	0.2370

[a] L = Ostwald coefficient ($cm^3\ cm^{-3}$)

P = 1 atm = 101.325 kPa = 1.01325 bar

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Density and composition of solution determined after absorption. Details in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) High purity grade sample, purity 99.96 mole %.

(2,3) Guaranteed reagent, solution degassed by boiling.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta L = \pm 1$ %.

REFERENCES:

1. Tokunaga, J. *J. Chem. Eng. Data* 1975, *20*, 41.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Barium chloride; $BaCl_2$; [10361-37-2] (3) Water; H_2O; [7732-18-5]	Setschenow, J. [Sechenov, I.M.] *Nouv. Mem. Soc. Imp. Nat. Moscow* 1889, *15*, 203-74.
VARIABLES: T/K = 288.35 c_2/mol dm^{-3} = 0 - 1.590	PREPARED BY: Pirketta Scharlin

EXPERIMENTAL VALUES:

t/°C	T/K [a]	Dilution x	c_2/mol dm^{-3} [a]	α [b]	k_{scc}/dm^3 mol^{-1} [a,c]
15.2	288.35	∞	0	1.009	-
		1	1.590	0.479	0.203

[a] Calculated by the compiler.

[b] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[c] k_{scc} = Setchenow salt effect parameter; $k_{scc} = (1/c_2)\ \lg(\alpha^{\circ}/\alpha)$.

Initial solution: 33.106 g $BaCl_2$ + 97.06 cm^3 water to make 100 cm^3 of solution (saturated solution).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Setchenow (Ref. 1) based his apparatus on those of Fernet (1857) and of Meyer (1857). The manometer was based on ideas he learned from Regnault in 1861. The one meter manometer had three branches, two for measuring the pressure and one a mercury reservoir. The manometer was connected to the absorption cell by a flexible silver capillary. The absorption cell was of two bulbs with a mark in the constricting connection. CO_2 gas was generated, saturated with water vapor and filled the bulbs and manometer to a known pressure less than atmospheric. The liquid was degassed by heating and then passed by the pressure difference into the lower bulb to the mark of known volume. The system was sealed, turned 90 degrees and shaken until equilibrium was established. The gas volume absorbed was reduced to 0 °C and one meter Hg pressure. The Bunsen coefficient was calculated.

SOURCE AND PURITY OF MATERIALS:

(1) Apparently generated from limestone and sulfuric acid. Dried.

(2) Not specified.

(3) Not specified, assumed to be distilled.

ESTIMATED ERROR:

The author makes a qualitative statement that the results are good to the second decimal.

REFERENCES:

1. Setschenow, J.

Akad. Nauk. SSSR Mem. Acad. imp. Sci. St. Petersburg 1887, *35*, [Ser. No. 7], 1-59.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Barium chloride; $BaCl_2$; [10361-37-2] (3) Water; H_2O; [7732-18-5]	Findlay, A; Shen, B. *J. Chem. Soc.* 1912, *101*, 1459-68.
VARIABLES:	**PREPARED BY:**
$T/K = 298.15$ $10^2\gamma_2/g\ cm^{-3} = 2.80 - 9.97$	C. L. Young

EXPERIMENTAL VALUES:

T/K	$10^2\gamma_2/g\ cm^{-3}$ [a]	$\rho/g\ cm^{-3}$	S [b]	10^4x_1 (p = 1 atm) [c]
298.15	2.80	1.018	0.789	5.89
	5.81	1.040	0.741	5.57
	8.15	1.054	0.710	5.38
	9.97	1.070	0.676	5.12

[a] γ = mass concentration of salt

[b] $$S = \frac{\text{concentration of gas in liquid phase}}{\text{concentration of gas in gaseous phase}}$$

Solubility was stated to be independent of pressure (over 1-2 atm pressure range); value quoted is the mean.

[c] Calculated by compiler assuming $V_{m,1} = 24.3 \times 10^{-3}\ m^3\ mol^{-1}$ at 1 atm.

Solubility in water: Ostwald coefficient $L = 0.825\ cm^3\ cm^{-3}$.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Gas buret and absorption pipet. Manometer tube was of such length as to allow measurements up to 2×10^5 Pa (about 2 atm).	(1) Purity 99.95 mole %. (2) No details given. (3) No details given.
	ESTIMATED ERROR:
	$\delta T/K = \pm 0.1$; $\delta S = \pm 1$ %. (estimated by compiler)
	REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]
(2) Barium chloride; $BaCl_2$; [10361-37-2]
(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Onda, K.; Sada, E; Kobayashi, T.; Kito, S.; Ito, K.

J. Chem. Eng. Jpn 1970, *3*, 18-24.

VARIABLES:

$T/K = 298.15$
$P/kPa = 101.325$
$c_2/mol\ L^{-1} = 0 - 1.082$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	$c_2/mol\ L^{-1}$	α [a]	T/K	$c_2/mol\ L^{-1}$	α [a]
298.15	0	0.7595	298.15	0.835	0.4961
	0.371	0.6325		1.082	0.4482
	0.539	0.5852			

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]; P= 1 atm = 1.01325 bar

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solutions made up by weight and density measured but not reported in paper. Equilibrium established between a measured volume of gas and a measured amount of gas-free liquid in a cell fitted with a magnetic stirrer. Amount of gas absorbed estimated from change in volume of gas. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial sample, minimum purity 99.8 mole %.

(2) Analytical grade.

(3) Distilled and degassed.

ESTIMATED ERROR: (by compiler)

$\delta T/K = \pm 0.2$; $\delta\alpha = \pm 2$ %

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]
(2) Barium chloride; $BaCl_2$; [10361-37-2]
(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Yasunishi, A.; Yoshida, F.

J. Chem. Eng. Data 1979, *24*, 11-14.

VARIABLES:

$T/K = 298.15$
$P/kPa = 101.325$
$c_2/mol\ L^{-1} = 0 - 1.564$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	$c_2/mol\ L^{-1}$	L [a]	T/K	$c_2/mol\ L^{-1}$	L [a]
298.15	0	0.8264	298.15	0.763	0.5624
	0.155	0.7640		0.899	0.5270
	0.317	0.7061		1.078	0.4834
	0.505	0.6436		1.119	0.4750
	0.646	0.6008		1.356	0.4264
	0.658	0.5914		1.564	0.3862

[a] L = Ostwald coefficient (cm^3 cm^{-3}); P= 1 atm = 101.325 kPa = 1.01325 bar

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Density and composition of solution determined after absorption. Details in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) High purity grade sample, purity 99.96 mole %.

(2,3) Guaranteed reagent, solution degassed by boiling.

REFERENCES:

1. Tokunaga, J. *J. Chem. Eng. Data* 1975, *20*, 41.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta L = \pm 1$ %.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Barium chloride; $BaCl_2$
[10361-37-2]

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

ORIGINAL MEASUREMENTS:

Eremina, A.O.; Efanov, L.N.;
Sorokina, N.A.

**Zh. Fiz. Khim.* 1989, *63*, 2491-94;
Russ. J. Phys. Chem. (Engl. Transl.) 1989, *63*, 1361-63.

VARIABLES:

T/K = 298.15 and 313.15
p/MPa = 0.1
10^3c_2/mol L^{-1} = 0 - 50

PREPARED BY:

Yu. P. Yampol'skii

EXPERIMENTAL VALUES:

Solubility of carbon dioxide in aqueous solutions of barium chloride. [a]

T/K	10^3c_2/mol L^{-1} [b]	10^3c_1/mol L^{-1} [c]
298.15	0	33.90
	2.5	33.25
	5	32.83
	7.5	32.50
	10	32.2
	12.5	32.77
	15	33.16
	20	32.94
	25	32.75
	50	31.75
313.15	0	22.69
	2.5	22.23
	5	21.86
	7.5	21.60
	10	21.45
	12.5	21.85
	15	22.22
	20	22.18
	25	22.11
	50	21.76

[a] Data taken from a graph by compiler.
[b] c_2 = concentration of $BaCl_2$
[c] c_1 = solubility of CO_2

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Attainment of the equilibrium was checked by the constancy of CO_2 content in 3-5 subsequent samples of gas after saturation of the solution.
The concentration of carbon dioxide was determined by titration. Detailed description of the technique is given in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Source not given. Before contacting with water solutions CO_2 was allowed to pass through the vessels with $NaHCO_3$, glass beads, glass wool and distilled water.

(2) Nothing specified.

(3) Distilled.

ESTIMATED ERROR:

$\delta c_1/c_1 = \pm\ 0.06 - 0.2\ \%$
$\delta T/K = \pm\ 0.05$

REFERENCES:

1. Burmakina, G.V.; Efanov, L.N.; Shnet, M.A. **Zh. Fiz. Khim.* 1982, *56*, 1159; *Russ. J. Phys. Chem. (Engl. Transl.)* 1982, *56*, 705.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Barium chloride; $BaCl_2$; [10361-37-2]

(3) Ammonium nitrate; NH_4NO_3; [6484-52-2]

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

ORIGINAL MEASUREMENTS:

Onda, K.; Sada, E.; Kobayashi, T.; Kito, S.; Ito, K.

J. Chem. Eng. Jpn. 1970, *3*, 137-42.

VARIABLES:

$T/K = 298.15$
$P/kPa = 101.325$
$c_2/mol\ L^{-1} = 0 - 0.302$
$c_3/mol\ L^{-1} = 0 - 0.783$

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	$c_2/mol\ L^{-1}$ [a]	$c_3/mol\ L^{-1}$ [a]	$I/mol\ L^{-1}$ [b]	α [b]
298.15	0	0	0	0.7595
	0.059	0.154	0.331	0.7370
	0.060	0.155	0.335	0.7371
	0.125	0.326	0.702	0.7086
	0.131	0.341	0.734	0.7078
	0.228	0.593	1.277	0.6679
	0.302	0.783	1.688	0.6429

[a] Calculated from ionic strength and ratios of ionic strengths given in paper.

[b] Quoted in original paper.
I = ionic strength; α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

$P = 1\ atm = 1.01325 \times 10^5\ Pa$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Concentrated solution prepared by weighting, less concentrated solutions prepared by dilution. Equilibrium established between a measure volume of gas and a measured amount of gas-free liquid in a cell fitted with a magnetic stirrer. Amount of gas absorbed estimated from change in volume of gas. Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

(1) Commercial sample, purity 99.8 mole %.

(2) Analytical grade sample.

(4) No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta\alpha = \pm 2\ \%$
(estimated by compiler).

REFERENCES:

1. Onda, K.; Sada, E.; Kobayashi, T.; Kito, S.; Ito, K.
J. Chem. Eng. Jpn. 1970, *3*, 18.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

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

ORIGINAL MEASUREMENTS:

Setchenow, J. [Sechenov, I.M.]

Ann. Chim. Phys. [6] 1892, *25*, 226-70.

VARIABLES:

$T/K = 288.35$

$c_2/\text{mol dm}^{-3} = 0 - 11.83$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	Dilution x	$c_2/\text{mol dm}^{-3}$ [a]	α [b]	$k_{scc}/\text{dm}^3\ \text{mol}^{-1}$ [a,c]
15.2	288.35	∞	0	1.009	-
		30	0.394	0.9355	0.0834
		20	0.591	0.899	0.0848
		10	1.183	0.808	0.0816
		4	2.957	0.596	0.0773
		3	3.943	0.497	0.0780
		1	11.83	0.120	0.0782

[a] Calculated by the compiler.

[b] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[c] k_{scc} = Setchenow salt effect parameter; $k_{scc} = (1/c_2)\ \lg(\alpha^o/\alpha)$.

Initial solution: 50.15 g LiCl + 75.23 cm^3 water to make 100 cm^3 of solution.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Setchenow (Ref. 1) based his apparatus on those of Fernet (1857) and of Meyer (1857). The manometer was based on ideas he learned from Regnault in 1861. The one meter manometer had three branches, two for measuring the pressure and one a mercury reservoir. The manometer was connected to the absorption cell by a flexible silver capillary. The absorption cell was of two bulbs with a mark in the constricting connection. CO_2 gas was generated, saturated with water vapor and filled the bulbs and manometer to a known pressure less than atmospheric. The liquid was degassed by heating and then passed by the pressure difference into the lower bulb to the mark of known volume. The system was sealed, turned 90 degrees and shaken until equilibrium was established. The gas volume absorbed was reduced to 0 °C and one meter Hg pressure. The Bunsen coefficient was calculated.

SOURCE AND PURITY OF MATERIALS:

(1) Apparently generated from limestone and sulfuric acid. Dried.

(2) Not specified.

(3) Not specified, assumed to be distilled.

ESTIMATED ERROR:

The author makes a qualitative statement that the results are good to the second decimal.

REFERENCES:

1. Setchenow, J.

Akad. Nauk. SSSR Mem. Acad. imp. Sci. St. Petersburg 1887, *35*, [Ser. No. 7], 1-59.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

VARIABLES:

$T/\mathrm{K} = 288.15 - 333.15$
$P/\mathrm{kPa} = 101.325$
$c_2/\mathrm{mol\ dm^{-3}} = 0 - 3.75$

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

$t/^{\circ}\mathrm{C}$	T/K	$c_2/\mathrm{mol\ dm^{-3}}$	α [a]	S [b]
15	288.15	0	0.990	-
		0.43	1.175	1.183
		0.77	1.093	1.112
		1.42	1.005	1.036
		3.75	0.697	0.748
20	293.15	0	0.860	-
		0.43	1.024	1.036
		0.77	0.962	0.980
		1.42	0.888	0.917
		3.75	0.640	0.687
25	298.15	0	0.758	0.5173
		0.43	0.910	0.922
		0.77	0.849	0.866
		1.42	0.775	0.801
		3.75	0.543	0.586
30	303.15	0	0.671	-
		0.43	0.8055	0.817
		0.77	0.751	0.767
		1.42	0.6785	0.7025
		3.75	0.475	0.513

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which a measured volume of gas-free liquid is stirred in the presence of the gas, and its decrease in volume is measured in a burette over mercury. The volume of liquid was measured at the experimental temperature. For calculation of the Kuenen coefficient, the density of the solution was obtained from Landolt-Börnstein extant 1969. The molar concentration of salt in the liquid was standardized at 20°C. These data are analyzed and discussed further in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) VEB Leuna Works; 99.8 vol %; the impurity was mostly water (author).

(2) DDR pro analysis grade by DDR Standard TGL 5021.

(3) Double distilled.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Gerecke, J.; Bittrich, H.J. *Wiss. Z. Tech. Hochsch. Chem. "Carl Schorlemmer" Leuna-Merseburg* 1971, *13*(2), 115-22.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

EXPERIMENTAL VALUES:

(continued)

$t/^\circ C$	T/K	$c_2/\text{mol dm}^{-3}$	α [a]	S [b]
35	308.15	0	0.605	-
		0.43	0.730	0.741
		0.77	0.661	0.676
		1.42	0.592	0.613
		3.75	0.408	0.4415
40	313.15	0	0.546	-
		0.43	0.6503	0.660
		0.77	0.5875	0.601
		1.42	0.518	0.537
		3.75	0.3607	0.390
45	318.15	0	0.482	-
		0.43	0.583	0.592
		0.77	0.516	0.529
		1.42	0.464	0.482
		3.75	0.3035	0.3283
50	323.15	0	0.436	-
		0.43	0.524	0.533
		0.77	0.467	0.479
		1.42	0.4112	0.427
		3.75	0.248	0.270
55	328.15	0	0.392	-
		0.43	0.472	0.480
		0.77	0.416	0.4265
		1.42	0.3663	0.381
		3.75	0.211	0.2296
60	333.15	0	0.372	-
		0.43	0.422	0.430
		0.77	0.377	0.388
		1.42	0.328	0.342
		3.75	0.1805	0.1966

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[b] S = Kuenen coefficient [cm^3 (STP) g^{-1} (H_2O) atm^{-1}].

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Lithium chloride; LiCl; [7447-41-8] (3) Water; H_2O; [7732-18-5]	Onda, K.; Sada, E; Kobayashi, T.; Kito, S.; Ito, K. *J. Chem. Eng. Jpn* 1970, 3, 18-24.
VARIABLES:	**PREPARED BY:**
$T/K = 298.15$ $P/kPa = 101.325$ $c_2/mol\ L^{-1} = 0 - 5.053$	C. L. Young

EXPERIMENTAL VALUES:

T/K	$c_2/mol\ L^{-1}$	α [a]
298.15	0	0.7595
	1.004	0.6288
	1.256	0.5977
	1.940	0.5305
	3.613	0.3950
	5.053	0.3182

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

P = 1 atm = 101.325 kPa = 1.01325 bar

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Solutions made up by weight and density measured but not reported in paper. Equilibrium established between a measured volume of gas and a measured amount of gas-free liquid in a cell fitted with a magnetic stirrer. Amount of gas absorbed estimated from change in volume of gas. Details in source.	(1) Commercial sample, minimum purity 99.8 mole %. (2) Analytical grade. (3) Distilled and degassed.
	ESTIMATED ERROR: $\delta T/K = \pm 0.2$; $\delta\alpha = \pm 2$ % (Estimated by the compiler.)
	REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]
(2) Lithium chloride; LiCl; [7447-41-8]
(3) Methanol; CH_4O; [67-56-1]
(4) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sada, E.; Kito, S.; Ito, Y.
Adv. Chem. Ser. 1976, *No. 155 (Thermodynamic Behavior of Electrolytes in Mixed Solvents Symp.*, 1975
Furter, W.F., Editor) 374-80.

VARIABLES:

T/K = 298.15
p_1/kPa = 101.325
c_2/mol dm^{-3} = 0 - 2.2550
x_3 = 0 - 1.0

PREPARED BY:

H.L. Clever

EXPERIMENTAL VALUES:

T/K	x_3	c_2/mol dm^{-3}	ρ/g cm^{-3}	α [a]
298.15	0.0	0	-	0.7597
		0.7707	1.0157	0.6565
		1.0798	1.0229	0.6207
		1.1883	1.0254	0.6050
	0.280	0	-	0.9695
		0.7433	0.9493	0.8078
		0.9897	0.9553	0.7714
		1.3854	0.9661	0.7066
	0.389	0	-	1.1775
		0.7288	0.9271	0.9875
		1.0750	0.9366	0.9010
		1.1291	0.9386	0.8955
	0.587	0	-	1.8161
		0.8652	0.8899	1.4639
		1.1876	0.8998	1.3525
		2.2293	0.9253	1.0496
	0.800	0	-	2.7813
		0.4316	0.8367	2.4566
		0.5525	0.8478	2.4073
		0.8636	0.8518	2.2003
		1.2905	0.8661	1.9650
	1.0	0	-	3.9003
		0.5930	0.8104	3.2643
		0.8000	0.8182	3.0662
		2.2550	0.8707	2.0391

[a] Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Full descriptions of the apparatus and the mode of operation are given elsewhere (Ref. 1). The principle of the method is that a known volume of gas in liquid-saturated vapor state is brought into contact with a measured amount of gas-free liquid. Equilibrium is established by agitation, and the volume of gas remaining is measured. After correction for the solvent vapor pressure, the change in the gas volume gives the solubility. The vapor pressures of the salt solutions at 20 °C were calculated by use of Raoult's law.

The gas free solution was prepared by mixing methanol, water and lithium chloride, each of which was separately degassed or desorbed.

In the paper the lithium chloride concentration was labelled ionic strength. The methanol mole fraction refers to the salt free liquid.

SOURCE AND PURITY OF MATERIALS:

(1) Source not given, commercial cylinder. Purity of > 99.8 % confirmed by gas chromatography.

(2,3) From Nakarai Chemicals Ltd. (Tokyo). Used without further purification.

(4) Distilled.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.01$ (compiler)
Mole fraction of salt free solvent reproducible to 0.001.

REFERENCES:

1. Onda, K.; Sada, E.; Kobayashi, T.; Kito, S.; Ito, K.

J. Chem. Eng. Jpn. 1970, 3, 18.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Lithium bromide; LiBr; [7550-35-8]

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

VARIABLES:

$T/K = 288.15 - 333.15$
$P/kPa = 101.325$
$c_2/mol\ dm^{-3} = 0 - 1.45$

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

$t/^oC$	T/K	$c_2/mol\ dm^{-3}$	α [a]	S [b]
15	288.15	0	0.990	-
		0.2	1.066	1.070
		0.4	1.010	1.020
		0.7	0.941	0.9575
		1.45	0.772	0.803
20	293.15	0	0.860	-
		0.2	0.945	0.951
		0.4	0.885	0.896
		0.7	0.841	0.856
		1.45	0.674	0.702
25	298.15	0	0.758	0.5173
		0.2	0.835	0.8415
		0.4	0.783	0.793
		0.7	0.753	0.767
		1.45	0.588	0.613
30	303.15	0	0.671	-
		0.2	0.742	0.750
		0.4	0.700	0.710
		0.7	0.676	0.689
		1.45	0.532	0.555

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AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which a measured volume of gas-free liquid is stirred in the presence of the gas, and its decrease in volume is measured in a burette over mercury. The volume of liquid was measured at the experimental temperature. For calculation of the Kuenen coefficient, the density of the solution was obtained from Landolt-Börnstein extant 1969. The molar concentration of salt in the liquid was standardized at 20°C. These data are analyzed and discussed further in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) VEB Leuna Works; 99.8 vol %; the impurity was mostly water (author).

(2) DDR pro analysis grade by DDR Standard TGL 5021.

(3) Double distilled.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Gerecke, J.; Bittrich, H.J. *Wiss. Z. Tech. Hochsch. Chem. "Carl Schorlemmer" Leuna-Merseburg* 1971, *13*(2), 115-22.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Lithium bromide; LiBr; [7550-35-8] (3) Water; H_2O; [7732-18-5]	Gerecke, J. *Diss. Dr. rer. Nat.* 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

EXPERIMENTAL VALUES:

(continued)

$t/°C$	T/K	c_2/mol dm^{-3}	α [a]	S [b]
35	308.15	0	0.605	-
		0.2	0.664	0.671
		0.4	0.634	0.644
		0.7	0.605	0.618
		1.45	0.486	0.5075
40	313.15	0	0.546	-
		0.2	0.601	0.608
		0.4	0.577	0.5865
		0.7	0.548	0.561
		1.45	0.449	0.469
45	318.15	0	0.482	-
		0.2	0.545	0.592
		0.7	0.499	0.511
		1.45	0.413	0.4325
50	323.15	0	0.436	-
		0.2	0.498	0.505
		0.7	0.453	0.464
		1.45	0.379	0.399
55	328.15	0	0.392	-
		0.2	0.450	0.4565
		0.7	0.406	0.417
60	333.15	0	0.372	-
		0.2	0.411	0.417
		0.7	0.367	0.377

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[b] S = Kuenen coefficient [cm^3 (STP) g^{-1} (H_2O) atm^{-1}].

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Lithium sulfate; Li_2SO_4; [10377-48-7] (3) Water; H_2O; [7732-18-5]	Lagarote, L. *Bull. Soc. Chim. Fr.* 1943, *10*, 416-7.
VARIABLES:	**PREPARED BY:**
$T/K = 290.15$ $c_2/\text{mol L}^{-1} = 0\text{-}2.285$	Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	$c_2/\text{mol L}^{-1}$	$S_1/\text{cm}^3\ \text{cm}^{-3}$ [b]	$k/\text{L mol}^{-1}$ [c]
17	290.15	0	1.02	-
		0.164	0.896	0.341
		0.390	0.774	0.310
		0.580	0.675	0.309
		1.055	0.484	0.308
		1.820	0.272	0.311
		2.285	0.200	0.310

[a] Calculated by the compiler.

[b] S_1 = solubility coefficient of CO_2.

$S_1 = (V'_1 - V)/v$, where $(V'_1 - V)$ is the volume of CO_2 dissolved at pressure P, and v is the volume of the aqueous Li_2SO_4 solution.

The paper contained no definitive information about the pressure P. The measurements probably were made at atmospheric pressure.

[c] k = Sechenov constant, defined by equation $\lg (S_0/S_1) = kc_2$, where S_0 and S_1 are the solubility coefficients of CO_2 in pure water and in Li_2SO_4 solution, respectively, and c_2 is the concentration of Li_2SO_4 in the aqueous Li_2SO_4 solution.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A volume V_1 of carbon dioxide, saturated with water vapor, was introduced into Bunte's burette under atmospheric pressure and at the temperature of 17 °C. A volume v of aqueous Li_2SO_4 solution of known concentration was then introduced, and the mixture was stirred until no diminution of volume was observed. When the initial temperature was reached, the volume V was read under the pressure P. The volume V_1 at the partial pressure P_1 of CO_2 was reduced to volume V'_1 at pressure P; $(V'_1 = V_1P_1/P)$.

The solubility coefficient S_1 of CO_2 was calculated from the equation

$$S_1 = \frac{(V'_1 - V)}{v}.$$

SOURCE AND PURITY OF MATERIALS:

Nothing specified.

ESTIMATED ERROR:

Nothing specified.

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Lithium sulfate; Li_2SO_4; [10377-48-7]

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

VARIABLES:

T/K = 288.15 - 333.15
P/kPa = 101.325
c_2/mol dm^{-3} = 0 - 2

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

t/°C	T/K	c_2/mol dm^{-3}	α [a]	S [b]
15	288.15	0	0.990	-
		0.25	0.811	0.8155
		0.5	0.704	0.7115
		1	0.520	0.5325
		2	0.284	0.299
20	293.15	0	0.860	-
		0.25	0.691	0.6955
		0.5	0.598	0.605
		1	0.437	0.448
		2	0.237	0.250
25	298.15	0	0.758	-
		0.25	0.594	0.5983
		0.5	0.519	0.525
		1	0.361	0.371
		2	0.203	0.2142
30	303.15	0	0.671	-
		0.25	0.518	0.523
		0.5	0.446	0.452
		1	0.302	0.3105
		2	0.181	0.191

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which a measured volume of gas-free liquid is stirred in the presence of the gas, and its decrease in volume is measured in a burette over mercury. The volume of liquid was measured at the experimental temperature. For calculation of the Kuenen coefficient, the density of the solution was obtained from Landolt-Börnstein extant 1969. The molar concentration of salt in the liquid was standardized at 20°C. These data are analyzed and discussed further in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) VEB Leuna Works; 99.8 vol %; the impurity was mostly water (author).

(2) DDR pro analysis grade by DDR Standard TGL 5021.

(3) Double distilled.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Gerecke, J.; Bittrich, H.J. *Wiss. Z. Tech. Hochsch. Chem. "Carl Schorlemmer" Leuna-Merseburg* 1971, *13*(2), 115-22.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Lithium sulfate; Li_2SO_4; [10377-48-7] (3) Water; H_2O; [7732-18-5]	Gerecke, J. *Diss. Dr. rer. Nat.* 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

EXPERIMENTAL VALUES:
(continued)

t/°C	T/K	c_2/mol dm^{-3}	α [a]	S [b]
35	308.15	0	0.605	-
		0.25	0.450	0.4550
		0.5	0.385	0.391
		1	0.261	0.268
		2	0.160	0.169
40	313.15	0	0.546	-
		0.25	0.391	0.3953
		0.5	0.338	0.344
		1	0.233	0.2395
		2	0.140	0.1485
45	318.15	0	0.482	-
		0.5	0.298	0.3035
		1	0.207	0.2133
		2	0.126	0.1338
50	323.15	0	0.436	-
		0.5	0.266	0.271
		1	0.186	0.192
		2	0.113	0.1195
55	328.15	0	0.392	-
		0.5	0.234	0.239
		1	0.106	0.176
		2	0.106	0.113
60	333.15	0	0.372	-
		0.5	0.208	0.2125
		1	0.151	0.156
		2	0.0987	0.105

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[b] S = Kuenen coefficient [cm^3 (STP) g^{-1} (H_2O) atm^{-1}].

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sodium fluoride; NaF; [7681-49-4]

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

VARIABLES:

T/K = 288.15 - 333.15
P/kPa = 101.325
c_2/mol dm^{-3} = 0 - 5

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

$t/^{o}C$	T/K	c_2/mol dm^{-3}	α [a]	S [b]
15	288.15	0	0.990	-
		0.5	0.800	0.800
20	293.15	0	0.860	-
		0.5	0.674	0.6745
25	298.15	0	0.758	-
		0.5	0.582	0.583
30	303.15	0	0.671	-
		0.5	0.488	0.489
35	308.15	0	0.605	-
		0.5	0.415	0.417
40	313.15	0	0.546	-
		0.5	0.356	0.3575
45	318.15	0	0.482	-
		0.5	0.304	0.306
50	323.15	0	0.436	-
		0.5	0.260	0.262
55	328.15	0	0.392	-
		0.5	0.228	0.230
60	333.15	0	0.372	-
		0.5	0.202	0.2043

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[b] S = Kuenen coefficient [cm^3 (STP) g^{-1} (H_2O) atm^{-1}].

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which a measured volume of gas-free liquid is stirred in the presence of the gas, and its decrease in volume is measured in a burette over mercury. The volume of liquid was measured at the experimental temperature. For calculation of the Kuenen coefficient, the density of the solution was obtained from Landolt-Börnstein extant 1969. The molar concentration of salt in the liquid was standardized at 20°C. These data are analyzed and discussed further in Ref.1.

SOURCE AND PURITY OF MATERIALS:

(1) VEB Leuna Works; 99.8 vol %; the impurity was mostly water (author).

(2) DDR pro analysis grade by DDR Standard TGL 5021.

(3) Double distilled.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Gerecke, J.; Bittrich, H.J. *Wiss. Z. Tech. Hochsch. Chem. "Carl Schorlemmer" Leuna-Merseburg* 1971, *13*(2), 115-22.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

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

ORIGINAL MEASUREMENTS:

Setchenow, J. [Sechenov, I.M.]

Ann. Chim. Phys. [6] 1892, *25*, 226-70.

VARIABLES:

$T/K = 288.35$

$c_2/\text{mol dm}^{-3} = 0 - 5.4$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	Dilution x	$c_2/\text{mol dm}^{-3}$ [a]	α [b]	$k_{scc}/\text{dm}^3\ \text{mol}^{-1}$ [a,c]
15.2	288.35	∞	0	1.009	-
		24.42	0.221	0.978	0.0613
		12.21	0.442	0.919	0.0918
		8.14	0.663	0.865	0.101
		6	0.900	0.811	0.105
		5	1.080	0.778	0.105
		4	1.350	0.728	0.105
		3	1.800	0.640	0.110
		2	2.700	0.530	0.104
		1	5.400	0.281	0.103

[a] Calculated by the compiler.

[b] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[c] k_{scc} = Setchenow salt effect parameter; $k_{scc} = (1/c_2)\ \lg(\alpha^{\circ}/\alpha)$.

Initial solution: 31.56 g NaCl + 88.4 cm^3 water to make 100 cm^3 of solution.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Setchenow (Ref. 1) based his apparatus on those of Fernet (1857) and of Meyer (1857). The manometer was based on ideas he learned from Regnault in 1861. The one meter manometer had three branches, two for measuring the pressure and one a mercury reservoir. The manometer was connected to the absorption cell by a flexible silver capillary. The absorption cell was of two bulbs with a mark in the constricting connection. CO_2 gas was generated, saturated with water vapor and filled the bulbs and manometer to a known pressure less than atmospheric. The liquid was degassed by heating and then passed by the pressure difference into the lower bulb to the mark of known volume. The system was sealed, turned 90 degrees and shaken until equilibrium was established. The gas volume absorbed was reduced to 0 °C and one meter Hg pressure. The Bunsen coefficient was calculated.

SOURCE AND PURITY OF MATERIALS:

(1) Apparently generated from limestone and sulfuric acid. Dried.

(2) Not specified.

(3) Not specified, assumed to be distilled.

ESTIMATED ERROR:

The author makes a qualitative statement that the results are good to the second decimal.

REFERENCES:

1. Setchenow, J.

Akad. Nauk. SSSR Mem. Acad. imp. Sci. St. Petersburg 1887, *35*, [Ser. No. 7], 1-59.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

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

ORIGINAL MEASUREMENTS:

Harned, H.S.; Davis, R. Jr.

J. Am. Chem. Soc. 1943, *65*, 2030-7.

VARIABLES:

$T/K = 273.15\text{-}323.15$
$P_1/kPa = 101.325$
$m_2/mol\ kg^{-1} = 0 - 3$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

t/°C	T/K [a]	m_2/mol kg^{-1} [b]	10^2S_1 [c]	Series [d]
0	273.15	0	7.726	A
		0.2	7.256	A
		0.5	6.708	A
			6.642	B
		1	5.869	A
			5.895	B
		2	4.608	A
			4.597	B
		3	3.695	A
			3.718	B
5	278.15	0	6.402	A
		0.2	6.099	A
		0.5	5.593	A
		1	4.932	A
		2	3.910	A
		3	3.166	A
10	283.15	0	5.359	A
			5.367	B
		0.2	5.096	A
		0.5	4.714	A
		1	4.160	A
			4.156	B
		2	3.339	A
		3	2.716	A
			2.729	B
15	288.15	0	4.554	A
		0.2	4.330	A
		0.5	4.009	A
		1	3.550	A
		2	2.886	A
		3	2.381	A

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The same apparatus and method were used for measurements of solubility and electromotive force. A detailed description of the experimental procedure is available in the source.

Equilibrium in the cell was attained by bubbling CO_2 through the solvent while gently rocking the thermostatted cell. Pressure was maintained constant at 1 atm. The concentration was determined by titrating about 90 cm^3 of solution with excess standard $Ba(OH)_2$ solution and back-titrating the excess.

SOURCE AND PURITY OF MATERIALS:

(1) From commercial tank. Purity 99.67 % ± 0.05 %.

(2) 99.98 % pure

(2) Quality not stated. Degassed by CO_2 bubbling and evacuation.

ESTIMATED ERROR:

δS_1 = ± (0.2-0.5) %, while at high temperatures and salt concentrations δS_1 = ± 1 %.
(By authors)

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Sodium chloride; NaCl; [7647-14-5] (3) Water; H_2O; [7732-18-5]	Harned, H.S.; Davis, R. Jr. *J. Am. Chem. Soc.* 1943, *65*, 2030-7.

EXPERIMENTAL VALUES: (continued)

t/°C	T/K [a]	m_2/mol kg^{-1} [b]	$10^2 S_1$ [c]	Series [d]
20	293.15	0	3.923	A
			3.928	B
		0.2	3.725	A
		0.5	3.450	A
		1	3.085	A
		2	2.504	A
		3	2.071	A
			2.086	B
25	298.15	0	3.438	A
			3.458	B
		0.2	3.278	A
		0.5	3.054	A
			3.036	B
		1	2.707	A
			2.668*	B
			2.734	C
		2	2.223	A
			2.227	B
			2.242	C
		3	1.810*	A
			1.844	B
			1.847	C
30	303.15	0	3.026	A
			3.021	B
		0.2	2.861	A
		0.5	2.674	A
			2.588*	B
		1	2.407	A
			2.418	B
		2	1.971	A
			1.927*	B
			1.965	C
		3	1.658	A
			1.688*	B
			1.655	C
35	308.15	0	2.678	A
		0.2	2.553	A
		0.5	2.388	A
		1	2.108*	A
			2.167	C
		2	1.763	A
			1.778	C
		3	1.488	A
			1.488	C
40	313.15	0	2.407	A
			2.407	B
		0.2	2.289	A
		0.5	2.141	A
			2.188*	B
		1	1.913	A
			1.922	B
		2	1.566	A
			1.629*	B
			1.575	C
		3	1.372*	B
			1.344	C

(continued next page)

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9]	Harned, H.S.; Davis, R. Jr.
(2) Sodium chloride; NaCl; [7647-14-5]	*J. Am. Chem. Soc.* 1943, *65*, 2030-7.
(3) Water; H_2O; [7732-18-5]	

EXPERIMENTAL VALUES: (continued)

t/°C	T/K [a]	m_2/mol kg^{-1} [b]	$10^2 S_1$ [c]	Series [d]
45	318.15	0	2.192	A
		0.2	2.084	A
		0.5	1.955	A
		1	1.752	A
			1.743	C
		2	1.492	A
			1.441	C
		3	1.212	A
			1.216	C
50	323.15	0	1.982	A
			1.969	B
		0.2	1.897	A
		0.5	1.753	A
			1.765	B
		1	1.597	A
			1.559*	B
		2	1.317	A
			1.330	B
			1.317	C
		3	1.093	A
			1.145*	B
			1.099	C

---

[a] Calculated by the compiler.

[b] m_2 = molality of NaCl.

[c] $S_1 = m_1/P_1$ where m_1 is the molality of CO_2 [mol kg^{-1}]. The S_1 values are at P_1 = 1 atm.
The starred values were not given as great a weight as the unstarred values in the final graphical estimation of S_1.

[d] **Series A** represents the mean of four simultaneous measurements of CO_2 in water. In addition, this series comprises single observations of the solubility in 0.2, 0.5, 1, 2, and 3 mol kg^{-1} NaCl solutions.
Series B represents the mean of three experiments at each temperature on each salt concentration recorded.
Series C: the results of series A and B were plotted on a large scale and all results in doubt redetermined.

The authors made large scale plots of (-lg S_1) *versus* molality of NaCl. The smoothed values obtained from these graphs are given in Table 2.

Table 2. Smoothed values of (-lg S_1). Deviations (Obs. - Calcd.)[e]

t/°C	Water	0.2 mol/kg	0.5 mol/kg	1 mol/kg	2 mol/kg	3 mol/kg
0	1.1144(+4)	1.1383(+2)	1.1738(0)	1.2313(-4)	1.3365(-8)	1.4290(-24)
5	1.1938(-10)	1.2167(-14)	1.2510(-18)	1.3065(+17)	1.4077(-14)	1.4980(-8)
10	1.2695(-5)	1.2920(-5)	1.3259(-3)	1.3800(-4)	1.4768(+4)	1.5642(+17)
15	1.3412(+13)	1.3638(+20)	1.3970(+25)	1.4482(-20)	1.5422(+27)	1.6255(+29)
20	1.4063(+15)	1.4285(+25)	1.4605(+8)	1.5110(+28)	1.6012(+25)	1.6822(+29)
25	1.4635(-16)	1.4842(+16)	1.5152(-18)	1.5645(-14)	1.6530(-9)	1.7323(-8)
30	1.5209(+1)	1.5410(-1)	1.5712(-3)	1.6191(-2)	1.7055(-1)	1.7820(-12)
35	1.5722(0)	1.5917(-3)	1.6210(-9)	1.6668(-20)	1.7508(-31)	1.8280(-27)
40	1.6200(+5)	1.6393(+2)	1.6678(-5)	1.7140(-7)	1.7982(-7)	1.8733(-21)
45	1.6593(-36)	1.6797(-27)	1.7092(-19)	1.7564(-5)	1.8404(-4)	1.9168(-8)
50	1.7053(+26)	1.7241(+22)	1.7523(+22)	1.7972(+15)	1.8815(+18)	1.9602(+21)

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[e] Numbers in parentheses represent deviations in fourth decimal place of (-lg S_1).

(continued next page)

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Sodium chloride; NaCl; [7647-14-5] (3) Water; H_2O; [7732-18-5]	Harned, H.S.; Davis, R. Jr. *J. Am. Chem. Soc.* 1943, *65*, 2030-7.

EXPERIMENTAL VALUES: (continued)

The authors expressed the solubility data as a function of the absolute temperature by equation (1):

$$-\lg S_1 = -A^*/T + D^* - C^*T \qquad (1)$$

The parameters of equation (1), obtained from the data by method of least squares, are given in Table 3.

