INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

ANALYTICAL CHEMISTRY DIVISION
COMMISSION ON SOLUBILITY DATA

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# SOLUBILITY DATA SERIES

Volume 12

# SULFUR DIOXIDE, CHLORINE, FLUORINE AND CHLORINE OXIDES

# SOLUBILITY DATA SERIES

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Robert Maxwell
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# SOLUBILITY DATA SERIES

## Volume 12

# SULFUR DIOXIDE, CHLORINE, FLUORINE AND CHLORINE OXIDES

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# SOLUBILITY DATA SERIES

INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

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# FOREWORD

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

How to communicate and disseminate numerical data effectively in chemical science and technology has been a problem of serious and growing concern to IUPAC, the International Union of Pure and Applied Chemistry, for the last two decades. The steadily expanding volume of numerical information, the formulation of new interdisciplinary areas in which chemistry is a partner, and the links between these and existing traditional subdisciplines in chemistry, along with an increasing number of users, have been considered as urgent aspects of the information problem in general, and of the numerical data problem in particular.

Among the several numerical data projects initiated and operated by various IUPAC commissions, the *Solubility Data Project* is probably one of the most ambitious ones. It is concerned with preparing a comprehensive critical compilation of data on solubilities in all physical systems, of gases, liquids and solids. Both the basic and applied branches of almost all scientific disciplines require a knowledge of solubilities as a function of solvent, temperature and pressure. Solubility data are basic to the fundamental understanding of processes relevant to agronomy, biology, chemistry, geology and oceanography, medicine and pharmacology, and metallurgy and materials science. Knowledge of solubility is very frequently of great importance to such diverse practical applications as drug dosage and drug solubility in biological fluids, anesthesiology, corrosion by dissolution of metals, properties of glasses, ceramics, concretes and coatings, phase relations in the formation of minerals and alloys, the deposits of minerals and radioactive fission products from ocean waters, the composition of ground waters, and the requirements of oxygen and other gases in life support systems.

The widespread relevance of solubility data to many branches and disciplines of science, medicine, technology and engineering, and the difficulty of recovering solubility data from the literature, lead to the proliferation of published data in an ever increasing number of scientific and technical primary sources. The sheer volume of data has overcome the capacity of the classical secondary and tertiary services to respond effectively.

While the proportion of secondary services of the review article type is generally increasing due to the rapid growth of all forms of primary literature, the review articles become more limited in scope, more specialized. The disturbing phenomenon is that in some disciplines, certainly in chemistry, authors are reluctant to treat even those limited-in-scope reviews exhaustively. There is a trend to preselect the literature, sometimes under the pretext of reducing it to manageable size. The crucial problem with such preselection - as far as numerical data are concerned - is that there is no indication as to whether the material was excluded by design or by a less than thorough literature search. We are equally concerned that most current secondary sources, critical in character as they may be, give scant attention to numerical data.

On the other hand, tertiary sources - handbooks, reference books, and other tabulated and graphical compilations - as they exist today, are comprehensive but, as a rule, uncritical. They usually attempt to cover whole disciplines, thus obviously are superficial in treatment. Since they command a wide market, we believe that their service to advancement of science is at least questionable. Additionally, the change which is taking place in the generation of new and diversified numerical data, and the rate at which this is done, is not reflected in an increased third-level service. The emergence of new tertiary literature sources does not parallel the shift that has occurred in the primary literature.

With the status of current secondary and tertiary services being as briefly stated above, the innovative approach of the *Solubility Data Project* is that its compilation and critical evaluation work involve consolidation and reprocessing services when both activities are based on intellectual and scholarly reworking of information from primary sources.

It comprises compact compilation, rationalization and simplification, and the fitting of isolated numerical data into a critically evaluated general framework.

The *Solubility Data Project* has developed a mechanism which involves a number of innovations in exploiting the literature fully, and which contains new elements of a more imaginative approach for transfer of reliable information from primary to secondary/tertiary sources. *The fundamental trend of the Solubility Data Project is toward integration of secondary and tertiary services with the objective of producing in-depth critical analysis and evaluation which are characteristic to secondary services, in a scope as broad as conventional tertiary services.*

Fundamental to the philosophy of the project is the recognition that the basic element of strength is the active participation of career scientists in it. Consolidating primary data, producing a truly critically-evaluated set of numerical data, and synthesizing data in a meaningful relationship are demands considered worthy of the efforts of top scientists. Career scientists, who themselves contribute to science by their involvement in active scientific research, are the backbone of the project. The scholarly work is commissioned to recognized authorities, involving a process of careful selection in the best tradition of IUPAC. This selection in turn is the key to the quality of the output. These top experts are expected to view their specific topics dispassionately, paying equal attention to their own contributions and to those of their peers. They digest literature data into a coherent story by weeding out what is wrong from what is believed to be right. To fulfill this task, the evaluator must cover *all* relevant open literature. No reference is excluded by design and every effort is made to detect every bit of relevant primary source. Poor quality or wrong data are mentioned and explicitly disqualified as such. In fact, it is only when the reliable data are presented alongside the unreliable data that proper justice can be done. The user is bound to have incomparably more confidence in a succinct evaluative commentary and a comprehensive review with a complete bibliography to both good and poor data.

It is the standard practice that any given solute-solvent system consists of two essential parts: I. Critical Evaluation and Recommended Values, and II. Compiled Data Sheets.

The Critical Evaluation part gives the following information:

(i) a verbal text of evaluation which discusses the numerical solubility information appearing in the primary sources located in the literature. The evaluation text concerns primarily the quality of data after consideration of the purity of the materials and their characterization, the experimental method employed and the uncertainties in control of physical parameters, the reproducibility of the data, the agreement of the worker's results on accepted test systems with standard values, and finally the fitting of data, with suitable statistical tests, to mathematical functions;

(ii) a set of recommended numerical data. Whenever possible, the set of recommended data includes weighted average and standard deviations, and a set of smoothing equations derived from the experimental data endorsed by the evaluator;

(iii) a graphical plot of recommended data.

The compilation part consists of data sheets of the best experimental data in the primary literature. Generally speaking, such independent data sheets are given only to the best and endorsed data covering the known range of experimental parameters. Data sheets based on primary sources where the data are of a lower precision are given only when no better data are available. Experimental data with a precision poorer than considered acceptable are reproduced in the form of data sheets when they are the only known data for a particular system. Such data are considered to be still suitable for some applications, and their presence in the compilation should alert researchers to areas that need more work.

The typical data sheet carries the following information:

(i) components - definition of the system - their names, formulas and Chemical Abstracts registry numbers;

(ii) reference to the primary source where the numerical information is reported. In cases when the primary source is a less common periodical or a report document, published though of limited availability, abstract references are also given;

(iii) experimental variables;

(iv) identification of the compiler;

(v) experimental values as they appear in the primary source. Whenever available, the data may be given both in tabular and graphical form. If auxiliary information is available, the experimental data are converted also to SI units by the compiler.

Under the general heading of Auxiliary Information, the essential experimental details are summarized:

(vi) experimental method used for the generation of data;

(vii) type of apparatus and procedure employed;

(viii) source and purity of materials;

(ix) estimated error;

(x) references relevant to the generation of experimental data as cited in the primary source.

This new approach to numerical data presentation, developed during our four years of existence, has been strongly influenced by the diversity of background of those whom we are supposed to serve. We thus deemed it right to preface the evaluation/compilation sheets in each volume with a detailed discussion of the principles of the accurate determination of relevant solubility data and related thermodynamic information.

Finally, the role of education is more than corollary to the efforts we are seeking. The scientific standards advocated here are necessary to strengthen science and technology, and should be regarded as a major effort in the training and formation of the next generation of scientists and engineers. Specifically, we believe that there is going to be an impact of our project on scientific-communication practices. The quality of consolidation adopted by this program offers down-to-earth guidelines, concrete examples which are bound to make primary publication services more responsive than ever before to the needs of users. The self-regulatory message to scientists of 15 years ago to refrain from unnecessary publication has not achieved much. The literature is still, in 1982, cluttered with poor-quality articles. The Weinberg report (in "Reader in Science Information", Eds. J. Sherrof and A. Hodina, Microcard Editions Books, Indian Head, Ins., 1973, p.292) states that "admonition to authors to restrain themselves from premature, unnecessary publication can have little effect unless the climate of the entire technical and scholarly community encourages restraint..." We think that projects of this kind translate the climate into operational terms by exerting pressure on authors to avoid submitting low-grade material. The type of our output, we hope, will encourage attention to quality as authors will increasingly realize that their work will not be suited for permanent retrievability unless it meets the standards adopted in this project. It should help to dispel confusion in the minds of many authors of what represents a permanently useful bit of information of an archival value, and what does not.