Table 3. Least squared constants of equation (1).

m_2/mol kg^{-1} [b]	A^*/K	D^*	C^*/K^{-1}
0.0	2385.73	14.0184	0.0152642
0.2	2347.16	13.8090	0.0149259
0.5	2309.60	13.6316	0.0146492
1.0	2195.84	12.9875	0.0136050
2.0	1912.43	11.2968	0.0108268
3.0	1622.96	9.5253	0.0078770

[b] m_2 = molality of NaCl.

The deviations of the observed results from those calculated by equation (1) are given in parentheses immediately following the values in Table 2 (previous page). The maximum deviation is 0.0036 and the average deviation is 0.0015 in lg S_1 which corresponds to 0.8 and 0.3 % in S_1.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Sodium chloride; NaCl; [7647-14-5] (3) Water; H_2O; [7732-18-5]	Rosenthal, W. *Thès. fac. sci. Univ. Strasbourg (France)* 1954.
VARIABLES: $T/K = 293.15$ $c_2/\text{mol dm}^{-3} = 0 - 5.058$	PREPARED BY: H.L. Clever

EXPERIMENTAL VALUES:

T/K	$c_2/\text{mol dm}^{-3}$ [a]	$L/\text{cm}^3\ \text{cm}^{-3}$ [a,b]	$k_{scc}/\text{dm}^3\ \text{mol}^{-1}$ [c,d]
293.15	0	0.879	-
	1.562	0.593	0.1095
	3.44	0.394	0.1015
	5.058	0.264	0.1035

[a] Original data.

[b] Ostwald coefficient.

[c] Sechenov constant; $k_{scc} = (1/c_2)\ \lg(L^0/L)$.

[d] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The prepared solvent and solution were charged into an evacuated cell after degassing, and the mass of solvent was determined by weight. Gas was introduced into the cell from a measuring buret in which the gas was stored over mercury. The cell was agitated while the gas pressure was maintained by adjusting the gas volume. The Ostwald coefficient was determined from the mass of solvent and the volume of gas absorbed. Solubilities were measured at pressures above and below atmospheric.

SOURCE AND PURITY OF MATERIALS:

(1) Source and purity not given. An aqueous "soda" solution absorbed 99.8 % of the gas.

(2) Source and purity not given. Recrystallized from water and dried.

(3) Boiled to remove carbon dioxide.

ESTIMATED ERROR:

$\delta T/K = \pm\ 0.2$
$\delta p/\text{kPa} = \pm\ 0.1$
$\delta L/L = \pm\ 0.02$ (compiler)

REFERENCES:

Some data in the thesis have been published. See:

1. Maillard, A.; Rosenthal, W. *Comp rend.* 1952, *234*, 2546-8.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

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

ORIGINAL MEASUREMENTS:

Ellis, A. J.; Golding, R. M.

Am. J. Sci. 1963, *261*, 47-60.

VARIABLES:

$T/K = 445 - 607$
$p_1/MPa = 1.59 - 9.31$
$c_2/mol\ dm^{-3} = 0 - 2.0$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	$c_2/mol\ dm^{-3}$	p_1/atm	P_1/MPa	10^2x_1	L [a]
450	0.0	15.7	1.59	0.223	0.26
475		17.7	1.79	0.283	0.29
477		36.1	3.66	0.582	0.30
502		46.3	4.69	0.767	0.31
502		43.5	4.41	0.754	0.32
508		29.7	3.01	0.473	0.30
534		53.1	5.38	1.08	0.39
534		49.6	5.03	1.01	0.38
538		23.1	2.34	0.472	0.39
538		20.4	2.07	0.426	0.40
582		75.5	7.65	2.11	0.51
582		72.1	7.31	1.92	0.49
582		68.1	6.90	1.83	0.49
607		62.6	6.34	2.12	0.59
607		59.2	6.00	1.99	0.58
449	0.5	65.3	6.62	0.893	0.23
449		62.6	6.34	0.839	0.23
509		67.4	6.83	1.03	0.28
509		63.3	6.41	0.970	0.28
540		63.0	6.38	1.13	0.33
540		59.5	6.03	1.03	0.33
559		57.8	5.86	1.12	0.36
559		55.8	5.65	1.08	0.36
582		54.3	5.50	1.18	0.40
582		48.8	4.94	1.09	0.41
582		47.5	4.81	1.06	0.41
445	1.0	45.1	4.57	0.548	0.21
445		43.9	4.45	0.533	0.21
450		26.4	2.67	0.317	0.21
468		51.5	5.22	0.610	0.20
468		50.0	5.07	0.626	0.22
468		48.7	4.93	0.584	0.21
492		34.7	3.52	0.446	0.24
500		61.4	6.22	0.784	0.23
500		59.3	6.01	0.794	0.24
528		40.8	4.13	0.606	0.28

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static bomb of approximately 100 cm^3 capacity. Samples of mixture analysed by absorbing water in Anhydrone and carbon dioxide in Carbosorb. Details in source.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 1.0$; $\delta x_1 = \pm 2$ %

(estimated by compiler)

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Sodium chloride; NaCl; [7647-14-5] (3) Water; H_2O; [7732-18-5]	Ellis, A. J.; Golding, R. M. *Am. J. Sci.* 1963, *261*, 47-60.

EXPERIMENTAL VALUES: (continued)

T/K	c_2/mol dm^{-3}	p_1/atm	P_1/MPa	10^2x_1	L [a]
537	1.0	71.1	7.20	1.04	0.26
537		69.0	6.99	1.00	0.26
565		48.8	4.94	0.806	0.32
565		46.7	4.73	0.789	0.33
579		67.0	6.79	1.05	0.30
598		91.9	9.31	1.73	0.35
598		87.8	8.90	1.81	0.38
449	2.0	68.8	6.97	0.674	0.16
449		64.6	6.55	0.651	0.17
472		67.7	6.86	0.695	0.17
472		65.6	6.65	0.669	0.18
501		66.5	6.74	0.736	0.20
501		63.1	6.39	0.675	0.20
535		64.5	6.54	0.763	0.22
579		64.5	6.54	0.847	0.25
579		60.5	6.13	0.752	0.24
579		56.3	5.70	0.746	0.26
603		54.9	5.56	0.742	0.27

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[a] L = Ostwald coefficient (cm^3 cm^{-3})

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

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

ORIGINAL MEASUREMENTS:

Yeh, S-Y.; Peterson, R. E.

J. Pharm. Sci. 1964, *53*, 822-4.

VARIABLES:

$T/K = 298.15\text{-}318.15$
$P/kPa = 101.325$
$10^2 w_2 = 0 \text{ and } 0.9$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

T/K [a]	$10^2 w_2$ [b]	m_2/mol kg^{-1} [a,c]	L [d]	ΔH°/kJ mol^{-1} [e]	ΔS°/J K^{-1} mol^{-1} [e]
298.15	0	0	0.8129	-20.52^{7}	-97.0^{7}
	0.9	0.155	0.7576	-20.58^{1}	-97.9^{1}
303.15	0	0	0.7264	-19.48^{4}	-93.7^{2}
	0.9	0.155	0.6800	-19.53^{9}	-94.5^{6}
310.15	0	0	0.6282	-18.03^{3}	-89.1^{2}
	0.9	0.155	0.5876	-18.08^{3}	-88.7^{0}
318.15	0	0	0.5453	-16.36^{7}	-83.6^{8}
	0.9	0.155	0.5100	-16.41^{4}	-84.5^{2}

[a] Calculated by compiler.

[b] w_2 = mass fraction of NaCl.

[c] m_2 = molality of NaCl.

[d] L = Ostwald coefficient (cm^3 cm^{-3}).

Each solubility value is the average of three or four measurements. The standard deviation of each measurement closely approximates 1 %.

[e] The thermodynamic changes are for the transfer of 1 mol of CO_2 from the gas phase at a concentration of 1 mol dm^{-3} to the solution at a concentration of 1 mol dm^{-3}.

In the original source the ΔH° and ΔS° values were given in the units cal mol^{-1} and cal K^{-1} mol^{-1}, respectively. Conversion to the SI units has been done by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Freshly boiled solution was introduced into 125 cm^3 absorption flask of solubility apparatus (1), then frozen and boiled under vacuum three times. Water-saturated gas was introduced and equilibrated (2) and weight of solution was determined.

SOURCE AND PURITY OF MATERIALS:

(1) Research grade. Matheson Co.

(2) Analytical grade.

(3) Distilled from glass apparatus.

ESTIMATED ERROR:

$\delta T/K = 0.05$
$\delta P/\text{mm Hg} = 0.2$
$\delta L/L = 0.01$

REFERENCES:

1. Geffken, G. *Z. Phys. Chem.* 1904, *49*, 257.
2. Yeh, S-Y.; Peterson, R. E. *J. Pharm. Sci.* 1963, *35*, 1281.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

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

ORIGINAL MEASUREMENTS:

Takenouchi, S.; Kennedy, G.

Am. J. Sci. 1965, *263*, 445-54.

VARIABLES:

$T/K = 423.15\text{-}723.15$
$P/\text{bar} = 100\text{-}1400$
$10^2 w_2 = 0,\ 6,\ \text{and}\ 20$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

t/°C	T/K [b]	P/bar	S_1 [a]		
			pure H_2O	6 wt-% NaCl [c]	20 wt-% NaCl [d]
150	423.15	100	3.1	2.5	0.9
		200	5.1	4.0	1.6
		300	6.1	4.7	2.2
		400	6.9	5.2	2.5
		500	7.5	5.6	2.8
		600	8.0	6.0	3.2
		800	9.0	6.6	3.8
		1000	9.7	7.2	4.3
		1200	10.3	7.7	4.8
		1400	10.8	8.0	5.3
200	473.15	100	3.2	2.5	
		200	6.1	4.4	
		300	7.9	5.6	
		400	9.5	6.5	
		500	10.8	7.2	
		600	11.8	7.9	
		800	13.2	8.9	
		1000	14.2	9.6	
		1200	15.0	10.2	
		1400	15.6	10.7	
250	523.15	100	2.8	2.4	1.0
		200	6.0	4.9	2.0
		300	9.6	6.8	2.8
		400	12.1	8.5	3.4
		500	14.3	10.0	4.1
		600	16.4	11.5	4.7
		800	20.4	13.4	5.7
		1000	24.2	14.8	6.6
		1200	27.2	16.1	7.6
		1400	28.8	17.0	8.2

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The experimental apparatus was the same used in previous experimental work.[1] After equilibration the CO_2 and NaCl content of the liquid samples was analyzed. The CO_2 composition was determined by titration against standard HCl solution. CO_2 was absorbed in sodium hydroxide and estimated by back titration with HCl. The NaCl concentration of the solution was determined by the Mohr method using standardized $AgNO_3$ solution and a potassium chromate solution as an indicator. The composition of the coexisting gas phase was not determined.

SOURCE AND PURITY OF MATERIALS:

(1), (2), and (3): Source and purity not stated.

ESTIMATED ERROR:

$\delta T/K = \pm\ 0.8\ \%$ (by authors)
$\delta S_1 = \pm\ 2\ \%$ (by authors)

REFERENCES:

1. Takenouchi, S.; Kennedy, G. *Am. J. Sci.* 1964, *262*, 1055-74.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9]	Takenouchi, S.; Kennedy, G.
(2) Sodium chloride; NaCl; [7647-14-5]	*Am. J. Sci.* 1965, *263*, 445-54.
(3) Water; H_2O; [7732-18-5]	

EXPERIMENTAL VALUES: (continued)

			S_1 [a]		
t/°C	T/K [b]	P/bar	pure H_2O	6 wt-% NaCl [c]	20 wt-% NaCl [d]
300	573.15	100	1.0	0.9	
		200	6.4	4.6	
		300	12.2	7.6	
		400	18.2	10.5	
		500	26.4	13.0	
		600		15.3	
		800		19.0	
		1000		21.6	
		1200		23.8	
		1400		25.3	
350	623.15	200	3.6	3.2	1.1
		300	14.3	7.5	2.6
		400		11.5	3.9
		500		14.8	5.1
		600		18.0	6.2
		800		23.0	7.9
		1000		28.2	9.5
		1200		31.0	10.8
		1400		34.0	12.0
400	673.15	300		1.7	
		400		7.5	
		500		13.5	
450	723.15	500			2.2
		600			4.2
		700			6.0
		800			7.6
		900			9.2

---

[a] S_1 is solubility of CO_2, expressed as mass % of CO_2 in water and NaCl solutions.

[b] Calculated by the compiler.

[c] Molality of NaCl in the 6 mass % NaCl solution is $m_2 = 1.09$ mol kg^{-1}. (calculated by the compiler)

[d] Molality of NaCl in the 20 mass % solution is $m_2 = 4.28$ mol kg^{-1}. (calculated by the compiler)

In the VARIABLES box, w_2 = mass fraction of NaCl.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

VARIABLES:

T/K = 288.15 - 333.15
P/kPa = 101.325
c_2/mol dm^{-3} = 0 - 4.3

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

t/°C	T/K	c_2/mol dm^{-3}	α [a]	s [b]
15	288.15	0	0.990	-
		0.5	0.807	0.815
		1	0.759	0.774
		2	0.607	0.633
		4.3	0.407	0.447
20	293.15	0	0.860	-
		0.5	0.728	0.735
		1	0.689	0.704
		2	0.560	0.585
		4.3	0.340	0.3743
25	298.15	0	0.758	-
		0.5	0.658	0.666
		1	0.605	0.619
		2	0.485	0.5075
		4.3	0.310	0.3423
30	303.15	0	0.671	-
		0.5	0.575	0.582
		1	0.532	0.545
		2	0.441	0.463
		4.3	0.282	0.312

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which a measured volume of gas-free liquid is stirred in the presence of the gas, and its decrease in volume is measured in a burette over mercury. The volume of liquid was measured at the experimental temperature. For calculation of the Kuenen coefficient, the density of the solution was obtained from Landolt-Börnstein extant 1969. The molar concentration of salt in the liquid was standardized at 20°C. These data are analyzed and discussed further in Ref.1.

SOURCE AND PURITY OF MATERIALS:

(1) VEB Leuna Works; 99.8 vol %; the impurity was mostly water (author).

(2) DDR pro analysis grade by DDR Standard TGL 5021.

(3) Double distilled.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Gerecke, J.; Bittrich, H.J. *Wiss. Z. Tech. Hochsch. Chem. "Carl Schorlemmer" Leuna-Merseburg* 1971, *13*(2), 115-22.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

EXPERIMENTAL VALUES:

(continued)

t/°C	*T*/K	c_2/mol dm^{-3}	α [a]	*S* [b]
35	308.15	0	0.605	-
		0.5	0.515	0.522
		1	0.477	0.4885
		2	0.401	0.421
		4.3	0.251	0.278
40	313.15	0	0.546	-
		0.5	0.443	0.450
		1	0.416	0.424
		2	0.358	0.377
		4.3	0.226	0.2507
45	318.15	0	0.482	-
		0.5	0.382	0.388
		1	0.374	0.385
		2	0.307	0.324
		4.3	0.207	0.2303
50	323.15	0	0.436	-
		0.5	0.345	0.351
		1	0.336	0.346
		2	0.276	0.2915
		4.3	0.190	0.2116
55	328.15	0	0.392	-
		2	0.240	0.254
		4.3	0.171	0.1911
60	333.15	0	0.372	-
		0.5	0.279	0.284
		1	0.266	0.275
		2	0.2225	0.2357
		4.3	0.153	0.1714

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[b] *S* = Kuenen coefficient [cm^3 (STP) g^{-1} (H_2O) atm^{-1}].

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

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

ORIGINAL MEASUREMENTS:

Onda, K.; Sada, E; Kobayashi, T.; Kito, S.; Ito, K.

J. Chem. Eng. Jpn 1970, *3*, 18-24.

VARIABLES:

$T/K = 298.15$

$P/kPa = 101.325$

$c_2/mol\ L^{-1} = 0 - 3.006$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	$c_2/mol\ L^{-1}$	α [a]
298.15	0	0.7595
	0.500	0.6644
	0.603	0.6489
	0.999	0.5972
	1.000	0.5941
	1.153	0.5686
	2.000	0.4712
	3.001	0.3776
	3.006	0.3729

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

P = 1 atm = 101.325 kPa = 1.01325 bar

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solutions made up by weight and density measured but not reported in paper. Equilibrium established between a measured volume of gas and a measured amount of gas-free liquid in a cell fitted with a magnetic stirrer. Amount of gas absorbed estimated from change in volume of gas. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial sample, minimum purity 99.8 mole %.

(2) Analytical grade.

(3) Distilled and degassed.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta\alpha = \pm 2$ %

(Estimated by the compiler.)

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

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

ORIGINAL MEASUREMENTS:

Malinin, S. D.; Savelyeva, N. I.

**Geokhimiya* 1972, (6), 643-53;
Geochem. Int. 1972, *9*, 410-8.

VARIABLES:

T/K = 298.15 - 358.15
P/bar = 47.95
c_2/mol L^{-1} = 0 - 4.458

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	c_2/mol L^{-1}	C_1 [a]	S_1 [b]
298.15	47.95	0.00	52.67	52.84
			52.95	
			52.84	
		0.905	40.81	43.25
			41.61	
			40.98	
			40.99	
			41.27+	
		1.793	32.71+	36.14
		2.597	26.19	30.43
			26.23	
323.15	47.95	0.00	32.86	32.86
			32.865+	
			32.90	
			32.73	
		0.358	29.84	30.38
			29.77	
		1.012	25.10	26.72
			25.25	
		1.794	20.80	23.14
			20.94	
		2.741	17.17	19.95

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Flow system with about 0.25 L of solution in 0.5 L stainless steel cell. After equilibrium established, liquid sampled and carbon dioxide absorbed in potassium hydroxide. Gain in weight of absorption train used to estimate amount of carbon dioxide. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) GOST 8050-64 sample.

(2) Analytical reagent grade sample.

(3) No details given.

ESTIMATED ERROR:

δT/K = ± 0.1; δC_1, δS_1 = ± 0.5 %;
δP/bar = ± 0.1

(estimated by compiler)

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Sodium chloride; NaCl; [7647-14-5] (3) Water; H_2O; [7732-18-5]	Malinin, S. D.; Savelyeva, N. I. **Geokhimiya* 1972, (6), 643-53; *Geochem. Int.* 1972, *9*, 410-8.

EXPERIMENTAL VALUES: (continued)

T/K	P/bar	c_2/mol L^{-1}	C_1 [a]	S_1 [b]
358.15	47.95	0.00	23.93 24.01 23.79+ 23.99+	23.92
		0.4162	21.38+ 21.42+	21.92
		1.133	17.81+ 17.88+	19.06
		2.200	14.07+ 14.19+	16.03
		3.216	11.68+	13.89
		4.429	9.29+ 9.20+	11.64
		4.458	9.18+ 9.24+	11.60

+ Equilibrium state approached from supersaturation

[a] Solubility of CO_2: $C_1 = m_1$ (in grams) / 1 kg of solution

[b] Solubility of CO_2: $S_1 = m_1$ (in grams) / 1 kg of water

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

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

ORIGINAL MEASUREMENTS:

Malinin, S. D.; Kurovskaya, N. A.

**Geokhimiya* 1975, (4), 547-50;
Geochem. Int. 1975, *12*, 199-201.

VARIABLES:

$T/K = 298.15 - 423.15$
$P/\text{bar} = 48.0$
$c_2/\text{mol L}^{-1} = 0 - 5.9154$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	$c_2/\text{mol L}^{-1}$	S_1 [a]
298.15	48.0	0.00	52.32
			52.57
			52.33
			52.27+
		2.081	33.64
			33.69
		3.039	28.29
			28.50
			28.07
		4.037	24.03
			24.10
		5.040	20.44
			20.53
373.15	48.0	0.00	19.44
			19.43+
			19.35
		0.9978	15.94+
			15.91
			15.86

T/K	P/bar	$c_2/\text{mol L}^{-1}$	S_1 [a]
373.15	48.0	1.9968	13.32
			13.37
		3.0979	11.49
			11.51
		3.9849	10.25
			10.16
		4.9873	9.199
			9.206
		5.9154	8.242
			8.269
423.15	48.0	0.00	15.21
			15.32
		1.0839	12.42
			12.37
		2.5208	9.899
		5.6522	6.694
			6.699

\+ Equilibrium state approached from supersaturation

[a] Solubility of CO_2: $S_1 = m_1$ (in grams) / 1 kg water

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Flow system with about 0.25 L of solution in 0.5 L stainless steel cell. After equilibrium established, liquid sampled and carbon dioxide absorbed in potassium hydroxide. Gain in weight of absorption train used to estimate amount of carbon dioxide. Details in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta S_1 = \pm 1$ %;
$\delta P/\text{bar} = \pm 0.5$

(estimated by compiler)

REFERENCES:

1. Malinin, S. D.; Savelyeva, N. I.
**Geokhimiya* 1972, (6), 643-53;
Geochem. Int. 1972, *9*, 410-8.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

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

ORIGINAL MEASUREMENTS:

Yasunishi, A.; Yoshida, F.

J. Chem. Eng. Data 1979, *24*, 11-14.

VARIABLES:

T/K = 288.15 - 308.15
P/kPa = 101.325
c_2/mol L^{-1} = 0 - 5.096

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	c_2/mol L^{-1}	L [a]
288.15	0	1.0634
	0.478	0.9404
	0.965	0.8309
	1.506	0.7314
	2.055	0.6346
	3.071	0.5032
	3.205	0.4939
	3.753	0.4363
	4.722	0.3487
298.15	0	0.8264
	0.455	0.7343
	1.000	0.6508
	1.442	0.5842
	1.945	0.5187
	2.486	0.4653
	3.098	0.4037
	3.400	0.3727
	4.216	0.3144
	5.096	0.2584
308.15	0	0.6675
	0.449	0.6016
	0.880	0.5456
	1.438	0.4821
	1.949	0.4307
	2.264	0.4036
	2.767	0.3637
	2.997	0.3456
	3.544	0.3083
	4.014	0.2782
	4.860	0.2330

[a] L = Ostwald coefficient (cm^3 cm^{-3})
P = 1 atm = 101.325 kPa = 1.01325 bar

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Density and composition of solution determined after absorption. Details in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) High purity grade sample, purity 99.96 mole %.

(2,3) Guaranteed reagent, solution degassed by boiling.

ESTIMATED ERROR:

δT/K = ± 0.05; δL = ± 1 %.

REFERENCES:

1. Tokunaga, J.
J. Chem. Eng. Data 1975, *20*, 41.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

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

ORIGINAL MEASUREMENTS:

Cramer, S. D.

Rep. Invest. - U.S., Bur. Mines 1982, RI 8706.

VARIABLES:

$T/K = 296.75 - 511.75$
$P/MPa = 0.8 - 6.2$
$c_2/mol\ dm^{-3} = 0 - 1.86$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	P/MPa	$c_2/mol\ dm^{-3}$	$m_2/mol\ kg^{-1}$	K_H/MPa [b]
33	306.15	0.8	0	0	206
126.3	399.45	2.0			602
132.5	405.65	2.0			617
146.0	419.15	2.8			565
153.5	426.65	3.1			580
198.1	471.25	4.1			537
213.1	486.25	5.8			484
23.6	296.75	0.8	0.49	0.50	199
73.7	346.85	1.7			499
123.6	396.75	2.1			645
25.2	298.35	1.9	1.86	1.95	329
52.9	326.05	1.3			514
57.2	330.35	1.2			506
74.7	347.85	1.5			637
82.1	355.25	1.4			647
84.8	357.95	0.9			820
97.4	370.55	1.9			939
128.4	401.55	1.7			1060
144.3	417.45	2.1			1037
238.6	511.75	6.2			928

[a] Calculated by the compiler.

[b] $K_H = P_1\phi_1/x_1$, where K_H = Henry's law constant, P_1 = partial pressure of gas ($P_1 = P - P_2$; P_2 is the vapor pressure of water at the corresponding temperature), ϕ_1 = fugacity coefficient (Smith, J.M. and Van Ness, H.C. *Chemical Engineering Thermodynamics*, McGraw-Hill, New York 1959), and x_1 = mole fraction of the dissolved CO_2.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility of CO_2 was determined from pressure-volume-temperature (PVT) measurements using the technique of gas extraction. The apparatus consisted of (1) a high-pressure, high-temperature section for dissolving the gas in the brine, (2) a heat exchanger for cooling (or heating) samples of gas-saturated brine to room temperature, and (3) a low-pressure, constant temperature section for making PVT measurements on collected gas and liquid samples.
A two liter, type 316 stainless steel stirred reactor, fitted with a heat- and chemical-resistant glass liner, was filled two-thirds full with brine.
The brine was deaerated by evacuating the reactor to the vapor pressure of the brine for at least 3 minutes. Upon reaching thermal equilibrium, the gas was injected into the reactor and allowed to distribute at a fixed partial pressure between the vapor and liquid phases. Equilibration occurred within 5 hours at 150 °C and above, and within 24 hours at lower temperatures.
The concentration of CO_2 in the liquid was determined by desorption from a a known volume of liquid followed by volumetric analysis of the evolved gas.

SOURCE AND PURITY OF MATERIALS:

(1) 99.5 %.

(2) Reagent grade.

(3) Demineralized.

ESTIMATED ERROR:

$\delta K_H/K_H = 0.058$ (by author)

(Detailed analysis of experimental contributions to the total error is given in the source.)

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Sodium chloride; NaCl; [7647-14-5] (3) Water; H_2O; [7732-18-5]	Burmakina, G.V.; Efanov, L.N.; Shnet, M.A. **Zh. Fiz. Khim.* 1982, *56*, 1159-61; *Russ. J. Phys. Chem. (Engl. Transl.)* 1982, *56*, 705-7.
VARIABLES:	PREPARED BY:
T/K = 298.15 p/MPa = 0.1 10^3c_2/mol L^{-1} = 0 - 200	Yu. P. Yampol'skii

EXPERIMENTAL VALUES:

Solubility of carbon dioxide in aqueous solutions of NaCl at 298.15 K. [a]

T/K	10^3c_2/mol L^{-1} [b]	10^3c_1/mol L^{-1} [c]
298.15	0	33.90
	1	33.50
	2	33.15
	5	33.00
	10	33.25
	25	33.10
	50	33.00
	100	32.50
	200	31.67

[a] Data taken from a graph by compiler.

[b] c_2 = concentration of NaCl

[c] c_1 = concentration of CO_2

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Attainment of the equilibrium was checked by the constancy of CO_2 content in 3-5 subsequent samples of gas after saturation of the solution. The concentration of carbon dioxide was determined by titration.

SOURCE AND PURITY OF MATERIALS:

(1) Source not given. Before contacting with water solutions CO_2 was allowed to pass through the vessels with $NaHCO_3$, glass beads, glass wool and distilled water.

(2) Nothing specified.

(3) Distilled.

ESTIMATED ERROR:

$\delta c_1/c_1 = \pm$ 0.06 - 0.2 %
δT/K = ± 0.05

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

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

ORIGINAL MEASUREMENTS:

Nighswander, J. A.; Kalogerakis, N.
Mehrotra, A. K.

J. Chem. Eng. Data 1989, *34*, 355-60.

VARIABLES:

$T/K = 352.85 - 473.65$
$P/MPa = 2.040 - 10.210$
$10^2 w_2 = 0$ and 1

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

TABLE 1 **Solubility, density and Henry's law data for the CO_2-H_2O system.**

T/K [a]	P/kPa	$10^2 x_1$ [b]	$m_1/mol\ kg^{-1}$ [c]	$\rho/kg\ m^{-3}$ [d]	$\ln(K_H/kPa)$ [e]
353.65	2330	0.47	0.262	951	8.967
353.35	4310	0.85	0.476	956	8.911
353.75	4340	0.84	0.470	951	8.930
353.65	6110	1.12	0.629	963	8.906
353.65	7760	1.37	0.771	950	8.868
353.65	7840	1.38	0.777	951	8.868
353.45	10160	1.64	0.925	961	8.846
352.85	10180	1.66	0.937	961	8.833
				av. $\ln(K_H/kPa)$ =	8.891 ± 0.045
393.05	2110	0.34	0.189	936	9.155
393.25	2130	0.35	0.195	933	9.135
393.25	4050	0.65	0.363	929	9.141
393.05	4090	0.67	0.374	926	9.120
393.15	5960	0.91	0.510	933	9.144
393.15	6050	0.91	0.510	926	9.157
393.05	8110	1.19	0.668	931	9.124
393.25	8160	1.20	0.674	926	9.111
393.25	9960	1.42	0.799	930	9.097
393.45	9980	1.45	0.817	930	9.078
				av. $\ln(K_H/kPa)$ =	9.126 ± 0.025

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Schematic diagrams of the apparatus, equilibrium cell, and sample analysis apparatus are shown in the source.

Approximately 500 mL of liquid was injected into the equilibrium cell. The cell was sealed and heated to the test temperature. Once thermal equilibrium was achieved, approximately 500 mL of CO_2 at 6 MPa was added from the CO_2 cylinder. The system pressure was increased to about 11 MPa by inserting the cell piston. The equilibrium cell was agitated until equilibrium at 10 MPa was achieved. Equilibrium was assumed when no cell pressure variation was observed over a 12 h period. Once equilibrium was reached, agitation was stopped and a sample of the liquid phase was withdrawn for analysis. The above procedure was then repeated decreasing the pressure by 2 MPa steps until the last samples at 2 MPa were collected.

SOURCE AND PURITY OF MATERIALS:

(1) Coleman Instrument grade with a minimum purity 99.99 %.

(2) Fisher Scientific laboratory grade with 99.98 % purity.

(3) Purified using a reverse osmosis system to a minimum resistance of 17 MΩ.

ESTIMATED ERROR:

$\delta T/T \le \pm 0.005$; $\delta P/P \le \pm 0.017$
$\delta x_1/x_1 = 0.02$; $\delta\rho/kg\ m^{-3} = 3$

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Sodium chloride; NaCl; [7647-14-5] (3) Water; H_2O; [7732-18-5]	Nighswander, J. A.; Kalogerakis, N. Mehrotra, A. K. *J. Chem. Eng. Data* 1989, *34*, 355-60.

EXPERIMENTAL VALUES: (continued)

TABLE 1 **Solubility, density and Henry's law data for the CO_2-H_2O system.**

T/K [a]	P/kPa	10^2x_1 [b]	m_1/mol kg^{-1} [c]	ρ/kg m^{-3} [d]	ln(K_H/kPa) [e]
432.85	2040	0.29	0.161	896	9.050
433.05	2060	0.29	0.161	893	9.061
433.05	3910	0.54	0.301	894	9.214
433.15	3940	0.56	0.313	890	9.185
432.85	5940	0.80	0.448	890	9.249
432.95	8060	1.10	0.617	890	9.203
432.95	8070	1.10	0.617	890	9.204

av. ln(K_H/kPa) = 9.167 ± 0.078

T/K [a]	P/kPa	10^2x_1 [b]	m_1/mol kg^{-1} [c]	ρ/kg m^{-3} [d]	ln(K_H/kPa) [e]
470.95	2450	0.22	0.122	851	8.946
471.25	4560	0.57	0.318	840	9.107
471.15	4600	0.52	0.290	860	9.212
470.85	6240	0.78	0.436	854	9.193
471.15	7970	1.06	0.595	853	9.166
470.75	8020	1.09	0.612	850	9.147
471.25	10200	1.30	0.731	857	9.215
471.15	10210	1.40	0.788	856	9.141

av. ln(K_H/kPa) = 9.141 ± 0.087

---

[a] Calculated by compiler
[b] x_1 = mole fraction of CO_2 in the solution
[c] m_1 = molality of CO_2
[d] ρ = density of the solution
[e] K_H = Henry's law constant

TABLE 2 **Solubility, density and Henry's law data for the CO_2-NaCl-H_2O system.** (NaCl 1 mass %)

T/K [a]	P/kPa	10^2x_1 [b]	m_1/mol kg^{-1} [c]	ρ/kg m^{-3} [d]	ln(K_H/kPa) [e]
353.45	4040	0.74	0.414	975	9.001
353.35	4130	0.76	0.425	974	8.983
353.35	6020	1.01	0.566	986	8.995
353.35	6070	1.08	0.606	982	8.933
353.45	8040	1.35	0.759	988	8.904
353.75	8050	1.34	0.754	981	8.913
353.15	9490	1.41	0.794	986	8.967
352.25	9940	1.54	0.868	981	8.899

av. ln(K_H/kPa) = 8.949 ± 0.042

T/K [a]	P/kPa	10^2x_1 [b]	m_1/mol kg^{-1} [c]	ρ/kg m^{-3} [d]	ln(K_H/kPa) [e]
393.15	2110	0.29	0.161	955	9.304
393.25	2140	0.31	0.173	951	9.252
393.25	4040	0.59	0.329	945	9.225
393.25	4060	0.61	0.341	942	9.197
393.55	6020	0.97	0.544	935	9.076
393.25	6040	0.97	0.544	928	9.079
393.25	8150	1.20	0.674	934	9.106
393.05	8160	1.18	0.663	945	9.124
393.15	9970	1.39	0.782	935	9.104
393.35	10030	1.38	0.777	945	9.116

av. ln(K_H/kPa) = 9.158 ± 0.080

(continued next page)

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Sodium chloride; NaCl; [7647-14-5] (3) Water; H_2O; [7732-18-5]	Nighswander, J. A.; Kalogerakis, N. Mehrotra, A. K. *J. Chem. Eng. Data* 1989, *34*, 355-60.

EXPERIMENTAL VALUES: (continued)

TABLE 2 **Solubility, density and Henry's law data for the CO_2-NaCl-H_2O system.** (NaCl 1 mass %)

T/K [a]	P/kPa	10^2x_1 [b]	m_1/mol kg^{-1} [c]	ρ/kg m^{-3} [d]	$\ln(K_H$/kPa) [e]
433.35	2150	0.28	0.156	916	9.128
433.15	4100	0.54	0.301	903	9.238
433.25	4120	0.55	0.307	911	9.225
433.05	6040	0.84	0.470	909	9.185
432.95	6060	0.87	0.487	902	9.154
432.85	7950	1.06	0.595	912	9.202
433.15	8030	1.03	0.578	918	9.241
433.05	9930	1.31	0.737	915	9.186
433.25	9970	1.36	0.765	914	9.151
				av. $\ln(K_H$/kPa) =	9.190 ± 0.040
473.15	4120	0.47	0.262	869	9.077
473.25	4150	0.47	0.262	879	9.086
472.95	6010	0.69	0.386	878	9.199
473.05	6010	0.76	0.425	871	9.101
473.05	8120	0.94	0.527	873	9.237
473.15	8130	0.98	0.549	878	9.196
473.65	9930	1.32	0.742	862	9.090
				av. $\ln(K_H$/kPa) =	9.141 ± 0.067

---

[a] Calculated by compiler
[b] x_1 = mole fraction of CO_2 in the solution
[c] m_1 = molality of CO_2
[d] ρ = density of the solution
[e] K_H = Henry's law constant

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

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

ORIGINAL MEASUREMENTS:

He, S.; Morse, J.W.

Geochim. Cosmochim. Acta **1993**, *57*, 3533-54.

VARIABLES:

$T/K = 273.15 - 363.15$
$P/MPa = 0.1032$
$m_2/mol\ kg^{-1} = 0.1 - 6.14$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

T/K [a]	$m_2/mol\ kg^{-1}$ [b]	$\rho/g\ cm^{-3}$ [c]	$10^2p_1/atm$ [d]	$10^3m_1/mol\ kg^{-1}$ [e]	γ_1 [f]
273.15	0.5	1.0214	96.6	63.6	1.18
	1.0	1.0411		57.8	1.30
	2.0	1.0787		45.7	1.65
	3.0	1.1140		39.5	1.90
	4.0	1.1460		31.7	2.38
	5.0	1.1776		26.9	2.79
	6.0	1.2095		21.9	3.44
298.15	0.5	1.0189	3.9	1.20	1.10
	1.0	1.0363		1.10	1.18
	2.0	1.0700		0.90	1.48
	3.0	1.1026		0.80	1.76
	4.0	1.1340		0.60	2.25
	5.0	1.1642		0.50	2.61
	6.14	1.1974		0.40	3.21
323.15	0.5	1.0081	85.4	15.5	1.07
	1.0	1.0262		14.7	1.13
	2.0	1.0608		13.3	1.25
	3.0	1.0934		10.6	1.56
	4.0	1.1240		9.2	1.81
	5.0	1.1524		8.4	1.98
	6.14	1.1824		7.4	2.25

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Either pure CO_2 gas or CO_2-N_2 mixtures were used in the experiments to maintain a constant $P(CO_2)$. The CO_2-N_2 mixtures were made by pumping predetermined amounts of CO_2 and N_2 into a gas tank and their composition was verified by gas chromatography.

CO_2 or CO_2-N_2 gas mixtures were equilibrated with the aqueous solutions in a series of stirred water-jacketed reaction vessels with condensers. The gas was premoistured by first passing it through distilled water at the temperature of experiment. Fine bubbles were obtained by using gas-dispersion tubes. The bubbling rate was 90 to 95 mL min^{-1}.

The mole fraction of CO_2 in the CO_2-N_2 mixture was determined using a Hewlett Packard (5790A) gas chromatograph.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial; purity 99.9 %.

(2) Source not mentioned.
Analytical reagent-grade which met ACS specifications.
Vacuum-dried before use.

(3) 18 MΩ water obtained from a Milli-Q Super-Q water system.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$
$\delta m_1/m_1 = \pm 0.012$
$\delta\gamma_1/\gamma_1 = \pm 0.04$

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

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

ORIGINAL MEASUREMENTS:

He, S.; Morse, J.W.

Geochim. Cosmochim. Acta 1993, *57*, 3533-54.

EXPERIMENTAL VALUES: (continued)

T/K [a]	m_2/mol kg^{-1} [b]	ρ/g cm^{-3} [c]	$10^2 p_1$/atm [d]	$10^3 m_1$/mol kg^{-1} [e]	γ_1 [f]
348.15	0.1	0.9795	60.3	7.8	1.03
	1.0	1.0120		7.4	1.09
	2.0	1.0463		7.0	1.15
	4.0	1.1090		6.4	1.26
	6.0	1.1638		5.9	1.37
363.15	0.1	0.9624	30.1	3.4	1.02
	1.0	1.0028		3.2	1.06
	2.0	1.0373		3.1	1.12
	4.0	1.1002		2.8	1.21
	6.0	1.1559		2.6	1.30

[a] Calculated by compiler

[b] m_2 = molality of NaCl

[c] ρ = density of solvent

[d] p_1 = partial pressure of CO_2

[e] m_1 = molality of CO_2

[f] γ_1 = activity coefficient of CO_2

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

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

ORIGINAL MEASUREMENTS:

Rumpf, B.; Nicolaisen, H.; Öcal, C.; Maurer, G.

J. Solution Chem. 1994, *23*, 431-48.

VARIABLES:

T/K = 313.14 - 433.12
p/MPa = 0.151 - 9.328
m_2/mol kg^{-1} = 0, near 4.0 and 6.0

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Solubility of carbon dioxide in aqueous sodium chloride.

T/K	p/MPa	m_2/mol kg^{-1} ^{a}	m_1/mol kg^{-1} ^{b}
323.17	1.059	0.0	0.196
323.16	1.247	0.0	0.230
323.17	1.432	0.0	0.259
323.17	1.660	0.0	0.299
323.17	1.809	0.0	0.323
323.17	3.480	0.0	0.581
323.18	5.798	0.0	0.871
313.16	0.467	3.997	0.0497
313.14	0.911	3.997	0.0995
313.14	1.900	3.997	0.1996
313.19	3.147	3.997	0.3098
313.19	5.123	3.997	0.4529
313.19	6.917	3.997	0.5497
333.13	0.625	3.997	0.0509
333.16	1.141	3.997	0.0909
333.16	1.328	3.997	0.1073
333.15	2.514	3.997	0.1922
333.16	2.871	3.997	0.2184
333.14	3.521	3.997	0.2570
333.17	4.737	3.997	0.3305
333.15	7.303	3.997	0.4472
333.16	9.642	3.997	0.5272

(continued on next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is a modification of one used in earlier work (1). It consists of a 30 mL high pressure optical cell, thermostat, magnetic stirrer, thermocouples and Pt resistance thermometer, pressure transducers and tanks for aqueous solutions, rinse water and solute gas. Measured amounts of gas and solvent are added to the cell, extra solvent is added until the gas phase disappears. The pressure is reduced by removing stepwise small known amounts of solvent until a small stable bubble appears. The solubility is calculated from the known amounts of solvent and carbon dioxide in the cell.

SOURCE AND PURITY OF MATERIALS:

(1) Carbon dioxide. Messer Griesheim, Ludwigshafen, > 99.995 mol %, used as received.

(2) Sodium chloride. Merck GmbH, Darmstadt. > 99.9 mass %. Degassed and dried under vacuum.

(3) Water. Deionized and degassed by vacuum distillation.

ESTIMATED ERROR:

δT/K = ± 0.1
$\delta p/p$ < ± 0.03 below 6 MPa
$\delta p/p$ < ± 0.05 at higher pressures
$\delta m_2/m_2$ = ± 0.003
$\delta m_1/m_1$ = ± 0.01 to 0.03

REFERENCES:

1. Rumpf, B.; Maurer, G. *Ber. Bunsenges. Phys. Chem.* 1993, *97*, 85.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

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

ORIGINAL MEASUREMENTS:

Rumpf, B.; Nicolaisen, H.; Öcal, C.; Maurer, G.

J. Solution Chem. 1994, *23*, 431-48.

EXPERIMENTAL VALUES: (continued)

T/K	p/MPa	m_2/mol kg^{-1} [a]	m_1/mol kg^{-1} [b]
353.12	0.817	4.001	0.0505
353.12	1.642	4.001	0.1014
353.10	3.387	4.001	0.2032
353.10	5.592	4.001	0.3084
353.12	6.940	4.001	0.3594
353.11	8.337	4.001	0.4116
353.11	9.637	4.001	0.4613
393.06	0.169	4.003	0.0000
393.07	1.204	4.001	0.0518
393.19	2.331	4.003	0.1035
393.10	4.742	4.001	0.2084
393.19	7.650	4.003	0.3135
393.12	9.328	4.003	0.3657
413.06	0.301	4.003	0.0000
413.07	1.393	4.003	0.0505
413.08	2.550	4.003	0.1011
413.09	5.042	4.003	0.2027
413.07	8.671	4.003	0.3272
432.97	0.515	4.003	0.0000
432.86	1.662	4.003	0.0506
432.96	2.858	4.003	0.1013
432.95	5.912	4.003	0.2188
432.98	9.048	4.003	0.3254
313.31	0.602	5.999	0.0517
313.22	1.232	5.999	0.1035
313.28	2.640	5.999	0.2074
313.27	4.430	5.999	0.3133
313.31	6.799	5.999	0.4177
313.19	8.427	5.999	0.4693
333.12	0.820	5.999	0.0526
333.12	1.678	5.999	0.1047
333.10	3.657	5.999	0.2106
333.00	6.844	5.999	0.3388
333.05	8.670	5.999	0.3965
353.12	0.997	5.999	0.0509
353.11	2.032	5.999	0.1021
353.08	4.394	5.999	0.2043
353.10	7.610	5.999	0.3085
353.08	9.044	5.999	0.3553
393.09	0.151	5.999	0.0000
393.17	1.421	5.999	0.0518
393.14	2.778	5.999	0.1031
393.13	5.937	5.999	0.2067
393.12	9.135	5.999	0.3049
413.10	0.275	5.999	0.0000
413.09	1.661	5.999	0.0511
413.09	3.195	5.999	0.1024
413.09	6.291	5.999	0.2051
413.12	9.201	5.999	0.2878
433.12	0.471	5.999	0.0000
433.07	1.898	5.999	0.0512
433.05	3.406	5.999	0.1025
433.08	6.578	5.999	0.2052
433.05	8.981	5.999	0.2743

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[a] m_2 = molality of NaCl

[b] m_1 = solubility of CO_2

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

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

ORIGINAL MEASUREMENTS:

Vázquez, G.; Chenlo, F.; Pereira, G.

Afinidad 1994, *51*, (No. 453) 369-74.

VARIABLES:

$T/\mathrm{K} = 298.1$
$P_1/\mathrm{bar} = 1.013$
$\gamma_2/\mathrm{g\ L^{-1}} = 0 - 160$

PREPARED BY:

Pirketta Scharlin
Rosa Crovetto

EXPERIMENTAL VALUES:

T/K	$\gamma_2/\mathrm{g\ L^{-1}}$ [a]	$c_2/\mathrm{mol\ L^{-1}}$ [b]	$\rho/\mathrm{kg\ m^{-3}}$ [c]	$c_1/\mathrm{mol\ dm^{-3}}$ [d]	L [e]
298.1	0	0	997.0	0.0333	0.814
	40	0.684	1028.7	0.0287	0.702
	80	1.369	1054.9	0.0244	0.597
	120	2.053	1079.4	0.0208	0.509
	160	2.738	1102.7	0.0178	0.435

[a] γ_2 = mass concentration of NaCl
[b] c_2 = concentration of NaCl; calculated by compiler
[c] ρ = density of aqueous NaCl solution
[d] c_1 = solubility of CO_2
[e] L = Ostwald coefficient [$\mathrm{cm^3\ cm^{-3}}$]; calculated by compiler (PS) (ideal gas behavior assumed)

The authors also report values for viscosity μ:

$\gamma_2/\mathrm{g\ L^{-1}}$	0	40	80	120	160
$\mu/\mathrm{mPa\ s}$	0.890	0.948	1.016	1.092	1.175

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is a combination of previous designs (Refs 1 and 2). It was modified to achieve a more accurate determination of the volume of the absorbent liquid. The apparatus measures the volume of absorbed gas as the volume of mercury that must be supplied to the system in order to restore the initial pressure.
The raw solubility data obtained are gas/liquid volume ratios.
A detailed description of apparatus, method and procedure is given in Ref. 3.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial, purity 99.5 mole %.

(2) No details given.

(3) Distilled and degassed.

ESTIMATED ERROR:

$\delta T/\mathrm{K} = \pm 0.1$
$\delta P/\mathrm{bar} = \pm 0.001$
$\delta c_1/c_1 < \pm 1\ \%$ [estimated by compiler (PS) on the basis of the information in Ref. 3]

REFERENCES:

1. Alvarez, J.R.; Fernández, A.; Coll, A. *Ing. Quím.* 1984, *16*, 67.
2. Haimour, N. *J. Chem. Eng. Data* 1990, *35*, 177.
3. Vázquez, G.; Chenlo, F.; Pereira, G.; Peaguda, J. *J. Chem. Eng. Data* 1994, *39*, 639.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

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

ORIGINAL MEASUREMENTS:

Vázquez, G.; Chenlo, F.; Pereira, G.; Peaguda, J.

An. Quim. 1994, *90*, 324-28.

VARIABLES:

$T/K = 293.1 - 308.1$
$P_1/bar = 1.013$
$m_2/mol\ kg^{-1} = 0.692 - 2.903$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

T/K	$\gamma_2/g\ L^{-1}$ [a]	$\rho/kg\ m^{-3}$ [b]	$m_2/mol\ kg^{-1}$ [c]	$c_1/mol\ dm^{-3}$ [d]	L [e]
293.1			0.692	0.0326	0.784
			1.404	0.0277	0.666
			2.143	0.0238	0.572
			2.903	0.0207	0.497
298.1	40	1029	0.692	0.0289	0.707
	80	1055	1.404	0.0243	0.594
	120	1078	2.143	0.0207	0.506
	160	1103	2.903	0.0179	0.438
303.1			0.692	0.0250	0.644
			1.404	0.0214	0.532
			2.143	0.0182	0.453
			2.903	0.0164	0.408
308.1			0.692	0.0227	0.574
			1.404	0.0193	0.488
			2.143	0.0165	0.417
			2.903	0.0147	0.372

[a] γ_2 = mass concentration of NaCl
[b] ρ = density of aqueous NaCl solution
[c] m_2 = molality of NaCl; calculated by compiler
[d] c_1 = solubility of CO_2
[e] L = Ostwald coefficient [$cm^3\ cm^{-3}$]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is a combination of previous designs (Refs 1 and 2). It was modified to achieve a more accurate determination of the volume of the absorbent liquid. The apparatus measures the volume of absorbed gas as the volume of mercury that must be supplied to the system in order to restore the initial pressure.
The raw solubility data obtained are gas/liquid volume ratios.
A detailed description of apparatus, method and procedure is given in Ref. 3.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial, purity 99.95 mole %.

(2) Probus. Grade not given.

(3) Distilled and degassed.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$
$\delta P/bar = \pm 0.001$
$\delta c_1/c_1 < \pm 1\ \%$ (estimated by compiler on the basis of the information in Ref. 3)

REFERENCES:

1. Alvarez, J.R.; Fernández, A.; Coll, A. *Ing. Quím.* 1984, *16*, 67.
2. Haimour, N. *J. Chem. Eng. Data* 1990, *35*, 177.
3. Vázquez, G.; Chenlo, F.; Pereira, G.; Peaguda, J. *J. Chem. Eng. Data* 1994, *39*, 639.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

(3) Hydrochloric acid; HCl; [7647-01-0]

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

ORIGINAL MEASUREMENTS:

Van Slyke, D. D.; Sendroy, J., Jr.; Hastings, A. B.; Neill, J. M.

J. Biol. Chem. 1928, *78*, 765-99.

VARIABLES:

T/K = 311.2
c_2/mol L^{-1} = 0 - 0.300
c_3/mol L^{-1} = 0.01
P = "atmospheric"

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

t/°C	T/K [a]	Method [b]	p_1/mmHg [c]	c_2/mol L^{-1}	c_3/mol L^{-1}	α [d]	S_1 [e]
38.0	311.2	B,T		0	0.01	0.5452*	0.5468*
		B	721.8	0.150	0.01	0.5300	0.5327
		T	715.1	0.150	0.01	0.5276	0.5302
		B	721.8	0.300	0.01	0.5116	0.5157
		T	715.1	0.300	0.01	0.5113	0.5154

[a] Calculated by the compiler.

[b] B: saturation by bubbling; T: saturation in rotating tonometer.

[c] 1 mmHg = 133.322 Pa = 1.33322 x 10^{-3} bar

[d] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

[e] S_1 = Kuenen coefficient [cm^3 (STP) g^{-1} atm^{-1}]

* Average of six measurements.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two procedures were used for saturating solutions with CO_2:

Saturation by bubbling (B). The solution was placed in the saturating tube, the lower end of which was connected through a wash bottle with a Kipp CO_2 generator. The tube and wash bottle were immersed in a constant temperature bath. CO_2 gas was bubbled through it rapidly for 30 minutes. The wash bottle was replaced by a mercury reservoir and the free gas was driven completely out of the saturating tube by admitting mercury underneath the solution. The CO_2 contents of the solutions were determined in the manometric gas apparatus (Refs 1 and 2).

Saturation in rotating tonometer (T). The technique used was that described by Austin *et al.* (Ref. 3).

Both procedures gave identical results with solutions of acids and salts.

SOURCE AND PURITY OF MATERIALS:

(1) From a Kipp CO_2 generator.

(2) Not specified.

(3) Not specified.

(4) Distilled.

ESTIMATED ERROR:

δT/K = ± 0.1
$\delta\alpha/\alpha$ = ± 0.005

REFERENCES:

1. Van Slyke, D. D.; Neill, J. M. *J. Biol. Chem.* 1924, *61*, 523.
2. Van Slyke, D. D.; Sendroy, J., Jr. *J. Biol. Chem.* 1927, *73*, 127.
3. Austin, J. H.; Cullen, G. E.; Hastings, A. B.; McLean, F. C.; Peters, J. P.; Van Slyke, D. D. *J. Biol. Chem.* 1922, *54*, 121.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]
(2) Sodium chloride; NaCl; [7647-14-5]
(3) Nitric acid; HNO_3; [7697-37-2]
(4) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Onda, K.; Sada, E.; Kobayashi, T.; Kito, S.; Ito, K.

J. Chem. Eng. Jpn. 1970, *3*, 137-42.

VARIABLES:

$T/K = 298.15$
$P/kPa = 101.325$
$c_2/mol\ L^{-1} = 0 - 1.397$
$c_3/mol\ L^{-1} = 0 - 0.766$

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	$c_2/mol\ L^{-1}$	$c_3/mol\ L^{-1}$	$I/mol\ L^{-1}$ [a]	α [a]
298.15	0	0	0	0.7595
	0.557 (*b*)	0.840 (*b*)	1.397	0.6865
	1.175 (*b*)	1.771 (*b*)	2.946	0.6241
	0.411 (*c*)	0.226 (*c*)	0.637	0.6898
	1.140 (*c*)	0.626 (*c*)	1.766	0.5953
	1.397 (*c*)	0.766 (*c*)	2.163	0.5661

[a] Quoted in original paper.
I = ionic strenght; α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

(*b*) Calculated from ratio of ionic strength NaCl:HNO_3 being 0.3988:0.6012 as quoted in original paper.

(*c*) Calculated from ratio of ionic strength NaCl:HNO_3 being 0.6458:0.3542 as quoted in original paper.

$P = 1\ atm = 1.01325 \times 10^5\ Pa$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Concentrated solution prepared by weighting, less concentrated solutions prepared by dilution. Equilibrium established between a measure volume of gas and a measured amount of gas-free liquid in a cell fitted with a magnetic stirrer. Amount of gas absorbed estimated from change in volume of gas. Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

(1) Commercial sample, purity 99.8 mole %.

(2) Analytical grade sample.

(4) No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta\alpha = \pm 2$ % (estimated by compiler).

REFERENCES:

1. Onda, K.; Sada, E.; Kobayashi, T.; Kito, S.; Ito, K. *J. Chem. Eng. Jpn.* 1970, *3*, 18.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]
(2) Sodium chloride; NaCl; [7647-14-5]
(3) Ammonium chloride; NH_4Cl; [12125-02-9]
(4) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Yasunishi, A.; Tsuji, M.; Sada, E.

Adv. Chem. Ser. 1979, *177*, 189-203.

VARIABLES:

T/K = 298.15
P/kPa = 101.325
(c_2+c_3)/mol dm^{-1} = 0 - 5.480

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T = 298.15 K;
P = 101.325 kPa

x_2 in mixed salt	(c_2+c_3) /mol dm^{-3}	L [a]
0.00	0	0.8264
	0.501	0.7880
	0.980	0.7576
	1.508	0.7328
	2.338	0.6915
	2.816	0.6721
	3.682	0.6452
	4.421	0.6258
	5.480	0.6015
0.25	0.426	0.7871
	0.892	0.7405
	1.709	0.6802
	2.550	0.6252
	3.398	0.5781
	4.077	0.5467
	4.459	0.5275
	5.051	0.5059
0.50	0.446	0.7655
	0.931	0.7147
	1.750	0.6309
	2.233	0.5896
0.50	3.453	0.5024
	4.157	0.4614
	4.731	0.4296
	5.176	0.4097
0.75	0.945	0.6831
	1.783	0.5834
	2.648	0.4954
	3.572	0.4243
	4.284	0.3737
	4.620	0.3552
	5.281	0.3165
1.00	0.455	0.7343
	1.000	0.6507
	1.442	0.5842
	1.945	0.5187
	2.486	0.4653
	3.400	0.3727
	4.216	0.3144
	5.096	0.2584

[a] L = Ostwald coefficient [cm^3 cm^{-3}]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Partial pressure determined from total pressure and vapor pressure of solution. The vapor pressure of the mixed salt solution estimated by the method of Robinson and Bower (1) from corresponding data for each component salt solution. Apparatus s6milar to that described in Ref. 2.

SOURCE AND PURITY OF MATERIALS:

(1) Extra pure grade, purity 99.96 mole %.

(2,3) Reagent grade.

(4) Deionized.

ESTIMATED ERROR:

δT/K = ± 0.05; δL = ± 1 %

REFERENCES:

1. Robinson, R.A.; Bower, V.E. *J. Res. Nat. Bur. Stand.* 1965, *69A*, 365.
2. Tokunaga, J. *J. Chem. Eng. Data* 1975, *20*, 41.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

(3) Ammonium nitrate; NH_4NO_3; [6484-52-2]

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

ORIGINAL MEASUREMENTS:

Onda, K.; Sada, E.; Kobayashi, T.; Kito, S.; Ito, K.

J. Chem. Eng. Jpn. <u>1970</u>, *3*, 137-42.

VARIABLES:

$T/K = 298.15$

$P/kPa = 101.325$

$c_2/mol\ L^{-1} = 0 - 1.931$

$c_3/mol\ L^{-1} = 0 - 1.11$

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	$c_2/mol\ L^{-1}$ [a]	$c_3/mol\ L^{-1}$ [a]	$I/mol\ L^{-1}$ [b]	α [b]
298.15	0	0	0	0.7595
	0.188	0.372	0.560	0.7188
	0.331	0.655	0.986	0.6909
	0.466	0.924	1.390	0.6673
	0.619	1.226	1.845	0.6381
	0.678	1.341	2.019	0.6304
	0.996	1.973	2.969	0.5710
	0.270	0.270	0.539	0.7057
	0.289	0.289	0.577	0.7030
	0.652	0.652	1.034	0.6630
	0.698	0.698	1.396	0.6251
	0.858	0.858	1.716	0.6082
	1.388	1.388	2.775	0.5320
	1.478	1.478	2.956	0.5218
	0.526	0.303	0.829	0.6717
	1.028	0.594	1.622	0.5885
	1.454	0.839	2.293	0.5314
	1.931	1.11	3.046	0.4826

[a] Calculated from ionic strength and ratios of ionic strengths given in paper.

[b] Quoted in original paper.
I = ionic strength; α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

$P = 1\ atm = 1.01325 \times 10^5\ Pa$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Concentrated solution prepared by weighting, less concentrated solutions prepared by dilution. Equilibrium established between a measure volume of gas and a measured amount of gas-free liquid in a cell fitted with a magnetic stirrer. Amount of gas absorbed estimated from change in volume of gas. Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

(1) Commercial sample, purity 99.8 mole %.

(2) Analytical grade sample.

(4) No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta\alpha = \pm 2$ % (estimated by compiler).

REFERENCES:

1. Onda, K.; Sada, E.; Kobayashi, T.; Kito, S.; Ito, K. *J. Chem. Eng. Jpn.* <u>1970</u>, *3*, 18.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]
(2) Sodium chloride; NaCl; [7647-14-5]
(3) Magnesium sulfate; $MgSO_4$; [7487-88-9]
(4) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Yasunishi, A.; Tsuji, M.; Sada, E.

Adv. Chem. Ser. 1979, *177*, 189-203.

VARIABLES:

$T/K = 298.15$
$P/kPa = 101.325$
$(c_2+c_3)/mol\ dm^{-3} = 0 - 2.486$

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	x_2 in mixed salt	(c_2+c_3) /mol dm^{-3}	L [a]
298.15	0.00	0	0.8264
		0.418	0.6480
		0.724	0.5355
		1.020	0.4513
		1.643	0.3047
		2.274	0.2049
	0.25	0.264	0.7194
		0.515	0.6329
		1.028	0.4837
		1.562	0.3766
		2.056	0.2872
	0.50	0.387	0.7001
		0.723	0.6110
		1.111	0.5147
		1.616	0.4215
		2.185	0.3315
	0.75	0.263	0.7540
		0.537	0.6917
		1.079	0.5799
		1.626	0.4811
		2.179	0.4104
	1.00	0.455	0.7343
		1.000	0.6508
		1.442	0.5842
		1.945	0.5187
		2.486	0.4653

[a] L = Ostwald coefficient [$cm^3\ cm^{-3}$]
P = 101.325 kPa

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Partial pressure determined from total pressure and vapor pressure of solution. The vapor pressure of the mixed salt solution estimated by the method of Robinson and Bower (1) from corresponding data for each component salt solution.
Apparatus similar to that described in ref. (2).

SOURCE AND PURITY OF MATERIALS:

(1) Extra pure grade, purity 99.96 mole %.

(2,3) Reagent grade.

(4) Deionized.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta L = \pm 1$ %.

REFERENCES:

1. Robinson, R.A.; Bower, V.E. *J. Res. Nat. Bur. Stand.* 1965, *69A*, 365.
2. Tokunaga, J. *J. Chem. Eng. Data* 1975, *20*, 41.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

(3) Calcium chloride; $CaCl_2$; [10043-52-4]

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

ORIGINAL MEASUREMENTS:

Malinin, S. D.; Savelyeva, N. I.

**Geokhimiya* 1972, (6), 643-53; *Geochem. Int.* 1972, *9*, 410-8.

VARIABLES:

T/K = 298.15
P/bar = 47.95
c_2/mol L^{-1} = 0.905
c_3/mol L^{-1} = 0.4368

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/bar	c_2/mol L^{-1}	c_3/mol L^{-1}	C_1 [a]	S_1 [b]
298.15	47.95	0.905	0.4368	41.41	43.43

[a] Solubility of CO_2: $C_1 = m_1$ (in grams) / 1 kg of solution

[b] Solubility of CO_2: $S_1 = m_1$ (in grams) / 1 kg of water

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Flow system with about 0.25 L of solution in 0.5 L stainless steel cell. After equilibrium established, liquid sampled and carbon dioxide absorbed in potassium hydroxide. Gain in weight of absorption train used to estimate amount of carbon dioxide. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) GOST 8050-64 sample.

(2) Analytical reagent grade sample.

(3) No details given.

ESTIMATED ERROR:

δT/K = ± 0.1; δC_1, δS_1 = ± 0.5 %;
δP/bar = ± 0.1

(estimated by compiler)

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

(3) Calcium sulfate; $CaSO_4$; [7778-18-9]

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

ORIGINAL MEASUREMENTS:

He, S.; Morse, J.W.

Geochim. Cosmochim. Acta 1993, *57*, 3533-54.

VARIABLES:

$T/\mathrm{K} = 273.15 - 363.15$

$P/\mathrm{MPa} = 0.1032$

$m_2/\mathrm{mol\ kg^{-1}} = 0.1 - 6.0$

$m_3/\mathrm{mol\ kg^{-1}} = 0.01$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

T/K [a]	m_2/mol kg^{-1} [b]	ρ/g cm^{-3} [c]	$10^2 p_1$/atm [d]	$10^3 m_1$/mol kg^{-1} [e]	γ_1 [f]
273.15	0.1	1.0114	96.6	74.5	1.03
	0.5	1.0224		66.7	1.15
	1.0	1.0411		59.0	1.30
	2.0	1.0787		40.1	1.63
	4.0	1.1460		31.8	2.42
	6.0	1.2095		22.6	3.40
298.15	0.1	1.0189	94.2	31.0	1.03
	0.5	1.0189		28.5	1.12
	1.0	1.0363		26.6	1.20
	2.0	1.0700		21.5	1.47
	4.0	1.1340		13.8	2.31
	6.0	1.1974		10.0	3.20
323.15	0.1	1.0081	85.4	16.0	1.02
	0.5	1.0081		14.8	1.10
	1.0	1.0262		14.0	1.16
	2.0	1.0608		12.2	1.33
	4.0	1.1240		9.1	1.79
	6.0	1.1824		6.8	2.40

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Either pure CO_2 gas or CO_2-N_2 mixtures were used in the experiments to maintain a constant $P(CO_2)$. The CO_2-N_2 mixtures were made by pumping predetermined amounts of CO_2 and N_2 into a gas tank and their composition was verified by gas chromatography.

CO_2 or CO_2-N_2 gas mixtures were equilibrated with the aqueous solutions in a series of stirred water-jacketed reaction vessels with condensers. The gas was premoistured by first passing it through distilled water at the temperature of experiment. Fine bubbles were obtained by using gas-dispersion tubes. The bubbling rate was 90 to 95 mL min^{-1}.

The mole fraction of CO_2 in the CO_2-N_2 mixture was determined using a Hewlett Packard (5790A) gas chromatograph.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial; purity 99.9 %.

(2,3) Source not mentioned. Analytical reagent-grade which met ACS specifications. Vacuum-dried before use.

(4) 18 MΩ water obtained from a Milli-Q Super-Q water system.

ESTIMATED ERROR:

$\delta T/\mathrm{K} = \pm\ 0.1$

$\delta m_1/m_1 = \pm\ 0.012$

$\delta\gamma_1/\gamma_1 = \pm\ 0.04$

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9]	He, S.; Morse, J.W.
(2) Sodium chloride, NaCl; [7647-14-5]	*Geochim. Cosmochim. Acta* 1993, *57*, 3533-54.
(3) Calcium sulfate; $CaSO_4$; [7778-18-9]	
(4) Water; H_2O; [7732-18-5]	

EXPERIMENTAL VALUES: (continued)

T/K [a]	m_2/mol kg^{-1} [b]	ρ/g cm^{-3} [c]	$10^2 p_1$/atm [d]	$10^3 m_1$/mol kg^{-1} [e]	γ_1 [f]
348.15	0.1	0.9795	60.3	8.1	1.02
	0.5	0.9795		7.9	1.05
	1.0	1.0120		7.6	1.07
	2.0	1.0463		7.2	1.15
	4.0	1.1090		6.0	1.37
	6.0	1.1638		5.6	1.48
363.15	0.1	0.9624	30.1	3.4	1.03
	0.5	0.9624		3.3	1.05
	1.0	1.0028		3.2	1.08
	2.0	1.0373		3.0	1.15
	4.0	1.1002		2.7	1.27
	6.0	1.1559		2.5	1.41

m_3, the molality of $CaSO_4$, was 0.01 mol kg^{-1} in all measurements

[a] Calculated by compiler
[b] m_2 = molality of NaCl
[c] ρ = density of solvent
[d] p_1 = partial pressure of CO_2
[e] m_1 = molality of CO_2
[f] γ_1 = activity coefficient of CO_2

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]
(2) Sodium chloride; NaCl; [7647-14-5]
(3) Barium chloride; $BaCl_2$; [10361-37-2]
(4) Ammonium nitrate; NH_4NO_3; [6484-52-2]
(5) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Onda, K.; Sada, E.; Kobayashi, T.; Kito, S.; Ito, K.

J. Chem. Eng. Jpn. 1970, *3*, 137-42.

VARIABLES:

$T/\mathrm{K} = 298.15$
$P/\mathrm{kPa} = 101.325$
$c_2/\mathrm{mol\ L^{-1}} = 0 - 0.632$
$c_3/\mathrm{mol\ L^{-1}} = 0 - 0.211$
$c_4/\mathrm{mol\ L^{-1}} = 0 - 0.632$

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	$c_2/\mathrm{mol\ L^{-1}}$ [a]	$c_3/\mathrm{mol\ L^{-1}}$ [a]	$c_4/\mathrm{mol\ L^{-1}}$ [a]	$I/\mathrm{mol\ L^{-1}}$ [b]	α [b]
298.15	0	0	0	0	0.7595
	0.068	0.023	0.068	0.203	0.7338
	0.209	0.070	0.209	0.626	0.6908
	0.254	0.085	0.254	0.762	0.6758
	0.463	0.151	0.463	1.390	0.6221
	0.632	0.211	0.632	1.895	0.5769

[a] Calculated from ionic strength and ratios of ionic strengths given in paper.

[b] Quoted in original paper.
I = ionic strength; α = Bunsen coefficient [$\mathrm{cm^3}$ (STP) $\mathrm{cm^{-3}\ atm^{-1}}$]

$P = 1\ \mathrm{atm} = 1.01325 \times 10^5\ \mathrm{Pa}$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Concentrated solution prepared by weighting, less concentrated solutions prepared by dilution. Equilibrium established between a measure volume of gas and a measured amount of gas-free liquid in a cell fitted with a magnetic stirrer. Amount of gas absorbed estimated from change in volume of gas. Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

(1) Commercial sample, purity 99.8 mole %.

(2) Analytical grade sample.

(5) No details given.

ESTIMATED ERROR:

$\delta T/\mathrm{K} = \pm 0.2$; $\delta\alpha = \pm 2$ % (estimated by compiler).

REFERENCES:

1. Onda, K.; Sada, E.; Kobayashi, T.; Kito, S.; Ito, K. *J. Chem. Eng. Jpn.* 1970, *3*, 18.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

(3) D-Glucose; (dextrose); $C_6H_{12}O_6$; [50-99-7]

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

ORIGINAL MEASUREMENTS:

Yuan, C-B.; Yang, J-Z.

Gaodeng Xuexiao Huaxue Xuebao 1993, *14*, 80-3.

VARIABLES:

T/K = 278.15 - 318.15
P/kPa = 101.325
m_2/mol kg^{-1} = 0.00 -3.00
10^2w_3 = 0 and 15

PREPARED BY:

Pirketta Scharlin
Xiaohui Shen

EXPERIMENTAL VALUES:

Table 1. Solubility of CO_2 at various molalities of NaCl in 15 mass-% glucose/water solution.

m_2/mol kg^{-1} [b]	10^2S_1/mol kg^{-1} [a] 278.15 K	288.15 K	298.15 K	308.15 K	318.15 K
0.00	6.11 *	4.29 *	3.13 *	2.56 *	2.10 *
0.00	4.78	3.72	2.67	2.12	1.71
0.20	4.63	3.20	2.58	2.03	1.69
0.50	4.17		2.35		1.64
1.00	4.25	2.83	2.45	1.80	1.55
2.00	3.25	2.53	1.86	1.56	1.35
3.00	2.61	2.28	1.75	1.55	1.31

[a] S_1 = solubility of CO_2; [b] m_2 = molality of NaCl; The values marked with asterisk (*) are solubilities in pure H_2O.

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static-state method. The authors designed a solubility apparatus which is composed of three isothermal presaturators, saturator and sampler. A schematic diagram of the apparatus is in the original source. CO_2 was introduced (10 hours) through the presaturators and the saturator which contained about 120 g of solvent. The equilibrated sample (about 100 g) was transferred from the saturator into the weighed sampler which contained a weighed amount of standard NaOH solution. The sampler was weighed again and shaken to complete the reaction between CO_2 and NaOH. The excess of NaOH and the $NaHCO_3$ was titrated potentiometrically with standard HCl solution. The mass of dissolved CO_2 was calculated from the equation

$$w = c_{HCl}(V_2-V_1)M$$

where w = mass of dissolved CO_2, c_{HCl} = concentration of HCl; V_1 and V_2 are volumes of the HCl solution to the first and second end point, respectively, and M = molar mass of CO_2.

SOURCE AND PURITY OF MATERIALS:

(1) Purity of CO_2 99.95 %.

(2) Primary-standard grade NaCl was dried in an oven at 170 °C for 3 hours and stored in desiccator.

(3) Not specified.

(4) Double deionized. Conductivity of H_2O was $< 1.5\times10^{-4}$ S m^{-1}

ESTIMATED ERROR:

δT/K = ± 0.02

When fitting the data to the equation lg S_1 = A/T + B + CT, the standard deviation σ was $0.02 < \sigma < 0.4$. (See Table 3 on the net page.)

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Sodium chloride; NaCl; [7647-14-5] (3) D-Glucose; (dextrose); $C_6H_{12}O_6$; [50-99-7] (4) Water; H_2O; [7732-18-5]	Yuan, C-B.; Yang, J-Z. *Gaodeng Xuexiao Huaxue Xuebao* 1993, *14*, 80-3.

EXPERIMENTAL VALUES: (continued)

The authors computed Setchenov salt effect parameter k_{smm}. Setchenow salt effect equation was given as

$$\lg\ (S^o/S_m) = k_{smm}m_2 \tag{1}$$

where

S^o = solubility of CO_2 in 15 mass-% glucose/water solution without NaCl,
S_m = solubility of CO_2 in 15 mass-% glucose/water solution with NaCl,
m_2 = molality of NaCl in 15 mass-% glucose/water solution

k_{smm} was obtained from the slope of the graph lg (S^o/S_m) vs. m_2. Values for k_{smm} computed at each temperature are listed in Table 2.

Table 2. Setchenow salt effect parameters for the solubility of CO_2 in in NaCl + 15 mass-% glucose/water solution at 278.15 to 318.15 K

T/K	278.15	288.15	298.15	308.15	318.15
10^2k_{smm}/mol kg^{-1}	8.48	7.57	6.67	6.11	4.76

The experimental solubilities from Table 1 were fitted to an equation

$$\lg S_1 = A/T + B + CT \tag{2}$$

The coefficients of eq. (2) and the standard deviation in lg S_1 are listed in Table 3.

Table 3. Coefficients of eq. (2) for smoothed results for solubility of CO_2 in pure H_2O, 15 mass-% glucose/H_2O and NaCl+15 % glucose/H_2O

System	A	B	C	σ [a]
Pure H_2O	4608.8	-28.953	0.04018	0.02
15 mass-% glucose/H_2O	2754.4	-16.607	0.01940	0.03
1 mol kg^{-1} NaCl + 15 % glucose/H_2O	4181.1	-26.490	0.03625	0.04
3 mol kg^{-1} NaCl + 15 % glucose/H_2O	1482.2	- 9.3530	0.008815	0.02

[a] σ = standard deviation in lg S_1

Using the values of Table 3, the thermodynamic quantities of the solution process for dissolving CO_2 can be calculated from the following relations:

$$\Delta G^o = -2.303R(A + BT + CT^2) \tag{3}$$

$$\Delta H^o = -2.303R(A - CT^2) \tag{4}$$

$$\Delta S^o = -2.303R(-B - 2CT^2) \tag{5}$$

$$\Delta C_p{}^o = -2.303R(- 2CT^2) \tag{6}$$

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sodium chlorate; $NaClO_3$; [7775-09-9]

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

ORIGINAL MEASUREMENTS:

Setchenow, J. [Sechenov, I.M.]

Ann. Chim. Phys. [6] 1892, *25*, 226-70.

VARIABLES:

$T/K = 288.35$

$c_2/\text{mol dm}^{-3} = 0 - 6.574$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	Dilution x	$c_2/\text{mol dm}^{-3}$ [a]	α [b]	$k_{scc}/\text{dm}^3\ \text{mol}^{-1}$ [a,c]
15.2	288.35	∞	0	1.009	-
		3	2.192	0.625	0.0949
		2	3.287	0.506	0.0912
		1	6.574	0.267	0.0878

[a] Calculated by the compiler.

[b] α = Bunsen coefficient [cm^3 (STP) $\text{cm}^{-3}\ \text{atm}^{-1}$].

[c] k_{scc} = Setchenow salt effect parameter; $k_{scc} = (1/c_2)\ \lg(\alpha^0/\alpha)$.

Initial solution: 69.98 g $NaClO_3$ + 74.0 cm^3 water to make 100 cm^3 of solution.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Setchenow (Ref. 1) based his apparatus on those of Fernet (1857) and of Meyer (1857). The manometer was based on ideas he learned from Regnault in 1861. The one meter manometer had three branches, two for measuring the pressure and one a mercury reservoir. The manometer was connected to the absorption cell by a flexible silver capillary. The absorption cell was of two bulbs with a mark in the constricting connection. CO_2 gas was generated, saturated with water vapor and filled the bulbs and manometer to a known pressure less than atmospheric. The liquid was degassed by heating and then passed by the pressure difference into the lower bulb to the mark of known volume. The system was sealed, turned 90 degrees and shaken until equilibrium was established. The gas volume absorbed was reduced to 0 °C and one meter Hg pressure. The Bunsen coefficient was calculated.

SOURCE AND PURITY OF MATERIALS:

(1) Apparently generated from limestone and sulfuric acid. Dried.

(2) Not specified.

(3) Not specified, assumed to be distilled.

ESTIMATED ERROR:

The author makes a qualitative statement that the results are good to the second decimal.

REFERENCES:

1. Setchenow, J.

Akad. Nauk. SSSR Mem. Acad. imp. Sci. St. Petersburg 1887, *35*, [Ser. No. 7], 1-59.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sodium perchlorate; $NaClO_4$; [7601-89-0]

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

VARIABLES:

$T/K = 288.15 - 333.15$
$P/kPa = 101.325$
$c_2/mol\ dm^{-3} = 0 - 1.6$

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

$t/°C$	T/K	$c_2/mol\ dm^{-3}$	α [a]	$t/°C$	T/K	$c_2/mol\ dm^{-3}$	α [a]
15	288.15	0	0.990	40	313.15	0	0.546
		0.2	0.910			0.2	0.465
		0.4	0.872			0.4	0.4535
		0.8	0.808			0.8	0.436
		1.6	0.664			1.6	0.314
20	293.15	0	0.860	45	318.15	0	0.482
		0.2	0.777			0.2	0.412
		0.4	0.751			0.4	0.401
		0.8	0.7085			0.8	0.3838
		1.6	0.565			1.6	0.2575
25	298.15	0	0.758	50	323.15	0	0.436
		0.2	0.678			0.2	0.366
		0.4	0.648			0.4	0.355
		0.8	0.623			0.8	0.3327
		1.6	0.488			1.6	0.220
30	303.15	0	0.671	55	328.15	0	0.392
		0.2	0.595			0.2	0.322
		0.4	0.576			0.4	0.305
		0.8	0.553			0.8	0.283
		1.6	0.4265			1.6	0.183
35	308.15	0	0.605	60	333.15	0	0.372
		0.2	0.526			0.8	0.246
		0.4	0.520			1.6	0.1578
		0.8	0.485				
		1.6	0.3661				

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which a measured volume of gas-free liquid is stirred in the presence of the gas, and its decrease in volume is measured in a burette over mercury. The volume of liquid was measured at the experimental temperature. The molar concentration of salt in the liquid was standardized at 20 °C.

These data are analyzed and discussed further in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) VEB Leuna Works; 99.8 vol %; the impurity was mostly water (author)

(2) DDR pro analysis grade by DDR Standard TGL 5021.

(3) Double distilled.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Gerecke, J.; Bittrich, H.J.

Wiss. Z. Tech. Hochsch. Chem. "Carl Schorlemmer" Leuna-Merseburg 1971, *13*(2), 115-22.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]
(2) Sodium bromide; NaBr; [7647-15-6]
(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Setchenow, J. [Sechenov, I.M.]
Ann. Chim. Phys. [6] 1892, *25*, 226-70.

VARIABLES:

$T/K = 288.35$
$c_2/\text{mol dm}^{-3} = 0 - 6.709$

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	Dilution	$c_2/\text{mol dm}^{-3}$ [a]	α [b]	$k_{scc}/\text{dm}^3\ \text{mol}^{-1}$ [a,c]
15.2	288.35	∞	0	1.009	-
		6	1.118	0.775	0.102
		1.5	4.473	0.364	0.099
		1	6.709	0.221	0.098

[a] Calculated by the compiler.
[b] α = Bunsen coefficient [cm^3 (STP) $\text{cm}^{-3}\ \text{atm}^{-1}$].
[c] k_{scc} = Setchenow salt effect parameter; $k_{scc} = (1/c_2)\ \lg(\alpha^0/\alpha)$.

Initial solution: 69.04 g NaBr + 81.15 cm^3 water to make 100 cm^3 of sln.

AUXILIARY INFORMATION

See other data sheets on J. Setchenow papers

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]
(2) Sodium bromide; NaBr; [7647-15-6]
(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Rosenthal, W.
Thès. fac. sci. Univ. Strasbourg (France) 1954.