If we succeed in that aim, even partially, we have then done our share in protecting the scientific community from unwanted and irrelevant, wrong numerical information.

A. S. Kertes

# PREFACE

This volume is concerned with the solubility of sulfur dioxide, chlorine, fluorine and the oxides of chlorine in pure liquids, liquid mixtures, aqueous solutions and miscellaneous fluids and fluid mixtures. The solubility in molten salts, slags, glasses, metals, alloys and polymeric material have been specifically excluded from this volume. There is always a problem in attempting to distinguish between gas solubilities and vapor-liquid equilibria and this problem is particularly troublesome in the case of sulfur dioxide solubilities. There is no absolute distinction between gas solubility and vapor-liquid equilibria. We have been fairly liberal in making the distinction and have included systems which some might classify as vapor-liquid equilibrium. The literature has been searched up until the middle of 1981. The editor or Professor H. L. Clever, Director, Solubility Data Center, Department of Chemistry, Emory University, Atlanta, Georgia USA would appreciate being notified of any omissions or more recent data.

Unlike most of the previous volumes in this series concerned with the solubility of gases in liquids, this volume deals with gases which react with the solvent in several cases. We have not attempted to evaluate equilibrium constants for reactions which take place in solution because the available data are not of sufficient quality or quantity to make a meaningful evaluation of such constants. Despite the industrial importance of both sulfur dioxide and chlorine, the solubility of these gases in most solvents is not known to better than a few per cent. Much of the data were obtained several decades ago and much of the data in this volume is barely accurate enough for modern applications.

In many cases meaningful evaluation of the solubility data has not been possible due to a lack of comparable data. Furthermore, in many cases it is not clear how the quoted solubilities have been calculated from the experimental results. Earlier in this series, Hayduk, in the preface to the ethane volume, made a plea for inclusion of all pertinent data used in the calculation of gas solubility in all future (original) publications and stated that in some instances compilers and evaluators have had to guess which data were used by the authors in their calculation of solubility. A similar plea and statement are relevant to this volume.

In several tables compilers have calculated solubilities not given in the original paper. In most cases the source of additional data needed for such calculations is given in the compiled table. The tables given by Riddick and Bunger in *Technique of Chemistry*, ed. Weissberger, A. Vol. II, Wiley-Interscience, New York, 1970, 3rd Ed. have been used but not specifically referenced in compiled tables.

The Editor acknowledges the advice and helpful suggestions of the members of the IUPAC Commission V8 on Solubility Data. Acknowledgement is also made to the University of Melbourne for travel support under the travel for research and special studies program. Finally, the Editor acknowledges the help of Lesley Flanagan who typed the major part of this volume.

Colin Young

Melbourne, December 1982.

# THE SOLUBILITY OF GASES AND LIQUIDS

## Introductory Information

C. L. Young, R. Battino, and H. L. Clever

### INTRODUCTION

The Solubility Data Project aims to make a comprehensive search of the literature for data on the solubility of gases, liquids and solids in liquids. Data of suitable accuracy are compiled into data sheets set out in a uniform format. The data for each system are evaluated and where data of sufficient accuracy are available values are recommended and in some cases a smoothing equation is given to represent the variation of solubility with pressure and/or temperature. A text giving an evaluation and recommended values and the compiled data sheets are published on consecutive pages. The following paper by E. Wilhelm gives a rigorous thermodynamic treatment on the solubility of gases in liquids.

### DEFINITION OF GAS SOLUBILITY

The distinction between vapor-liquid equilibria and the solubility of gases in liquids is arbitrary. It is generally accepted that the equilibrium set up at 300K between a typical gas such as argon and a liquid such as water is gas-liquid solubility whereas the equilibrium set up between hexane and cyclohexane at 350K is an example of vapor-liquid equilibrium. However, the distinction between gas-liquid solubility and vapor-liquid equilibrium is often not so clear. The equilibria set up between methane and propane above the critical temperature of methane and below the critical temperature of propane may be classed as vapor-liquid equilibrium or as gas-liquid solubility depending on the particular range of pressure considered and the particular worker concerned.

The difficulty partly stems from our inability to rigorously distinguish between a gas, a vapor, and a liquid; a subject which has been discussed in numerous textbooks. We have taken a fairly liberal view in these volumes and have included systems which may be regarded, by some workers, as vapor-liquid equilibria.

### UNITS AND QUANTITIES

The solubility of gases in liquids is of interest to a wide range of scientific and technological disciplines and not solely to chemistry. Therefore a variety of ways for reporting gas solubility have been used in the primary literature. Sometimes, because of insufficient available information, it has been necessary to use several quantities in the compiled tables. Where possible, the gas solubility has been quoted as a mole fraction of the gaseous component in the liquid phase. The units of pressure used are bar, pascal, millimeters of mercury, and atmosphere. Temperatures are reported in Kelvins.

### EVALUATION AND COMPILATION

The solubility of comparatively few systems is known with sufficient accuracy to enable a set of recommended values to be presented. This is true both of the measurements near atmospheric pressure and at high pressures. Although a considerable number of systems have been studied by at least two workers, the range of pressures and/or temperatures is often sufficiently different to make meaningful comparison impossible.

Occasionally, it is not clear why two groups of workers obtained very different sets of results at the same temperature and pressure, although both sets of results were obtained by reliable methods and are internally consistent. In such cases, sometimes an incorrect assessment has been given. There are several examples where two or more sets of data have been classified as tentative although 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 only be regarded as an "informed guess".

Many of the 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). For example, it is difficult to determine coexisting liquid and vapor compositions near the critical point of a mixture using some widely used 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.

It is occasionally possible to evaluate data on mixtures of a given substance with a member of a homologous series by considering all the available data for the given substance with other members of the homologous series. In this study the use of such a technique has been limited.

The estimated error is often omitted in the original article and sometimes the errors quoted do not cover all the variables. In order to increase the usefulness of the compiled tables *estimated* errors have been included even when absent from the original article. If the error on *any* variable has been inserted by the compiler, this has been noted.

## PURITY OF MATERIALS

The purity of materials has been quoted in the compiled tables where given in the original publication. The solubility is usually more sensitive to impurities in the gaseous component than to liquid impurities in the liquid component. However, the most important impurities are traces of a gas dissolved in the liquid. Inadequate degassing of the absorbing liquid is probably the most often overlooked serious source of error in gas solubility measurements.

## APPARATUS AND PROCEDURES

In the compiled tables brief mention is made of the apparatus and procedure. There are several reviews on experimental methods of determining gas solubilities and these are given in References 1-7.

## METHODS OF EXPRESSING GAS SOLUBILITIES

Because gas solubilities are important for many different scientific and engineering problems, they have been expressed in a great many ways:

### The Mole Fraction, x(g)

The mole fraction solubility for a binary system is given by:

$$x(g) = \frac{n(g)}{n(g) + n(l)}$$

$$= \frac{W(g)/M(g)}{\{W(g)/M(g)\} + \{W(l)/M(l)\}}$$

here n is the number of moles of a substance (an *amount* of substance), W is the mass of a substance, and M is the molecular mass. To be unambiguous, the partial pressure of the gas (or the total pressure) and the temperature of measurement must be specified.

### The Weight Per Cent Solubility, wt%

For a binary system this is given by

$$wt\% = 100\ W(g)/\{W(g) + W(l)\}$$

where W is the weight of substance. As in the case of mole fraction, the pressure (partial or total) and the temperature must be specified. The weight per cent solubility is related to the mole fraction solubility by

$$x(g) = \frac{\{wt\%/M(g)\}}{\{wt\%/M(g)\} + \{(100 - wt\%)/M(l)\}}$$

## The Weight Solubility, $C_W$

The weight solubility is the number of moles of dissolved gas per gram of solvent when the partial pressure of gas is 1 atmosphere. The weight solubility is related to the mole fraction solubility at one atmosphere partial pressure by

$$x(g)\ (\text{partial pressure 1 atm}) = \frac{C_W M(l)}{1 + C_W M(l)}$$

where M(l) is the molecular weight of the solvent.

## The Moles Per Unit Volume Solubility, n

Often for multicomponent systems the density of the liquid mixture is not known and the solubility is quoted as moles of gas per unit volume of liquid mixture. This is related to the mole fraction solubility by

$$x(g) = \frac{n\, v^{o}(l)}{1 + n\, v^{o}(l)}$$

where $v^{o}(l)$ is the molar volume of the liquid component.

## The Bunsen Coefficient, $\alpha$

The Bunsen coefficient is defined as the volume of gas reduced to 273.15K and 1 atmosphere pressure which is absorbed by unit volume of solvent (at the temperature of measurement) under a partial pressure of 1 atmosphere. If ideal gas behavior and Henry's law are assumed to be obeyed, then

$$\alpha = \frac{V(g)}{V(l)} \frac{273.15}{T}$$

where V(g) is the volume of gas absorbed and V(l) is the original (starting) volume of absorbing solvent. The mole fraction solubility x is related to the Bunsen coefficient by

$$x(g, 1\ \text{atm}) = \frac{\alpha}{\alpha + \frac{273.15}{T} \frac{v^{o}(g)}{v^{o}(l)}}$$

where $v^{o}(g)$ and $v^{o}(l)$ are the molar volumes of gas and solvent at a pressure of one atmosphere. If the gas is ideal,

$$x(g) = \frac{\alpha}{\alpha + \frac{273.15R}{v^{o}(l)}}$$

Real gases do not follow the ideal gas law and it is important to establish the real gas law used for calculating $\alpha$ in the original publication and to make the necessary adjustments when calculating the mole fraction solubility.

## The Kuenen Coefficient, S

This is the volume of gas, reduced to 273.15K and 1 atmosphere pressure, dissolved at a partial pressure of gas of 1 atmosphere by 1 gram of solvent.

## The Ostwald Coefficient, L

The Ostwald coefficient, L, is defined as the ratio of the volume of gas absorbed to the volume of the absorbing liquid, all measured at the same temperature:

$$L = \frac{V(g)}{V(1)}$$

If the gas is ideal and Henry's Law is applicable, the Ostwald coefficient is independent of the partial pressure of the gas. It is necessary, in practice, to state the temperature and total pressure for which the Ostwald coefficient is measured. The mole fraction solubility, x(g), is related to the Ostwald coefficient by

$$x(g) = \left[\frac{RT}{P(g)\ L\ v^{o}(1)} + 1\right]^{-1}$$

where P is the partial pressure of gas. The mole fraction solubility will be at a partial pressure of P(g). (See the following paper by E. Wilhelm for a more igorous definition of the Ostwald coefficient.)

## The Absorption Coefficient, β

There are several "absorption coefficients", the most commonly used one being defined as the volume of gas, reduced to 273.15K and 1 atmosphere, absorbed per unit volume of liquid when the total pressure is 1 atmosphere. β is related to the Bunsen coefficient by

$$\beta = \alpha(1 - P(1))$$

where P(1) is the partial pressure of the liquid in atmospheres.

## The Henry's Law Constant

A generally used formulation of Henry's Law may be expressed as

$$P(g) = K_H x(g)$$

where $K_H$ is the Henry's Law constant and x(g) the mole fraction solubility. Other formulations are

$$P(g) = K_2 C(1) \qquad \text{or} \qquad C(g) = K_c C(1)$$

where $K_2$ and $K_c$ are constants, C the concentration, and (1) and (g) refer to the liquid and gas phases. Unfortunately, $K_H$, $K_2$ and $K_c$ are all sometimes referred to as Henry's Law constants. Henry's Law is a *limiting law* but can sometimes be used for converting solubility data from the experimental pressure to a partial gas pressure of 1 atmosphere, provided the mole fraction of the gas in the liquid is small, and that the difference in pressures is small. Great caution must be exercised in using Henry's Law.

## The Mole Ratio, N

The mole ratio, N, is defined by

$$N = n(g)/n(1)$$

Table 1 contains a presentation of the most commonly used inter-conversions not already discussed.

For gas solubilities greater than about 0.01 mole fraciton at a partial pressure of 1 atmosphere there are several additional factors which must be taken into account to unambiguously report gas solubilities. Solution densities or the partial molar volume of gases must be known. Corrections should be made for the possible non-ideality of the gas or the non-applicability of Henry's Law.

TABLE 1 Interconversion of parameters used for reporting solubility

$$L = \alpha(T/273.15)$$

$$C_w = \alpha/v_o\rho$$

$$K_H = \frac{17.033 \times 10^6 \rho(\mathrm{soln})}{\alpha\, M(1)} + 760$$

$$L = C_w\, v_{t,\mathrm{gas}}\, \rho$$

where $v_o$ is the molal volume of the gas in $\mathrm{cm^3 mol^{-1}}$ at 0°C, $\rho$ the density of the solvent at the temperature of the measurement, $\rho_{\mathrm{soln}}$ the density of the solution at the temperature of the measurement, and $v_{t,\mathrm{gas}}$ the molal volume of the gas ($\mathrm{cm^3 mol^{-1}}$) at the temperature of the measurement.

SALT EFFECTS

Salt effect studies have been carried out for many years. The results are often reported as Sechenov (Setchenow) salt effect parameters. There appears to be no common agreement on the units of either the gas solubility, or the electrolyte concentration.

Many of the older papers report the salt effect parameter in a form equivalent to

$$k_{scc}/\mathrm{mol\ dm^{-3}} = (1/(c_2/\mathrm{mol\ dm^{-3}}))\ \log\ ((c_1^{\circ}/\mathrm{mol\ dm^{-3}})/(c_1/\mathrm{mol\ dm^{-3}}))$$

where the molar gas solubility ratio, $c_1^{\circ}/c_1$, is identical to the Bunsen coefficient ratio, $\alpha^{\circ}/\alpha$, or the Ostwald coefficient ratio, $L^{\circ}/L$. One can designate the salt effect parameters calculated from the three gas solubility ratios as $k_{scc}$, $k_{sc\alpha}$, $k_{scL}$, respectively, but they are identical, and $k_{scc}/\mathrm{dm^3\ mol^{-1}}$ describes all of them. The superzero refers to the solubility in the pure solvent.

Recent statistical mechanical theories favor a molal measure of the electrolyte and gas solubility. Some of the more recent salt effects are reported in the form

$$k_{smm}/\mathrm{kg\ mol^{-1}} = (1/(m_2/\mathrm{mol\ kg^{-1}})\ \log\ ((m_1^{\circ}/\mathrm{mol\ kg^{-1}})/(m_1/\mathrm{mol\ kg^{-1}})$$

In this equation the $m_1^{\circ}/m_1$ ratio is identical to the Kuenen coefficient ratio, $s_1^{\circ}/s_1$, or the solvomolality ratio referenced to water, $A_{sm}^{\circ}/A_{sm}$. Thus the salt effect parameters $k_{smm}$, $k_{sms}$, and $k_{smA_{sm}}$ are well represented by the $k_{smm}/\mathrm{kg\ mol^{-1}}$.

Some experimentalists and theoreticians prefer the gas solubility ratio as a mole fraction ratio, $x_1^{\circ}/x_1$. It appears that most calculate the mole fraction on the basis of the total number of ions. The salt effect parameters

$$k_{scx}/\mathrm{dm^3\ mol^{-1}} = (1/(c_2/\mathrm{mol\ dm^{-3}}))\ \log\ (x_1^{\circ}/x_1)$$

and

$$k_{smx}/\mathrm{kg\ mol^{-1}} = (1/(m_2/\mathrm{mol\ kg^{-1}}))\ \log\ (x_1^{\circ}/x_1)$$

are both in the literature, but $k_{scx}$ appears to be the more common.