VARIABLES:

$T/K = 293.15$
$c_2/\text{mol dm}^{-3} = 0 - 7.08$

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	$c_2/\text{mol dm}^{-3}$ [a]	$L/\text{cm}^3\ \text{cm}^{-3}$ [a,b]	$k_{scc}/\text{dm}^3\ \text{mol}^{-1}$ [c,d]
293.15	0	0.879	-
	1.384	0.658	0.091
	1.81	0.616	0.0855
	4.79	0.336	0.087
	7.08	0.211	0.0875

[a] Original data. [b] Ostwald coefficient.
[c] Sechenov constant; $k_{scc} = (1/c_2)\ \lg(L^0/L)$. [d] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The prepared solvent and solution were charged into an evacuated cell after degassing, and the mass of solvent was determined by weight. Gas was introduced into the cell from a measuring buret in which the gas was stored over mercury. The cell was agitated while the gas pressure was maintained by adjusting the gas volume. The Ostwald coefficient was determined from the mass of solvent and the volume of gas absorbed. Solubilities were measured at pressures above and below atmospheric.

SOURCE AND PURITY OF MATERIALS:

(1) Source and purity not given. An aqueous "soda" solution absorbed 99.8 % of the gas.

(2) Source and purity not given. Recrystallized from water and dried.

(3) Boiled to remove carbon dioxide.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta p/\text{kPa} = \pm 0.1$
$\delta L/L = \pm 0.02$ (compiler)

REFERENCES:

Some data in the thesis have been published.
See: 1. Maillard, A.; Rosenthal, W. *Comp rend.* 1952, *234*, 2546-8.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sodium bromide; NaBr; [7647-15-6]

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

VARIABLES:

$T/K = 288.15 - 333.15$
$P/kPa = 101.325$
$c_2/mol\ dm^{-3} = 0 - 4.5$

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

$t/^{\circ}C$	T/K	$c_2/mol\ dm^{-3}$	α [a]	S [b]
15	288.15	0	0.990	-
		0.5	0.844	0.855
		1	0.806	0.828
		2	0.698	0.736
		4.5	0.388	0.440
20	293.15	0	0.860	-
		0.5	0.755	0.767
		1	0.705	0.725
		2	0.615	0.650
		4.5	0.356	0.405
25	298.15	0	0.758	-
		0.5	0.669	0.6805
		1	0.627	0.646
		2	0.552	0.584
		4.5	0.331	0.378
30	303.15	0	0.671	-
		0.5	0.602	0.612
		1	0.561	0.578
		2	0.484	0.513
		4.5	0.307	0.351

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which a measured volume of gas-free liquid is stirred in the presence of the gas, and its decrease in volume is measured in a burette over mercury. The volume of liquid was measured at the experimental temperature. For calculation of the Kuenen coefficient, the density of the solution was obtained from Landolt-Börnstein extant 1969. The molar concentration of salt in the liquid was standardized at 20°C. These data are analyzed and discussed further in Ref.1.

SOURCE AND PURITY OF MATERIALS:

(1) VEB Leuna Works; 99.8 vol %; the impurity was mostly water (author).

(2) DDR pro analysis grade by DDR Standard TGL 5021.

(3) Double distilled.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Gerecke, J.; Bittrich, H.J. *Wiss. Z. Tech. Hochsch. Chem. "Carl Schorlemmer" Leuna-Merseburg* 1971, *13*(2), 115-22.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Sodium bromide; NaBr; [7647-15-6] (3) Water; H_2O; [7732-18-5]	Gerecke, J. *Diss. Dr. rer. Nat.* 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

EXPERIMENTAL VALUES:
(continued)

t/°C	*T*/K	c_2/mol dm^{-3}	α [a]	*S* [b]
35	308.15	0	0.605	-
		0.5	0.540	0.549
		1	0.504	0.520
		2	0.442	0.470
		4.5	0.285	0.327
40	313.15	0	0.546	-
		0.5	0.485	0.494
		1	0.454	0.470
		2	0.392	0.4177
		4.5	0.262	0.301
45	318.15	0	0.482	-
		0.5	0.437	0.446
		1	0.407	0.422
		2	0.350	0.374
		4.5	0.236	0.272
50	323.15	0	0.436	-
		0.5	0.391	0.3995
		1	0.368	0.382
		2	0.311	0.332
		4.5	0.230	0.265
55	328.15	0	0.392	-
		0.5	0.355	0.3635
		1	0.330	0.343
		2	0.289	0.310
		4.5	0.225	0.261
60	333.15	0	0.372	-
		0.5	0.322	0.330
		1	0.297	0.309
		2	0.257	0.2755
		4.5	0.219	0.254

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[b] *S* = Kuenen coefficient [cm^3 (STP) g^{-1} (H_2O) atm^{-1}].

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sodium bromide; NaBr; [7647-15-6]

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

ORIGINAL MEASUREMENTS:

Vázquez, G.; Chenlo, F.; Pereira, G.; Peaguda, J.

An. Quim. 1994, *90*, 324-28.

VARIABLES:

$T/K = 298.1$
$P_1/bar = 1.013$
$m_2/mol\ kg^{-1} = 0.392 - 2.951$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

T/K	$\gamma_2/g\ L^{-1}$ [a]	$\rho/kg\ m^{-3}$ [b]	$m_2/mol\ kg^{-1}$ [c]	$c_1/mol\ dm^{-3}$ [d]	L [e]
298.1	40	1031	0.392	0.0286	0.700
	80	1057	0.796	0.0266	0.651
	120	1088	1.205	0.0253	0.619
	160	1116	1.627	0.0230	0.563
	200	1145	2.057	0.0212	0.518
	240	1174	2.497	0.0201	0.492
	280	1202	2.951	0.0181	0.443

[a] γ_2 = mass concentration of NaBr
[b] ρ = density of aqueous NaBr solution
[c] m_2 = molality of NaBr; calculated by compiler
[d] c_1 = solubility of CO_2
[e] L = Ostwald coefficient [$cm^3\ cm^{-3}$]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is a combination of previous designs (Refs 1 and 2). It was modified to achieve a more accurate determination of the volume of the absorbent liquid. The apparatus measures the volume of absorbed gas as the volume of mercury that must be supplied to the system in order to restore the initial pressure.
The raw solubility data obtained are gas/liquid volume ratios.
A detailed description of apparatus, method and procedure is given in Ref. 3.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial, purity 99.95 mole %.

(2) Merck. Grade not given.

(3) Distilled and degassed.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$
$\delta P/bar = \pm 0.001$
$\delta c_1/c_1 < \pm 1$ % (estimated by compiler on the basis of the information in Ref. 3)

REFERENCES:

1. Alvarez, J.R.; Fernández, A.; Coll, A. *Ing. Quím.* 1984, *16*, 67.
2. Haimour, N. *J. Chem. Eng. Data* 1990, *35*, 177.
3. Vázquez, G.; Chenlo, F.; Pereira, G.; Peaguda, J. *J. Chem. Eng. Data* 1994, *39*, 639.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Sodium iodide; NaI; [7681-82-5] (3) Water; H_2O; [7732-18-5]	Rosenthal, W. *Thès. fac. sci. Univ. Strasbourg (France)* 1954.
VARIABLES:	**PREPARED BY:**
$T/K = 293.15$ $c_2/\text{mol dm}^{-3} = 0 - 6.012$	H.L. Clever

EXPERIMENTAL VALUES:

T/K	$c_2/\text{mol dm}^{-3}$ [a]	$L/\text{cm}^3\ \text{cm}^{-3}$ [a,b]	$k_{scc}/\text{dm}^3\ \text{mol}^{-1}$ [c,d]
293.15	0	0.879	-
	0.161	0.650	0.0815
	4.27	0.415	0.0765
	6.012	0.322	0.0725

[a] Original data.

[b] Ostwald coefficient.

[c] Sechenov constant; $k_{scc} = (1/c_2)\ \lg(L^0/L)$.

[d] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The prepared solvent and solution were charged into an evacuated cell after degassing, and the mass of solvent was determined by weight. Gas was introduced into the cell from a measuring buret in which the gas was stored over mercury. The cell was agitated while the gas pressure was maintained by adjusting the gas volume. The Ostwald coefficient was determined from the mass of solvent and the volume of gas absorbed. Solubilities were measured at pressures above and below atmospheric.

SOURCE AND PURITY OF MATERIALS:

(1) Source and purity not given. An aqueous "soda" solution absorbed 99.8 % of the gas.

(2) Source and purity not given. Recrystallized from water and dried.

(3) Boiled to remove carbon dioxide.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$
$\delta p/kPa = \pm 0.1$
$\delta L/L = \pm 0.02$ (compiler)

REFERENCES:

Some data in the thesis have been published. See:

1. Maillard, A.; Rosenthal, W. *Comp rend.* 1952, *234*, 2546-8.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sodium iodide; NaI; [7681-82-5]

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

VARIABLES:

$T/K = 288.15 - 333.15$

$P/kPa = 101.325$

$c_2/mol\ dm^{-3} = 0 - 4$

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

$t/^{\circ}C$	T/K	$c_2/mol\ dm^{-3}$	α [a]	S [b]
15	288.15	0	0.990	-
		0.5	0.858	0.875
		1	0.814	0.844
		2	0.661	0.713
		4	0.470	0.553
20	293.15	0	0.860	-
		0.5	0.766	0.781
		1	0.727	0.756
		2	0.587	0.634
		4	0.418	0.493
25	298.15	0	0.758	0.5173
		0.5	0.694	0.709
		1	0.642	0.668
		2	0.522	0.566
		4	0.374	0.4425
30	303.15	0	0.671	-
		0.5	0.627	0.641
		1	0.565	0.590
		2	0.458	0.497
		4	0.326	0.387

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which a measured volume of gas-free liquid is stirred in the presence of the gas, and its decrease in volume is measured in a burette over mercury. The volume of liquid was measured at the experimental temperature. For calculation of the Kuenen coefficient, the density of the solution was obtained from Landolt-Börnstein extant 1969. The molar concentration of salt in the liquid was standardized at 20°C. These data are analyzed and discussed further in Ref.1.

SOURCE AND PURITY OF MATERIALS:

(1) VEB Leuna Works; 99.8 vol %; the impurity was mostly water (author).

(2) DDR pro analysis grade by DDR Standard TGL 5021.

(3) Double distilled.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Gerecke, J.; Bittrich, H.J. *Wiss. Z. Tech. Hochsch. Chem. "Carl Schorlemmer" Leuna-Merseburg* 1971, *13*(2), 115-22.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9]	Gerecke, J.
(2) Sodium iodide; NaI; [7681-82-5]	*Diss. Dr. rer. Nat.* 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.
(3) Water; H_2O; [7732-18-5]	

EXPERIMENTAL VALUES:
(continued)

$t/^\circ C$	T/K	$c_2/\text{mol dm}^{-3}$	α [a]	S [b]
35	308.15	0	0.605	-
		0.5	0.570	0.584
		1	0.498	0.521
		2	0.409	0.445
		4	0.308	0.366
40	313.15	0	0.546	-
		0.5	0.513	0.5265
		1	0.445	0.4655
		2	0.369	0.402
		4	0.303	0.3612
45	318.15	0	0.482	-
		0.5	0.465	0.478
		1	0.408	0.428
		2	0.327	0.357
		4	0.292	0.3495
50	323.15	0	0.436	-
		0.5	0.430	0.443
		1	0.367	0.386
		2	0.294	0.322
		4	0.288	0.3455
55	328.15	0	0.392	-
		0.5	0.395	0.407
		1	0.334	0.3516
		2	0.269	0.295
		4	0.284	0.340
60	333.15	0	0.372	-
		0.5	0.366	0.378
		1	0.307	0.324
		2	0.244	0.268
		4	0.290	0.350

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[b] S = Kuenen coefficient [cm^3 (STP) g^{-1} (H_2O) atm^{-1}].

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Sodium hydrogen sulfite; $NaHSO_3$; [7631-90-5] (3) Water; H_2O; [7732-18-5]	Onda, K.; Sada, E; Kobayashi, T.; Kito, S.; Ito, K. *J. Chem. Eng. Jpn* 1970, *3*, 18-24.
VARIABLES: $T/K = 298.15$ $P/kPa = 101.325$ $c_2/mol\ L^{-1} = 0 - 2.015$	PREPARED BY: C. L. Young

EXPERIMENTAL VALUES:

T/K	$c_2/mol\ L^{-1}$	α [a]
298.15	0	0.7595
	0.505	0.6528
	1.017	0.5524
	2.015	0.3917

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

P = 1 atm = 101.325 kPa = 1.01325 bar

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solutions made up by weight and density measured but not reported in paper. Equilibrium established between a measured volume of gas and a measured amount of gas-free liquid in a cell fitted with a magnetic stirrer. Amount of gas absorbed estimated from change in volume of gas. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial sample, minimum purity 99.8 mole %.

(2) Analytical grade.

(3) Distilled and degassed.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta\alpha = \pm 2$ %

(Estimated by the compiler.)

REFERENCES:

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Sodium sulfate; Na_2SO_4 [7757-82-6] (3) Water; H_2O; [7732-18-5]	Setchenow, J. [Sechenov, I.M.] *Ann. Chim. Phys.* [6] 1892, *25*, 226-70.
VARIABLES:	**PREPARED BY:**
$T/K = 288.35$ $c_2/\text{mol dm}^{-3} = 0 - 2.002$	Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	Dilution x	$c_2/\text{mol dm}^{-3}$ [a]	α [b]	$k_{scc}/\text{dm}^3\ \text{mol}^{-1}$ [a,c]
15.2	288.35	∞	0	1.009	-
		20	0.100	0.950	0.261
		10	0.200	0.876	0.307
		5	0.400	0.753	0.317
		4	0.501	0.700	0.317
		3	0.667	0.620	0.317
		2	1.001	0.485	0.318
		1	2.002	0.2335	0.317

[a] Calculated by the compiler.

[b] α = Bunsen coefficient [cm^3 (STP) $\text{cm}^{-3}\ \text{atm}^{-1}$].

[c] k_{scc} = Setchenow salt effect parameter; $k_{scc} = (1/c_2)\ \lg(\alpha^{\circ}/\alpha)$.

Initial solution: 28.44 g Na_2SO_4 + 94.76 cm^3 water to make 100 cm^3 of solution.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Setchenow (Ref. 1) based his apparatus on those of Fernet (1857) and of Meyer (1857). The manometer was based on ideas he learned from Regnault in 1861. The one meter manometer had three branches, two for measuring the pressure and one a mercury reservoir. The manometer was connected to the absorption cell by a flexible silver capillary. The absorption cell was of two bulbs with a mark in the constricting connection. CO_2 gas was generated, saturated with water vapor and filled the bulbs and manometer to a known pressure less than atmospheric. The liquid was degassed by heating and then passed by the pressure difference into the lower bulb to the mark of known volume. The system was sealed, turned 90 degrees and shaken until equilibrium was established. The gas volume absorbed was reduced to 0 °C and one meter Hg pressure. The Bunsen coefficient was calculated.

SOURCE AND PURITY OF MATERIALS:

(1) Apparently generated from limestone and sulfuric acid. Dried.

(2) Not specified.

(3) Not specified, assumed to be distilled.

ESTIMATED ERROR:

The author makes a qualitative statement that the results are good to the second decimal.

REFERENCES:

1. Setchenow, J.
Akad. Nauk. SSSR Mem. Acad. imp. Sci. St. Petersburg 1887, *35*, [Ser. No. 7], 1-59.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Sodium sulfate; Na_2SO_4; [7757-82-6] (3) Water; H_2O; [7732-18-5]	Markham, A.A.; Kobe, K.A. *J. Am. Chem. Soc.* 1941, *63*, 449-54.
VARIABLES: T/K = 298.15 and 313.15 P/kPa = 101.325 $m_2/mol\ kg^{-1}$ = 0 - 1.5	PREPARED BY: D.M. Mason

EXPERIMENTAL VALUES:

$t/^{\circ}C$	T/K	$m_2/mol\ kg^{-1}$	α [a]	S [b]
25	298.15	0.0	0.7565	0.7587
		0.25	0.6335	0.6381
		0.5	0.5330	0.5399
		1	0.3855	0.3957
		1.5	0.2824	0.2943
40	313.15	0.0	0.5133	0.5173
		0.25	0.4394	0.4450
		0.5	0.3735	0.3804
		1	0.2781	0.2872
		1.5	0.2073	0.2175

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[b] S = Kuenen coefficient [cm^3 (STP) $g^{-1}(H_2O)$ atm^{-1}].

The authors fitted their data to equations:

$S_m/S_o = am_2 + 1/(1 + bm_2)$, as follows:

$t/^{\circ}C$	a	b
25	-0.0760	0.666
40	-0.0838	0.560

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which the gas is agitated with a measured quantity of gas-free liquid and the decrease in volume of solution-saturated gas is measured in a burette over mercury. The pressure was adjusted to yield one atmosphere partial pressure of carbon dioxide. The volume of gas was reduced to 0°C by the ideal gas law. Experiments were conducted to show that the agitation did not cause supersaturation.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial cylinder, 99.8 % pure.

(2) Analytical grade.

(3) Distilled and degassed.

ESTIMATED ERROR:

$\delta T/K$ = ± 0.03 (authors),
$\delta\alpha/\alpha$, $\delta S/S$ = ± 0.002 (authors).

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sodium sulfate; Na_2SO_4; [7757-82-6]

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

ORIGINAL MEASUREMENTS:

Shchennikova, M.K.; Devyatykh, G.G.; Korshunov, I.A.
Zh. Prikl. Khim. (Leningrad) 1957, *30*, 1080-4; * *J. Appl. Chem. USSR* (Engl. Transl.) 1957, *30*(2), 1149-52.

VARIABLES:

$T/K = 298 - 348$
$c_2/\text{mol dm}^{-3} = 0.2 - 1.68$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	$c_2/\text{mol dm}^{-3}$ [a]	10^4x_1	α [b]	L [a,c]
26	299.15	0.2	5.34	0.658	0.721
			5.41	0.678	0.742
35	308.15		3.85	0.473	0.543
45	318.15		2.78	0.340	0.396
			2.75	0.336	0.391
65	338.15		1.51	0.183	0.226
25	298.15	0.415	4.93	0.608	0.664
50	323.15		2.72	0.332	0.393
75	348.15		1.28	0.154	0.196
25	298.15	0.62	4.23	0.521	0.569
			4.32	0.531	0.580
50	323.15		2.30	0.280	0.331
75	348.15		0.95	0.115	0.146
26	299.15	1.025	3.29	0.403	0.441
			3.42	0.419	0.459
35	308.15		2.62	0.320	0.361
43	316.15		2.22	0.270	0.312
55	328.15		1.46	0.176	0.211
65	338.15		1.07	0.128	0.158
25	298.15	1.3	2.42	0.295	0.322
25	298.15	1.68	2.14	0.253	0.276
			2.09	0.247	0.270
30	303.15		1.97	0.232	0.257
35	308.15		1.40	0.164	0.185
50	323.15		0.84	0 123	0.146

[a] Calculated by the compiler.
[b] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].
[c] L = Ostwald coefficient [cm^3 cm^{-3}].

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Isotopic dilution method, with C^{14} radioactive carbon isotope as a tracer. Experimental procedure described in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

Not given.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Shchennikova, M.K.; Devyatykh, G.G; Korshunov, I.A. *Zh. Prikl. Khim. (Leningrad)* 1957, *30*, 833-8; * *J. Appl. Chem. USSR* (Engl. Transl.) 1957, *30*(6), 881-6.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sodium sulfate; Na_2SO_4; [7757-82-6]

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

VARIABLES:

T/K = 288.15 - 333.15
P/kPa = 101.325
c_2/mol dm^{-3} = 0 - 1

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

t/°C	T/K	c_2/mol dm^{-3}	α [a]	S [b]
15	288.15	0	0.990	-
		0.25	0.780	0.784
		0.5	0.695	0.702
		1	0.545	0.5575
20	293.15	0	0.860	-
		0.25	0.672	0.676
		0.5	0.611	0.618
		1	0.467	0.479
25	298.15	0	0.758	0.5173
		0.25	0.577	0.582
		0.5	0.527	0.534
		1	0.411	0.422
30	303.15	0	0.671	-
		0.25	0.501	0.5055
		0.5	0.464	0.4705
		1	0.361	0.372
35	308.15	0	0.605	-
		0.25	0.439	0.4435
		0.5	0.409	0.415
		1	0.326	0.3365

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which a measured volume of gas-free liquid is stirred in the presence of the gas, and its decrease in volume is measured in a burette over mercury. The volume of liquid was measured at the experimental temperature. For calculation of the Kuenen coefficient, the density of the solution was obtained from Landolt-Börnstein extant 1969. The molar concentration of salt in the liquid was standardized at 20°C. These data are analyzed and discussed further in Ref.1.

SOURCE AND PURITY OF MATERIALS:

(1) VEB Leuna Works; 99.8 vol %; the impurity was mostly water (author).

(2) DDR pro analysis grade by DDR Standard TGL 5021.

(3) Double distilled.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Gerecke, J.; Bittrich, H.J. *Wiss. Z. Tech. Hochsch. Chem. "Carl Schorlemmer" Leuna-Merseburg* 1971, *13*(2), 115-22.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Sodium sulfate; Na_2SO_4; [7757-82-6] (3) Water; H_2O; [7732-18-5]	Gerecke, J. *Diss. Dr. rer. Nat.* 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

EXPERIMENTAL VALUES:

(continued)

$t/^\circ C$	T/K	c_2/mol dm^{-3}	α [a]	S [b]
40	313.15	0	0.546	-
		0.25	0.391	0.395
		0.5	0.356	0.362
		1	0.286	0.296
45	318.15	0	0.482	-
		0.25	0.345	0.349
		0.5	0.316	0.3215
		1	0.252	0.261
50	323.15	0	0.436	-
		0.25	0.311	0.315
		0.5	0.282	0.287
		1	0.226	0.234
55	328.15	0	0.392	-
		0.25	0.278	0.282
		0.5	0.253	0.258
		1	0.200	0.2075
60	333.15	0	0.372	-
		1	0.181	0.188

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[b] S = Kuenen coefficient [cm^3 (STP) g^{-1} (H_2O) atm^{-1}].

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sodium sulfate; Na_2SO_4;
[7757-82-6]

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

ORIGINAL MEASUREMENTS:

Onda, K.; Sada, E; Kobayashi, T.; Kito, S.; Ito, K.

J. Chem. Eng. Jpn 1970, *3*, 18-24.

VARIABLES:

$T/K = 298.15$

$P/kPa = 101.325$

$c_2/mol\ L^{-1} = 0 - 1.436$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	$c_2/mol\ L^{-1}$	α [a]
298.15	0	0.7595
	0.540	0.5242
	0.678	0.4742
	1.436	0.2867

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

P = 1 atm = 101.325 kPa = 1.01325 bar

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solutions made up by weight and density measured but not reported in paper. Equilibrium established between a measured volume of gas and a measured amount of gas-free liquid in a cell fitted with a magnetic stirrer. Amount of gas absorbed estimated from change in volume of gas. Details in source.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial sample, minimum purity 99.8 mole %.

(2) Analytical grade.

(3) Distilled and degassed.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta\alpha = \pm 2$ %

(Estimated by the compiler.)

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sodium sulfate; Na_2SO_4; [7757-82-6]

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

ORIGINAL MEASUREMENTS:

Yasunishi, A.; Yoshida, F.

J. Chem. Eng. Data 1979, *24*, 11-14.

VARIABLES:

T/K = 288.15 - 308.15
P/kPa = 101.325
c_2/mol L^{-1} = 0 - 2.205

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	c_2/mol L^{-1}	L [a]
288.15	0	1.0634
	0.285	0.7995
	0.587	0.6632
	0.786	0.5743
	0.888	0.5247
	1.063	0.4803
298.15	0	0.8264
	0.210	0.7165
	0.219	0.7081
	0.261	0.6874
	0.440	0.6040
	0.510	0.5792
	0.625	0.5363
	0.657	0.5273
	0.770	0.4859
	0.949	0.4318
	0.951	0.4287
	1.190	0.3627
	1.529	0.2954
	1.710	0.2601
	2.205	0.1828
308.15	0	0.6675
	0.215	0.5825
	0.439	0.5066
	0.683	0.4270
	0.940	0.3687
	1.202	0.3191
	1.481	0.2645
	1.763	0.2243

[a] L = Ostwald coefficient (cm^3 cm^{-3})
P = 1 atm = 101.325 kPa = 1.01325 bar

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Density and composition of solution determined after absorption. Details in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) High purity grade sample, purity 99.96 mole %.

(2,3) Guaranteed reagent, solution degassed by boiling.

ESTIMATED ERROR:

δT/K = ± 0.05; δL = ± 1 %.

REFERENCES:

1. Tokunaga, J.
J. Chem. Eng. Data 1975, *20*, 41.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sodium sulfate; Na_2SO_4; [7757-82-6]

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

ORIGINAL MEASUREMENTS:

Corti, H. R.; Krenzer, M. E.; de Pablo, J. J.; Prausnitz, J. M.

Ind. Eng. Chem. Res. 1990, *29*, 1043-50.

VARIABLES:

T/K = 323.15 and 348.15
p/bar = 37.9 -145.1
m_2/mol kg^{-1} = 0.95 - 2.72

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

System $CO_2(1) + Na_2SO_4(2) + H_2O(3)$ at 50 and 75 °C.

t/°C	T/K [a]	p/bar	m_2/mol kg^{-1}	m_1/mol kg^{-1} [a]	10^3x_1
50	323.15	95.6	1.95	0.370	5.99
		145.1	1.98	0.388	6.27
		76.6	2.71	0.222	3.47
		137.6	2.72	0.296	4.62
75	348.15	37.9	0.95	0.263	4.48
		75.8	0.96	0.463	7.87
		97.9	0.97	0.550	9.33
		43.1	1.97	0.159	2.59
		72.1	1.91	0.263	4.28
		132.7	2.01	0.405	6.54

[a] Calculated by the compiler.
It was assumed the mole fraction was based on the total moles, $n_t = n_{CO_2} + n_{H_2O} + n_{Na^+} + n_{SO_4{}^{2-}}$.

The paper contained no definitive statement as to whether total pressure or partial pressue was measured or as to how mole fraction was calculated.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus was designed for the measurement of N_2SO_4 solubility in aqueous solutions of CO_2. The equilibrium cell is a high pressure stainless steel Jerguson liquid level gage with an internal volume of about 150 mL. Mixing is achieved by recirculating both phases for about 4 hours. The apparatus is in an air bath controlled to ± 0.1 K, pressure is measured with a Heise bourdan tube pressure gage to ± 0.02 MPa. The carbon dioxide is measured in a calibrated, about 1.3 mL, sampling loop. The gas is "flashed" to atm pressure and the volume of CO_2 gas measured to an accuracy of 1 % by displacement of a CO_2 saturated aqueous solution.

SOURCE AND PURITY OF MATERIALS:

(1) Carbon dioxide. No information.

(2) Sodium sulfate. No information.

(3) Water. No information.

ESTIMATED ERROR:

$\delta T/\mathrm{K} = \pm\ 0.1$
$\delta p/\mathrm{bar} = \pm\ 0.2$
$\delta x_1/x_1 = \pm\ 0.01$

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sodium sulfate; Na_2SO_4; [7757-82-6]

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

ORIGINAL MEASUREMENTS:

He, S.; Morse, J.W.

Geochim. Cosmochim. Acta 1993, *57*, 3533-54.

VARIABLES:

T/K = 273.15 - 363.15
P/MPa = 0.1032
m_2/mol kg^{-1} = 0.01 - 3.0

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

T/K [a]	m_2/mol kg^{-1} [b]	ρ/g cm^{-3} [c]	10^2p_1/atm [d]	10^3m_1/mol kg^{-1} [e]	γ_1 [f]
273.15	0.01	1.0038	96.6	74.3	1.01
	0.05	1.0082		70.6	1.07
	0.1	1.0143		68.3	1.10
	0.2	1.0259		65.8	1.14
	0.3	1.0391		64.4	1.17
298.15	0.1	1.0100	94.2	29.4	1.09
	0.5	1.0576		25.0	1.28
	1.0	1.1134		19.6	1.64
	1.5	1.1651		15.0	2.14
	2.0	1.2127		13.6	2.36
323.15	0.1	1.0013	85.4	17.1	1.07
	1.0	1.1035		12.8	1.43
	2.0	1.1966		10.8	1.70
	3.0	1.2821		9.5	1.94
348.15	0.1	0.9928	60.3	7.8	1.04
	0.5	1.0447		7.3	1.11
	1.0	1.1041		6.5	1.25
	2.0	1.2053		6.2	1.31
	3.0	1.2828		5.9	1.36
363.15	0.1	0.9223	30.1	3.3	1.03
	0.5	1.0358		3.1	1.07
	1.0	1.0962		2.9	1.13
	2.0	1.1951		2.5	1.19
	3.0	1.2650		2.1	1.24

[a] Calculated by compiler
[b] m_2 = molality of Na_2SO_4
[c] ρ = density of solvent
[d] p_1 = partial pressure of CO_2
[e] m_1 = molality of CO_2
[f] γ_1 = activity coefficient of CO_2

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Either pure CO_2 gas or CO_2-N_2 mixtures were used in the experiments to maintain a constant $P(CO_2)$. The CO_2-N_2 mixtures were made by pumping predetermined amounts of CO_2 and N_2 into a gas tank and their composition was verified by gas chromatography.
CO_2 or CO_2-N_2 gas mixtures were equilibrated with the aqueous solutions in a series of stirred water-jacketed reaction vessels with condensers. The gas was premoistured by first passing it through distilled water at the temperature of experiment. Fine bubbles were obtained by using gas-dispersion tubes. The bubbling rate was 90 to 95 mL min^{-1}.
The mole fraction of CO_2 in the CO_2-N_2 mixture was determined using a Hewlett Packard (5790A) gas chromatograph.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial; purity 99.9 %.

(2) Source not mentioned.
Analytical reagent-grade which met ACS specifications.
Vacuum-dried before use.

(3) 18 MΩ water obtained from a Milli-Q Super-Q water system.

ESTIMATED ERROR:

δT/K = ± 0.1
$\delta m_1/m_1$ = ± 0.012
$\delta\gamma_1/\gamma_1$ = ± 0.04

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sodium sulfate; Na_2SO_4; [7757-82-6]

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

ORIGINAL MEASUREMENTS:

Rumpf, B.; Maurer, G.

Ber. Bunsenges. Phys. Chem. 1993, *97*, 85-97.

VARIABLES:

T/K = 313.11 - 433.06
p/MPa = 0.0192 - 9.713
m_2/mol kg^{-1} = near 1.00 and 2.00

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

The authors used Pitzer's semiempirical model to correlate the data. The dissociation of the carbon dioxide can be neglected at the concentrations here. The system was treated as containing a non-dissociating gas, G and a completely dissociating electrolyte, MX. A temperature dependent interaction parameter, $B^o_{CO_2,Na_2SO_4}$, and a temperature independent interaction parameter, $\Gamma_{CO_2,Na_2SO_4,Na_2SO_4}$, were derived from the experimental data.

For the $CO_2 + Na_2SO_4 + H_2O$ system the values are:

$$B^o_{CO_2,Na_2SO_4} = 0.4458 - 225.4(T/K)^{-1} + 56200(T/K)^{-2}$$

which gives values:

T/K	313.15	353.15	393.15	433.15
$B^o_{CO_2,Na_2SO_4}$	0.2991	0.2582	0.2361	0.2250

and $\Gamma_{CO_2,Na_2SO_4,Na_2SO_4} = -0.0070$.

(continued on the next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is a modification of one used in earlier work (1). It consists of a high pressure optical cell, thermostat, magnetic stirrer, thermocouples and Pt resistance thermometer, pressure transducers and tanks for aqueous solutions, rinse water and solute gas.
The thermostated about 30 mL high pressure optical cell is filled with carbon dioxide. Pressure and temperature of the gas are measured after equilibration. A known amount of aqueous solvent is added which is slightly greater than that needed to completely dissolve the gas. The pressure in the cell is reduced stepwise by removing very small amounts of the liquid until the first stable bubble appears.
The mass of carbon dioxide is calculated from the Bender equation (2). The volume of the cell is known within 0.06 mL. The solvent density is from the literature.

SOURCE AND PURITY OF MATERIALS:

(1) Carbon dioxide. Messer Griesheim, Ludwigshafen, > 99.995 mol %, used as received.

(2) Sodium sulfate. Riedel de Haen AG, Seelze, > 99 mass %. Degassed and dried under vacuum.

(3) Water. Deionized and degassed by vacuum distillation.

ESTIMATED ERROR:

δT/K = ± 0.1
$\delta m_2/m_2$ = ± 0.003
$\delta m_1/m_1$ = ± 0.01 to 0.03

REFERENCES:

1. Rumpf, B.; Maurer, G. *Fluid Phase Equilib.* 1992, *81*, 241-60.
2. Bender, E. 5th Proc. Symp. Thermophys. Prop., ASME, NY, 1970, 227-35.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9]	Rumpf, B.; Maurer, G.
(2) Sodium sulfate; Na_2SO_4; [7757-82-6]	*Ber. Bunsenges. Phys. Chem.* 1993, *97*, 85-97.
(3) Water; H_2O; [7732-18-5]	

EXPERIMENTAL VALUES: (continued)

Solubility of carbon dioxide in aqueous sodium sulfate.

T/K	p/MPa	m_2/mol kg^{-1}	m_1/mol kg^{-1}
313.12	0.422	1.013	0.0511
313.12	0.824	1.013	0.1022
313.11	1.705	1.013	0.2014
313.11	2.685	1.013	0.3071
313.11	3.770	1.013	0.4115
313.11	5.064	1.013	0.5151
313.11	6.615	1.013	0.6131
313.12	7.846	1.013	0.6745
313.14	0.729	2.010	0.0508
313.14	1.436	2.010	0.1003
313.12	3.110	2.010	0.2016
313.14	5.206	2.010	0.3031
313.13	6.784	2.010	0.3535
313.13	7.419	2.010	0.3807
323.14	0.513	1.012	0.0522
323.14	1.814	1.012	0.1785
323.15	1.805	1.014	0.1793
323.15	2.688	1.014	0.2587
323.15	4.386	1.014	0.3854
323.14	4.346	1.012	0.3889
323.15	5.195	1.014	0.4430
323.15	6.697	1.012	0.5310
323.16	8.317	1.012	0.6010
333.29	0.0192	0.998	0.0
333.15	0.564	1.011	0.0494
333.15	1.108	1.012	0.0995
333.15	1.206	1.014	0.1079
333.15	2.347	1.014	0.1991
333.15	2.364	1.012	0.1995
333.15	3.770	1.012	0.2973
333.15	3.748	1.012	0.2994
333.15	5.381	1.012	0.4024
333.15	7.246	1.012	0.5058
333.15	8.313	1.011	0.5456
333.15	8.599	1.012	0.5578
333.15	8.978	1.011	0.5667
333.17	0.953	2.010	0.0507
333.15	1.728	2.010	0.0942
333.15	2.994	2.010	0.1517
333.15	4.128	2.010	0.2018
333.16	5.525	2.010	0.2505
333.16	7.159	2.010	0.3038
333.15	8.080	2.010	0.3296
353.16	0.0464	1.004	0.0
353.15	0.718	1.011	0.0500
353.15	1.398	1.011	0.0996
353.15	2.185	1.011	0.1502
353.15	2.973	1.011	0.2004
353.15	4.673	1.011	0.3005
353.15	5.719	1.011	0.3510
353.16	6.774	1.011	0.4014
353.15	8.007	1.011	0.4517
353.15	9.357	1.011	0.4896

(continued on the next page)

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sodium sulfate; Na_2SO_4; [7757-82-6]

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

ORIGINAL MEASUREMENTS:

Rumpf, B.; Maurer, G.

Ber. Bunsenges. Phys. Chem. 1993, *97*, 85-97.

EXPERIMENTAL VALUES: (continued)

T/K	p/MPa	m_2/mol kg^{-1}	m_1/mol kg^{-1}
353.15	0.0436	2.002	0.0
353.14	1.138	2.010	0.0502
353.14	2.354	2.010	0.1007
353.15	3.641	2.010	0.1515
353.14	5.101	2.010	0.2023
353.15	6.842	2.010	0.2534
353.15	8.781	2.010	0.3040
393.34	0.1893	1.007	0.0
393.14	0.1906	1.004	0.0
393.15	1.023	1.011	0.0502
393.17	1.963	1.011	0.1007
393.15	2.931	1.011	0.1504
393.16	3.965	1.011	0.2047
393.15	6.105	1.011	0.2994
393.16	7.344	1.011	0.3528
393.14	8.603	1.011	0.4033
393.15	9.372	1.011	0.4286
393.15	9.325	1.011	0.4294
393.12	1.488	2.002	0.0509
393.12	2.988	2.010	0.1047
393.14	4.372	2.002	0.1524
393.12	6.139	2.010	0.2022
393.14	8.051	2.010	0.2527
393.13	8.864	2.002	0.2778
393.14	8.821	2.002	0.2784
413.15	0.3468	1.007	0.0
413.14	1.212	1.011	0.0501
413.16	2.180	1.011	0.1007
413.14	3.187	1.011	0.1508
413.14	4.234	1.011	0.2005
413.15	6.381	1.013	0.3023
413.15	7.725	1.011	0.3510
413.15	8.942	1.011	0.4030
413.14	9.713	1.011	0.4306
413.18	0.337	1.999	0.0
413.16	1.656	2.002	0.0513
413.16	3.098	2.002	0.1011
413.17	4.705	2.002	0.1517
413.18	6.344	2.002	0.2030
413.17	8.214	2.002	0.2527
413.16	9.094	2.002	0.2792
433.08	0.598	0.994	0.0
433.15	1.567	1.013	0.0498
433.16	2.428	1.011	0.0995
433.16	3.390	1.013	0.1498
433.14	4.498	1.013	0.2001
433.16	5.496	1.013	0.2501
433.16	6.661	1.013	0.3005
433.14	7.827	1.013	0.3511
433.15	9.054	1.013	0.4010
433.15	0.578	2.002	0.0
433.16	1.904	2.002	0.0509
433.10	3.298	2.002	0.1007
433.14	4.830	2.002	0.1511
433.14	6.447	2.002	0.2025
433.09	6.461	2.002	0.2024
433.15	8.289	2.002	0.2527
433.15	9.189	2.002	0.2787

COMPONENTS: (1) Carbon dioxide; CO_2; [124-38-9] (2) Sulfuric acid; H_2SO_4; [7664-93-9] (3) Sodium sulfate; Na_2SO_4; [7757-82-6] (4) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Kobe, K.A.; Kenton, F.H. *Ind. Eng. Chem., Anal. Ed.* 1938, *10*, 76-7.
VARIABLES: T/K = 298.15 p_1/kPa = 101.325	PREPARED BY: P.L. Long H.L. Clever

EXPERIMENTAL VALUES:

t/°C	T/K	V/cm^3 [a]	v_1/cm^3 [b]	α [c]	L [d]
25	298.15	49.54	13.40	0.247	0.270

[a] Solvent volume.

[b] Carbon dioxide volume absorbed.

[c] Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[d] Ostwald coefficient [cm^3 cm^{-3}].

The solvent is a mixture of

800 g H_2O
200 g Na_2SO_4 (anhydrous)
40 ml H_2SO_4 (concentrated, c = 18 mol dm^{-3})

Thus the molality of the solution is

m_2/mol kg^{-1} = 0.90 (H_2SO_4)
m_3/mol kg^{-1} = 1.76 (Na_2SO_4)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is described in detail in an earlier paper (Ref. 1). The apparatus consists of a gas buret, a pressure compensator, and a 200 cm^3 absorption bulb and mercury leveling bulb. The absorption bulb is attached to a shaking mechanism.