The following conversions were worked out among the various forms of the salt effect parameter from standard definitions of molarity, molality, and mole fraction assuming the gas solubilities are small.

$$k_{smc} = (c_2/m_2)\ k_{scc} = (c_2/m_2)\ k_{scm} + F_{1m}$$

$$k_{scm} = k_{scc} - F_{1c} = (m_2/c_2)\ k_{smc} - F_{1c} = (m_2/c_2)\ K_{smm}$$

$$k_{scx} = (m_2/c_2)\ k_{smx} = (m_2/c_2)\ \mathrm{ksmm} + F_{2c}$$

$$k_{smm} = k_{smx} - F_{2m} = (c_2/m_2)\ k_{scx} - F_{2m}$$

$$k_{smx} = (c_2/m_2)\ k_{scx} = (c_2/m_2)\ k_{scc} + F_{3m}$$

$$k_{scc} = k_{scx} - F_{3c} = (m_2/c_2)\ k_{smx} - F_{3c}$$

where

$$F_{1m} = (1/m_2)\ \log\ [(\rho°/\rho)\ (1000 + m_2M_2)/1000]$$

$$F_{1c} = (m_2/c_2)\ F_{1m}$$

$$F_{2m} = (1/m_2)\ \log\ [(1000 + \nu m_3\ M_3)/1000]$$

$$F_{2c} = (m_2/c_2)\ F_{2m}$$

$$F_{3m} = (1/m_2)\ \log\ [(1000\rho + (\nu M_3 - M_2)\ c_2)/1000\rho°)$$

$$F_{3c} = (m_2/c_2)\ F_{3m}$$

The factors $F_{1m}$, $F_{1c}$, $F_{2m}$, $F_{2c}$, $F_{3m}$, and $F_{3c}$ can easily be calculated from aqueous electrolyte data such as weight per cent and density as found in Volume III of the International Critical Tables. The values are small and change nearly linearly with both temperature and molality. The factors normally amount to no more than 10 to 20 per cent of the value of the salt effect parameter.

The symbols in the equations above are defined below:

| Component | Molar Concentration $c$/mol dm$^{-3}$ | Molal Concentration $m$/mol kg$^{-1}$ | Mole Fraction $x$ | Molecular Weight $M$/g mol$^{-1}$ |
|---|---|---|---|---|
| Nonelectrolyte | $c_1°$, $c_1$ | $m_1°$, $m_1$ | $x_1°$, $x_1$ | $M_1$ |
| Electrolyte | $c_2$ | $m_2$ | $x_2$ | $M_2$ |
| Solvent | $c_3$ | $m_3$ | $x_3$ | $M_3$ |

The superscript "°" refers to the nonelectrolyte solubility in the pure solvent. The pure solvent and solution densities are $\rho°$/g cm$^{-3}$ and $\rho$/g cm$^{-3}$, respectively. They should be the densities of gas saturated solvent (water) and salt solution, but the gas free densities will differ negligibly in the $\rho°/\rho$ ratio. The number of ions per formula of electrolyte is symbolized by $\nu$.

The following table gives estimated errors in $k_{scc}$ for various salt concentrations and a range of random errors in the gas solubility measurement

Error in $k_{scc}$/dm$^3$ mol$^{-1}$[a]

| $c_2$/ mol dm$^{-3}$ | Random Error in gas solubility Measurement | | | | |
|---|---|---|---|---|---|
| | ±2% | ±1% | ±0.5% | ±0.1% | ±0.05% |
| 1 | ±18% | ±9% | ±5% | ±1.5% | ±1% |
| 0.1 | ±175% | ±87% | ±43% | ±9% | ±4% |
| 0.05 | ±350% | ±174% | ±87% | ±17% | ±9% |
| 0.01 | ±1750% | ±870% | ±435% | ±87% | ±43% |

[a] Based on a $k_{scc}$ value of 0.100.

## AQUAMOLAL OR SOLVOMOLAL, $A_{sm}$ or $m_i^{(s)}$

The term aquamolal was suggested by R. E. Kerwin (9). The unit was first used in connection with $D_2O$ and $H_2O + D_2O$ mixtures. It has since been extended in use to other solvents. The unit represents the numbers of moles of solute per 55.51 moles of solvent. It is represented by

$m_i^{(s)}/\text{mol kg}^{-1} = (n_1 M_2/w_2)(w_2/M_0) = m_i(M_2/M_0)$ where an amount of $n_i$ of solute $i$ is dissolved in a mass $w_2$ of solvent of molar mass $M_2$; $M_0$ is the molar mass of a reference solvent and $m_i/\text{mol kg}^{-1}$ is the conventional molality in the reference solvent. The reference solvent is normally water.

## TEMPERATURE DEPENDENCE OF GAS SOLUBILITY

In a few cases it has been found possible to fit the mole fraction solubility at various temperatures using an equation of the form

$$\ln x = A + B / (T/100K) + C \ln (T/100K) + DT/100K$$

It is then possible to write the thermodynamic functions $\Delta\overline{G}_1^\circ$, $\Delta\overline{H}_1^\circ$, $\Delta\overline{S}_1^\circ$ and $\Delta\overline{C}_{p_1}$ for the transfer of the gas from the vapor phase at 101,325 Pa partial pressure to the (hypothetical) solution phase of unit mole fraction as:

$$\Delta\overline{G}_1^\circ = -RAT - 100\ RB - RCT \ln (T/100) - RDT^2/100$$

$$\Delta\overline{S}_1^\circ = RA + RC \ln (T/100) + RC + 2\ RDT/100$$

$$\Delta\overline{H}_1^\circ = -100\ RB + RCT + RDT^2/100$$

$$\Delta\overline{C}_{p_1}^\circ = RC + 2\ RDT/100$$

In cases where there are solubilities at only a few temperatures it is convenient to use the simpler equations

$$\Delta\overline{G}_1^\circ = -RT \ln x = A + BT$$

in which case $A = \Delta\overline{H}_1^\circ$ and $-B = \Delta\overline{S}_1^\circ$

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Revised: April 1982 (R.B., H.L.C.)

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Miscellaneous compounds of similar volatility to sulfur dioxide.

EVALUATOR:

Colin L. Young,
School of Chemistry,
University of Melbourne,
Parkville, Victoria 3052,
Australia.

March 1982

EVALUATION:

In general measurements generally referred to as vapor-liquid equilibrium determinations are not considered in the Solubility Data Series since it is necessary to limit the scope of the mixtures considered. Many studies of mixtures containing sulfur dioxide, which has a boiling point of 263 K are usually classified as vapor-liquid equilibrium determinations rather than gas solubility measurements.

Below is a list of systems which have been excluded from the compilation on the grounds that

(a) the experimental method was such that it was only suitable if both components were of similar volatility;

(b) the data were presented only in graphical form;

(c) the vapor pressure of the two pure components did not vary by a factor greater than three at the temperature of the measurements.

The list, which includes vapor-liquid equilibrium determinations, is given so that the user of this volume can refer to the original article if further information is required.

| Solvent | | | Reference |
|---|---|---|---|
| 1,2,3-Trichloropropane | $C_3H_5Cl_3$ | [96-18-4] | 1 |
| 1,2-Dichloropropane | $C_3H_6Cl_2$ | [78-87-5] | 1 |
| Tetrachloromethane | $CCl_4$ | [56-23-5] | 1 |
| Trichloromethane | $CHCl_3$ | [67-66-3] | 1 |
| Dichloromethane | $CH_2Cl_2$ | [75-09-2] | 1,2 |
| Tetrachloroethene | $C_2Cl_4$ | [127-18-4] | 1,6 |
| 1,1,2-Trichloroethene | $C_2HCl_3$ | [79-01-6] | 1 |
| 1,1-Dichloroethene | $C_2H_2Cl_2$ | [75-35-4] | 1 |
| *cis*-1,2-Dichloroethene | $C_2H_2Cl_2$ | [156-59-2] | 1 |
| *trans*-1,2-Dichloroethene | $C_2H_2Cl_2$ | [156-60-5] | 1 |
| 1,1,2,2-Tetrachloroethane | $C_2H_2Cl_4$ | [79-34-5] | 1 |
| 1,1,2-Trichloroethane | $C_2H_3Cl_3$ | [79-00-5] | 1 |
| 1,1,1-Trichloroethane | $C_3H_3Cl_3$ | [71-55-6] | 1 |
| 1,1-Dichloroethane | $C_2H_4Cl_2$ | [75-34-3] | 1 |
| 1,2-Dichloroethane | $C_2H_4Cl_2$ | [107-06-2] | 1,2 |
| 2-Chloropropane | $C_3H_7Cl$ | [75-29-6] | 1 |
| 1,4-Dichlorobutane | $C_4H_8Cl_2$ | [110-56-5] | 1 |
| 2-Chlorobutane | $C_4H_9Cl$ | [78-86-4] | 1 |
| 1-Chloro-2-methylpropane | $C_4H_9Cl$ | [513-36-0] | 1 |
| 2-Chloro-2-methylpropane | $C_4H_9Cl$ | [507-20-0] | 1 |
| Chloromethane | $CH_3Cl$ | [74-87-3] | 3 |
| Chloroethane | $C_2H_5Cl$ | [75-00-3] | 3 |
| 1-Chloropropane | $C_3H_7Cl$ | [540-54-5] | 3 |
| 1-Chlorobutane | $C_4H_9Cl$ | [109-69-3] | 3 |
| 1-Chloropentane | $C_5H_{11}Cl$ | [543-59-9] | 3 |
| 1-Chlorohexane | $C_6H_{13}Cl$ | [544-10-5] | 3 |
| 1-Chloroheptane | $C_7H_{15}Cl$ | [629-06-1] | 3 |
| Thionyl chloride | $Cl_2OS$ | [7719-09-7] | 3 |
| Sulfuryl chloride | $Cl_2O_2S$ | [7791-25-5] | 3 |
| 2-Methyl-1-propene | $C_4H_8$ | [115-11-7] | 4 |
| 3-Methyl-1-butene | $C_5H_{10}$ | [563-45-1] | 5 |
| Hydrogen fluoride | $HF$ | [7664-39-3] | 7 |
| Benzenamine (Aniline) | $C_6H_7N$ | [62-53-3] | 8 |