The solvent and the gas are placed in the absorption bulb. The bulb is shaken until equilibrium is reached. The remaining gas is returned to the buret. The difference in the final and initial volumes is taken as the volume of gas absorbed.

SOURCE AND PURITY OF MATERIALS:

(1) Source not given. Purity stated to be 99+ %.

(2,3) Sources not given. Analytical grade.

(4) Distilled.

ESTIMATED ERROR:

$\delta\alpha$/cm^3 = ± 0.005 (authors)

REFERENCES:

1. Kobe, K.A.; Williams, J.S.
Ind. Eng. Chem., Anal. Ed. 1935, *7*, 37.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]
(2) Sodium sulfate; Na_2SO_4; [7757-82-6]
(3) Sulfuric acid; H_2SO_4; [7664-93-9]
(4) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Shchennikova, M.K.; Devyatykh, G.G.; Korshunov, I.A.
Zh. Prikl. Khim. (Leningrad) 1957, *30*, 1080-4; * *J. Appl. Chem. USSR* (Engl. Transl.) 1957, *30*(2), 1149-52.

VARIABLES:

$T/K = 298 - 348$
$c_2/\text{mol dm}^{-3} = 0.2 - 1.3$
$c_3/\text{mol dm}^{-3} = 0.2 - 5.66$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

t	T [a]	c_2 [a]	c_3 [a]	mass % H_2SO_4	10^4x_1	α [b]	L [a,c]
°C	K	mol dm^{-3}	mol dm^{-3}				
25	298.15	0.2	0.238	2.3	5.79	0.706	0.771
					5.46	0.667	0.728
25	298.15	0.2	0.483	4.6	5.91	0.717	0.783
					5.72	0.694	0.758
50	323.15	0.2	0.483	4.6	2.90	0.346	0.409
25	298.15	0.2	1.001	9.25	5.52	0.660	0.720
					5.36	0.642	0.701
25	298.15	0.2	3.73	30	5.43	0.590	0.644
					5.45	0.592	0.646
25	298.15	0.2	5.66	42	5.60	0.585	0.638
					5.67	0.593	0.647
35	308.15				4.21	0.438	0.494
45	318.15				3.30	0.342	0.398
55	328.15				2.50	0.250	0.300
65	338.15				2.08	0.212	0.262
25	298.15	0.415	1.001	9.25	4.82	0.574	0.626
					4.62	0.550	0.600
50	323.15				2.86	0.341	0.403
25	298.15	0.415	5.66	42	5.15	0.524	0.572
					5.15	0.524	0.572
25	298.15	0.62	1.001	9.25	4.16	0.491	0.536
					4.20	0.496	0.541
25	298.15	0.62	5.66	42	5.09	0.518	0.565
50	323.15				2.40	0.240	0.284
75	348.15				1.0	0.099	0.126
25	298.15	0.835	1.001	9.25	3.71	0.435	0.475
					3.69	0.432	0.472
25	298.15	1.3	1.001	9.25	2.63	0.304	0.332

[a] Calculated by the compiler.
[b] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].
[c] L = Ostwald coefficient [cm^3 cm^{-3}].

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Isotopic dilution method, with C^{14} radioactive carbon isotope as a tracer. Experimental procedure described in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

Not given.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Shchennikova, M.K.; Devyatykh, G.G; Korshunov, I.A. *Zh. Prikl. Khim. (Leningrad)* 1957, *30*, 833-8; * *J. Appl. Chem. USSR* (Engl. Transl.) 1957, *30*(6), 881-6.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Ammonium sulfate; $(NH_4)_2SO_4$; [7783-20-2]

(3) Sodium sulfate; Na_2SO_4; [7757-82-6]

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

ORIGINAL MEASUREMENTS:

Rumpf, B.; Maurer, G.

Ber. Bunsenges. Phys. Chem. 1993, *97*, 85-97.

VARIABLES:

$T/K = 313.17 - 433.16$
$p/MPa = 0.0084 - 9.673$
$m_2/mol\ kg^{-1} = m_3/mol\ kg^{-1} = 1.003$

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

The authors estimated the solubility of carbon dioxide in the multicomponent electrolyte system from the results of the carbon dioxide solubility in the single electrolyte aqueous solutions. The authors approach and approximation used are outlined in the paper.

(continued on the next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is a modification of one used in earlier work (1). It consists of a high pressure optical cell, thermostat, magnetic stirrer, thermocouples and Pt resistance thermometer, pressure transducers and tanks for aqueous solutions, rinse water and solute gas.
The thermostated about 30 mL high pressure optical cell is filled with carbon dioxide. Pressure and temperature of the gas are measured after equilibration. A known amount of aqueous solvent is added which is slightly greater than that needed to completely dissolve the gas. The pressure in the cell is reduced stepwise by removing very small amounts of the liquid until the first stable bubble appears.
The mass of carbon dioxide is calculated from the Bender equation (2). The volume of the cell is known within 0.06 mL. The solvent density is from the literature.

SOURCE AND PURITY OF MATERIALS:

(1) Carbon dioxide. Messer Griesheim, Ludwigshafen, > 99.995 mol %, used as received.
(2) Ammonium sulfate. Merck GmbH, Darmstadt, > 99.5 mass %. Degassed and dried under vacuum.
(3) Sodium sulfate. Riedel de Haen AG, Seelze, > 99 mass %. Degassed and dried under vacuum.
(4) Water. Deionized and degassed by vacuum distillation.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$
$\delta m_2/m_2 = \delta m_3/m_3 = \pm 0.003$
$\delta m_1/m_1 = \pm 0.01$ to 0.03

REFERENCES:

1. Rumpf, B.; Maurer, G. *Fluid Phase Equilib.* 1992, *81*, 241-60.
2. Bender, E. 5th Proc. Symp. Thermophys. Prop., ASME, NY, 1970, 227-35.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Ammonium sulfate; $(NH_4)_2SO_4$; [7783-20-2] (3) Sodium sulfate; Na_2SO_4; [7757-82-6] (4) Water; H_2O; [7732-18-5]	Rumpf, B.; Maurer, G. *Ber. Bunsenges. Phys. Chem.* 1993, *97*, 85-97.

EXPERIMENTAL VALUES: (continued)

System $CO_2(1) + (NH_4)_2SO_4(2) + Na_2SO_4(3) + H_2O(4)$

T/K	p/MPa	m_2/mol kg^{-1}	m_3/mol kg^{-1}	m_1/mol kg^{-1}
313.17	0.0084	1.003	1.003	0.0
313.19	0.504	1.003	1.003	0.0502
313.19	1.098	1.003	1.003	0.1041
313.18	2.341	1.003	1.003	0.2087
313.19	3.803	1.003	1.003	0.3160
313.18	5.543	1.003	1.003	0.4231
313.18	8.263	1.003	1.003	0.5323
333.19	0.0177	1.003	1.003	0.0
333.19	0.703	1.003	1.003	0.0506
333.19	1.468	1.003	1.003	0.1039
333.18	3.169	1.003	1.003	0.2089
333.19	5.155	1.003	1.003	0.3128
333.19	7.802	1.003	1.003	0.4187
333.18	8.561	1.003	1.003	0.4446
333.17	9.673	1.003	1.003	0.4704
353.15	0.0415	1.003	1.003	0.0
353.20	0.940	1.003	1.003	0.0526
353.19	1.855	1.003	1.003	0.1047
353.20	4.007	1.003	1.003	0.2104
353.16	6.570	1.003	1.003	0.3152
353.14	8.142	1.003	1.003	0.3696
393.08	0.1833	1.003	1.003	0.0
393.14	1.300	1.003	1.003	0.0522
393.13	2.553	1.003	1.003	0.1048
393.14	5.221	1.003	1.003	0.2098
393.14	8.257	1.003	1.003	0.3145
413.16	0.3388	1.003	1.003	0.0
413.15	1.531	1.003	1.003	0.0541
413.15	1.571	1.003	1.003	0.0527
413.15	2.844	1.003	1.003	0.1053
413.15	5.686	1.003	1.003	0.2109
413.15	8.967	1.003	1.003	0.3174
413.16	8.987	1.003	1.003	0.3172
433.16	0.5808	1.003	1.003	0.0
433.16	1.845	1.003	1.0035	0.0523
433.14	1.876	1.003	1.003	0.0523
433.14	3.146	1.003	1.003	0.1043
433.14	4.540	1.003	1.003	0.1569
433.13	6.017	1.003	1.003	0.2094
433.15	7.598	1.003	1.003	0.2622
433.15	9.104	1.003	1.003	0.3129

COMPONENTS:	**ORIGINAL MEASUREMENTS:**
(1) Carbon dioxide; CO_2; [124-38-9] (2) Sodium sulfate; Na_2SO_4; [7757-82-6] (3) Ammonium nitrate; NH_4NO_3; [6484-52-2] (4) Water; H_2O; [7732-18-5]	Onda, K.; Sada, E.; Kobayashi, T.; Kito, S.; Ito, K. *J. Chem. Eng. Jpn.* 1970, *3*, 137-42.
VARIABLES:	**PREPARED BY:**
T/K = 298.15 P/kPa = 101.325 c_2/mol L^{-1} = 0 - 0.445 c_3/mol L^{-1} = 0 - 1.334	C.L. Young

EXPERIMENTAL VALUES:

T/K	c_2/mol L^{-1} [a]	c_3/mol L^{-1} [a]	I/mol L^{-1} [b]	α [b]
298.15	0	0	0	0.7595
	0.077	0.231	0.487	0.7109
	0.087	0.260	0.548	0.7051
	0.147	0.441	0.931	0.6724
	0.234	0.702	1.481	0.6248
	0.341	1.024	2.160	0.5797
	0.445	1.334	2.814	0.5259

[a] Calculated from ionic strength and statement that ratio of ionic strength of sodium sulfate to total ionic strength equals 0.5259:1.

[b] Quoted in original paper.
I = ionic strength; α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

P = 1 atm = 1.01325×10^5 Pa

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Concentrated solution prepared by weighting, less concentrated solutions prepared by dilution. Equilibrium established between a measure volume of gas and a measured amount of gas-free liquid in a cell fitted with a magnetic stirrer. Amount of gas absorbed estimated from change in volume of gas. Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

(1) Commercial sample, purity 99.8 mole %.

(2) Analytical grade sample.

(4) No details given.

ESTIMATED ERROR:

δT/K = ± 0.2; $\delta\alpha$ = ± 2 %
(estimated by compiler).

REFERENCES:

1. Onda, K.; Sada, E.; Kobayashi, T.; Kito, S.; Ito, K. *J. Chem. Eng. Jpn.* 1970, *3*, 18.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

(3) Sodium sulfate; Na_2SO_4; [7757-82-6]

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

ORIGINAL MEASUREMENTS:

Yasunishi, A.; Tsuji, M.; Sada, E.

Adv. Chem. Ser. 1979, *177*, 189-203.

VARIABLES:

$T/K = 298.15$

$P/kPa = 101.325$

$(c_2+c_3)/mol\ dm^{-3} = 0 - 2.486$

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	x_2 in mixed salt	(c_2+c_3) /mol dm^{-3}	L [a]
298.15	0.00	0	0.8264
		0.210	0.7165
		0.657	0.5273
		1.190	0.3627
		1.710	0.2601
		2.205	0.1828
	0.25	0.233	0.7198
		0.518	0.6098
		0.854	0.5103
		1.274	0.4038
		1.744	0.3197
	0.50	0.272	0.7283
		0.595	0.6281
		1.035	0.5201
		1.502	0.4215
		2.060	0.3360
	0.75	0.266	0.7507
		0.534	0.6844
		1.005	0.5892
		1.545	0.4907
		2.073	0.4017
	1.00	0.455	0.7343
		1.000	0.6508
		1.442	0.5842
		1.945	0.5187
		2.486	0.4653

[a] L = Ostwald coefficient [$cm^3\ cm^{-3}$]
P = 101.325 kPa

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Partial pressure determined from total pressure and vapor pressure of solution. The vapor pressure of the mixed salt solution estimated by the method of Robinson and Bower (1) from corresponding data for each component salt solution. Apparatus similar to that described in ref. (2).

SOURCE AND PURITY OF MATERIALS:

(1) Extra pure grade, purity 99.96 mole %.

(2,3) Reagent grade.

(4) Deionized.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta L = \pm 1$ %.

REFERENCES:

1. Robinson, R.A.; Bower, V.E. *J. Res. Nat. Bur. Stand.* 1965, *69A*, 365.
2. Tokunaga, J. *J. Chem. Eng. Data* 1975, *20*, 41.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]
(2) Sodium chloride; NaCl; [7647-14-5]
(3) Sodium sulfate; Na_2SO_4; [7757-82-6]
(4) Ammonium chloride; NH_4Cl; [12125-02-9]
(5) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Yasunishi, A.; Tsuji, M.; Sada, E.

Adv. Chem. Ser. 1979, *177*, 189-203.

VARIABLES:

T/K = 298.15
P/kPa = 101.325
$(c_2+c_3+c_4)$/mol dm^{-3} = 0 - 3.453

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	x_2 in mixed salt	x_3 in mixed salt	$(c_2+c_3+c_4)$ /mol dm^{-3}	L [a]
298.15	0	0	0	0.8264
	0.50	0.50	0.272	0.7283
			0.595	0.6281
			1.035	0.5201
			1.502	0.4215
			2.060	0.3360
	0.50	0.375	0.404	0.7067
			0.812	0.6068
			1.211	0.5271
			1.627	0.4565
			1.978	0.4011
	0.50	0.25	0.332	0.7447
			0.720	0.6591
			1.113	0.5899
			1.576	0.5165
			1.981	0.4613
			2.484	0.4017
	0.50	0.125	0.407	0.7558
			0.800	0.6900
			1.207	0.6348
			1.572	0.5867
			2.008	0.5384
			2.549	0.4870
	0.50	0.000	0.446	0.7655
			0.931	0.7147
			1.750	0.6309
			2.233	0.5896
			3.453	0.5042

[a] L = Ostwald coefficient [cm^3 cm^{-3}]
P = 101.325 kPa

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Partial pressure determined from total pressure and vapor pressure of solution. The vapor pressure of the mixed salt solution estimated by the method of Robinson and Bower (1) from corresponding data for each component salt solution.
Apparatus similar to that described in ref. (2).

SOURCE AND PURITY OF MATERIALS:

(1) Extra pure grade, purity 99.96 mole %.

(2,3,4) Reagent grade.

(5) Deionized.

ESTIMATED ERROR:

δT/K = ± 0.05; δL = ± 1 %.

REFERENCES:

1. Robinson, R.A.; Bower, V.E. *J. Res. Nat. Bur. Stand.* 1965, *69A*, 365.
2. Tokunaga, J. *J. Chem. Eng. Data* 1975, *20*, 41.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Sodium nitrate; $NaNO_3$; [7631-99-4] (3) Water; H_2O; [7732-18-5]	Setchenow, J. [Sechenov, I.M.] *Ann. Chim. Phys.* [6] 1892, *25*, 226-70.
VARIABLES: T/K = 288.35 c_2/mol dm^{-3} = 0 - 7.356	PREPARED BY: Pirketta Scharlin

EXPERIMENTAL VALUES:

t/°C	T/K ^{a}	Dilution x	c_2/mol dm^{-3} ^{a}	α ^{b}	k_{scc}/dm^3 mol^{-1} ^{a,c}
15.2	288.35	∞	0	1.009	-
		6	1.226	0.795	0.0844
		5	1.471	0.762	0.0829
		4	1.839	0.710	0.0830
		3	2.452	0.620	0.0862
		2	3.678	0.495	0.0841
		1	7.356	0.224	0.0838

[a] Calculated by the compiler.

[b] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[c] k_{scc} = Setchenow salt effect parameter; $k_{scc} = (1/c_2)\ \lg(\alpha^\circ/\alpha)$.

Initial solution: 62.52 g $NaNO_3$ + 74.10 cm^3 water to make 100 cm^3 of solution.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Setchenow (Ref. 1) based his apparatus on those of Fernet (1857) and of Meyer (1857). The manometer was based on ideas he learned from Regnault in 1861. The one meter manometer had three branches, two for measuring the pressure and one a mercury reservoir. The manometer was connected to the absorption cell by a flexible silver capillary. The absorption cell was of two bulbs with a mark in the constricting connection. CO_2 gas was generated, saturated with water vapor and filled the bulbs and manometer to a known pressure less than atmospheric. The liquid was degassed by heating and then passed by the pressure difference into the lower bulb to the mark of known volume. The system was sealed, turned 90 degrees and shaken until equilibrium was established. The gas volume absorbed was reduced to 0 °C and one meter Hg pressure. The Bunsen coefficient was calculated.

SOURCE AND PURITY OF MATERIALS:

(1) Apparently generated from limestone and sulfuric acid. Dried.

(2) Not specified.

(3) Not specified, assumed to be distilled.

ESTIMATED ERROR:

The author makes a qualitative statement that the results are good to the second decimal.

REFERENCES:

1. Setchenow, J.

Akad. Nauk. SSSR Mem. Acad. imp. Sci. St. Petersburg 1887, *35*, [Ser. No. 7], 1-59.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Sodium nitrate; $NaNO_3$; [7631-99-4] (3) Water; H_2O; [7732-18-5]	Markham, A.A.; Kobe, K.A. *J. Am. Chem. Soc.* 1941, *63*, 449-54.
VARIABLES:	PREPARED BY:
$T/K = 273.35$ and 298.15 $P/kPa = 101.325$ $m_2/mol\ kg^{-1} = 0 - 4$	D.M. Mason

EXPERIMENTAL VALUES:

$t/^{\circ}C$	T/K	$m_2/mol\ kg^{-1}$	α [a]	S [b]
0.2	273.35	0.0	1.7023	1.7025
		0.2	1.6167	1.6247
		0.5	1.5040	1.5229
		3	0.8840	0.9589
		4	0.4055	0.5099
25	298.15	0.0	0.7565	0.7587
		0.1	0.7415	0.7458
		0.2	0.7289	0.7352
		0.5	0.6946	0.7069
		1	0.6352	0.6562
		2	0.5406	0.5758
		3	0.4659	0.5109
		4	0.2474	0.3151

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[b] S = Kuenen coefficient [cm^3 (STP) $g^{-1}(H_2O)$ atm^{-1}].

The authors fitted their data to equations:

$S_m/S_o = am_2 + 1/(1 + bm_2)$, as follows:

$t/^{\circ}C$	a	b
0.2	-0.0054	0.240
25	-0.0050	0.150

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which the gas is agitated with a measured quantity of gas-free liquid and the decrease in volume of solution-saturated gas is measured in a burette over mercury. The pressure was adjusted to yield one atmosphere partial pressure of carbon dioxide. The volume of gas was reduced to 0°C by the ideal gas law. Experiments were conducted to show that the agitation did not cause supersaturation.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial cylinder, 99.8 % pure.

(2) Analytical grade.

(3) Distilled and degassed.

ESTIMATED ERROR:

$\delta T/K = <\pm 0.1$ at 0.2°C,
± 0.03 at 25°C (authors),
$\delta\alpha/\alpha$, $\delta S/S = \pm 0.002$ (authors).

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sodium nitrate; $NaNO_3$; [7631-99-4]

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

VARIABLES:

T/K = 288.15 - 333.15
P/kPa = 101.325
c_2/mol dm^{-3} = 0 - 4

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

$t/^{\circ}C$	T/K	c_2/mol dm^{-3}	α [a]	S [b]
15	288.15	0	0.990	-
		0.25	0.956	-
		0.5	0.931	0.948
		1	0.863	0.889
		2	0.741	0.792
		4	0.532	0.612
20	293.15	0	0.860	-
		0.25	0.816	-
		0.5	0.807	0.822
		1	0.756	0.780
		2	0.642	0.687
		4	0.461	0.5315
25	298.15	0	0.758	-
		0.25	0.718	-
		0.5	0.694	0.707
		1	0.644	0.666
		2	0.547	0.5865
		4	0.404	0.4665
30	303.15	0	0.671	-
		0.25	0.602	-
		0.5	0.591	0.603
		1	0.542	0.561
		2	0.464	0.498
		4	0.356	0.412

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which a measured volume of gas-free liquid is stirred in the presence of the gas, and its decrease in volume is measured in a burette over mercury. The volume of liquid was measured at the experimental temperature. For calculation of the Kuenen coefficient, the density of the solution was obtained from Landolt-Börnstein extant 1969. The molar concentration of salt in the liquid was standardized at 20°C. These data are analyzed and discussed further in Ref.1.

SOURCE AND PURITY OF MATERIALS:

(1) VEB Leuna Works; 99.8 vol %; the impurity was mostly water (author).

(2) DDR pro analysis grade by DDR Standard TGL 5021.

(3) Double distilled.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Gerecke, J.; Bittrich, H.J. *Wiss. Z. Tech. Hochsch. Chem. "Carl Schorlemmer" Leuna-Merseburg* 1971, *13*(2), 115-22.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Sodium nitrate; $NaNO_3$; [7631-99-4] (3) Water; H_2O; [7732-18-5]	Gerecke, J. *Diss. Dr. rer. Nat.* 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

EXPERIMENTAL VALUES:
(continued)

$t/^{\circ}C$	T/K	$c_2/mol\ dm^{-3}$	α [a]	S [b]
35	308.15	0	0.605	-
		0.25	0.516	-
		0.5	0.510	0.521
		1	0.468	0.486
		2	0.403	0.434
		4	0.314	0.365
40	313.15	0	0.546	-
		0.25	0.455	-
		0.5	0.444	0.454
		1	0.404	0.4195
		2	0.355	0.383
		4	0.280	0.326
45	318.15	0	0.482	-
		0.25	0.401	-
		0.5	0.391	0.401
		1	0.345	0.359
		2	0.311	0.3355
		4	0.247	0.2882
50	323.15	0	0.436	-
		0.25	0.350	-
		0.5	0.344	0.353
		1	0.299	0.3115
		2	0.268	0.290
		4	0.219	0.2564
55	328.15	0	0.392	-
		0.25	0.309	-
		0.5	0.306	0.314
		1	0.262	0.273
		2	0.237	0.257
		4	0.200	0.2347
60	333.15	0	0.372	-
		0.25	0.275	-
		0.5	0.274	0.282
		1	0.230	0.2402
		2	0.211	0.2294
		4	0.179	0.2104

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[b] S = Kuenen coefficient [cm^3 (STP) g^{-1} (H_2O) atm^{-1}].

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sodium nitrate; $NaNO_3$; [7631-99-4]

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

ORIGINAL MEASUREMENTS:

Yasunishi, A.; Yoshida, F.

J. Chem. Eng. Data 1979, *24*, 11-14.

VARIABLES:

T/K = 288.15 - 308.15
P/kPa = 101.325
c_2/mol L^{-1} = 0 - 7.256

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	c_2/mol L^{-1}	L [a]	T/K	c_2/mol L^{-1}	L [a]
288.15	0	1.0634	298.15	5.177	0.3253
	0.608	0.9498		5.911	0.2876
	1.370	0.8161		7.256	0.2257
	2.019	0.7235			
	2.760	0.6210	308.15	0	0.6675
	3.565	0.5300		0.346	0.6320
	4.503	0.4413		0.620	0.6071
	5.929	0.3376		0.997	0.5703
				1.279	0.5466
298.15	0	0.8264		1.688	0.5091
	0.382	0.7723		2.003	0.4794
	0.871	0.7098		2.387	0.4536
	1.388	0.6500		2.704	0.4306
	2.139	0.5646		3.137	0.3999
	3.092	0.4749		3.645	0.3686
	3.670	0.4277		3.967	0.3463
	4.455	0.3711		5.186	0.2829

[a] L = Ostwald coefficient (cm^3 cm^{-3})

P = 1 atm = 101.325 kPa = 1.01325 bar

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Density and composition of solution determined after absorption. Details in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) High purity grade sample, purity 99.96 mole %.

(2,3) Guaranteed reagent, solution degassed by boiling.

ESTIMATED ERROR:

δT/K = ± 0.05; δL = ± 1 %.

REFERENCES:

1. Tokunaga, J. *J. Chem. Eng. Data* 1975, *20*, 41.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sodium dihydrogen phosphate; NaH_2PO_4; [7558-80-7]

(3) Phosphoric acid; H_3PO_4; [7664-38-2]

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

ORIGINAL MEASUREMENTS:

Van Slyke, D. D.; Sendroy, J., Jr.; Hastings, A. B.; Neill, J. M.

J. Biol. Chem. 1928, *78*, 765-99.

VARIABLES:

$T/K = 311.2$
$c_2/\text{mol L}^{-1} = 0 - 0.300$
$c_3/\text{mol L}^{-1} = 0.011 - 0.300$
P = "atmospheric"

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	p_1/mmHg [b]	$c_2/\text{mol L}^{-1}$	$c_3/\text{mol L}^{-1}$	α [c]	S_1 [d]
38.0	311.2	723.7	0	0.150	0.5396	0.5451
		723.7	0	0.300	0.5317	0.5410
		710.7	0.0375	0.011	0.5360	0.5381
		710.7	0.075	0.019	0.5272	0.5302
		710.7	0.120	0.024	0.5175	0.5217
		712.6	0.150	0.015	0.5109	0.5151
		718.3	0.300	0.030	0.4791	0.4864
		712.6	0.300	0.030	0.4823	0.4891

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[a] Calculated by the compiler.

[b] 1 mmHg = 133.322 Pa = 1.33322×10^{-3} bar

[c] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

[d] S_1 = Kuenen coefficient [cm^3 (STP) g^{-1} atm^{-1}]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solutions were saturated with CO_2 by a bubbling method:

Saturation by bubbling. The solution was placed in the saturating tube, the lower end of which was connected through a wash bottle with a Kipp CO_2 generator. The tube and wash bottle were immersed in a constant temperature bath. CO_2 was bubbled through it rapidly for 30 minutes. The wash bottle was replaced by a mercury reservoir and the free gas was driven completely out of the saturating tube by admitting mercury underneath the solution. The CO_2 contents of the solutions were determined in the manometric gas apparatus (Refs 1 and 2).

SOURCE AND PURITY OF MATERIALS:

(1) From a Kipp CO_2 generator.

(2) The NaH_2PO_4 solutions were prepared by addition of NaOH to standard H_3PO_3.

(3) Not specified.

(4) Distilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$
$\delta \alpha/\alpha = \pm 0.005$

REFERENCES:

1. Van Slyke, D. D.; Neill, J. M. *J. Biol. Chem.* 1924, *61*, 523.

2. Van Slyke, D. D.; Sendroy, J., Jr. *J. Biol. Chem.* 1927, *73*, 127.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sodium formate; CHO_2Na; [141-53-7]

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

VARIABLES:

$T/K = 288.15 - 333.15$
$P/kPa = 101.325$
$c_2/mol\ dm^{-3} = 0 - 4$

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

$t/^{\circ}C$	T/K	$c_2/mol\ dm^{-3}$	α [a]	S [b]
15	288.15	0	0.990	-
		0.1	1.010	1.0145
		0.2	1.028	1.034
		0.5	0.965	0.978
		1	0.945	0.970
		2	0.933	0.9875
		4	1.047	1.184
20	293.15	0	0.860	-
		0.1	0.885	0.890
		0.2	0.905	0.911
		0.5	0.836	0.849
		1	0.842	0.866
		2	0.829	0.879
		4	0.955	1.082
25	298.15	0	0.758	-
		0.1	0.778	0.783
		0.2	0.791	0.7975
		0.5	0.741	0.754
		1	0.747	0.7695
		2	0.741	0.7875
		4	0.870	0.988

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AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which a measured volume of gas-free liquid is stirred in the presence of the gas, and its decrease in volume is measured in a burette over mercury. The volume of liquid was measured at the experimental temperature. For calculation of the Kuenen coefficient, the density of the solution was obtained from Landolt-Börnstein extant 1969. The molar concentration of salt in the liquid was standardized at 20°C. These data are analyzed and discussed further in Ref.1.

SOURCE AND PURITY OF MATERIALS:

(1) VEB Leuna Works; 99.8 vol %; the impurity was mostly water (author).

(2) DDR pro analysis grade by DDR Standard TGL 5021.

(3) Double distilled.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Gerecke, J.; Bittrich, H.J. *Wiss. Z. Tech. Hochsch. Chem. "Carl Schorlemmer" Leuna-Merseburg* 1971, *13*(2), 115-22.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sodium formate; CHO_2Na;
[141-53-7]

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch.
"Carl Schorlemmer", Leuna-
Merseburg, DDR.

EXPERIMENTAL VALUES:
(continued)

$t/^{\circ}C$	T/K	$c_2/\text{mol dm}^{-3}$	α [a]	S [b]
30	303.15	0	0.671	-
		0.1	0.687	0.692
		0.2	0.717	0.7235
		0.5	0.662	0.674
		1	0.675	0.696
		2	0.667	0.709
		4	0.806	0.918
35	308.15	0	0.605	-
		0.1	0.616	0.621
		0.2	0.646	0.6525
		0.5	0.594	0.605
		1	0.611	0.631
		2	0.611	0.651
		4	0.729	0.832
40	313.15	0	0.546	-
		0.1	0.560	0.565
		0.2	0.583	0.583
		0.5	0.531	0.541
		1	0.553	0.5715
		2	0.542	0.578
		4	0.659	0.754
45	318.15	0	0.482	-
		0.1	0.505	0.510
		0.2	0.528	0.534
		0.5	0.468	0.478
		1	0.506	0.523
		2	0.500	0.5355
		4	0.602	0.691
50	323.15	0	0.436	-
		0.1	0.452	0.457
		0.2	0.480	0.487
		0.5	0.447	0.456
		1	0.479	0.496
		2	0.480	0.515
		4	0.582	0.670
55	328.15	0	0.392	-
		0.1	0.409	0.414
		0.2	0.434	0.440
		1	0.462	0.480
		2	0.456	0.490
		4	0.567	0.654
60	333.15	0	0.372	-
		0.1	0.373	0.378
		0.2	0.396	0.402
		1	0.433	0.451
		2	0.450	0.484
		4	0.548	0.635

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[b] S = Kuenen coefficient [cm^3 (STP) g^{-1} (H_2O) atm^{-1}].

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sodium acetate; $C_2H_3O_2Na$; [127-09-3]

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

VARIABLES:

T/K = 288.15 - 333.15
P/kPa = 101.325
c_2/mol dm^{-3} = 0 - 2

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

t/°C	T/K	c_2/mol dm^{-3}	α [a]	S [b]
15	288.15	0	0.990	-
		0.25	1.241	1.254
		0.5	1.292	1.322
		1	1.532	1.600
		2	1.841	2.02
20	293.15	0	0.860	-
		0.25	1.113	1.126
		0.5	1.177	1.202
		1	1.400	1.463
		2	1.691	1.856
25	298.15	0	0.758	-
		0.25	0.999	1.0125
		0.5	1.033	1.0585
		1	1.253	1.312
		2	1.553	1.706
30	303.15	0	0.671	-
		0.25	0.898	0.911
		0.5	0.939	0.962
		1	1.168	1.225
		2	1.450	1.595

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which a measured volume of gas-free liquid is stirred in the presence of the gas, and its decrease in volume is measured in a burette over mercury. The volume of liquid was measured at the experimental temperature. For calculation of the Kuenen coefficient, the density of the solution was obtained from Landolt-Börnstein extant 1969. The molar concentration of salt in the liquid was standardized at 20°C. These data are analyzed and discussed further in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) VEB Leuna Works; 99.8 vol %; the impurity was mostly water (author).

(2) DDR pro analysis grade by DDR Standard TGL 5021.

(3) Double distilled.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Gerecke, J.; Bittrich, H.J. *Wiss. Z. Tech. Hochsch. Chem. "Carl Schorlemmer" Leuna-Merseburg* 1971, *13*(2), 115-22.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Sodium acetate; $C_2H_3O_2Na$; [127-09-3] (3) Water; H_2O; [7732-18-5]	Gerecke, J. *Diss. Dr. rer. Nat.* 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

EXPERIMENTAL VALUES:

(continued)

$t/^{\circ}C$	T/K	$c_2/\text{mol dm}^{-3}$	α [a]	S [b]
35	308.15	0	0.605	-
		0.25	0.816	0.8285
		0.5	0.852	0.875
		1	1.074	1.128
		2	1.357	1.494
40	313.15	0	0.546	-
		0.25	0.745	0.757
		0.5	0.774	0.795
		1	0.991	1.040
		2	1.268	1.399
45	318.15	0	0.482	-
		0.25	0.682	0.694
		0.5	0.706	0.726
		1	0.911	0.959
		2	1.186	1.311
50	323.15	0	0.436	-
		0.25	0.621	0.632
		0.5	0.644	0.662
		1	0.841	0.887
		2	1.117	1.237
55	328.15	0	0.392	-
		0.25	0.568	0.578
		0.5	0.594	0.612
		1	0.783	0.8275
		2	1.050	1.160
60	333.15	0	0.372	-
		2	0.997	1.108

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[b] S = Kuenen coefficient [cm^3 (STP) g^{-1} (H_2O) atm^{-1}].

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sodium phenoxide; C_6H_5ONa; [139-02-6]

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

ORIGINAL MEASUREMENTS:

Kimura, H.; Takeuchi, T.

Kagaku Kogaku 1963, *27*, 2-6.

VARIABLES:

$T/K = 273.7 - 353.2$
$p_1/kPa = 9.38 - 100$
$c_2/mol\ dm^{-3} = 0.3138 - 3.04$

PREPARED BY:

T. Tominaga

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	$c_2/mol\ dm^{-3}$	p_1/atm	p_1/kPa [a]	$c_1/mol\ dm^{-3}$ [b]	(c_1/p_1) [c]
0.5	273.7	0.805	0.98	99	1.221	1.295
			0.54	55	1.081	2.01
			0.448	45.4	1.011	2.26
			0.262	26.5	0.797	3.04
			0.128	13.0	0.797	6.22
20	293.2	0.805	0.98	99	1.186	1.210
			0.534	54.1	1.081	2.024
			0.25	25.3	1.00	4.00
			0.213	21.6	0.7473	3.50
			0.143	14.5	0.6319	5.581
		1.3	0.99	100	1.857	1.876
			0.616	62.4	1.770	2.833
			0.267	27.1	1.694	6.345
			0.151	15.3	1.650	10.96
		2.0	0.99	100	3.073	3.104
			0.477	48.3	3.069	6.434
			0.229	23.2	3.107	13.17
			0.122	12.4	2.877	23.58
		3.04	0.99	100	4.09	4.14
50	323.2	0.805	0.98	99	1.029	1.05
			0.443	44.9	0.8763	1.975
			0.373	37.8	0.9792	2.60
			0.215	21.8	0.8824	4.10
			0.163	16.5	0.7175	4.40
		2.0	0.99	100	3.08	3.104
			0.604	61.2	2.737	4.53
			0.216	21.9	2.525	11.62
			0.126	12.8	2.29	18.20
80	353.2	0.3138	0.98	99	0.2142	0.2677
			0.441	44.7	0.2502	0.568
			0.336	34.0	0.1951	0.580
			0.0926	9.38	0.107	1.155

[a] Calculated by the compiler.

[b] Solubility of CO_2 (mol/dm^3 sln).

[c] $(c_1/p_1)/mol\ dm^{-3}\ atm^{-1}$ = solubility of CO_2 at its one atm partial pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The absorption vessel was 500 mL five-necked glass flask, to which a fixed amount (ca. 400 ml) of sodium phenoxide solution was placed. Carbon dioxide and air, both washed and dried, were mixed together and brought into contact with sodium phenoxide solution without stirring at atmospheric total pressure. Equilibrium was confirmed by the gas volume in the gas burette and chemical analysis of the solution.

SOURCE AND PURITY OF MATERIALS:

(1) Carbon dioxide. From a cylinder, purity not specified.
(2) Sodium phenoxide. Sodium hydroxide was dissolved in distilled water, impurities filtered out, diluted with distilled water, and equivalent amount of phenol was dissolved.
(3) Water. Distilled.

ESTIMATED ERROR:

Nothing specified.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) *P*-[[*p*-(dimethylamino)phenyl]azo] benzenesulfonic acid, sodium salt, (methyl orange); $C_{14}H_{14}N_3O_3SNa$; [547-58-0]

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

ORIGINAL MEASUREMENTS:

Findlay, A; Shen, B.

J. Chem. Soc. 1912, *101*, 1459-68.

VARIABLES:

$T/K = 298.15$

$10^2\gamma_2/g\ cm^{-3} = 0.309 - 0.857$

$p_1/bar = 0.968 - 1.792$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	$10^2\gamma_2/g\ cm^{-3}$ [a]	$\rho/g\ cm^{-3}$	p_1/bar	S [b]	p_1/bar	S [b]
298.15	0.309	0.998	0.968	0.831	1.097	0.833
			1.220	0.829	1.408	0.827
			1.588	0.826	1.759	0.826
	0.428	1.000	0.984	0.855	1.117	0.850
			1.243	0.844	1.433	0.838
			1.620	0.835	1.792	0.831
	0.593	1.002	0.976	0.900	1.109	0.887
			1.232	0.880	1.424	0.864
			1.612	0.855	1.780	0.850
	0.857	1.004	0.972	0.975	1.105	0.952
			1.224	0.936	1.417	0.915
			1.604	0.899	1.768	0.890

[a] γ = mass concentration of salt

[b] $$S = \frac{\text{concentration of gas in liquid phase}}{\text{concentration of gas in gaseous phase}}$$

Solubility in water: Ostwald coefficient $L = 0.825\ cm^3\ cm^{-3}$.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric static method. Care was taken to reduce dead space because of small amounts of gas absorbed. Apparatus similar to that described in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Purity 99.95 mole %.

(2) No details given.

(3) No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta S = \pm 1$ %.

(estimated by compiler)

REFERENCES:

1. Findlay, A.; Creighton, H.J.M.

J. Chem. Soc. 1910, *97*, 536.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sodium lactate; $C_3H_5O_3Na$; [920-49-0]

(3) 2-Hydroxypropanoic acid; (lactic acid); $C_3H_6O_3$; [50-21-5]

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

ORIGINAL MEASUREMENTS:

Van Slyke, D. D.; Sendroy, J., Jr.; Hastings, A. B.; Neill, J. M.

J. Biol. Chem. 1928, *78*, 765-99.

VARIABLES:

T/K = 311.2
c_2/mol L^{-1} = 0 - 0.300
c_3/mol L^{-1} = 0.100 - 0.300
P = "atmospheric"

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

t/°C	T/K [a]	Method [b]	p_1/mmHg [c]	c_2/mol L^{-1}	c_3/mol L^{-1}	α [d]	S_1 [e]
38.0	311.2	B	712.9	0	0.150	0.5436	0.5508
		B	714.4	0	0.150	0.5473	0.5540
		B	712.9	0	0.300	0.5434	0.5569
		B	700.8	0.150	0.100	0.5214	0.5303
		T	707.0	0.150	0.150	0.5220	0.5350
		B	700.8	0.300	0.100	0.5023	0.5174
		T	707.0	0.300	0.300	0.4980	0.5207

[a] Calculated by the compiler.

[b] B: saturation by bubbling; T: saturation in rotating tonometer.

[c] 1 mmHg = 133.322 Pa = 1.33322×10^{-3} bar

[d] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

[e] S_1 = Kuenen coefficient [cm^3 (STP) g^{-1} atm^{-1}]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two procedures were used for saturating solutions with CO_2:

Saturation by bubbling (B). The solution was placed in the saturating tube, the lower end of which was connected through a wash bottle with a Kipp CO_2 generator. The tube and wash bottle were immersed in a constant temperature bath. CO_2 gas was bubbled through it rapidly for 30 minutes. The wash bottle was replaced by a mercury reservoir and the free gas was driven completely out of the saturating tube by admitting mercury underneath the solution. The CO_2 contents of the solutions were determined in the manometric gas apparatus (Refs 1 and 2).