(cont.)

| COMPONENTS: | EVALUATOR: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Miscellaneous compounds of similar volatility to sulfur dioxide. | Colin L. Young,<br>School of Chemistry,<br>University of Melbourne,<br>Parkville, Victoria 3052,<br>Australia.<br>March 1982 |

In addition to the above systems the work of Komissarov *et al.* (9) have not been compiled. These workers studied the system sulfur dioxide + oxygen + tetradecane. It is, however, not clear as to what conditions the reported numerical data refer.

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*J. Chem. Thermodynamics*, 1978, *10*, 343.

9. Komissarov, V. D.; Saitova, M. A.; Kuramshin, E. M.; Timirova, R.G.
*Khim. Prom.*, 1973, *49*, 738.

| | |
|---|---|
| COMPONENTS:<br>1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Water; $H_2O$; [7732-18-5] | EVALUATOR:<br>Rubin Battino,<br>Department of Chemistry,<br>Wright State University,<br>Dayton, Ohio 45435, U.S.A.<br>July 1981 |

CRITICAL EVALUATION:

For this critical evaluation of the solubility of sulfur dioxide in water at around atmospheric pressure, we examined the literature from 1855 until the present. Surprisingly, the earliest work (1) (that of Schönfeld as reported by Bunsen in several papers) is very close to the best modern values – in the middle of the temperature range studied (273-313 K). These early results are within 2-4 per cent of the values to be recommended in this section.

Reactive gases like sulfur dioxide pose a special problem with respect to gas solubilities. $SO_2(g)$ is in equilibrium (at saturation) with $SO_2(aq)$, but the $SO_2(aq)$ is also in equilibrium with other species in solution. The solubilities reported here as mole fractions at 101.325 kPa partial pressure of gas are bulk solubilities, i.e., they are taken as if all of the $SO_2$-containing species in solution were simply $SO_2(aq)$. There are many papers dealing with the remaining ionization and equilibrium constants.

Many of the measurements made on sulfur dioxide solubilities were carried out at different partial pressures. Due to the high solubilities (mole fractions at 101.325 kPa partial pressure of gas of 0.003 to 0.06) exhibited by this system and the chemical interactions involved, the system does not obey Henry's law even over relatively small extrapolations. We limited our interpolations to within about 13 kPa either side of 101.325 kPa.

Of the more modern determinations we judged the work of four workers to be sufficiently reliable to use for smoothing via least squares analysis. Individual data points which were more than about two standard deviations from the smoothed values were rejected. Thus, 24 points were used for the final smoothing and were obtained as follows (reference – number of data points used from that reference): 2-10, 3-8, 4-1, 5-5. The best fit for the 24 points is

$$\ln x_1 = -25.26286 + 45.75521/(T/100K) + 5.685450 \ln (T/100K)$$

where $x_1$ is the mole fraction solubility at 101.325 kPa partial pressure of gas. The standard deviation in $x_1$ was $1.7 \times 10^{-4}$ or about ±1.8 per cent at the mid-range of 283 to 380 K. The following table gives the recommended smoothed values of the mole fraction and the Ostwald coefficient at 5 K intervals calculated from the above equation. (Thermodynamic properties are not presented - due to the complexity of the aqueous solution. They would be meaningless.)

| T/K | $x_1$ [a] | L [b] | T/K | $10^2 x_1$ [a] | L [b] |
|---|---|---|---|---|---|
| 278.15 | 0.0499 | 66.6 | 333.15 | 9.22 | 13.9 |
| 283.15 | 0.0413 | 55.6 | 338.15 | 8.19 | 12.5 |
| 288.15 | 0.0345 | 46.9 | 343.15 | 7.31 | 11.3 |
| 293.15 | 0.0290 | 39.8 | 348.15 | 6.55 | 10.2 |
| 298.15 | 0.0246 | 34.1 | 353.15 | 5.90 | 9.27 |
| 303.15 | 0.0210 | 29.5 | 358.15 | 5.33 | 8.47 |
| 308.15 | 0.0180 | 25.6 | 363.15 | 4.84 | 7.76 |
| 313.15 | 0.0156 | 22.4 | 368.15 | 4.41 | 7.14 |
| 318.15 | 0.0136 | 19.7 | 373.15 | 4.03 | 6.59 |
| 323.15 | 0.0119 | 19.7 | 378.15 | 3.70 | 6.10 |
| 328.15 | 0.0104 | 15.5 | 383.15 | 3.40 | 5.66 |

[a] Mole fraction solubility at 101.325 kPa partial pressure of gas.

[b] Ostwald coefficient.

(cont.)

| COMPONENTS: | EVALUATOR: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Water; $H_2O$; [7732-18-5] | Rubin Battino,<br>Department of Chemistry,<br>Wright State University,<br>Dayton, Ohio 45435, U.S.A.<br>July 1981 |

CRITICAL EVALUATION:

The results of several workers were not used in the smoothing process. Bunsen/Schönfeld's early measurements (1) were surprisingly good at the middle of their temperature range of 273 to 313 K but differed strongly at the extremes. Sims' early work (6) ranged 4-5 per cent high and low. Fox's two values (7) were high and very high. Lindner's values (8) were all at lower pressures. Baume and Tykociner's values at three temperatures (9) were very high when interpolated to 101.325 kPa. Smith and Parkhurst's results (10) were erratically low and high. Öman's results (11) were very low at all temperatures he investigated (313-368 K). The interpolated Maass and Maass results (12) were over 10 per cent low. The interpolated Morgan and Maass (13) results were also quite low (4-7 per cent). The extrapolared value for Conrad and Beuschlein (14) from data over a pressure range of 41 to 97 kPa at 298 K was low. Johnstone and Leppla's results (15) were at too low pressures to be reasonably extrapolated. Otuka's results (16) were mostly at pressures above atmospheric and not readily extrapolated. Parkinson's determinations (17) were at rather low partial pressures of sulfur dioxide (0.08-3.5 kPa). The Bodor *et al.* (18) results were quite low (7-14 per cent) after extrapolation and interpolation to 101.325 kPa. Tokunaga's measurements (19) were of reasonable precision but systematically higher than the recommended values. Douabul and Riley's results (20) were 6 to 14 per cent higher than the recommended values. Byerley *et al.*'s two values (21) were 8 and 12 per cent low. Vosolsobe *et al.*'s results (22) were at too low pressure to be extrapolated. Sano and Nakamoto's value agrees with the value in the table. This system awaits a definitive study.

References:

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19. Tokunaga, J. *J. Chem. Eng. Data* 1974, *19*, 162-5.
20. Douabul, A.; Riley, J. *J. Chem. Eng. Data* 1979, *24*, 274-6.
21. Byérley, J. J.; Rempel, G. L.; Le, V. T. *J. Chem. Eng. Data* 1980, *25*, 55-6.

| COMPONENTS: | EVALUATOR: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Water; $H_2O$; [7732-18-5] | Rubin Battino,<br>Department of Chemistry,<br>Wright State University,<br>Dayton, Ohio 45435, U.S.A.<br>July 1981 |

CRITICAL EVALUATION:

22. Vosolsobe, J.; Simecek, S.; Michalek, J.; Kadler, B. *Chem. Prumysl.* 1965, *15*, 401.

23. Sano, H.; Nakamoto, Y. *Nippon Kagaku Zasshi* 1968, *89*, 369.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]

2. Water; $H_2O$; [7732-18-5]

ORIGINAL MEASUREMENTS:

Bunsen, R.
*Ann.* 1855, *93*, 1-50.
(Schönfeld, M. *Ann.* 1855,
*93*, 26).

VARIABLES:

T/K = 273-313

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

| t/°C | $T^a$/K | $x_1{}^{a,b}$ | $\alpha^c$/cm$^3$ (STP) cm$^{-3}$ atm$^{-1}$ | t/°C | $T^a$/K | $x_1{}^{a,b}$ | $\alpha^c$/cm$^3$ (STP) cm$^{-3}$ atm$^{-1}$ |
|---|---|---|---|---|---|---|---|
| 0 | 273 | 0.0525 | 68.861 | 21 | 294 | 0.0274 | 34.989 |
| 1 | 274 | 0.0511 | 67.003 | 22 | 295 | 0.0266 | 33.910 |
| 2 | 275 | 0.0498 | 65.169 | 23 | 296 | 0.0258 | 32.847 |
| 3 | 276 | 0.0485 | 63.360 | 24 | 297 | 0.0250 | 31.800 |
| 4 | 277 | 0.0472 | 61.576 | 25 | 298 | 0.0242 | 30.766 |
| 5 | 278 | 0.0459 | 59.816 | 26 | 299 | 0.0234 | 29.748 |
| 6 | 279 | 0.0446 | 58.080 | 27 | 300 | 0.0227 | 28.744 |
| 7 | 280 | 0.0434 | 56.369 | 28 | 301 | 0.0219 | 27.754 |
| 8 | 281 | 0.0421 | 54.683 | 29 | 302 | 0.0212 | 26.780 |
| 9 | 282 | 0.0409 | 53.021 | 30 | 303 | 0.0204 | 25.819 |
| 10 | 283 | 0.0397 | 51.383 | 31 | 304 | 0.0197 | 24.873 |
| 11 | 284 | 0.0385 | 49.770 | 32 | 305 | 0.0190 | 23.942 |
| 12 | 285 | 0.0373 | 48.182 | 33 | 306 | 0.0183 | 23.025 |
| 13 | 286 | 0.0361 | 46.618 | 34 | 307 | 0.0176 | 22.122 |
| 14 | 287 | 0.0350 | 45.079 | 35 | 308 | 0.0169 | 21.234 |
| 15 | 288 | 0.0339 | 43.564 | 36 | 309 | 0.0162 | 20.361 |
| 16 | 289 | 0.0327 | 42.073 | 37 | 310 | 0.0155 | 19.502 |
| 17 | 290 | 0.0316 | 40.608 | 38 | 311 | 0.0149 | 18.658 |
| 18 | 291 | 0.0306 | 39.165 | 39 | 312 | 0.0142 | 17.827 |
| 19 | 292 | 0.0295 | 37.749 | 40 | 313 | 0.0136 | 17.013 |
| 20 | 293 | 0.0283 | 36.216 | | | | |

[a] Calculated by compiler.
[b] Mole fraction solubility at 101.325 kPa partial pressure of gas.
[c] Bunsen coefficient.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Analysed chemically. This is really Schönfeld's data (1) as cited by Bunsen. Data were smoothed by Schönfeld.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.03$ (compiler's estimate).

REFERENCES:

1. Schönfeld, M.
*Ann.*
1855, *93*, 26.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7746-09-5]

2. Water; $H_2O$; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sims, T. H.
*J. Chem. Soc.*
1862, *14*, 1-22.

VARIABLES:

T/K = 281-323

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

| $t^a$/°C | $T^b$/K | $x_1^{b,c}$ | Solubility$^d$ (volume) | Solubility$^e$ (weight) |
|---|---|---|---|---|
| 8 | 281.2 | 0.0451 | 58.7 | 0.168 |
| 10 | 283.2 | 0.0415 | 53.9 | 0.154 |
| 12 | 285.2 | 0.0384 | 49.6 | 0.142 |
| 14 | 287.2 | 0.0353 | 45.6 | 0.130 |
| 16 | 289.2 | 0.0329 | 42.2 | 0.121 |
| 18 | 291.2 | 0.0305 | 39.3 | 0.112 |
| 20 | 293.2 | 0.0284 | 36.4 | 0.104 |
| 22 | 295.2 | 0.0268 | 34.2 | 0.098 |
| 24 | 297.2 | 0.0252 | 32.3 | 0.092 |
| 26 | 299.2 | 0.0239 | 30.5 | 0.087 |
| 28 | 301.2 | 0.0228 | 28.9 | 0.083 |
| 30 | 303.2 | 0.0215 | 27.3 | 0.078 |
| 32 | 305.2 | 0.0201 | 25.7 | 0.073 |
| 34 | 307.2 | 0.0190 | 24.3 | 0.069 |
| 36 | 309.2 | 0.0180 | 22.8 | 0.065 |
| 38 | 311.2 | 0.0171 | 21.6 | 0.062 |
| 40 | 313.2 | 0.0160 | 20.4 | 0.058 |
| 42 | 315.2 | 0.0152 | 19.3 | 0.055 |
| 44 | 317.2 | 0.0147 | 18.4 | 0.053 |

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The experimental method is similar to that of Roscoe (1). Accurate analysis was used to determine the quantity of gas absorbed by a known weight of water under known conditions of temperature and pressure. The analysis was iodimetric. Details are given in the paper.

SOURCE AND PURITY OF MATERIALS:

1. Evolved from sulfuric acid and copper and washed with water before freezing into a container.

2. No details given.

ESTIMATED ERROR:

Solubility/Solubility = 0.03 (compiler's estimate).

REFERENCES:

1. Roscoe, H. E.
*J. Chem. Soc.*
1855, *8*, 14.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7746-09-5]
2. Water; $H_2O$; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sims, J. H.
*J. Chem. Soc.*
1862, *14*, 1-22.

EXPERIMENTAL VALUES:

| $t^a$/°C | $T^b$/K | $x_1{}^{b,c}$ | Solubility[d] (volume) | Solubility[e] (weight) |
|---|---|---|---|---|
| 46 | 319.2 | 0.0139 | 17.4 | 0.050 |
| 48 | 321.2 | 0.0130 | 16.4 | 0.047 |
| 50 | 323.2 | 0.0125 | 15.6 | 0.045 |

[a] These are smoothed values presented by Sims at 2 K intervals. The smoothed values are based on extensive pressure-dependent measurements at 7, 20, 39.8, and 50 °C. They were calculated for an $SO_2$ partial pressure of 760 mmHg. The pressure range at each temperature ranged from about 27 to 2000 mmHg, so the smoothed values at 760 mmHg are interpolations.

[b] Calculated by compiler.

[c] Mole fraction solubility at 101.325 kPa partial pressure of gas.

[d] Solubility in $cm^3$ $SO_2$/g $H_2O$. Effectively an Ostwald coefficient.

[e] Solubility in g $SO_2$/g $H_2O$. Mole fraction solubilities were calculated from the values in this column.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Water; $H_2O$; [7732-18-5] | Fox, C.J.J.<br>*Z. Phys. Chem.* 1902, *41*, 458-482. |
| VARIABLES: | PREPARED BY: |
| Temperature | C.L. Young |

EXPERIMENTAL VALUES:

Partial pressure = 0.101325 MPa

| T/K | Ostwald coefficient, $L$ | Mole fraction of sulfur dioxide, [c] $x_{SO_2}$ |
|---|---|---|
| 298.2 | 32.76[a] | 0.0257 |
| 308.2 | 22.43[b] | 0.0178 |

[a] average of 6 values.

[b] average of 5 values.

[c] calculated by compiler assuming ideal gas molar volume for sulfur dioxide.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was passed through the water until saturated at the barometric pressure. After saturation a sample of solution was analysed, the amount of sulfur dioxide being determined by iodine-thiosulfate titration.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.8 mole per cent major impurity water.
2. Conductivity grade.

ESTIMATED ERROR:

$\delta x_{SO_2} = \pm 3\%$

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]

ORIGINAL MEASUREMENTS:

Lindner, J.