Saturation in rotating tonometer (T). The technique used was that described by Austin *et al.* (Ref. 3).

Both procedures gave identical results with solutions of acids and salts.

SOURCE AND PURITY OF MATERIALS:

(1) From a Kipp CO_2 generator.

(2) Na-lactate solutions were made by adding known excess of lactic acid to solutions of $NaHCO_3$.

(3) Not specified.

(4) Distilled.

ESTIMATED ERROR:

δT/K = ± 0.1
$\delta\alpha/\alpha$ = ± 0.005

REFERENCES:

1. Van Slyke, D. D.; Neill, J. M. *J. Biol. Chem.* 1924, *61*, 523.
2. Van Slyke, D. D.; Sendroy, J., Jr. *J. Biol. Chem.* 1927, *73*, 127.
3. Austin, J. H.; Cullen, G. E.; Hastings, A. B.; McLean, F. C.; Peters, J. P.; Van Slyke, D. D. *J. Biol. Chem.* 1922, *54*, 121.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Sulfuric acid monododecyl ester sodium salt; (sodium dodecyl sulfate); $C_{12}H_{25}O_4SNa$; [151-21-3] (3) Water; H_2O; [7732-18-5]	Ownby, D. W.; Prapaitrakul, W.; King, A. D. Jr. *J. Colloid Interface Sci.* 1988, *125*, 526-33.
VARIABLES: $T/K = 298.15$ $m_2/\text{mol kg}^{-1} = 0.0 - 0.6$	PREPARED BY: H. L. Clever

EXPERIMENTAL VALUES:

Solubility of carbon dioxide in aqueous sodium dodecyl sulfate.

$t/°C$	T/K [a]	$m_2/\text{mol kg}^{-1}$ [b]	$10^2 m_1/\text{mol kg}^{-1}$ [c]
25	298.15	0.0	3.32, 3.392*
		0.2	3.54
		0.4	3.69
		0.6	3.91

---

[a] Added by the compiler.

[b] m_2 = molality of sodium dodecyl sulfate.

[c] m_1 = solubility of carbon dioxide.

* Value from Wilhelm, E.; Battino, R.; Wilcock, R. J. *Chem. Rev.* 1977, *72*, 219.

The measurements are made at several pressures up to 10 - 15 atm (1 - 1.5 MPa). The solubility values have been corrected to 1 atm (0.103 MPa) partial pressure of CO_2. See method below.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus and method are described in earlier papers (1, 2). Solubility is determined in a thermostated, magnetic stirred cylindrical brass bomb with an observation window. The solution is prepared and put in a glass liner in the bomb. The system is sealed, evacuated to a pressure just above water vapor pressure, and outgassed with stirring for several hours. The gas is added to a known pressure and equilibrated with stirring for a minimum of five hours. Stirring is stopped, the solution is allowed to become still. The gas is vented leaving the supersaturated solution under a gaseous pressure of atmospheric pressure for a fixed time of 30 to 60 seconds. The rate of gas loss during the still condition is measured to use in a later correction. The gas is stirred and collected. The total volume of gas is measured along with ambient pressure and temperature.

SOURCE AND PURITY OF MATERIALS:

(1) Carbon dioxide. Matheson Gas Products. Commercial grade, stated to be 99.5 % min purity.

(2) Sodium dodecyl sulfate. BDH Prod. No. 44244, Lot No. 908811C, stated to be 99.0 %.

(3) Water. Nothing specified, but have used doubly distilled water in earlier work.

ESTIMATED ERROR:

$\delta T/K$ not specified.
$\delta m_1/\text{mol kg}^{-1} = 0.02 \times 10^{-2}$

REFERENCES:

1. Matheson, I.B.C.; King, A.D. Jr. *J. Colloid Interface Sci.* 1978, *66*, 464.

2. Bolden, P.L.; Hoskins, J.C.; King, A.D. Jr. *J. Colloid Interface Sci.* 1983, *91*, 454.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) 1-Heptanesulfonic acid, sodium salt; (sodium 1-heptylsulfonate); $C_7H_{15}O_3SNa$; [22767-50-6]

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

ORIGINAL MEASUREMENTS:

Ownby, D. W.; Prapaitrakul, W.; King, A. D. Jr.

J. Colloid Interface Sci. 1988, *125*, 526-33.

VARIABLES:

$T/K = 298.15$

$m_2/\text{mol kg}^{-1} = 0.0 - 1.2$

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Solubility of carbon dioxide in aqueous sodium 1-heptylsulfonate.

$t/°C$	T/K [a]	$m_2/\text{mol kg}^{-1}$ [b]	$10^2 m_1/\text{mol kg}^{-1}$ [c]
25	298.15	0.0	3.32, 3.392*
		0.2	3.17
		0.3	3.12
		0.4	3.05
		0.5	3.05
		0.6	3.07
		0.8	3.16
		1.0	3.26
		1.2	3.33

---

[a] Added by the compiler.

[b] m_2 = molality of sodium 1-heptylsulfonate.

[c] m_1 = solubility of carbon dioxide.

* Value from Wilhelm, E.; Battino, R.; Wilcock, R. J. *Chem. Rev.* 1977, *72*, 219.

The measurements are made at several pressures up to 10 - 15 atm (1 - 1.5 MPa). The solubility values have been corrected to 1 atm (0.103 MPa) partial pressure of CO_2. See method below.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus and method are described in earlier papers (1, 2). Solubility is determined in a thermostated, magnetic stirred cylindrical brass bomb with an observation window. The solution is prepared and put in a glass liner in the bomb. The system is sealed, evacuated to a pressure just above water vapor pressure, and outgassed with stirring for several hours. The gas is added to a known pressure and equilibrated with stirring for a minimum of five hours. Stirring is stopped, the solution is allowed to become still. The gas is vented leaving the supersaturated solution under a gaseous pressure of atmospheric pressure for a fixed time of 30 to 60 seconds. The rate of gas loss during the still condition is measured to use in a later correction. The gas is stirred and collected. The total volume of gas is measured along with ambient pressure and temperature.

SOURCE AND PURITY OF MATERIALS:

(1) Carbon dioxide. Matheson Gas Products. Commercial grade, stated to be 99.5 % min purity.

(2) Sodium 1-heptylsulfonate. Lancaster Synthesis, Ltd., stated to be 99 %.

(3) Water. Nothing specified, but have used doubly distilled water in earlier work.

ESTIMATED ERROR:

$\delta T/K$ not specified.

$\delta m_1/\text{mol kg}^{-1} = 0.02 \times 10^{-2}$

REFERENCES:

1. Matheson, I.B.C.; King, A.D. Jr. *J. Colloid Interface Sci.* 1978, *66*, 464.
2. Bolden, P.L.; Hoskins, J.C.; King, A.D. Jr. *J. Colloid Interface Sci.* 1983, *91*, 454.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Octanoic acid, pentadecafluoro-, sodium salt; (sodium perfluorooctanoate); $C_8F_{15}O_2Na$; [335-95-5]

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

ORIGINAL MEASUREMENTS:

Ownby, D. W.; Prapaitrakul, W.; King, A. D. Jr.

J. Colloid Interface Sci. 1988, *125*, 526-33.

VARIABLES:

T/K = 298.15
m_2/mol kg^{-1} = 0.0 - 0.6

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Solubility of carbon dioxide in aqueous sodium perfluorooctanoate.

t/°C	T/K [a]	m_2/mol kg^{-1} [b]	$10^2 m_1$/mol kg^{-1} [c]
25	298.15	0.0	3.32, 3.392*
		0.2	3.61
		0.4	3.90
		0.6	4.16

---

[a] Added by the compiler.

[b] m_2 = molality of sodium perfluorooctanoate.

[c] m_1 = solubility of carbon dioxide.

* Value from Wilhelm, E.; Battino, R.; Wilcock, R. J. *Chem. Rev.* 1977, *72*, 219.

The measurements are made at several pressures up to 10 - 15 atm (1 - 1.5 MPa). The solubility values have been corrected to 1 atm (0.103 MPa) partial pressure of CO_2. See method below.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus and method are described in earlier papers (1, 2). Solubility is determined in a thermostated, magnetic stirred cylindrical brass bomb with an observation window. The solution is prepared and put in a glass liner in the bomb. The system is sealed, evacuated to a pressure just above water vapor pressure, and outgassed with stirring for several hours. The gas is added to a known pressure and equilibrated with stirring for a minimum of five hours. Stirring is stopped, the solution is allowed to become still. The gas is vented leaving the supersaturated solution under a gaseous pressure of atmospheric pressure for a fixed time of 30 to 60 seconds. The rate of gas loss during the still condition is measured to use in a later correction. The gas is stirred and collected. The total volume of gas is measured along with ambient pressure and temperature.

SOURCE AND PURITY OF MATERIALS:

(1) Carbon dioxide. Matheson Gas Products. Commercial grade, stated to be 99.5 % min purity.

(2) Sodium perfluorooctanoate. Prepared *in situ* by titrating perfluorooctanoic acid with sodium hydroxide to pH 9-12.

(3) Water. Nothing specified, but have used doubly distilled water in earlier work.

ESTIMATED ERROR:

δT/K not specified.
δm_1/mol kg^{-1} = 0.02 x 10^{-2}

REFERENCES:

1. Matheson, I.B.C.; King, A.D. Jr. *J. Colloid Interface Sci.* 1978, *66*, 464.

2. Bolden, P.L.; Hoskins, J.C.; King, A.D. Jr. *J. Colloid Interface Sci.* 1983, *91*, 454.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Sodium trifluoroacetate;
$NaC_2O_2F_3$; [2923-18-4]

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

ORIGINAL MEASUREMENTS:

Castellani, F.; Berchiesi, G.

Anal. Proc. (London) 1994, *31*, 293-94.

VARIABLES:

$T/K = 294.65$
$p/kPa = 94.8$
$m_2/mol\ kg^{-1} = 18.9986$

PREPARED BY:

H.L. Clever
Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/°C$	T/K	$m_2/mol\ kg^{-1}$ [a]	$c_1/mol\ L^{-1}$ [b]	$k_{smc}/kg\ mol^{-1}$ [c]
21.5	294.65	0	0.0353 [d]	-
		18.9986	0.007_7	0.035

[a] m_2 = molality of sodium trifluoroacetate

[b] c_1 = solubility of carbon dioxide

[c] k_{smc} = salt effect parameter; calculated by compiler (H.L.C.)

[d] Estimated by compiler (H.L.C) from other data.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Schiff azometer (Ref. 1) was used. The authors measured also the solubility of O_2 and N_2. The gas dissolved in the solution, after being extracted by heating, was collected in a graduated tube. The volume contractions when the collected gas was put in contact successively with KOH and an alkaline solution of pyrogallol gave the content of CO_2 and O_2, respectively, the remaining volume being mainly N_2. The accuracy (operating at constant pressure) was within 0.5 %.

SOURCE AND PURITY OF MATERIALS:

(1) No details given.

(2) Fluka, Buchs, Switzerland. Purity not given. The salt was stored several days at 90 °C under a dynamic vacuum.

(3) Doubly distilled.

ESTIMATED ERROR:

No details given about δT, δp and δc_1.

REFERENCES:

1. Vogel, A.I. *A Textbook of Quantitative Inorganic Analysis, Including Elementary Instrumental Analysis*, 3rd Ed., Longmans Green, London, 1961, p. 1074.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Potassium chloride; KCl; [7447-40-7]

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

ORIGINAL MEASUREMENTS:

Setchenow, J. [Sechenov, I.M.]

Ann. Chim. Phys. [6] 1892, *25*, 226-70.

VARIABLES:

$T/K = 288.35$
$c_2/\text{mol dm}^{-3} = 0 - 2.564$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	Dilution x	$c_2/\text{mol dm}^{-3}$ [a]	α [b]	$k_{scc}/\text{dm}^3\text{ mol}^{-1}$ [a,c]
15.2	288.35	∞	0	1.009	-
		3	0.8546	0.819	0.106
		2	1.282	0.745	0.103
		1	2.564	0.579	0.0941

[a] Calculated by the compiler.

[b] α= Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[c] k_{scc} = Setchenow salt effect parameter; $k_{scc} = (1/c_2)\ \lg(\alpha^0/\alpha)$.

Initial solution: 28.2 g KCl + 87.4 cm^3 water to make 100 cm^3 of solution.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Setchenow (Ref. 1) based his apparatus on those of Fernet (1857) and of Meyer (1857). The manometer was based on ideas he learned from Regnault in 1861. The one meter manometer had three branches, two for measuring the pressure and one a mercury reservoir. The manometer was connected to the absorption cell by a flexible silver capillary. The absorption cell was of two bulbs with a mark in the constricting connection. CO_2 gas was generated, saturated with water vapor and filled the bulbs and manometer to a known pressure less than atmospheric. The liquid was degassed by heating and then passed by the pressure difference into the lower bulb to the mark of known volume. The system was sealed, turned 90 degrees and shaken until equilibrium was established. The gas volume absorbed was reduced to 0 °C and one meter Hg pressure. The Bunsen coefficient was calculated.

SOURCE AND PURITY OF MATERIALS:

(1) Apparently generated from limestone and sulfuric acid. Dried.

(2) Not specified.

(3) Not specified, assumed to be distilled.

ESTIMATED ERROR:

The author makes a qualitative statement that the results are good to the second decimal.

REFERENCES:

1. Setchenow, J.

Akad. Nauk. SSSR Mem. Acad. imp. Sci. St. Petersburg 1887, *35*, [Ser. No. 7], 1-59.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Potassium chloride; KCl; [7447-40-7]

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

ORIGINAL MEASUREMENTS:

Geffcken, G.

Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1904, *49*, 257-302.

VARIABLES:

T/K = 288.15 and 298.15

c_2/mol dm^{-3} = 0 - 1.058

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	c_2/mol dm^{-3}	L [a]
288.15	0	1.070
	0.423	0.9892
	0.432	0.9865
	1.045	0.8875
	1.058	0.8910
298.15	0	0.8255
	0.423	0.7695
	0.432	0.7667
	1.045	0.6920
	1.058	0.6961

[a] L = Ostwald coefficient (cm^3 cm^{-3})

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method using simple absorption pipet and buret. Diagram and detailed description given in original paper.

SOURCE AND PURITY OF MATERIALS:

(1) Obtained by the sublimation of solid carbon dioxide. Dried.

(2) Not specified.

(3) Degassed.

ESTIMATED ERROR:

δT/K = ± 0.1; δL = ± 1 %.

(estimated by compiler)

REFERENCES:

COMPONENTS: (1) Carbon dioxide; CO_2; [124-38-9] (2) Potassium chloride; KCl; [7447-40-7] (3) Water; H_2O; [7732-18-5]	ORIGINAL MEASUREMENTS: Findlay, A; Shen, B. *J. Chem. Soc.* 1912, *101*, 1459-68.
VARIABLES: T/K = 298.15 $10^2\gamma_2$/g cm^{-3} = 1.84 - 7.46	PREPARED BY: C. L. Young

EXPERIMENTAL VALUES:

T/K	$10^2\gamma_2$/g cm^{-3} [a]	ρ/g cm^{-3}	S [b]	10^4x_1 (p = 1 atm) [c]
298.15	1.84	1.008	0.792	5.90
	3.05	1.017	0.764	5.70
	4.58	1.026	0.749	5.60
	7.46	1.044	0.701	5.26

[a] γ = mass concentration of salt

[b] $$S = \frac{\text{concentration of gas in liquid phase}}{\text{concentration of gas in gaseous phase}}$$

Solubility was stated to be independent of pressure (over 1-2 atm pressure range); value quoted is the mean.

[c] Calculated by compiler assuming $V_{m,1}$ = 24.3 x 10^{-3} m^3 mol^{-1} at 1 atm.

Solubility in water: Ostwald coefficient L = 0.825 cm^3 cm^{-3}.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE: Gas buret and absorption pipet. Manometer tube was of such length as to allow measurements up to 2 x 10^5 Pa (about 2 atm).	SOURCE AND PURITY OF MATERIALS: (1) Purity 99.95 mole %. (2) No details given. (3) No details given.
	ESTIMATED ERROR: δT/K = ± 0.1; δS = ± 1 %. (estimated by compiler)
	REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Potassium chloride; KCl; [7447-40-7]

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

ORIGINAL MEASUREMENTS:

Markham, A.A.; Kobe, K.A.

J. Am. Chem. Soc. 1941, *63*, 449-54.

VARIABLES:

$T/K = 273.35 - 313.15$
$P/kPa = 101.325$
$m_2/mol\ kg^{-1} = 0 - 4$

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

$t/^{\circ}C$	T/K	$m_2/mol\ kg^{-1}$	α [a]	S [b]
0.2	273.35	0.0	1.7023	1.7025
		0.1	1.6611	1.6654
		0.2	1.6268	1.6352
		0.5	1.5285	1.5481
		1	1.4020	1.4389
		2	1.1980	1.2644
		3	1.0460	1.1356
25	298.15	0.0	0.7565	0.7587
		0.1	0.7432	0.7475
		0.2	0.7307	0.7369
		0.5	0.6937	0.7055
		1	0.6442	0.6646
		2	0.5646	0.5998
		3	0.5030	0.5503
		4	0.4563	0.5141
40	313.15	0.0	0.5133	0.5173
		1	0.4360	0.4522
		2	0.3853	0.4168
		3	0.3520	0.3874

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].
[b] S = Kuenen coefficient [cm^3 (STP) $g^{-1}(H_2O)$ atm^{-1}].

The authors fitted their data to equations:

$S_m/S_o = am_2 + 1/(1 + bm_2)$, as follows:

$t/^{\circ}C$	a	b
0.2	0.0207	0.216
25	0.0201	0.168
40	0.0380	0.190

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which the gas is agitated with a measured quantity of gas-free liquid and the decrease in volume of solution-saturated gas is measured in a burette over mercury. The pressure was adjusted to yield one atmosphere partial pressure of carbon dioxide. The volume of gas was reduced to 0°C by the ideal gas law. Experiments were conducted to show that the agitation did not cause supersaturation.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial cylinder, 99.8 % pure.

(2) Analytical grade.

(3) Distilled and degassed.

ESTIMATED ERROR:

$\delta T/K$ = <± 0.1 at 0.2°C, ± 0.03 at other temperatures (authors),
$\delta\alpha/\alpha$, $\delta S/S$ = ± 0.002 (authors).

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Potassium chloride; KCl; [7447-40-7]

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

VARIABLES:

T/K = 288.15 - 333.15
P/kPa = 101.325
c_2/mol dm^{-3} = 0 - 3

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

t/°C	T/K	c_2/mol dm^{-3}	α [a]	S [b]
15	288.15	0	0.990	-
		0.5	0.899	0.922
		1	0.820	0.847
		2	0.736	0.785
		3	0.680	0.752
20	293.15	0	0.860	-
		0.5	0.781	0.794
		1	0.714	0.7405
		2	0.616	0.659
		3	0.575	0.6375
25	298.15	0	0.758	-
		0.5	0.693	0.706
		1	0.642	0.6645
		2	0.560	0.5995
		3	0.501	0.556
30	303.15	0	0.671	-
		0.5	0.606	0.6175
		1	0.547	0.567
		2	0.4955	0.532
		3	0.452	0.502

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which a measured volume of gas-free liquid is stirred in the presence of the gas, and its decrease in volume is measured in a burette over mercury. The volume of liquid was measured at the experimental temperature. For calculation of the Kuenen coefficient, the density of the solution was obtained from Landolt-Börnstein extant 1969. The molar concentration of salt in the liquid was standardized at 20°C. These data are analyzed and discussed further in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) VEB Leuna Works; 99.8 vol %; the impurity was mostly water (author).

(2) DDR pro analysis grade by DDR Standard TGL 5021.

(3) Double distilled.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Gerecke, J.; Bittrich, H.J. *Wiss. Z. Tech. Hochsch. Chem. "Carl Schorlemmer" Leuna-Merseburg* 1971, *13*(2), 115-22.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Potassium chloride; KCl; [7447-40-7] (3) Water; H_2O; [7732-18-5]	Gerecke, J. *Diss. Dr. rer. Nat.* 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

EXPERIMENTAL VALUES:
(continued)

$t/^{\circ}\mathrm{C}$	T/K	$c_2/\mathrm{mol\ dm^{-3}}$	α [a]	S [b]
35	308.15	0	0.605	-
		0.5	0.525	0.5363
		1	0.478	0.4964
		2	0.434	0.467
		3	0.403	0.449
40	313.15	0	0.546	-
		0.5	0.471	0.482
		1	0.425	0.4425
		2	0.381	0.4102
		3	0.341	0.383
45	318.15	0	0.482	-
		0.5	0.4195	0.430
		1	0.381	0.397
		2	0.345	0.372
		3	0.316	0.3534
50	323.15	0	0.436	-
		0.5	0.376	0.386
		1	0.337	0.352
		2	0.3020	0.3265
		3	0.2825	0.3166
55	328.15	0	0.392	-
		0.5	0.333	0.342
		1	0.302	0.3155
		2	0.2710	0.2936
		3	0.251	0.281
60	333.15	0	0.372	-
		0.5	0.302	0.3102
		1	0.272	0.2844
		2	0.245	0.2655
		3	0.227	0.254

[a] α = Bunsen coefficient [$\mathrm{cm^3}$ (STP) $\mathrm{cm^{-3}}$ $\mathrm{atm^{-1}}$].

[b] S = Kuenen coefficient [$\mathrm{cm^3}$ (STP) $\mathrm{g^{-1}}$ (H_2O) $\mathrm{atm^{-1}}$].

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Potassium chloride; KCl; [7447-40-7] (3) Water; H_2O; [7732-18-5]	Yasunishi, A.; Yoshida, F. *J. Chem. Eng. Data* 1979, *24*, 11-14.
VARIABLES: T/K = 298.15 and 308.15 P/kPa = 101.325 c_2/mol L^{-1} = 0 - 4.131	PREPARED BY: C. L. Young

EXPERIMENTAL VALUES:

T/K	c_2/mol L^{-1}	L [a]
298.15	0	0.8264
	0.498	0.7576
	0.980	0.7041
	1.890	0.6177
	2.702	0.5554
	3.505	0.5063
	4.131	0.4703
308.15	0	0.6675
	0.420	0.6227
	0.804	0.5826
	1.340	0.5433
	1.723	0.5136
	2.201	0.4787
	2.727	0.4493
	3.048	0.4363
	3.619	0.4057
	3.660	0.4028
	4.110	0.3817

[a] L = Ostwald coefficient (cm^3 cm^{-3})

P = 1 atm = 101.325 kPa = 1.01325 bar

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Density and composition of solution determined after absorption. Details in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) High purity grade sample, purity 99.96 mole %.

(2,3) Guaranteed reagent, solution degassed by boiling.

ESTIMATED ERROR:

δT/K = ± 0.05; δL = ± 1 %.

REFERENCES:

1. Tokunaga, J.
   J. Chem. Eng. Data 1975, *20*, 41.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Potassium chloride; KCl; [7447-40-7]

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

ORIGINAL MEASUREMENTS:

Burmakina, G.V.; Efanov, L.N.; Shnet, M.A.

**Zh. Fiz. Khim.* 1982, *56*, 1159-61; *Russ. J. Phys. Chem. (Engl. Transl.)* 1982, *56*, 705-7.

VARIABLES:

T/K = 298.15
p/MPa = 0.1
$10^3 c_2$/mol L^{-1} = 0 - 200

PREPARED BY:

Yu. P. Yampol'skii

EXPERIMENTAL VALUES:

Solubility of carbon dioxide in aqueous solutions of KCl at 298.15 K. [a]

T/K	$10^3 c_2$/mol L^{-1} [b]	$10^3 c_1$/mol L^{-1} [c]
298.15	0	33.90
	1	33.85
	2	33.55
	5	33.35
	10	33.60
	20	33.65
	50	33.50
	100	33.20
	200	32.50

[a] Data taken from a graph by compiler.

[b] c_2 = concentration of KCl

[c] c_1 = concentration of CO_2

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Attainment of the equilibrium was checked by the constancy of CO_2 content in 3-5 subsequent samples of gas after saturation of the solution. The concentration of carbon dioxide was determined by titration.

SOURCE AND PURITY OF MATERIALS:

(1) Source not given. Before contacting with water solutions CO_2 was allowed to pass through the vessels with $NaHCO_3$, glass beads, glass wool and distilled water.

(2) Nothing specified.

(3) Distilled.

ESTIMATED ERROR:

$\delta c_1/c_1$ = ± 0.06 - 0.2 %
δT/K = ± 0.05

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Potassium chloride; KCl; [7447-40-7]

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

ORIGINAL MEASUREMENTS:

He, S.; Morse, J.W.

Geochim. Cosmochim. Acta 1993, *57*, 3533-54.

VARIABLES:

$T/\mathrm{K} = 273.15 - 363.15$

$P/\mathrm{MPa} = 0.1032$

$m_2/\mathrm{mol\ kg^{-1}} = 0.1 - 5.0$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

T/K [a]	$m_2/\mathrm{mol\ kg^{-1}}$ [b]	$\rho/\mathrm{g\ cm^{-3}}$ [c]	$10^2 p_1/\mathrm{atm}$ [d]	$10^3 m_1/\mathrm{mol\ kg^{-1}}$ [e]	γ_1 [f]
273.15	0.1	1.0059	96.6	71.3	1.06
	0.505	1.0248		69.1	1.09
	1.008	1.0473		62.9	1.20
	2.015	1.0896		57.2	1.32
	3.004	1.1275		53.4	1.41
	3.508	1.1443		52.5	1.44
298.15	0.1	1.0027	94.2	30.8	1.05
	1.0	1.0417		29.1	1.10
	2.0	1.0820		24.5	1.31
	4.0	1.1528		22.3	1.43
323.15	0.106	1.0015	85.4	16.1	1.03
	1.001	1.0328		15.3	1.09
	1.999	1.0672		14.5	1.15
	2.994	1.1026		13.3	1.25
	3.997	1.1377		12.8	1.30
	4.998	1.1727		12.3	1.35
348.15	0.1	0.9804	60.3	7.9	1.02
	1.0	1.0179		7.5	1.08
	2.0	1.0570		7.2	1.12
	3.0	1.0932		6.8	1.18
	5.0	1.1567		6.5	1.24
363.15	0.1	0.9708	30.1	3.4	1.01
	1.0	1.0087		3.3	1.04
	2.0	1.0478		3.2	1.09
	3.0	1.0841		3.1	1.12
	5.0	1.1476		2.8	1.20

[a] Calculated by compiler

[b] m_2 = molality of KCl

[c] ρ = density of solvent

[d] p_1 = partial pressure of CO_2

[e] m_1 = molality of CO_2

[f] γ_1 = activity coefficient of CO_2

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Either pure CO_2 gas or CO_2-N_2 mixtures were used in the experiments to maintain a constant $P(CO_2)$. The CO_2-N_2 mixtures were made by pumping predetermined amounts of CO_2 and N_2 into a gas tank and their composition was verified by gas chromatography.
CO_2 or CO_2-N_2 gas mixtures were equilibrated with the aqueous solutions in a series of stirred water-jacketed reaction vessels with condensers. The gas was premoistured by first passing it through distilled water at the temperature of experiment. Fine bubbles were obtained by using gas-dispersion tubes. The bubbling rate was 90 to 95 mL $\mathrm{min^{-1}}$.
The mole fraction of CO_2 in the CO_2-N_2 mixture was determined using a Hewlett Packard (5790A) gas chromatograph.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial; purity 99.9 %.

(2) Source not mentioned. Analytical reagent-grade which met ACS specifications. Vacuum-dried before use.

(3) 18 MΩ water obtained from a Milli-Q Super-Q water system.

ESTIMATED ERROR:

$\delta T/\mathrm{K} = \pm 0.1$

$\delta m_1/m_1 = \pm 0.012$

$\delta \gamma_1/\gamma_1 = \pm 0.04$

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Potassium chloride; KCl; [7447-40-7]

(3) Hydrochloric acid; HCl; [7647-01-0]

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

ORIGINAL MEASUREMENTS:

Van Slyke, D. D.; Sendroy, J., Jr.; Hastings, A. B.; Neill, J. M.

J. Biol. Chem. 1928, *78*, 765-99.

VARIABLES:

T/K = 311.2
$c_2/\text{mol L}^{-1}$ = 0 - 0.300
$c_3/\text{mol L}^{-1}$ = 0.01
P = "atmospheric"

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	Method [b]	p_1/mmHg [c]	$c_2/\text{mol L}^{-1}$	$c_3/\text{mol L}^{-1}$	α [d]	S_1 [e]
38.0	311.2	B,T		0	0.01	0.5452*	0.5468*
		B	700.8	0.150	0.01	0.5325	0.5363
		T	709.0	0.150	0.01	0.5314	0.5343
		B	700.8	0.300	0.01	0.5207	0.5260
		T	709.0	0.300	0.01	0.5187	0.5241

[a] Calculated by the compiler.

[b] B: saturation by bubbling; T: saturation in rotating tonometer.

[c] 1 mmHg = 133.322 Pa = 1.33322×10^{-3} bar

[d] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

[e] S_1 = Kuenen coefficient [cm^3 (STP) g^{-1} atm^{-1}]

* Average of six measurements.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two procedures were used for saturating solutions with CO_2:

Saturation by bubbling (B). The solution was placed in the saturating tube, the lower end of which was connected through a wash bottle with a Kipp CO_2 generator. The tube and wash bottle were immersed in a constant temperature bath. CO_2 gas was bubbled through it rapidly for 30 minutes. The wash bottle was replaced by a mercury reservoir and the free gas was driven completely out of the saturating tube by admitting mercury underneath the solution. The CO_2 contents of the solutions were determined in the manometric gas apparatus (Refs 1 and 2).

Saturation in rotating tonometer (T). The technique used was that described by Austin *et al.* (Ref. 3).

Both procedures gave identical results with solutions of acids and salts.

SOURCE AND PURITY OF MATERIALS:

(1) From a Kipp CO_2 generator.

(2) Not specified.

(3) Not specified.

(4) Distilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$
$\delta\alpha/\alpha = \pm 0.005$

REFERENCES:

1. Van Slyke, D. D.; Neill, J. M. *J. Biol. Chem.* 1924, *61*, 523.

2. Van Slyke, D. D.; Sendroy, J., Jr. *J. Biol. Chem.* 1927, *73*, 127.

3. Austin, J. H.; Cullen, G. E.; Hastings, A. B.; McLean, F. C.; Peters, J. P.; Van Slyke, D. D. *J. Biol. Chem.* 1922, *54*, 121.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Potassium chloride; KCl; [7447-40-7]

(3) Calcium chloride; $CaCl_2$; [10043-52-4]

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

ORIGINAL MEASUREMENTS:

Yasunishi, A.; Tsuji, M.; Sada, E.

Adv. Chem. Ser. 1979, *177*, 189-203.

VARIABLES:

$T/K = 298.15$

$P/kPa = 101.325$

$(c_2+c_3)/mol\ dm^{-3} = 0 - 3.801$

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	x_2 in mixed salt	(c_2+c_3) /mol dm^{-3}	L [a]
298.15	0.00	0	0.8264
		0.558	0.6477
		1.237	0.4701
		2.008	0.3380
		2.809	0.2544
		3.801	0.1876
	0.25	0.426	0.7037
		0.865	0.6011
		1.611	0.4605
		2.361	0.3704
		3.233	0.2845
	0.50	0.512	0.7012
		1.079	0.6003
		1.675	0.5062
		2.605	0.3947
		3.401	0.3253
	0.75	0.429	0.7455
		0.904	0.6735
		1.845	0.5558
		2.714	0.4691
		3.501	0.4057
	1.00	0.498	0.7576
		0.980	0.7041
		1.890	0.6177
		2.702	0.5554
		3.505	0.5063

[a] L = Ostwald coefficient [$cm^3\ cm^{-3}$]
$P = 101.325$ kPa

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Partial pressure determined from total pressure and vapor pressure of solution. The vapor pressure of the mixed salt solution estimated by the method of Robinson and Bower (1) from corresponding data for each component salt solution.
Apparatus similar to that described in ref. (2).

SOURCE AND PURITY OF MATERIALS:

(1) Extra pure grade, purity 99.96 mole %.

(2,3) Reagent grade.

(4) Deionized.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta L = \pm 1$ %.

REFERENCES:

1. Robinson, R.A.; Bower, V.E. *J. Res. Nat. Bur. Stand.* 1965, *69A*, 365.
2. Tokunaga, J. *J. Chem. Eng. Data* 1975, *20*, 41.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]
(2) Sodium chloride; NaCl; [7647-14-5]
(3) Potassium chloride; KCl; [7447-40-7]
(4) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Yasunishi, A.; Tsuji, M.; Sada, E.

Adv. Chem. Ser. 1979, *177*, 189-203.

VARIABLES:

$T/K = 298.15$
$P/kPa = 101.325$
$(c_2+c_3)/mol\ dm^{-3} = 0 - 4.396$

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	x_2 in mixed salt	(c_2+c_3) /mol dm^{-3}	L [a]
298.15	0.00	0	0.8264
		0.498	0.6576
		0.980	0.7041
		1.890	0.6177
		2.702	0.5554
		3.505	0.5063
		4.131	0.4703
	0.25	0.537	0.7455
		1.039	0.6813
		1.765	0.6073
		2.114	0.5705
		3.104	0.4948
		4.125	0.4243
	0.50	0.479	0.7502
		1.051	0.6720
		1.851	0.5742
		2.297	0.5344
		3.343	0.4439
		4.396	0.3765
	0.75	0.545	0.7271
		1.077	0.6511
		1.830	0.5545
		2.277	0.5070
		3.434	0.4028
		4.311	0.3415
	1.00	0.455	0.7343
		1.000	0.6508
		1.945	0.5187
		2.486	0.4653
		3.400	0.3727
		4.216	0.3144

[a] L = Ostwald coefficient [$cm^3\ cm^{-3}$]
P = 101.325 kPa

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Partial pressure determined from total pressure and vapor pressure of solution. The vapor pressure of the mixed salt solution estimated by the method of Robinson and Bower (1) from corresponding data for each component salt solution.
Apparatus similar to that described in ref. (2).

SOURCE AND PURITY OF MATERIALS:

(1) Extra pure grade, purity 99.96 mole %.

(2,3) Reagent grade.

(4) Deionized.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta L = \pm 1$ %.

REFERENCES:

1. Robinson, R.A.; Bower, V.E. *J. Res. Nat. Bur. Stand.* 1965, *69A*, 365.
2. Tokunaga, J. *J. Chem. Eng. Data* 1975, *20*, 41.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]
(2) Potassium chloride; KCl;
[7447-40-7]
(3) Sodium chloride; NaCl;
[7647-14-5]
(4) Calcium chloride; $CaCl_2$;
[10043-52-4]
(5) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Yasunishi, A.; Tsuji, M.; Sada, E.

Adv. Chem. Ser. 1979, *177*, 189-203.

VARIABLES:

$T/K = 298.15$
$P/kPa = 101.325$
$(c_2+c_3+c_4)/mol\ dm^{-3} = 0 - 4.396$

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	x_2 in mixed salt	x_3 in mixed salt	$(c_2+c_3+c_4)$ /mol dm^{-3}	L [a]
298.15	0	0	0	0.8264
	0.50	0.50	0.479	0.7502
			1.051	0.6720
			1.851	0.5742
			2.297	0.5344
			3.343	0.4439
			4.396	0.3765
	0.50	0.25	0.386	0.7505
			0.722	0.6873
			1.428	0.5901
			1.938	0.5291
			2.455	0.4704
			2.762	0.4405
	0.50	0.00	0.512	0.7012
			1.079	0.6003
			1.675	0.5062
			2.605	0.3947
			3.401	0.3253

[a] L = Ostwald coefficient [$cm^3\ cm^{-3}$]
P = 101.325 kPa

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Partial pressure determined from total pressure and vapor pressure of solution. The vapor pressure of the mixed salt solution estimated by the method of Robinson and Bower (1) from corresponding data for each component salt solution.
Apparatus similar to that described in ref. (2).

SOURCE AND PURITY OF MATERIALS:

(1) Extra pure grade, purity 99.96 mole %.

(2,3,4) Reagent grade.

(5) Deionized.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta L = \pm 1$ %.

REFERENCES:

1. Robinson, R.A.; Bower, V.E. *J. Res. Nat. Bur. Stand.* 1965, *69A*, 365.
2. Tokunaga, J. *J. Chem. Eng. Data* 1975, *20*, 41.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]
(2) Potassium bromide; KBr;
[7758-02-3]
(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Setchenow, J. [Sechenov, I.M.]
Ann. Chim. Phys. [6] 1892, *25*,
226-70.

VARIABLES:

$T/K = 288.35$
$c_2/\text{mol dm}^{-3} = 0 - 4.228$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/{}^\circ C$	T/K [a]	Dilution x	$c_2/\text{mol dm}^{-3}$ [a]	α [b]	$k_{scc}/\text{dm}^3\ \text{mol}^{-1}$ [a,c]
15.2	288.35	∞	0	1.009	-
		6	0.7046	0.908	0.0650
		3	1.409	0.819	0.0643
		2	2.114	0.748	0.0615
		1	4.228	0.579	0.0571

[a] Calculated by the compiler.
[b] α = Bunsen coefficient [cm^3 (STP) $\text{cm}^{-3}\ \text{atm}^{-1}$].
[c] k_{scc} = Setchenow salt effect parameter; $k_{scc} = (1/c_2)\ \lg(\alpha^\circ/\alpha)$.

Initial solution: 50.31 g KBr + 83.21 cm^3 water to make 100 cm^3 of sln.

AUXILIARY INFORMATION

See other data sheets on J. Setchenow papers.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]
(2) Potassium bromide; KBr;
[7758-02-3]
(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Geffcken, G.
Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1904, *49*,
257-302.

VARIABLES:

$T/K = 288.15$ and 298.15
$c_2/\text{mol dm}^{-3} = 0 - 1.064$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	$c_2/\text{mol dm}^{-3}$	L [a]	T/K	$c_2/\text{mol dm}^{-3}$	L [a]
288.15	0	1.070	298.15	0	0.8255
	0.550	0.9783		0.550	0.7621
	0.565	0.9766		0.565	0.7619
	1.056	0.9100		1.056	0.7030
	1.064	0.9065		1.064	0.7068

[a] L = Ostwald coefficient ($\text{cm}^3\ \text{cm}^{-3}$)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method using simple absorption pipet and buret. Diagram and detailed description given in original paper.

SOURCE AND PURITY OF MATERIALS:

(1) Obtained by the sublimation of solid carbon dioxide. Dried.

(2) Not specified.

(3) Degassed.

ESTIMATED ERROR: (by compiler)

$\delta T/K = \pm\ 0.1$; $\delta L = \pm\ 1$ %.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Potassium bromide; KBr; [7758-02-3]

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

VARIABLES:

T/K = 288.15 - 333.15
P/kPa = 101.325
c_2/mol dm^{-3} = 0 - 4

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

$t/^\circ C$	T/K	c_2/mol dm^{-3}	α [a]	S [b]
15	288.15	0	0.990	-
		0.5	0.938	0.955
		1	0.864	0.8965
		2	0.793	0.855
		4	0.901	1.054
20	293.15	0	0.860	-
		0.5	0.806	0.822
		1	0.742	0.770
		2	0.705	0.7605
		4	0.849	0.996
25	298.15	0	0.758	0.5173
		0.5	0.710	0.725
		1	0.660	0.687
		2	0.631	0.683
		4	0.797	0.936
30	303.15	0	0.671	-
		0.5	0.634	0.648
		1	0.596	0.621
		2	0.578	0.6275
		4	0.736	0.867

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AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which a measured volume of gas-free liquid is stirred in the presence of the gas, and its decrease in volume is measured in a burette over mercury. The volume of liquid was measured at the experimental temperature. For calculation of the Kuenen coefficient, the density of the solution was obtained from Landolt-Börnstein extant 1969. The molar concentration of salt in the liquid was standardized at 20°C. These data are analyzed and discussed further in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) VEB Leuna Works; 99.8 vol %; the impurity was mostly water (author).

(2) DDR pro analysis grade by DDR Standard TGL 5021.

(3) Double distilled.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Gerecke, J.; Bittrich, H.J. *Wiss. Z. Tech. Hochsch. Chem. "Carl Schorlemmer" Leuna-Merseburg* 1971, *13*(2), 115-22.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Potassium bromide; KBr; [7758-02-3] (3) Water; H_2O; [7732-18-5]	Gerecke, J. *Diss. Dr. rer. Nat.* 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

EXPERIMENTAL VALUES:
(continued)

$t/^{\circ}C$	T/K	$c_2/\text{mol dm}^{-3}$	α [a]	S [b]
35	308.15	0	0.605	-
		0.5	0.562	0.575
		1	0.527	0.550
		2	0.504	0.548
		4	0.676	0.798
40	313.15	0	0.546	-
		0.5	0.492	0.504
		1	0.477	0.498
		2	0.443	0.482
		4	0.642	0.760
45	318.15	0	0.482	-
		0.5	0.453	0.464
		1	0.412	0.431
		2	0.402	0.4385
		4	0.608	0.720
50	323.15	0	0.436	-
		0.5	0.401	0.412
		1	0.3665	0.384
		2	0.368	0.4015
		4	0.581	0.690
55	328.15	0	0.392	-
		0.5	0.362	0.3725
		1	0.340	0.357
		2	0.333	0.364
		4	0.557	0.665
60	333.15	0	0.372	-
		0.5	0.328	0.338
		1	0.318	0.334
		2	0.304	0.333
		4	0.532	0.636

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[b] S = Kuenen coefficient [cm^3 (STP) g^{-1} (H_2O) atm^{-1}].

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Potassium iodide; KI; [7681-11-0]

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

ORIGINAL MEASUREMENTS:

Setchenow, J. [Sechenov, I.M.]

Ann. Chim. Phys. [6] 1892, *25*, 226-70.

VARIABLES:

$T/K = 288.35$

$c_2/\text{mol dm}^{-3} = 0 - 5.767$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	Dilution x	$c_2/\text{mol dm}^{-3}$ [a]	α [b]	$k_{scc}/\text{dm}^3\ \text{mol}^{-1}$ [a,c]
15.2	288.35	∞	0	1.009	-
		3	1.922	0.773	0.0602
		2	2.884	0.688	0.0577
		1	5.767	0.506	0.0520

[a] Calculated by the compiler.

[b] α = Bunsen coefficient [cm^3 (STP) $\text{cm}^{-3}\ \text{atm}^{-1}$].

[c] k_{scc} = Setchenow salt effect parameter; $k_{scc} = (1/c_2)\ \lg(\alpha^\circ/\alpha)$.

Initial solution: 95.73 g KI + 69.33 cm^3 water to make 100 cm^3 of solution.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Setchenow (Ref. 1) based his apparatus on those of Fernet (1857) and of Meyer (1857). The manometer was based on ideas he learned from Regnault in 1861. The one meter manometer had three branches, two for measuring the pressure and one a mercury reservoir. The manometer was connected to the absorption cell by a flexible silver capillary. The absorption cell was of two bulbs with a mark in the constricting connection. CO_2 gas was generated, saturated with water vapor and filled the bulbs and manometer to a known pressure less than atmospheric. The liquid was degassed by heating and then passed by the pressure difference into the lower bulb to the mark of known volume. The system was sealed, turned 90 degrees and shaken until equilibrium was established. The gas volume absorbed was reduced to 0 °C and one meter Hg pressure. The Bunsen coefficient was calculated.

SOURCE AND PURITY OF MATERIALS:

(1) Apparently generated from limestone and sulfuric acid. Dried.

(2) Not specified.

(3) Not specified, assumed to be distilled.

ESTIMATED ERROR:

The author makes a qualitative statement that the results are good to the second decimal.

REFERENCES:

1. Setchenow, J.

Akad. Nauk. SSSR Mem. Acad. imp. Sci. St. Petersburg 1887, *35*, [Ser. No. 7], 1-59.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Potassium iodide; KI; [7681-11-0]

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

ORIGINAL MEASUREMENTS:

Geffcken, G.

Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1904, *49*, 257-302.

VARIABLES:

T/K = 288.15 and 298.15
c_2/mol dm^{-3} = 0 - 1.119

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	c_2/mol dm^{-3}	L [a]
288.15	0	1.070
	0.559	0.9809
	0.573	0.9835
	1.043	0.9144
	1.119	0.9090
298.15	0	0.8255
	0.559	0.7678
	0.573	0.7676
	1.043	0.7236
	1.119	0.7166

[a] L = Ostwald coefficient (cm^3 cm^{-3})

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method using simple absorption pipet and buret. Diagram and detailed description given in original paper.

SOURCE AND PURITY OF MATERIALS:

(1) Obtained by the sublimation of solid carbon dioxide. Dried.

(2) Not specified.

(3) Degassed.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta L = \pm 1$ %.

(estimated by compiler)

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Potassium iodide; KI;
[7681-11-0]

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

VARIABLES:

T/K = 288.15 - 333.15
P/kPa = 101.325
c_2/mol dm^{-3} = 0 - 5

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

$t/^{\circ}C$	T/K	c_2/mol dm^{-3}	α [a]	S [b]
15	288.15	0	0.990	-
		0.5	0.952	0.978
		1	0.894	0.938
		2	0.808	0.892
		5	0.699	0.920
20	293.15	0	0.860	-
		0.5	0.820	0.845
		1	0.771	0.818
		2	0.685	0.758
		5	0.655	0.864
25	298.15	0	0.758	0.5173
		0.5	0.719	0.742
		1	0.678	0.713
		2	0.616	0.682
		5	0.588	0.788
30	303.15	0	0.671	-
		0.5	0.629	0.650
		1	0.595	0.6275
		2	0.548	0.608
		5	0.535	0.7085

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AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which a measured volume of gas-free liquid is stirred in the presence of the gas, and its decrease in volume is measured in a burette over mercury. The volume of liquid was measured at the experimental temperature. For calculation of the Kuenen coefficient, the density of the solution was obtained from Landolt-Börnstein extant 1969. The molar concentration of salt in the liquid was standardized at 20°C. These data are analyzed and discussed further in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) VEB Leuna Works; 99.8 vol %; the impurity was mostly water (author).

(2) DDR pro analysis grade by DDR Standard TGL 5021.

(3) Double distilled.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Gerecke, J.; Bittrich, H.J. *Wiss. Z. Tech. Hochsch. Chem. "Carl Schorlemmer" Leuna-Merseburg* 1971, *13*(2), 115-22.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Potassium iodide; KI; [7681-11-0] (3) Water; H_2O; [7732-18-5]	Gerecke, J. *Diss. Dr. rer. Nat.* 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

EXPERIMENTAL VALUES:

(continued)

t/°C	T/K	c_2/mol dm^{-3}	α [a]	S [b]
35	308.15	0	0.605	-
		0.5	0.556	0.5755
		1	0.518	0.5475
		2	0.457	0.508
		5	0.494	0.6565
40	313.15	0	0.546	-
		1	0.462	0.489
		2	0.418	0.466
		5	0.4814	0.642
45	318.15	0	0.482	-
		0.5	0.4456	0.462
		1	0.412	0.437
		2	0.372	0.416
		5	0.456	0.6085
50	323.15	0	0.436	-
		1	0.363	0.386
		2	0.322	0.3606
55	328.15	0	0.392	-
		0.5	0.361	0.375
		1	0.327	0.348
		2	0.296	0.332
		5	0.396	0.531
60	333.15	0	0.372	-
		0.5	0.3188	0.332
		1	0.288	0.307
		2	0.251	0.282
		5	0.3615	0.4885

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[b] S = Kuenen coefficient [cm^3 (STP) g^{-1} (H_2O) atm^{-1}].

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Potassium iodide; KI; [7681-11-0]

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

ORIGINAL MEASUREMENTS:

Onda, K.; Sada, E; Kobayashi, T.; Kito, S.; Ito, K.

J. Chem. Eng. Jpn 1970, *3*, 18-24.

VARIABLES:

$T/K = 298.15$
$P/kPa = 101.325$
$c_2/mol\ dm^{-3} = 1.003-2.002$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

T/K	$c_2/mol\ dm^{-3}$	α [a]	L [b,c]
298.15	0	0.7595	0.8290
	1.003	0.6640	0.7248
	2.002	0.5976	0.6523

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[b] L = Ostwald coefficient [cm^3 cm^{-3}].

[c] Calculated by the compiler.

P = 1 atm = 101.325 kPa = 1.01325 bar

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solutions were made up by weight. Concentration of each solution was verified by measuring the density. (Density was not reported in paper.) A measured volume of gas was brought into contact with a measured quantity of gas-free solvent. Equilibrium was established by agitation using a magnetic stirrer. The volume of remaining gas was measured. The amount of gas absorbed was estimated from change in volume of gas. Details in original paper.

SOURCE AND PURITY OF MATERIALS:

(1) From commercial cylinder. Purity 99.8 %.

(2) Analytical grade.

(3) Distilled and degassed.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta\alpha = \pm 2$ %

(Estimated by the compiler.)

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Potassium iodide; KI; [7681-11-0]

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

ORIGINAL MEASUREMENTS:

Vázquez, G.; Chenlo, F.; Pereira, G.; Peaguda, J.

An. Quim. 1994, *90*, 324-28.

VARIABLES:

$T/\mathrm{K} = 298.1$

$P_1/\mathrm{bar} = 1.013$

$m_2/\mathrm{mol\ kg^{-1}} = 0.245 - 1.835$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

T/K	$\gamma_2/\mathrm{g\ L^{-1}}$ [a]	$\rho/\mathrm{kg\ m^{-3}}$ [b]	$m_2/\mathrm{mol\ kg^{-1}}$ [c]	$c_1/\mathrm{mol\ dm^{-3}}$ [d]	L [e]
298.1	40	1024	0.245	0.0303	0.741
	80	1053	0.495	0.0292	0.714
	120	1082	0.751	0.0283	0.692
	160	1111	1.014	0.0283	0.692
	200	1141	1.280	0.0272	0.665
	240	1165	1.563	0.0269	0.658
	280	1199	1.835	0.0267	0.653

[a] γ_2 = mass concentration of KI

[b] ρ = density of aqueous KI solution

[c] m_2 = molality of KI; calculated by compiler

[d] c_1 = solubility of CO_2

[e] L = Ostwald coefficient [$\mathrm{cm^3\ cm^{-3}}$]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is a combination of previous designs (Refs 1 and 2). It was modified to achieve a more accurate determination of the volume of the absorbent liquid. The apparatus measures the volume of absorbed gas as the volume of mercury that must be supplied to the system in order to restore the initial pressure.
The raw solubility data obtained are gas/liquid volume ratios.
A detailed description of apparatus, method and procedure is given in Ref. 3.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial, purity 99.95 mole %.

(2) Merck. Grade not given.

(3) Distilled and degassed.

ESTIMATED ERROR:

$\delta T/\mathrm{K} = \pm\ 0.1$

$\delta P/\mathrm{bar} = \pm\ 0.001$

$\delta c_1/c_1 < \pm\ 1\ \%$ (estimated by compiler on the basis of the information in Ref. 3)

REFERENCES:

1. Alvarez, J.R.; Fernández, A.; Coll, A. *Ing. Quím.* 1984, *16*, 67.
2. Haimour, N. *J. Chem. Eng. Data* 1990, *35*, 177.
3. Vázquez, G.; Chenlo, F.; Pereira, G.; Peaguda, J. *J. Chem. Eng. Data* 1994, *39*, 639.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Potassium sulfate; K_2SO_4; [7778-80-5]

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

ORIGINAL MEASUREMENTS:

Yasunishi, A.; Yoshida, F.

J. Chem. Eng. Data 1979, *24*, 11-14.

VARIABLES:

$T/K = 298.15$
$P/kPa = 101.325$
$c_2/mol\ L^{-1} = 0 - 0.454$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	$c_2/mol\ L^{-1}$	L [a]
298.15	0	0.8264
	0.093	0.7816
	0.188	0.7435
	0.283	0.7059
	0.454	0.6442

[a] L = Ostwald coefficient ($cm^3\ cm^{-3}$)

P = 1 atm = 101.325 kPa = 1.01325 bar

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Density and composition of solution determined after absorption. Details in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) High purity grade sample, purity 99.96 mole %.

(2,3) Guaranteed reagent, solution degassed by boiling.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta L = \pm 1$ %.

REFERENCES:

1. Tokunaga, J.
J. Chem. Eng. Data 1975, *20*, 41.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Potassium sulfate; K_2SO_4; [7778-80-5]

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

ORIGINAL MEASUREMENTS:

He, S.; Morse, J.W.

Geochim. Cosmochim. Acta 1993, *57*, 3533-54.

VARIABLES:

$T/K = 273.15 - 363.15$
$P/MPa = 0.1032$
$m_2/mol\ kg^{-1} = 0.01 - 0.9$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

T/K [a]	$m_2/mol\ kg^{-1}$ [b]	$\rho/g\ cm^{-3}$ [c]	$10^2 p_1/atm$ [d]	$10^3 m_1/mol\ kg^{-1}$ [e]	γ_1 [f]
273.15	0.01	1.0017	96.6	74.1	1.02
	0.1	1.0152		69.3	1.09
	0.2	1.0291		67.1	1.14
	0.3	1.0425		64.7	1.16
	0.4	1.0553		59.8	1.26
298.15	0.1	1.0109	94.2	29.9	1.07
	0.2	1.0246		28.1	1.10
	0.3	1.0372		27.9	1.15
	0.4	1.0505		26.4	1.22
	0.6	1.0747		24.4	1.31
323.15	0.02	0.9917	85.4	17.9	1.02
	0.1	1.0017		17.3	1.06
	0.5	1.0525		15.5	1.18
	0.81	1.0893		14.6	1.25
348.15	0.1	0.9884	60.3	7.8	1.04
	0.3	1.0140		7.5	1.08
	0.5	1.0388		7.4	1.09
	0.7	1.0629		7.1	1.15
	0.9	1.0862		6.7	1.20
363.15	0.1	0.9788	30.1	3.4	1.02
	0.3	1.0046		3.3	1.05
	0.5	1.0292		3.2	1.08
	0.7	1.0523		3.1	1.11
	0.9	1.0762		3.0	1.14

[a] Calculated by compiler
[b] m_2 = molality of K_2SO_4
[c] ρ = density of solvent
[d] p_1 = partial pressure of CO_2
[e] m_1 = molality of CO_2
[f] γ_1 = activity coefficient of CO_2

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Either pure CO_2 gas or CO_2-N_2 mixtures were used in the experiments to maintain a constant $P(CO_2)$. The CO_2-N_2 mixtures were made by pumping predetermined amounts of CO_2 and N_2 into a gas tank and their composition was verified by gas chromatography.

CO_2 or CO_2-N_2 gas mixtures were equilibrated with the aqueous solutions in a series of stirred water-jacketed reaction vessels with condensers. The gas was premoistured by first passing it through distilled water at the temperature of experiment. Fine bubbles were obtained by using gas-dispersion tubes. The bubbling rate was 90 to 95 mL min^{-1}.

The mole fraction of CO_2 in the CO_2-N_2 mixture was determined using a Hewlett Packard (5790A) gas chromatograph.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial; purity 99.9 %.

(2) Source not mentioned.
Analytical reagent-grade which met ACS specifications.
Vacuum-dried before use.

(3) 18 MΩ water obtained from a Milli-Q Super-Q water system.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$
$\delta m_1/m_1 = \pm 0.012$
$\delta \gamma_1/\gamma_1 = \pm 0.04$

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]
(2) Potassium nitrate; KNO_3; [7757-79-1]
(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Setschenow, J. [Sechenov, I.M.]
Nouv. Mem. Soc. Imp. Nat. Moscow 1889, *15*, 203-74.

VARIABLES:

$T/K = 288.35$
$c_2/\text{mol dm}^{-3} = 0 - 2.325$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	Dilution x	$c_2/\text{mol dm}^{-3}$ [a]	α [b]	$k_{scc}/\text{dm}^3\ \text{mol}^{-1}$ [a,c]
15.2	288.35	∞	0	1.009	-
		4	0.5813	0.959	0.0380
		2	1.163	0.8905	0.0466
		1	2.325	0.781	0.0478

[a] Calculated by the compiler.
[b] α = Bunsen coefficient [cm^3 (STP) $\text{cm}^{-3}\ \text{atm}^{-1}$].
[c] k_{scc} = Setchenow salt effect parameter; $k_{scc} = (1/c_2)\ \lg(\alpha^o/\alpha)$.

Initial solution: 23.51 g KNO_3 + 90.10 cm^3 water to make 100 cm^3 of sln.

AUXILIARY INFORMATION

See other data sheets on J. Setchenow papers.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]
(2) Potassium nitrate; KNO_3; [7757-79-1]
(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Geffcken, G.
Z. Phys. Chem., Stoechiom. Verwandtschaftsl. 1904, *49*, 257-302.

VARIABLES:

$T/K = 288.15$ and 298.15
$c_2/\text{mol dm}^{-3} = 0 - 1.033$

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	$c_2/\text{mol dm}^{-3}$	L [a]	T/K	$c_2/\text{mol dm}^{-3}$	L [a]
288.15	0	1.070	298.15	0	0.8255
	0.536	1.002		0.536	0.7832
	0.537	0.9997		0.537	0.7818
	1.022	0.9439		1.022	0.7452
	1.033	0.9421		1.033	0.7447

[a] L = Ostwald coefficient ($\text{cm}^3\ \text{cm}^{-3}$)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method using simple absorption pipet and buret. Diagram and detailed description given in original paper.

SOURCE AND PURITY OF MATERIALS:

(1) Obtained by the sublimation of solid carbon dioxide. Dried.

(2) Not specified.

(3) Degassed.

ESTIMATED ERROR: (by compiler)

$\delta T/K = \pm 0.1$; $\delta L = \pm 1\ \%$.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Potassium nitrate; KNO_3; [7757-79-1]

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

ORIGINAL MEASUREMENTS:

Markham, A.A.; Kobe, K.A.

J. Am. Chem. Soc. 1941, *63*, 449-54.

VARIABLES:

$T/K = 273.35 - 313.15$

$P/kPa = 101.325$

$m_2/mol\ kg^{-1} = 0 - 3$

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

$t/^{\circ}C$	T/K	$m_2/mol\ kg^{-1}$	α [a]	S [b]
0.2	273.35	0.0	1.7023	1.7025
		0.1	1.6680	1.6740
		0.2	1.6470	1.6584
		0.5	1.5733	1.6012
		1	1.4610	1.5142
25	298.15	0.0	0.7565	0.7587
		0.1	0.7501	0.7552
		0.2	0.7421	0.7500
		0.5	0.7182	0.7345
		1	0.6860	0.7156
		2	0.6296	0.6834
		3	0.5818	0.6568
40	313.15	0.0	0.5133	0.5173
		1	0.4704	0.4937
		2	0.4370	0.4776
		3	0.4083	0.4642

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[b] S = Kuenen coefficient [cm^3 (STP) $g^{-1}(H_2O)$ atm^{-1}].

The authors fitted their data to equations:

$S_m/S_o = am_2 + 1/(1 + bm_2)$, as follows:

$t/^{\circ}C$	a	b
0.2	0.0350	0.170
25	0.0248	0.088
40	0.0343	0.086

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which the gas is agitated with a measured quantity of gas-free liquid and the decrease in volume of solution-saturated gas is measured in a burette over mercury. The pressure was adjusted to yield one atmosphere partial pressure of carbon dioxide. The volume of gas was reduced to 0°C by the ideal gas law. Experiments were conducted to show that the agitation did not cause supersaturation.

SOURCE AND PURITY OF MATERIALS:

(1) Commercial cylinder, 99.8 % pure.

(2) Analytical grade.

(3) Distilled and degassed.

ESTIMATED ERROR:

$\delta T/K = <\pm 0.1$ at 0.2°C, ± 0.03 at other temperatures (authors),

$\delta\alpha/\alpha$, $\delta S/S = \pm 0.002$ (authors).

REFERENCES:

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Potassium nitrate; KNO_3; [7757-79-1]

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

VARIABLES:

$T/K = 288.15 - 328.15$
$P/kPa = 101.325$
$c_2/\text{mol dm}^{-3} = 0 - 2$

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

$t/^{\circ}C$	T/K	$c_2/\text{mol dm}^{-3}$	α [a]	S [b]
15	288.15	0	0.990	-
		0.25	0.951	0.961
		0.5	0.920	0.941
		1	0.888	0.925
		2	0.807	0.878
20	293.15	0	0.860	-
		0.25	0.843	0.852
		0.5	0.792	0.8115
		1	0.773	0.807
		2	0.709	0.773
25	298.15	0	0.758	0.5173
		0.25	0.744	0.752
		0.5	0.720	0.738
		1	0.681	0.6841
		2	0.636	0.695
30	303.15	0	0.671	-
		0.25	0.653	0.661
		0.5	0.637	0.6535
		1	0.602	0.630
		2	0.568	0.621

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which a measured volume of gas-free liquid is stirred in the presence of the gas, and its decrease in volume is measured in a burette over mercury. The volume of liquid was measured at the experimental temperature. For calculation of the Kuenen coefficient, the density of the solution was obtained from Landolt-Börnstein extant 1969. The molar concentration of salt in the liquid was standardized at 20°C. These data are analyzed and discussed further in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) VEB Leuna Works; 99.8 vol %; the impurity was mostly water (author).

(2) DDR pro analysis grade by DDR Standard TGL 5021.

(3) Double distilled.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Gerecke, J.; Bittrich, H.J. *Wiss. Z. Tech. Hochsch. Chem. "Carl Schorlemmer" Leuna-Merseburg* 1971, *13*(2), 115-22.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Potassium nitrate; KNO_3; [7757-79-1] (3) Water; H_2O; [7732-18-5]	Gerecke, J. *Diss. Dr. rer. Nat.* 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

EXPERIMENTAL VALUES:

(continued)

t/°C	T/K	c_2/mol dm^{-3}	α [a]	S [b]
35	308.15	0	0.605	-
		0.25	0.568	0.576
		0.5	0.552	0.567
		1	0.523	0.548
		2	0.504	0.553
40	313.15	0	0.546	-
		0.25	0.508	0.516
		0.5	0.485	0.499
		1	0.465	0.4885
		2	0.449	0.4935
45	318.15	0	0.482	-
		0.25	0.447	0.455
		0.5	0.432	0.445
		1	0.414	0.435
		2	0.402	0.443
50	323.15	0	0.436	-
		0.25	0.399	0.407
		0.5	0.390	0.402
		1	0.373	0.393
		2	0.362	0.400
55	328.15	0	0.392	-
		0.25	0.360	0.3675
		0.5	0.351	0.363
		1	0.340	0.359
		2	0.323	0.357

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[b] S = Kuenen coefficient [cm^3 (STP) g^{-1} (H_2O) atm^{-1}].

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Potassium nitrate; KNO_3; [7757-79-1]

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

ORIGINAL MEASUREMENTS:

Yasunishi, A.; Yoshida, F.

J. Chem. Eng. Data 1979, *24*, 11-14.

VARIABLES:

T/K = 298.15 and 308.15
P/kPa = 101.325
c_2/mol L^{-1} = 0 - 1.768

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	c_2/mol L^{-1}	L ^{a}
298.15	0	0.8264
	0.288	0.7994
	0.801	0.7592
	1.101	0.7399
	1.412	0.7164
	1.630	0.7023
308.15	0	0.6675
	0.275	0.6503
	0.661	0.6285
	0.961	0.6119
	1.549	0.5805
	1.692	0.5709
	1.768	0.5693

[a] L = Ostwald coefficient (cm^3 cm^{-3})

P = 1 atm = 101.325 kPa = 1.01325 bar

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Density and composition of solution determined after absorption. Details in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) High purity grade sample, purity 99.96 mole %.

(2,3) Guaranteed reagent, solution degassed by boiling.

ESTIMATED ERROR:

δT/K = ± 0.05; δL = ± 1 %.

REFERENCES:

1. Tokunaga, J.
J. Chem. Eng. Data 1975, *20*, 41.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

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

(3) Potassium nitrate; KNO_3; [7757-79-1]

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

ORIGINAL MEASUREMENTS:

Yasunishi, A.; Tsuji, M.; Sada, E.

Adv. Chem. Ser. 1979, *177*, 189-203.

VARIABLES:

$T/K = 298.15$

$P/kPa = 101.325$

$(c_2+c_3)/mol\ dm^{-3} = 0 - 3.400$

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	x_2 in mixed salt	(c_2+c_3) /mol dm^{-3}	L [a]
298.15	0.00	0	0.8264
		0.288	0.7994
		0.801	0.7592
		1.101	0.7399
		1.412	0.7164
		1.630	0.7023
	0.25	0.298	0.7956
		0.614	0.7663
		1.007	0.7244
		1.290	0.6983
		1.664	0.6649
	0.50	0.289	0.7857
		0.711	0.7352
		1.127	0.6854
		1.601	0.6330
		2.173	0.5820
	0.75	0.264	0.7784
		0.620	0.7315
		0.913	0.6901
		1.324	0.6367
		1.723	0.5883
	1.00	0.455	0.7343
		1.000	0.6508
		1.442	0.5842
		1.945	0.5187
		2.486	0.4653
		3.400	0.3727

[a] L = Ostwald coefficient [$cm^3\ cm^{-3}$]
P = 101.325 kPa

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Partial pressure determined from total pressure and vapor pressure of solution. The vapor pressure of the mixed salt solution estimated by the method of Robinson and Bower (1) from corresponding data for each component salt solution. Apparatus similar to that described in ref. (2).

SOURCE AND PURITY OF MATERIALS:

(1) Extra pure grade, purity 99.96 mole %.

(2,3) Reagent grade.

(4) Deionized.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta L = \pm 1$ %.

REFERENCES:

1. Robinson, R.A.; Bower, V.E. *J. Res. Nat. Bur. Stand.* 1965, *69A*, 365.
2. Tokunaga, J. *J. Chem. Eng. Data* 1975, *20*, 41.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]
(2) Sodium chloride; NaCl; [7647-14-5]
(3) Magnesium sulfate; $MgSO_4$; [7487-88-9]
(4) Potassium nitrate; KNO_3; [7757-79-1]
(5) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Yasunishi, A.; Tsuji, M.; Sada, E.

Adv. Chem. Ser. 1979, *177*, 189-203.

VARIABLES:

$T/K = 298.15$
$P/kPa = 101.325$
$(c_2+c_3+c_4)/mol\ dm^{-3} = 0 - 2.264$

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	x_2 in mixed salt	x_3 in mixed salt	$(c_2+c_3+c_4)$ /mol dm^{-3}	L [a]
298.15	0	0	0	0.8264
	0.50	0.50	0.387	0.7001
			0.723	0.6110
			1.111	0.5147
			1.616	0.4215
			2.185	0.3315
	0.50	0.25	0.193	0.7859
			0.498	0.7206
			0.814	0.6577
			1.131	0.6067
			1.493	0.5506
			1.910	0.4949
			2.264	0.4497
	0.50	0	0.289	0.7857
			0.711	0.7352
			1.127	0.6854
			1.601	0.6330
			2.173	0.5820

[a] L = Ostwald coefficient [$cm^3\ cm^{-3}$]
P = 101.325 kPa

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric apparatus with multibulb buret and magnetic stirrer. Amount of solution and gas absorbed determined volumetrically. Partial pressure determined from total pressure and vapor pressure of solution. The vapor pressure of the mixed salt solution estimated by the method of Robinson and Bower (1) from corresponding data for each component salt solution.
Apparatus similar to that described in ref. (2).

SOURCE AND PURITY OF MATERIALS:

(1) Extra pure grade, purity 99.96 mole %.

(2,3,4) Reagent grade.

(5) Deionized.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta L = \pm 1$ %.

REFERENCES:

1. Robinson, R.A.; Bower, V.E. *J. Res. Nat. Bur. Stand.* 1965, *69A*, 365.
2. Tokunaga, J. *J. Chem. Eng. Data* 1975, *20*, 41.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Potassium dihydrogen phosphate; KH_2PO_4; [7778-77-0]

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

VARIABLES:

T/K = 288.15 - 333.15

P/kPa = 101.325

c_2/mol dm^{-3} = 0 - 1

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

$t/^{\circ}C$	T/K	c_2/mol dm^{-3}	α [a]	S [b]
15	288.15	0	0.990	-
		0.25	0.875	0.884
		0.5	0.793	0.810
		1	0.489	0.513
20	293.15	0	0.860	-
		0.25	0.782	0.7905
		0.5	0.704	0.720
		1	0.418	0.438
25	298.15	0	0.758	-
		0.25	0.692	0.700
		0.5	0.619	0.634
		1	0.355	0.3733
30	303.15	0	0.671	-
		0.25	0.614	0.6218
		0.5	0.547	0.561
		1	0.307	0.323
35	308.15	0	0.605	-
		0.25	0.550	0.5575
		0.5	0.491	0.504
		1	0.266	0.2801

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AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which a measured volume of gas-free liquid is stirred in the presence of the gas, and its decrease in volume is measured in a burette over mercury. The volume of liquid was measured at the experimental temperature. For calculation of the Kuenen coefficient, the density of the solution was obtained from Landolt-Börnstein extant 1969. The molar concentration of salt in the liquid was standardized at 20°C. These data are analyzed and discussed further in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) VEB Leuna Works; 99.8 vol %; the impurity was mostly water (author).

(2) DDR pro analysis grade by DDR Standard TGL 5021.

(3) Double distilled.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Gerecke, J.; Bittrich, H.J. *Wiss. Z. Tech. Hochsch. Chem. "Carl Schorlemmer" Leuna-Merseburg* 1971, *13*(2), 115-22.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Potassium dihydrogen phosphate; KH_2PO_4; [7778-77-0]

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

EXPERIMENTAL VALUES:

(continued)

t/°C	T/K	c_2/mol dm^{-3}	α [a]	S [b]
40	313.15	0	0.546	-
		0.25	0.489	0.4962
		0.5	0.431	0.4422
		1	0.228	0.2305
45	318.15	0	0.482	-
		0.25	0.436	0.443
		0.5	0.385	0.3855
		1	0.198	0.209
50	323.15	0	0.436	-
		0.25	0.401	0.4075
		0.5	0.344	0.354
		1	0.169	0.179
55	328.15	0	0.392	-
		0.25	0.359	0.365
		0.5	0.312	0.3218
		1	0.150	0.1592
60	333.15	0	0.372	-
		0.25	0.327	0.333
		0.5	0.283	0.2925

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

[b] S = Kuenen coefficient [cm^3 (STP) g^{-1} (H_2O) atm^{-1}].

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Potassium dihydrogen phosphate; KH_2PO_4; [7778-77-0]

(3) Phosphoric acid; H_3PO_4; [7664-38-2]

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

ORIGINAL MEASUREMENTS:

Van Slyke, D. D.; Sendroy, J., Jr.; Hastings, A. B.; Neill, J. M.

J. Biol. Chem. 1928, *78*, 765-99.

VARIABLES:

$T/K = 311.2$
$c_2/\text{mol L}^{-1} = 0 - 0.300$
$c_3/\text{mol L}^{-1} = 0.015 - 0.300$
P = "atmospheric"

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	p_1/mmHg [b]	$c_2/\text{mol L}^{-1}$	$c_3/\text{mol L}^{-1}$	α [c]	S_1 [d]
38.0	311.2	723.7	0	0.150	0.5396	0.5451
		723.7	0	0.300	0.5317	0.5410
		720.3	0.150	0.015	0.5163	0.5237
		720.3	0.300	0.030	0.4906	0.4996
		712.6	0.300	0.030	0.4915	0.5005

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[a] Calculated by the compiler.

[b] 1 mmHg = 133.322 Pa = 1.33322×10^{-3} bar

[c] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

[d] S_1 = Kuenen coefficient [cm^3 (STP) g^{-1} atm^{-1}]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solutions were saturated with CO_2 by a bubbling method:

Saturation by bubbling. The solution was placed in the saturating tube, the lower end of which was connected through a wash bottle with a Kipp CO_2 generator. The tube and wash bottle were immersed in a constant temperature bath. CO_2 was bubbled through it rapidly for 30 minutes. The wash bottle was replaced by a mercury reservoir and the free gas was driven completely out of the saturating tube by admitting mercury underneath the solution. The CO_2 contents of the solutions were determined in the manometric gas apparatus (Refs 1 and 2).

SOURCE AND PURITY OF MATERIALS:

(1) From a Kipp CO_2 generator.

(2) The KH_2PO_4 solutions were prepared by dissolving weighed amounts of the salt in standard dilute H_3PO_3.

(3) Not specified.

(4) Distilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$
$\delta\alpha/\alpha = \pm 0.005$

REFERENCES:

1. Van Slyke, D. D.; Neill, J. M. *J. Biol. Chem.* 1924, *61*, 523.

2. Van Slyke, D. D.; Sendroy, J., Jr. *J. Biol. Chem.* 1927, *73*, 127.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) ß-D-Fructofuranosyl-α-D-glucopyranoside; (sucrose); $C_{12}H_{22}O_{11}$; [57-50-1]

(3) Potassium dihydrogen phosphate; KH_2PO_4; [7778-77-0]

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

ORIGINAL MEASUREMENTS:

de Molineri, N.A.;
de Cozzitorti, P.A.; Sosa, A.B.;
Katz, M.

Anal. Asoc. Quím. Argentina 1989, *77*, 333-40.

VARIABLES:

$T/K = 288 - 308$
$P/kPa = 101.3$
$10^2w_2 = 5 - 15$
$10^2w_3 = 0 - 15$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

10^2w_2 [a]	10^2w_3 [b]	α [c] (T = 288 K)	α [c] (T = 298 K)	α [c] (T = 308 K)
5	0	0.939	0.734	0.559
5	2.5	0.877	0.688	0.519
5	5	0.818	0.639	0.487
5	7.5	0.764	0.599	0.452
5	10	0.715	0.557	0.424
5	12.5	0.665	0.522	0.393
5	15	0.622	0.485	0.369
7.5	0	0.930	0.725	0.552
7.5	2.5	0.867	0.680	0.512
7.5	5	0.810	0.631	0.480
7.5	7.5	0.754	0.591	0.445
7.5	10	0.705	0.548	0.417
7.5	12.5	0.656	0.514	0.387
7.5	15	0.616	0.476	0.362

(continued next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

An Erlenmeyer flask calibrated with distilled water up to a final value of 152.31 mL was connected to a pressure transducer which in turn was connected to a digital multimeter. The apparatus was calibrated with a manometer containing dibutylphtalate. Known volumes of gas and degassed solvent were introduced into the flask which was submerged in a thermostatic bath. Composition of solvent was checked by refractive index measurement at 28 °C.

The full description of the apparatus and mode of operation have been given in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) Source not mentioned.
Purity 99.9 %.

(2) Source not mentioned.
Purity 99.9 %.

(3) Merck, pro analysi.

(4) Double distilled, degassed.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$
$\delta P/kPa = \pm 0.007$
$\delta\alpha/\alpha = \pm 1$ %

REFERENCES:

1. Postigo, M.A.; Pedrosa, G.C.; Katz, M.

Anal. Asoc. Quím. Argentina 1978, *66*, 25.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) ß-D-Fructofuranosyl-α-D-glucopyranoside; (sucrose); $C_{12}H_{22}O_{11}$; [57-50-1] (3) Potassium dihydrogen phosphate; KH_2PO_4; [7778-77-0] (3) Water; H_2O; [7732-18-5]	de Molineri, N.A.; de Cozzitorti, P.A.; Sosa, A.B.; Katz, M. *Anal. Asoc. Quím. Argentina* <u>1989</u>, *77*, 333-40.

EXPERIMENTAL VALUES: (continued)

$10^2 w_2$ [a]	$10^2 w_3$ [b]	α [c] (T = 288 K)	α [c] (T = 298 K)	α [c] (T = 308 K)
10	0	0.916	0.713	0.543
10	2.5	0.854	0.668	0.503
10	5	0.797	0.619	0.471
10	7.5	0.741	0.579	0.435
10	10	0.692	0.536	0.408
10	12.5	0.642	0.502	0.378
10	15	0.599	0.464	0.353
12.5	0	0.901	0.698	0.531
12.5	2.5	0.836	0.652	0.490
12.5	5	0.780	0.604	0.459
12.5	7.5	0.723	0.564	0.423
12.5	10	0.674	0.521	0.396
12.5	12.5	0.626	0.487	0.365
12.5	15	0.582	0.449	0.341
15	0	0.877	0.679	0.516
15	2.5	0.815	0.634	0.475
15	5	0.759	0.585	0.444
15	7.5	0.702	0.545	0.408
15	10	0.653	0.502	0.381
15	12.5	0.603	0.468	0.350
15	15	0.561	0.430	0.326

[a] w_2 = mass fraction of sucrose

[b] w_3 = mass fraction of KH_2PO_4

[c] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Potassium hydrogen oxalate; C_2HO_4K; [127-95-7]

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

ORIGINAL MEASUREMENTS:

Van Slyke, D. D.; Sendroy, J., Jr.; Hastings, A. B.; Neill, J. M.

J. Biol. Chem. 1928, *78*, 765-99.

VARIABLES:

$T/K = 311.2$
$c_2/\text{mol L}^{-1} = 0.300$ and 0.600
$P =$ "atmospheric"

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	p_1/mmHg [b]	$c_2/\text{mol L}^{-1}$	α [c]	S_1 [d]
38.0	311.2	718.5	0.300	0.5211	0.5328
		718.5	0.600	0.4969	0.1340

---

[a] Calculated by the compiler.

[b] 1 mmHg = 133.322 Pa = 1.33322×10^{-3} bar

[c] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

[d] S_1 = Kuenen coefficient [cm^3 (STP) g^{-1} atm^{-1}]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solutions were saturated with CO_2 by a bubbling method:

Saturation by bubbling. The solution was placed in the saturating tube, the lower end of which was connected through a wash bottle with a Kipp CO_2 generator. The tube and wash bottle were immersed in a constant temperature bath. CO_2 was bubbled through it rapidly for 30 minutes. The wash bottle was replaced by a mercury reservoir and the free gas was driven completely out of the saturating tube by admitting mercury underneath the solution. The CO_2 contents of the solutions were determined in the manometric gas apparatus (Refs 1 and 2).

SOURCE AND PURITY OF MATERIALS:

(1) From a Kipp CO_2 generator.

(2) The KHC_2O_4 solutions were prepared from $K_2C_2O_4$ plus equimolar amounts of free oxalic acid crystals.

(3) Distilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$
$\delta\alpha/\alpha = \pm 0.005$

REFERENCES:

1. Van Slyke, D. D.; Neill, J. M. *J. Biol. Chem.* 1924, *61*, 523.

2. Van Slyke, D. D.; Sendroy, J., Jr. *J. Biol. Chem.* 1927, *73*, 127.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Potassium lactate; $C_3H_5O_3K$; [996-31-6]

(3) 2-Hydroxypropanoic acid; (lactic acid); $C_3H_6O_3$; [50-21-5]

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

ORIGINAL MEASUREMENTS:

Van Slyke, D. D.; Sendroy, J., Jr.; Hastings, A. B.; Neill, J. M.