*Monatsh.*

1912, *33*, 613-672.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

| T/K | *p*/mmHg | *p*/kPa | Solubility $/(g_{(SO_2)}/10^2\ cm^3$ (sat.soln.) |
|---|---|---|---|
| 273.2 | 0.4 | 0.05 | 0.0537 |
| | 3.5 | 0.47 | 0.237 |
| | 29.4 | 3.92 | 1.227 |
| | 109.4 | 14.59 | 3.804 |
| 293.2 | 1.4 | 0.19 | 0.0534 |
| | 11.75 | 1.57 | 0.234 |
| | 87.9 | 11.72 | 1.212 |
| | 313 | 41.7 | 3.750 |
| 323.2 | 4.9 | 0.65 | 0.0525 |
| | 30.5 | 4.07 | 0.2276 |
| | 204.5 | 27.26 | 1.181 |
| | 696 | 92.8 | 3.628 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Manometric method. Fairly complicated method, of historical interest only.

SOURCE AND PURITY OF MATERIALS:

No purity data given.

ESTIMATED ERROR:

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Water; $H_2O$; [7732-18-5] | Smith, W.T.; Parkhurst, R.B.<br>*J. Am. Chem. Soc.* 1922, *44*, 1918-1927 |
| VARIABLES:<br>Temperature, pressure | PREPARED BY:<br>C.L. Young |

EXPERIMENTAL VALUES:

| T/K | Partial pressure of sulfur dioxide $p$/mmHg | $p$/kPa | Wt. of $SO_2$ per 100 $cm^3$ water /g | Mole fraction of sulfur dioxide, $x_{SO_2}$ |
|---|---|---|---|---|
| 278.2 | 474.8 | 63.30 | 11.55 | 0.0315 |
| 293.2 | 198.6 | 26.48 | 2.97 | 0.00828 |
| | 224.4 | 29.92 | 3.34 | 0.00931 |
| | 366.6 | 48.88 | 5.22 | 0.0145 |
| | 1107.8 | 147.69 | 15.01 | 0.0405 |
| 313.2 | 306.4 | 40.85 | 2.21 | 0.00618 |
| | 373.8 | 49.84 | 2.68 | 0.00748 |
| 333.2 | 175.7 | 23.42 | 0.84 | 0.00236 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static system in which water was saturated with sulfur dioxide at stated pressure. Samples of saturated solutions analysed by iodine-thiosulfate titration. Details in source.

SOURCE AND PURITY OF MATERIALS:

1. Virginia Smelting Co. sample.
2. Degassed.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{SO_2} = \pm 5\%$
(estimated by compiler)

REFERENCES:

**COMPONENTS:**

1. Sulfur dioxide; $SO_2$; [7746-09-5]
2. Water; $H_2O$; [7732-18-5]

**ORIGINAL MEASUREMENTS:**

Hudson, J. C.

*J. Chem. Soc.*

1925, 1332-1347.

**VARIABLES:**

Temperature

**PREPARED BY:**

C. L. Young

**EXPERIMENTAL VALUES:**

| T/K | Total pressure | Partial pressure | | Solubility | | Mole fraction of sulfur dioxide, $x_{SO_2}$ at a partial pressure of 101.3 kPa |
|---|---|---|---|---|---|---|
| | $P$/mmHg | $p$/mmHg | $p$/kPa | $S_1^*$ | $S_o^\#$ | |
| 283.15 | 777.3 | 764.2 | 101.9 | 15.53 | 15.44 | 0.04162 |
| | 776.3 | 767.1 | 102.3 | 15.50 | 15.36 | 0.04141 |
| | 776.3 | 767.0 | 102.3 | 15.58 | 15.44 | 0.04162 |
| | 775.4 | 766.2 | 102.2 | 15.48 | 15.36 | 0.04141 |
| | 766.2 | 757.0 | 100.9 | 15.28 | 15.32 | 0.04131 |
| 288.15 | 769.5 | 757.6 | 101.0 | 12.72 | 12.76 | 0.03464 |
| | 772.5 | 760.6 | 101.4 | 12.75 | 12.74 | 0.03459 |
| | 769.5 | 757.6 | 101.0 | 12.64 | 12.68 | 0.03443 |
| 293.15 | 787.7 | 771.3 | 102.8 | 10.79 | 10.63 | 0.02903 |
| | 773.3 | 765.9 | 102.1 | 10.61 | 10.66 | 0.02911 |
| | 778.6 | 762.2 | 101.6 | 10.68 | 10.64 | 0.02905 |
| | 779.1 | 762.7 | 101.7 | 10.65 | 10.61 | 0.02898 |
| | 773.9 | 757.5 | 101.0 | 10.64 | 10.68 | 0.02916 |
| 303.05 | 798.5 | 768.5 | 102.5 | 7.640 | 7.554 | 0.02080 |
| | 789.4 | 759.4 | 101.2 | 7.600 | 7.607 | 0.02095 |
| | 791.0 | 761.0 | 101.5 | 7.610 | 7.600 | 0.02093 |
| | 800.9 | 770.9 | 102.8 | 7.674 | 7.565 | 0.02083 |
| 313.15 | 800.9 | 747.3 | 99.63 | 5.428 | 5.520 | 0.01529 |
| | 801.4 | 747.8 | 99.70 | 5.441 | 5.529 | 0.01531 |
| | 798.1 | 744.5 | 99.26 | 5.406 | 5.516 | 0.01528 |

(cont.)

## AUXILIARY INFORMATION

**METHOD/APPARATUS/PROCEDURE:**

Sulfur dioxide was bubbled through water in a thermostatted tube. Mercury manometer used to measure total pressure at sautration. After saturation, tube weighed and sulfur dioxide content determined by oxidation with hydrogen peroxide in sodium hydroxide solution and the gravimetric estimation of sulfate as barium sulfate. The partial pressure of sulfur dioxide was calculated assuming partial pressure of water could be calculated from Raoult's Law.

**SOURCE AND PURITY OF MATERIALS:**

1. Obtained from a cylinder; the purity was stated to be high, the major impurity being water, less than 0.4%.
2. No details given.

**ESTIMATED ERROR:**

$\delta T/K = \pm 0.1$; $\delta p/\text{mmHg} = \pm 0.2$;

$\delta x_{SO_2} = \pm 0.001$ (estimated by compiler).

**REFERENCES:**

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7746-09-5]
2. Water; $H_2O$; [7732-18-5]

ORIGINAL MEASUREMENTS:

Hudson, J. C.
*J. Chem. Soc.*
1925, 1332-1347.

EXPERIMENTAL VALUES:

| T/K | Total pressure $P$/mmHg | Partial pressure $p$/mmHg | $p$/kPa | Solubility $S_1^*$ | $S_0^\#$ | Mole fraction of sulfur dioxide, $x_{SO}$ at a partial pressure of 101.3 kPa |
|---|---|---|---|---|---|---|
| 313.15 | 816.7 | 763.1 | 101.7 | 5.593 | 5.569 | 0.01542 |
| | 815.7 | 762.1 | 101.6 | 5.585 | 5.555 | 0.01538 |
| | 815.7 | 762.1 | 101.6 | 5.581 | 5.550 | 0.01537 |
| 321.30 | 799.0 | 717.0 | 95.59 | 4.147 | 4.395 | 0.01221 |
| | 801.5 | 719.5 | 95.93 | 4.132 | 4.365 | 0.01213 |
| | 794.3 | 712.3 | 94.97 | 4.108 | 4.382 | 0.01217 |
| | 840.9 | 758.9 | 101.2 | 4.409 | 4.415 | 0.01226 |
| 333.15 | 881.5 | 735 | 98.0 | 3.151 | 3.257 | 0.009077 |
| | 894.5 | 748 | 99.7 | 3.192 | 3.244 | 0.009041 |
| | 894.5 | 748 | 99.7 | 3.215 | 3.268 | 0.009107 |
| | 886.5 | 740 | 98.7 | 3.142 | 3.220 | 0.008975 |
| 343.15 | 897 | 666.5 | 88.86 | 2.278 | 2.598 | 0.007254 |
| | 892.5 | 662 | 88.3 | 2.277 | 2.614 | 0.007298 |
| | 893 | 662.5 | 88.33 | 2.300 | 2.637 | 0.007362 |
| | 892 | 661.5 | 88.19 | 2.251 | 2.585 | 0.007218 |
| 353.15 | 883 | 531.5 | 70.86 | 1.496 | 2.139 | 0.005980 |
| | 883 | 531.5 | 70.86 | 1.490 | 2.131 | 0.005958 |
| | 958 | 606.5 | 80.86 | 1.704 | 2.130 | 0.005955 |
| | 967 | 616 | 82.1 | 1.714 | 2.114 | 0.005910 |
| 363.15 | 893 | 378 | 50.4 | 0.901 | 1.801 | 0.005040 |
| | 954.3 | 439.5 | 58.60 | 1.037 | 1.785 | 0.004995 |
| | 960 | 439 | 58.5 | 1.056 | 1.829 | 0.005118 |

* g of $SO_2$ per 100 g of water at stated pressure.