J. Biol. Chem. 1928, *78*, 765-99.

VARIABLES:

$T/K = 311.2$
$c_2/\text{mol L}^{-1} = 0 - 0.300$
$c_3/\text{mol L}^{-1} = 0.100 - 0.300$
P = "atmospheric"

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	Method [b]	p_1/mmHg [c]	$c_2/\text{mol L}^{-1}$	$c_3/\text{mol L}^{-1}$	α [d]	S_1 [e]
38.0	311.2	B	712.9	0	0.150	0.5436	0.5508
		B	714.4	0	0.150	0.5473	0.5540
		B	712.9	0	0.300	0.5434	0.5569
		B	721.8	0.150	0.100	0.5278	0.5398
		T	720.4	0.150	0.150	0.5288	0.5429
		B	721.8	0.300	0.100	0.5106	0.5308
		T	720.4	0.300	0.300	0.5103	0.5362

[a] Calculated by the compiler.

[b] B: saturation by bubbling; T: saturation in rotating tonometer.

[c] 1 mmHg = 133.322 Pa = 1.33322×10^{-3} bar

[d] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

[e] S_1 = Kuenen coefficient [cm^3 (STP) g^{-1} atm^{-1}]

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two procedures were used for saturating solutions with CO_2:

Saturation by bubbling (B). The solution was placed in the saturating tube, the lower end of which was connected through a wash bottle with a Kipp CO_2 generator. The tube and wash bottle were immersed in a constant temperature bath. CO_2 gas was bubbled through it rapidly for 30 minutes. The wash bottle was replaced by a mercury reservoir and the free gas was driven completely out of the saturating tube by admitting mercury underneath the solution. The CO_2 contents of the solutions were determined in the manometric gas apparatus (Refs 1 and 2).

Saturation in rotating tonometer (T). The technique used was that described by Austin *et al.* (Ref. 3).

Both procedures gave identical results with solutions of acids and salts.

SOURCE AND PURITY OF MATERIALS:

(1) From a Kipp CO_2 generator.

(2) K-lactate solutions were made by adding known excess of lactic acid to solutions of $KHCO_3$.

(3) Not specified.

(4) Distilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$
$\delta\alpha/\alpha = \pm 0.005$

REFERENCES:

1. Van Slyke, D. D.; Neill, J. M. *J. Biol. Chem.* 1924, *61*, 523.
2. Van Slyke, D. D.; Sendroy, J., Jr. *J. Biol. Chem.* 1927, *73*, 127.
3. Austin, J. H.; Cullen, G. E.; Hastings, A. B.; McLean, F. C.; Peters, J. P.; Van Slyke, D. D. *J. Biol. Chem.* 1922, *54*, 121.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]
(2) Potassium thiocyanate; KSCN; [333-20-0]
(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Setchenow, J. [Sechenov, I.M.]
Ann. Chim. Phys. [6] 1892, *25*, 226-70.

VARIABLES:

T/K = 288.35
$c_2/\text{mol dm}^{-3}$ = 0 - 10.065

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	Dilution x	$c_2/\text{mol dm}^{-3}$ [a]	α [b]	$k_{scc}/\text{dm}^3\ \text{mol}^{-1}$ [a,c]
15.2	288.35	∞	0	1.009	-
		3	3.355	0.691	0.0490
		2	5.032	0.590	0.0463
		1	10.065	0.387	0.0413

[a] Calculated by the compiler.
[b] α = Bunsen coefficient [cm^3 (STP) $\text{cm}^{-3}\ \text{atm}^{-1}$].
[c] k_{scc} = Setchenow salt effect parameter; $k_{scc} = (1/c_2)\ \lg(\alpha^0/\alpha)$.
Initial solution: 97.8 g KSCN + 45.33 cm^3 water to make 100 cm^3 of sln.

AUXILIARY INFORMATION

See other data sheets on J. Setchenow papers.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]
(2) Potassium aluminium sulfate; $KAl(SO_4)_2$; [10043-67-1]
(3) Water; H_2O; [7732-18-5]

ORIGINAL MEASUREMENTS:

Rosenthal, W.
Thès. fac. sci. Univ. Strasbourg (France) 1954.

VARIABLES:

T/K = 293.15
$c_2/\text{mol dm}^{-3}$ = 0 and 0.1246

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

T/K	$c_2/\text{mol dm}^{-3}$ [a]	$L/\text{cm}^3\ \text{cm}^{-3}$ [a,b]	$k_{scc}/\text{dm}^3\ \text{mol}^{-1}$ [c,d]
293.15	0	0.879	-
	0.1246	0.690	0.844

[a] Original data; [b] Ostwald coefficient;
[c] Sechenov constant; $k_{scc} = (1/c_2)\ \lg(L^0/L)$; [d] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The prepared solvent and solution were charged into an evacuated cell after degassing, and the mass of solvent was determined by weight. Gas was introduced into the cell from a measuring buret in which the gas was stored over mercury. The cell was agitated while the gas pressure was maintained by adjusting the gas volume. The Ostwald coefficient was determined from the mass of solvent and the volume of gas absorbed. Solubilities were measured at pressures above and below atmospheric.

SOURCE AND PURITY OF MATERIALS:

(1) Source and purity not given. An aqueous "soda" solution absorbed 99.8 % of the gas.

(2) Source and purity not given. Recrystallized from water and dried.

(3) Boiled to remove carbon dioxide.

ESTIMATED ERROR:

$\delta T/K = \pm\ 0.2$; $\delta p/\text{kPa} = \pm\ 0.1$
$\delta L/L = \pm\ 0.02$ (compiler)

REFERENCES:

Some data in the thesis have been published.
See: 1. Maillard, A.; Rosenthal, W. *Comp rend.* 1952, *234*, 2546-8.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Rubidium chloride; RbCl; [7791-11-9] (3) Water; H_2O; [7732-18-5]	Geffcken, G. *Z. Phys. Chem., Stoechiom. Verwandtschaftsl.* 1904, *49*, 257-302.
VARIABLES: T/K = 288.15 and 298.15 c_2/mol dm^{-3} = 0 - 1.012	PREPARED BY: C. L. Young

EXPERIMENTAL VALUES:

T/K	c_2/mol dm^{-3}	L [a]
288.15	0	1.070
	0.479	0.9908
	0.481	0.9910
	1.007	0.9210
	1.012	0.9200
298.15	0	0.8255
	0.479	0.7705
	0.481	0.7698
	1.007	0.7190
	1.012	0.7157

[a] L = Ostwald coefficient (cm^3 cm^{-3})

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Cesium chloride; CsCl; [7647-17-8] (3) Water; H_2O; [7732-18-5]	Geffcken, G. *Z. Phys. Chem., Stoechiom. Verwandtschaftsl.* 1904, *49*, 257-302.
VARIABLES: T/K = 288.15 and 298.15 c_2/mol dm^{-3} = 0 - 0.554	PREPARED BY: C. L. Young

EXPERIMENTAL VALUES:

T/K	c_2/mol dm^{-3}	L [a]
288.15	0	1.070
	0.552	1.001
	0.554	0.9995
298.15	0	0.8255
	0.552	0.7771
	0.554	0.7769

[a] L = Ostwald coefficient (cm^3 cm^{-3})

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Volumetric method using simple absorption pipet and buret. Diagram and detailed description given in original paper.	(1) Obtained by the sublimation of solid carbon dioxide. Dried. (2) Not specified. (3) Degassed.
	ESTIMATED ERROR: (by compiler) $\delta T/K = \pm 0.1$; $\delta L = \pm 1$ %.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Cesium chloride; CsCl; [7647-17-8]

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

ORIGINAL MEASUREMENTS:

Gerecke, J.

Diss. Dr. rer. Nat. 1969, Hochsch. "Carl Schorlemmer", Leuna-Merseburg, DDR.

VARIABLES:

T/K = 288.15 - 303.15
P/kPa = 101.325
c_2/mol dm^{-3} = 0 - 2

PREPARED BY:

D.M. Mason

EXPERIMENTAL VALUES:

$t/^{\circ}C$	T/K	c_2/mol dm^{-3}	α [a]
15	288.15	0	0.990
		0.5	0.959
		1	0.888
		2	0.843
20	293.15	0	0.860
		0.5	0.831
		1	0.799
		2	0.749
25	298.15	0	0.758
		0.5	0.716
		1	0.694
		2.8	0.650
30	303.15	0	0.671
		0.5	0.631
		1	0.603
		2	0.580

[a] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The principle of the Ostwald method was used in which a measured volume of gas-free liquid is stirred in the presence of the gas, and its decrease in volume is measured in a burette over mercury. The volume of liquid was measured at the experimental temperature. The molar concentration of salt in the liquid was standardized at 20°C.
These data are analyzed and discussed further in Ref. 1.

SOURCE AND PURITY OF MATERIALS:

(1) VEB Leuna Works; 99.8 vol %; the impurity was mostly water (author).

(2) DDR pro analysis grade by DDR Standard TGL 5021.

(3) Double distilled.

ESTIMATED ERROR:

Not given.

REFERENCES:

1. Gerecke, J.; Bittrich, H.J. *Wiss. Z. Tech. Hochsch. Chem. "Carl Schorlemmer" Leuna-Merseburg* 1971, *13*(2), 115-22.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9]	Mackenzie, J. J.
(2) Ammonium chloride Sodium chloride Potassium chloride	*Ann. Phys. (Leipzig) [3]* 1877, *1*, 438-51.
(3) Water; H_2O; [7732-18-5]	

EXPERIMENTAL VALUES:

t/°C	T/K	10^2w_2 [a]	d^{15}_{15} [b]	c_2/mol L^{-1} [c]	m_2/mol kg^{-1} [d]	α [e]
		Ammonium chloride; NH_4Cl; [12125-02-9]				
8	281	6.465	1.021	1.234	1.292	1.0227±0.0007 (2)
		8.723	1.047	1.707	1.787	1.0000±0.0000 (2)
		12.727	1.053	2.505	2.726	0.9220±0.0023 (2)
10	283	24.233	1.072	4.857	5.979	0.8132±0.0106 (3)
15	288	6.465	1.021	1.234	1.292	0.8253±0.0106 (3)
		8.723	1.047	1.707	1.787	0.7973±0.0115 (3)
		12.727	1.053	2.505	2.726	0.7981±0.0129 (3)
		24.233	1.072	4.857	5.979	0.7384±0.0146 (2)
22	295	6.465	1.021	1.234	1.292	0.7182±0.0040 (2)
		8.723	1.047	1.707	1.787	0.7022±0.0122 (2)
		12.727	1.053	2.707	2.726	0.6840±0.0203 (3)
						or 0.6958±0.0017 (2)
		24.233	1.053	4.857	5.979	0.5998±0.0172 (3)
		Sodium chloride; NaCl; [7647-14-5]				
6.4	279.6	7.062	1.038	1.254	1.300	0.8990±0.0402 (4)
		12.995	1.080	2.402	2.565	0.6326±0.0181 (4)
		17.42	1.123	3.347	3.610	0.5181±0.0319 (3)
						or 0.4998±0.0045 (2)
		26.00	1.195	5.317	6.012	0.3470±0.0314 (3)
						or 0.3649±0.0064 (2)
15	288	7.062	1.038	1.254	1.300	0.7347±0.0186 (3)
		12.995	1.080	2.402	2.565	0.5569±0.0057 (2)
		17.42	1.123	3.347	3.610	0.4306±0.0101 (3)
		26.00	1.195	5.317	6.012	0.2969±0.0168 (3)
22	295	12.995	1.080	2.402	2.565	0.4822±0.0104 (2)
		17.42	1.123	3.347	3.610	0.3892±0.0084 (3)
		26.00	1.195	5.317	6.012	0.2630±0.0192 (3)
						or 0.2741±0.0020 (2)
		Potassium chloride; KCl; [7447-40-7]				
8	281	6.0548	1.021	0.828	0.864	0.9880±0.0004 (2)
		8.6460	1.053	1.221	1.269	0.9178±0.0116 (3)
		11.974	1.080	1.734	1.824	0.8639±0.0056 (3)
		22.506	1.549 ?	(3.468)	3.895	0.6877±0.0107 (3)
15	288	6.0548	1.021	0.828	0.864	0.7772±0.0282 (3)
						or 0.7935±0.0033 (2)
		8.6460	1.053	1.221	1.269	0.7768±0.0107 (3)
		11.974	1.080	1.734	1.824	0.7202±0.0085 (3)
		22.506	1.549 ?	(3.468)	3.895	0.5707±0.0091 (3)
22	295	6.0548	1.021	0.828	0.864	0.6701±0.0225 (3)
						or 0.6820±0.0091 (2)
		8.6460	1.053	1.221	1.269	0.6488±0.0269 (3)
						or 0.6339±0.0105 (2)
		11.974	1.080	1.734	1.824	0.5970±0.0087 (3)
						or 0.5832±0.0008 (2)
		22.506	1.549 ?	(3.468)	3.895	0.4801±0.0239 (3)

[a] w_2 = mass fraction of salt

[b] d^{15}_{15} = relative density

[c] c_2 = concentration of salt

[d] m_2 = molality of salt

[e] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

(continued on next page)

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Ammonium chloride Sodium chloride Potassium chloride (3) Water; H_2O; [7732-18-5]	Mackenzie, J. J. *Ann. Phys. (Leipzig) [3]* 1877, *1*, 438-51.
VARIABLES: $T/K = 279.6 - 295.2$ $p_1/kPa = 93.6 - 101.6$	PREPARED BY: H. L. Clever

EXPERIMENTAL VALUES: (continued)

AUXILIARY INFORMATION:

For ammonium chloride at 288 K and 8.723 mass % the paper gave an average solubility of 0.7906. The compiler's average of 0.7973 is given in the table.

The relative density of 22.506 mass % KCl must be a printing error. Comparison with density values in the *International Critical Tables* leads one to assume the value should be 1.149. The concentration is calculated with the assumption.

The compiler calculated and added the Kelvin temperatures, the concentration and molality values and the standard deviations.

For values of large standard deviation the compiler has dropped the value with largest deviation and given a second average.

These data are of marginal value. Some show a standard deviation as large as 10 %, although many show a standard deviation under 3 %.

The author clearly states these are Bunsen coefficients. However, the compiler's analysis of the author's calculations indicates the gas volume was reduced to the partial pressure at equilibrium. If this is true the values need to be reduced from 0 to 7.5 % to the Bunsen coefficients.
Tabulated in the paper are pressure and volume of dry gas before equilibration, volume and partial pressure of wet CO_2 gas not absorbed, and mercury volume displaced.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
The apparatus consisted of a bulb of known volume in which the initial pressure and carbon dioxide (reduced to 0 °C) was measured; a bulb of known volume for the solvent; and a manometer system to adjust the final volume of the unabsorbed wet gas and measure its total pressure (reduced to 0 °C). The final total pressure of wet gas was reduced to the partial pressure of carbon dioxide by subtraction of the solution water vapor pressure. There was a statement that the carbon dioxide solubility in water was measured, but no solubility values were given.	(1) Carbon dioxide. Prepared by action of sulfuric acid on marble. Dried by bubbling through sulfuric acid. (2) Salts. Recrystallized. Solution prepared by weight and checked by evaporation to dry salt. (3) Water. Nothing specified. ESTIMATED ERROR: Temperature: Nothing specified. Solubility: Nothing specified, but see standard deviations in table.

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9]	Mackenzie, J. J.
(2) Calcium chloride Strontium chloride Barium chloride	*Ann. Phys. (Leipzig) [3]* <u>1877</u>, *1*, 438-51.
(3) Water; H_2O; [7732-18-5]	

EXPERIMENTAL VALUES:

t/°C	T/K	10^2w_2 [a]	$d\,^{15}_{15}$ [b]	c_2/mol L^{-1} [c]	m_2/mol kg^{-1} [d]	α [e]
		Calcium chloride;	$CaCl_2$;	[10043-52-4]		
8	281	4.365	1.036	0.407	0.411	0.9423±0.0112 (3)
		5.739	1.049	0.542	0.549	0.8548±0.0016 (2)
		8.045	1.068	0.774	0.788	0.8383±0.0003 (2)
		15.793	1.139	1.621	1.690	0.6315±0.0010 (2)
16.25	289.4	4.365	1.036	0.407	0.411	0.7587±0.0039 (2)
		5.739	1.049	0.542	0.549	0.7260±0.0058 (3)
		8.045	1.068	0.774	0.788	0.6740±0.0035 (3)
		15.793	1.139	1.621	1.690	0.5202±0.0049 (3)
22	295	4.365	1.036	0.407	0.411	0.6726±0.0057 (2)
		5.739	1.049	0.542	0.549	0.6159±0.0067 (3)
		8.045	1.068	0.774	0.788	0.5809±0.0095 (3)
		15.793	1.139	1.621	1.690	0.4709±0.0166 (3)
30	303	4.365	1.036	0.407	0.411	0.5957±0.0072 (2)
		5.739	1.049	0.542	0.549	0.5266±0.0086 (3)
		8.045	1.068	0.774	0.788	0.4998±0.0029 (3)
		15.793	1.139	1.621	1.690	0.3995±0.0056 (2)
		Strontium chloride;	$SrCl_2$;	[10476-85-4]		
8	281	9.511	1.087	0.652	0.663	0.7789±0.0035 (2)
		12.325	1.116	0.868	0.887	0.7367±0.0086 (2)
		17.713	1.173	1.311	1.358	0.6057±0.0209 (2)
		31.194	1.343	2.643	2.860	0.2854±0.0014 (2)
16.25	289.4	9.511	1.087	0.652	0.663	0.6633±0.0022 (2)
		12.325	1.116	0.868	0.887	0.5859±0.0102 (3)
		17.713	1.173	1.311	1.358	0.4727±0.0062 (3)
		31.194	1.343	2.643	2.860	0.2449±0.0123 (3)
22	295	9.511	1.087	0.652	0.663	0.5806±0.0171 (2)
		12.325	1.116	0.868	0.887	0.5071±0.0073 (3)
		17.713	1.173	1.311	1.358	0.4435±0.0009 (2)
		31.194	1.343	2.643	2.860	0.2474±0.0066 (3)
30	303	9.511	1.087	0.652	0.663	0.5079±0.0246 (2)
		12.325	1.116	0.868	0.887	0.5386±0.0070 (3)
		17.713	1.173	1.311	1.358	0.3672±0.0243 (2)
		31.194	1.343	2.643	2.860	0.2231±0.0027 (3)
		Barium chloride;	$BaCl_2$;	[10361-37-2]		
8	281	7.316	1.068	0.375	0.379	0.9694±0.0232 (2)
		9.753	1.092	0.511	0.519	1.0207±0.0106 (2)
		25.215	1.273	1.541	1.619	0.4949±0.0130 (2)
12.5	285.7	14.030	1.137	0.766	0.784	0.6779±0.0 (1)
15	288	25.215	1.273	1.541	1.619	0.4385±0.0025 (2)
16.25	289.4	7.316	1.068	0.375	0.379	0.7441±0.0040 (2)
		9.753	1.092	0.511	0.519	0.6445±0.0037 (2)
		14.030	1.137	0.766	0.784	0.6179±0.0033 (2)

[a] w_2 = mass fraction of salt [b] $d\,^{15}_{15}$ = relative density

[c] c_2 = concentration of salt

[d] m_2 = molality of salt

[e] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

(continued on next page)

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Calcium chloride
Strontium chloride
Barium chloride

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

ORIGINAL MEASUREMENTS:

Mackenzie, J. J.

Ann. Phys. (Leipzig) [3] 1877, *1*, 438-51.

VARIABLES:

T/K = 281.2 - 303.2
p_1/kPa = 94.45 - 100.2

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES: (continued)

t/°C	T/K	$10^2 w_2$ [a]	d^{15}_{15} [b]	c_2/mol L^{-1} [c]	m_2/mol kg^{-1} [d]	α [e]
		Barium chloride;	$BaCl_2$;	[10361-37-2] (continued)		
22	295	7.316	1.068	0.375	0.379	0.6803±0.0155 (2)
		9.753	1.092	0.511	0.519	0.6072±0.0058 (3)
		14.030	1.137	0.766	0.784	0.5235±0.0061 (2)
		25.215	1.273	1.541	1.619	0.3833±0.0086 (2)
30	303	7.316	1.068	0.375	0.379	0.5655±0.0132 (2)
		9.753	1.092	0.511	0.519	0.5426±0.0132 (2)
		14.030	1.137	0.766	0.784	0.4672±0.0040 (2)
		25.215	1.273	1.541	1.619	0.3152±0.0103 (2)

[a] w_2 = mass fraction of salt [b] d^{15}_{15} = relative density
[c] c_2 = concentration of salt
[d] m_2 = molality of salt
[e] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

The compiler calculated and added the Kelvin temperatures, the concentration and molality values and the standard deviations.

These data are of marginal value. Some show a standard deviation as large as 6.6 %, although many show a standard deviation under 3 %.

See the ammonium chloride, sodium chloride, and potassium chloride data sheet from this paper for additional comments.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consisted of a bulb of known volume in which the initial pressure and carbon dioxide (reduced to 0 °C) was measured; a bulb of known volume for the solvent; and a manometer system to adjust the final volume of the unabsorbed wet gas and measure its total pressure (reduced to 0 °C). The final total pressure of wet gas was reduced to the partial pressure of carbon dioxide by subtraction of the solution water vapor pressure.

There was a statement that the carbon dioxide solubility in water was measured, but no solubility values were given.

SOURCE AND PURITY OF MATERIALS:

(1) Carbon dioxide. Prepared by action of sulfuric acid on marble. Dried by bubbling through sulfuric acid.

(2) Salts. Recrystallized. Solution prepared by weight and checked by evaporation to dry salt.

(3) Water. Nothing specified.

ESTIMATED ERROR:

Temperature: Nothing specified.

Solubility: Nothing specified, but see standard deviations in table.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Electrolyte (saturated)

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

ORIGINAL MEASUREMENTS:

Passauer, H.

Feuerungstech. 1931, *19*, 142-45. [1949: merged and became *Brennst. - Waerme-Kraft*]

Chem. Abstr. 1932, *26*, 2934.

VARIABLES:

$T/\mathrm{K} = 293.15$
$p/\mathrm{MPa} = 0.101$

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

The data are taken from *Chem. Abstr.* as the original paper was not available to us. All aqueous electrolyte solutions are at or near saturation at 293.15 K.

Electrolyte; Formula; CA Registry Number	α [a]
Water; H_2O; [7732-18-5] (distilled water)	0.83
Water; H_2O; [7732-18-5] (tap water)	0.77
Ammonium chloride; NH_4Cl; [12125-02-9]	0.45
Ammonium nitrate; NH_4NO_3; [6484-52-2]	0.36
Zinc chloride; $ZnCl_2$; [7646-85-7]	0.125
Zinc iodide; ZnI_2; [10139-47-6]	0.28
Silver nitrate; $AgNO_3$; [7761-88-8]	0.12
Iron (II) chloride; $FeCl_2$; [7758-94-3]	0.125
Magnesium chloride; $MgCl_2$; [7786-30-3]	0.18
Calcium chloride; $CaCl_2$; [10043-52-4]	0.14
Barium iodide; BaI_2; [13718-50-8]	0.22
Sodium chloride; NaCl; [7647-14-5]	0.28
Sodium thiosulfate; $Na_2S_2O_3$; [7772-98-7]	0.12
Sodium nitrite; $NaNO_2$; [7632-00-0]	0.225
Sodium hydrogen carbonate; $NaHCO_3$; [144-55-8]	0.85^{+}
Sodium dichromate; $Na_2Cr_2O_7$; [10588-01-9]	0.11
Potassium chloride; KCl; [7447-40-7]	0.50
Potassium iodide; KI; [7681-11-0]	0.30
Potassium sulfate; K_2SO_4; [7778-80-5]	0.53

[a] α = Bunsen coefficient $[(\mathrm{cm}^3)_1/(\mathrm{cm}^3)_2\ \mathrm{atm}^{-1}]$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Absorption of pure CO_2 at 20 °C (293.15 K) was determined in a gas buret type of apparatus. The cm^3 of CO_2 absorbed per 100 cm^3 of saturated aqueous solution of the salts listed above was measured. The abstract does not make clear if the gas volume absorbed was reduced to standard conditions, however, a reference (1) to this work implies the absorbed gas volumes were reduced to standard conditions.

Neither density nor composition of the saturated salt solutions were given.

SOURCE AND PURITY OF MATERIALS:

The abstract gives no information on source and purity of the components other than the statement "pure CO_2".

ESTIMATED ERROR:

No information given in abstract.

REFERENCES:

1. Nahoczky, A.

Bányász. Kohász. Lapok 1933, *66*, 332-35.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Various salts; (see data table below)

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

ORIGINAL MEASUREMENTS:

Nahoczky, A.

Bányászati Kohászati Lapok 1933, *66*, 332-35.

VARIABLES:

T/K = 288.15
P/kPa = 101.325

PREPARED BY:

I. Labádi

EXPERIMENTAL VALUES:

Solubility of CO_2 in saturated or nearly saturated aqueous solutions of variuos salts.

	ρ/g cm^{-3} [a]	α [b]
Potassium dichromate; $K_2Cr_2O_7$; [7778-50-9]	1.065	0.817
Potassium oxalate; $K_2C_2O_4$; [583-52-8]	1.155	0.722
Hexa-ammonium molybdate; $(NH_4)_6Mo_7O_{24}$; [12027-67-7]	1.27	0.698
Tripotassium hexacyanoferrate; $K_3[Fe(CN)_6]$; [13746-66-2]	1.14	0.580
Copper sulfate; $CuSO_4$; [7758-98-7]	1.12	0.538
Manganese sulfate; $MnSO_4$; [7785-87-7]	1.20	0.466
Sodium chloride; NaCl; [7647-14-5]	-	0.280
Magnesium sulfate; $MgSO_4$; [7487-88-9]	1.225	0.206
Magnesium chloride; $MgCl_2$; [7786-30-3]	1.23	0.202
Sodium thiosulfate; $Na_2S_2O_3$; [7772-98-7]	1.295	0.129
1/2 $MgSO_4$ + 1/2 NaCl	1.325	0.223
1/2 $MgCl_2$ + 1/2 NaCl	1.32	0.216
1/2 $Na_2S_2O_3$ + 1/2 $MgSO_4$	1.24	0.192
$Na_2S_2O_3$ + 1/3 glycerine; $C_3H_8O_3$; [56-81-5]	1.275	0.191
$MgSO_4$ + 1/5 alcohol; (ethanol) C_2H_6O; [64-17-5] [c]	1.178	0.257
1/3 $MnSO_4$ + 1/3 $MgCl_2$ + 1/3 NaCl	1.28	0.266
1/3 $MnSO_4$ + 1/3 $MgSO_4$ + 1/3 NaCl	1.28	0.250

---

[a] Density of the saturated liquid.

[b] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}]

[c] It is assumed by the compiler that "alcohol" in the original source is ethanol.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Carbon dioxide was added by a calibrated burette to a calibrated vessel filled up with solvent at 1 atm pressure. Amount of the absorbed gas was measured volumetrically.

SOURCE AND PURITY OF MATERIALS:

(1) CO_2 was prepared by Kipp apparatus, washed with cadmium acetate and dried with sulfuric acid.

(2) Nothing specified.

(3) Nothing specified.

ESTIMATED ERROR:

$\delta\alpha$ = ± 0.005 cm^3 (STP) cm^{-3} atm^{-1}

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Various salts and acids, see data table below

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

ORIGINAL MEASUREMENTS:

Kobe, K. A., Williams, J. S.

Ind. Eng. Chem. 1935, *7* (1), 37-8.

VARIABLES:

$T/K = 298.15$
$P/kPa = 104.46$
$10^2w_2 = 0 - 50$

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

Total pressure P in the measurements was 783.5 mmHg (104.46 kPa, 1.045 bar), and temperature 25 °C (298.15 K).

	10^2w_2 [a]	S_1 [b]	α [c]
Water; H_2O; [7732-18-5]	-	0.823	0.754
Sulfuric acid; H_2SO_4; [7664-93-9]	5	0.746	0.683
	10	0.717	0.657
Sodium chloride; NaCl; [7647-14-5]	10	0.551	0.505
	20	0.334	0.306
	25	0.257	0.236
H_2SO_4 (5 mass %) + NaCl (20 mass %)		0.328	0.302
Hydrochloric acid; HCl; [7647-01-0]	2		
+ NaCl	20	0.352	0.323
Sodium sulfate; Na_2SO_4; [7757-82-6]	20	0.260	0.237
H_2SO_4 (5 vol. %) + Na_2SO_4 (20 mass %)		0.263	0.242
Phosphoric acid; H_3PO_4; [7664-38-2]	7		
+ Sodium phosphate; Na_3PO_4; [7601-54-9]	10	0.280	0.256
Calcium chloride; $CaCl_2$; [10043-52-4]	40	0.158	0.144
Magnesium chloride; $MgCl_2$; [7786-30-3]	30	0.164	0.150
Zinc chloride; $ZnCl_2$; [7646-85-7]	50	0.386	0.354
Aluminium chloride; $AlCl_3$; [7446-70-0]	25	0.243	0.222
Aluminium sulfate; $Al_2(SO_4)_3$; [10043-01-3]	20	0.221	0.203

[a] w_2 = mass fraction of component 2. (10^2w = mass %)

[b] S_1 = solubility of CO_2 expressed as mL of CO_2 per mL of solution at a partial pressure of 760 mmHg (101.325 kPa, 1.013 bar) of CO_2.

[c] α = Bunsen coefficient [cm^3 (STP) cm^{-3} atm^{-1}].

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

All-glass apparatus. The total pressure was kept constant during equilibration. The equilibration cell was shaken in a constant temperature bath. After equilibration, a liquid sample was volumetrically anlyzed for solution and CO_2 content.

Detailed description given in the original source.

SOURCE AND PURITY OF MATERIALS:

(1) "Pure". Saturated with water vapor.

(2) Analytical grade.

(3) Distilled.

ESTIMATED ERROR:

$\delta\alpha = \pm 0.005$ (by author)

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Aerosol OT; $C_{20}H_{38}O_7S.Na$; [577-11-7]

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

ORIGINAL MEASUREMENTS:

Gjaldbæk, J. Chr.

Acta Chem. Scand. 1953, *7*, 537-44.

VARIABLES:

$T/K = 298.15$
$p_1/kPa = 101.325$
$10^2 w_2 = 0 - 0.15$

PREPARED BY:

J. Chr. Gjaldbæk

EXPERIMENTAL VALUES:

T/K	$p_1/mmHg$	$10^2 w_2$ [a]	$10^4 x_1$ [b]	α/cm^3 (STP) cm^{-3} atm^{-1} [c]
298.15	(760)	0.00	6.12	0.754
	793.4	0.15	6.10	0.751
	725.2	0.15	6.09	0.750

[a] w_2 = mass fraction of Aerosol OT

Aerosol OT ≡ Dioctylester of the sodium salt of sulfotartaric acid. pH = 7.4.

[b] The mole fraction solubility values were adjusted to a gas partial pressure of 101.325 kPa (1 atm) by the compiler assuming Henry's law is obeyed.

[c] α = Bunsen coefficient

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A calibrated all-glass combined manometer and bulb was enclosed in an air thermostat and shaken until equilibrium. Mercury was used for calibration and as confining liquid. The solvent was degassed in the apparatus.

The absorbed volume of gas is calculated from the initial and final amounts, both saturated with solvent vapor. The amount of solvent is determined by the weight of displaced mercury.

The mole fraction solubility values are at 1 atm assuming Henry's law is obeyed.

Details of the apparatus and procedure are given in Ref. 1 and 2.

SOURCE AND PURITY OF MATERIALS:

(1) Prepared from potassium bicarbonate (analytical reagent) and concentrated sulfuric acid. 99.9 % CO_2.

(2) 100 %. American Cyanamide Co.

(3) Redistilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$
$\delta x_1/x_1 = \pm 0.015$

REFERENCES:

1. Lannung, A.
J. Am. Chem. Soc. 1930, *52*, 68.

2. Gjaldbæk, J. Chr.
Acta Chem. Scand. 1952, *6*, 623.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Teepol CH 53; [50642-03-0]

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

ORIGINAL MEASUREMENTS:

Rosenthal, W.

Thès. fac. sci. Univ. Strasbourg (France) 1954.

VARIABLES:

$T/K = 293.15$
$w_2/g\ kg^{-1} \simeq 0 - 1$

PREPARED BY:

H.L. Clever

EXPERIMENTAL VALUES:

$t/°C$	T/K [a]	$10^3\sigma/N\ m^{-1}$ [a,b]	$L/cm^3\ cm^{-3}$ [c]
20.0	293.2	73	0.879 [d]
		38	0.881 [e]

[a] Calculated by the compiler.

[b] σ is surface tension.
In the original paper σ was given in units dyn cm^{-1}.
Relation to SI units: $1\ dyn\ cm^{-1} = 10^{-3}\ N\ m^{-1} = 10^{-3}\ J\ m^{-2}$.

[c] Ostwald coefficient.

[d] Solvent pure water.

[e] Solvent pure water + 1 ‰ Teepol CH 53.

NOTE: Teepol CH 53 is sodium salt of dodecyl benzenesulfonic acid mixture with α-(nonylphenyl)-ω-hydroxypoly(oxo-1,2-ethanediyl).

The small amount of the surface active agent does not affect the solubility of carbon dioxide in water although it decreases the water surface tension to about one-half the pure water value.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The prepared solvent and solution were charged into an evacuated cell after degassing, and the mass of solvent was determined by weight. Gas was introduced into the cell from a measuring buret in which the gas was stored over mercury. The cell was agitated while the gas pressure was maintained by adjusting the gas volume. The Ostwald coefficient was determined from the mass of solvent and the volume of gas absorbed. Solubilities were measured at pressures above and below atmospheric.

SOURCE AND PURITY OF MATERIALS:

(1) No information.

(2) No information.

(3) Made carbon dioxide free by boiling.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$
$\delta p/kPa = \pm 0.1$
$\delta L/L = \pm 0.02$ (compiler)

REFERENCES:

Some data in the thesis have been published. See:

1. Maillard, A.; Rosenthal, W. *Comp rend.* 1952, *234*, 2546-8.

COMPONENTS:

(1) Carbon dioxide; CO_2; [124-38-9]

(2) Synthetic Salton Sea geothermal brine (SSGB)

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

ORIGINAL MEASUREMENTS:

Cramer, S. D.

Rep. Invest. - U.S., Bur. Mines 1982, RI 8706.

VARIABLES:

$T/K = 278.05 - 522.35$

$P/MPa = 0.8 - 5.9$

$c_2/mol\ dm^{-3} = 0$ and 4.19

PREPARED BY:

Pirketta Scharlin

EXPERIMENTAL VALUES:

Salton Sea geothermal brine (SSGB) was a synthetic brine based on Helgeson's analysis of unflashed hypersaline brine from geothermal well IID-2 which is located in the Imperial Valley of California (Helgeson, H. C. *Am. J. Sci.* 1968, *266*, 129-166).

Detailed composition for the SSGB is given in Table 1.

The pH (measured at 25 °C) of SSGB is 4.6. For experimental purposes the pH of the brine was adjusted to neutral by the addition of NaOH.

The synthetic SSGB was prepared from chloride salts of the constituent metal ions, sodium silicate, sodium sulfide, and sodium metaborate, in accordance with the composition given in Table 1.

Table 1. Composition of SSGB (parts per million by weight).

Ba	250	Fe	2000	Rb	70
B	390	Pb	80	SiO_2	400
Ca	28800	Li	210	Ag	<1[a]
Cs	20	Mg	10	Na	53000
Cl	155000	Mn	1370	Sr	440
Cu	3[a]	K	16500	S	30
				Zn	500

[a] Not included in synthetic brine.

(continued on the next page)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility of CO_2 was determined from pressure-volume-temperature (PVT) measurements using the technique of gas extraction. The apparatus consisted of (1) a high-pressure, high-temperature section for dissolving the gas in the brine, (2) a heat exchanger for cooling (or heating) samples of gas-saturated brine to room temperature, and (3) a low-pressure, constant temperature section for making PVT measurements on collected gas and liquid samples.
A two liter, type 316 stainless steel stirred reactor, fitted with a heat- and chemical-resistant glass liner, was filled two-thirds full with brine. The brine was deaerated by evacuating the reactor to the vapor pressure of the brine for at least 3 minutes. Upon reaching thermal equilibrium, the gas was injected into the reactor and allowed to distribute at a fixed partial pressure between the vapor and liquid phases. Equilibration occurred within 5 hours at 150 °C and above, and within 24 hours at lower temperatures. The concentration of CO_2 in the liquid was determined by desorption from a a known volume of liquid followed by volumetric analysis of the evolved gas.

SOURCE AND PURITY OF MATERIALS:

(1) 99.5 %.

(2) Prepared from reagent grade chemicals.

(3) Demineralized.

ESTIMATED ERROR:

$\delta K_H/K_H = 0.058$ (by author)

(Detailed analysis of experimental contributions to the total error is given in the source.)

COMPONENTS:	ORIGINAL MEASUREMENTS:
(1) Carbon dioxide; CO_2; [124-38-9] (2) Synthetic Salton Sea geothermal brine (SSGB) (3) Water; H_2O; [7732-18-5]	Cramer, S. D. *Rep. Invest. - U.S., Bur. Mines* 1982, RI 8706.

EXPERIMENTAL VALUES: (continued)

System $CO_2(1)$ + SSGB(2) + $H_2O(3)$

Table 2. Mean experimental values of the Henry's law constant K_H.

t/°C	T/K [a]	P/MPa	c_2/mol dm^{-3}	m_2/mol kg^{-1}	K_H/MPa [b]
33	306.15	0.8	0	0	206
126.3	399.45	2.0			602
132.5	405.65	2.0			617
146.0	419.15	2.8			565
153.5	426.65	3.1			580
198.1	471.25	4.1			537
213.1	486.25	5.8			484
4.9	278.05	1.8	4.19	4.87	363
5.0	278.15	1.8			333
11.7	248.85	1.5			392
26.4	299.55	1.2			575
39	312.15	1.9			670
60.4	333.55	1.7			951
75.4	348.55	2.1			1144
97	370.15	2.1			1506
124.2	397.35	2.2			1622
137.1	410.25	2.2			2109
156.3	429.45	1.5			1938
159	432.15	2.5			1833
199.8	472.95	3.9			1702
228.6	501.75	4.9			2081
249.2	522.35	5.9			2182

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[a] Calculated by the compiler.

[b] $K_H = P_1\phi_1/x_1$, where K_H = Henry's law constant, P_1 = partial pressure of gas ($P_1 = P - P_2$; P_2 is the vapor pressure of water at the corresponding temperature), ϕ_1 = fugacity coefficient (Smith, J.M. and Van Ness, H.C. *Chemical Engineering Thermodynamics*, McGraw-Hill, New York 1959), and x_1 = mole fraction of the dissolved CO_2.

SYSTEM INDEX

Page numbers preceded by E refer to evaluation texts whereas page numbers not preceded by E refer to compiled tables. Compounds are named as in Chemical Abstracts indexes. Since *carbon dioxide* and *water* are usually two of the compounds they are omitted in the listing.

REGISTRY NUMBER INDEX

Page numbers preceded by E refer to evaluation texts whereas page numbers not preceded by E refer to compiled tables. Since *carbon dioxide ([124-38-9])* and *water ([7732-18-5])* are usually two of the compounds they are omitted in the listing.

AUTHOR INDEX

Page numbers preceded by E refer to evaluation texts whereas page numbers not preceded by E refer to compiled tables.

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