\# g of $SO_2$ per 100 g of water at pressure of 101.3 kPa.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]

ORIGINAL MEASUREMENTS:

Maass, C.E.; Maass, O.

*J. Am. Chem. Soc.* 1928, *50*, 1352-1368.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | Total Pressure $p$/cmHg | Total Pressure $p/10^4$Pa | Mass % of $SO_2$ | Mole fraction of sulfur dioxide, $x_{SO_2}$ |
|---|---|---|---|---|
| 283.2 | 24.3 | 3.24 | 4.57 | 0.0133 |
| | 45.2 | 6.03 | 8.19 | 0.0245 |
| | 67.4 | 8.99 | 11.64 | 0.0357 |
| | 87.4 | 11.65 | 14.75 | 0.0464 |
| | 124.5 | 16.60 | 18.91 | 0.0615 |
| | 128.8 | 17.17 | 19.86 | 0.0652 |
| | 154.3 | 20.57 | 23.10 | 0.0779 |
| 289.7 | 31.0 | 4.13 | 4.48 | 0.0130 |
| | 57.2 | 7.63 | 8.03 | 0.0240 |
| | 84.4 | 11.25 | 11.42 | 0.0350 |
| | 111.4 | 14.85 | 14.31 | 0.0449 |
| | 151.9 | 20.25 | 18.57 | 0.0603 |
| | 156.0 | 20.80 | 19.52 | 0.0637 |
| | 188.4 | 25.12 | 22.71 | 0.0763 |
| 295.2 | 37.8 | 5.04 | 4.40 | 0.0128 |
| | 69.3 | 9.24 | 7.88 | 0.0235 |
| | 102.2 | 13.63 | 11.17 | 0.0342 |
| | 132.6 | 17.68 | 14.04 | 0.0439 |
| | 178.3 | 23.77 | 18.22 | 0.0590 |
| | 186.1 | 24.81 | 19.14 | 0.0624 |
| | 222.2 | 29.62 | 22.32 | 0.0748 |
| 298.2 | 66.2 | 8.83 | 6.9 | 0.0204 |
| | 246.9 | 32.92 | 22.4 | 0.0751 |
| 300.2 | 44.8 | 5.97 | 4.32 | 0.0125 |
| | 81.0 | 10.80 | 7.71 | 0.0230 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The vapor pressure of solutions containing a known amount of sulfur dioxide were measured.

SOURCE AND PURITY OF MATERIALS:

1. Commercial sample, dried and distilled several times in vacuo.
2. Degassed.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{SO_2} = \pm 2\%$

(estimated by compiler)

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7746-09-5]
2. Water; $H_2O$; [7732-18-5]

ORIGINAL MEASUREMENTS:

Maass, C.E.; Maass, O.

*J. Am. Chem. Soc.* 1928, *50*, 1352-1368.

EXPERIMENTAL VALUES:

| T/K | Total Pressures $p$/cmHg | $p/10^4$Pa | Mass % of $SO_2$ | Mole fraction of sulfur dioxide, $x_{SO_2}$ |
|---|---|---|---|---|
| 300.2 | 118.3 | 15.77 | 10.95 | 0.0334 |
| | 152.8 | 20.37 | 13.74 | 0.0429 |
| | 206.9 | 27.58 | 17.85 | 0.0576 |
| | 255.6 | 34.08 | 21.86 | 0.0729 |

| T/K | $x_{SO_2}$ [a] |
|---|---|
| 283.2 | 0.03838 |
| 290.0 | 0.03053 |
| 295.2 | 0.02518 |
| 298.2 | 0.02157 |
| 300.2 | 0.02141 |

[a] Calculated by compiler for a partial pressure of sulfur dioxide of 101.3 kPa.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7746-09-5]
2. Water; $H_2O$; [7732-18-5]

ORIGINAL MEASUREMENTS:

Morgan, O. M.; Maass, O.

*Can. J. Res.*

1931, *5*, 162-99.

VARIABLES:

T/K = 273-298

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

| $P$/cm Hg | $P^a$/kPa | % $SO_2^b$ | $P$/cm Hg | $P^a$/kPa | % $SO_2^b$ |
|---|---|---|---|---|---|
| t/°C = 0 | T/K = 273 | | t/°C = 18 | T/K = 291 | |
| 0.17 | 0.23 | 0.1369 | 0.32 | 0.43 | 0.0816 |
| 0.63 | 0.84 | 0.3374 | 1.10 | 1.47 | 0.2605 |
| 1.97 | 2.63 | 0.8888 | 2.68 | 3.57 | 0.5563 |
| 6.05 | 8.07 | 2.284 | 5.92 | 7.89 | 1.103 |
| 11.55 | 15.40 | 3.978 | 14.83 | 19.77 | 2.458 |
| 17.30 | 22.06 | 5.597 | 26.66 | 35.54 | 4.150 |
| 29.21 | 38.94 | 8.630 | 39.01 | 52.01 | 5.773 |
| 41.63 | 55.50 | 11.52 | 51.44 | 68.58 | 7.340 |
| 55.02 | 73.35 | 14.23 | 63.69 | 84.91 | 8.831 |
| | | | 76.04 | 101.38 | 10.30 |
| t/°C = 10 | T/K = 283 | | t/°C = 25 | T/K = 298 | |
| 0.35 | 0.47 | 0.1267 | 0.79 | 1.05 | 0.1735 |
| 1.00 | 1.33 | 0.3414 | 3.42 | 4.56 | 0.5448 |
| 2.12 | 2.83 | 0.6360 | 7.37 | 9.83 | 1.056 |
| 4.71 | 6.28 | 1.261 | 13.61 | 18.15 | 1.809 |
| 10.98 | 14.64 | 2.593 | 25.28 | 33.70 | 3.116 |
| 19.52 | 26.02 | 4.256 | 40.00 | 53.33 | 4.672 |
| 28.37 | 37.82 | 5.872 | 55.00 | 73.33 | 6.184 |
| 46.62 | 62.15 | 8.937 | 69.88 | 93.17 | 7.640 |
| 64.18 | 85.57 | 11.68 | 81.17 | 108.22 | 8.756 |
| 73.58 | 98.10 | 13.03 | | | |

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The amount of sulfur dioxide dissolved was determined via conductivity measurements.

SOURCE AND PURITY OF MATERIALS:

1. From Ansul Chemical Co., Marinette, Wisconsin. Distilled three times.
2. "Conductivity water".

ESTIMATED ERROR:

$\delta\%\ SO_2/\%\ SO_2 = \pm 0.05$
(compiler's estimate).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7746-09-5]

2. Water; $H_2O$; [7732-18-5]

ORIGINAL MEASUREMENTS:

Morgan, O. M.; Maass, O.

*Can. J. Res.*

1931, *5*, 162-99.

EXPERIMENTAL VALUES:

[a] Calculated by compiler.

[b] Presumably a weight per cent of the total amount of sulfur dioxide as $SO_2$ in the water.

| T/K | $H^a$ | $x_1{}^b$ |
|---|---|---|
| 283 | 0.01080 | 0.0386 |
| 291 | 0.00870 | 0.0295 |
| 298 | 0.00758 | 0.0235 |

[a] Henry's law constant calculated by authors from $[SO_2] = Hp$ where $[SO_2]$ is in mol $dm^{-3}$ and $p$ is in cm Hg. These are smoothed and averaged values.

[b] Mole fraction solubility at 101.325 kPa partial pressure of gas calculated by compiler from data around 101.325 kPa given in the paper. Mole fractions calculated from the Henry's law constants given by the authors are quite different since for this system H (as calculated) is concentration-dependent.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]

ORIGINAL MEASUREMENTS:

Conrad, F. H.; Beuschlein, W. L.

*J. Am. Chem. Soc.*

1934, *56*, 2554-2562.

VARIABLES:

Pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

| T/K | Partial Pressure of sulfur dioxide $p$/mmHg | $p$/kPa | Solubility, $S$ /($gSO_2/100gH_2O$) | Mole fraction of sulfur dioxide in solution, $x_{SO_2}$ |
|---|---|---|---|---|
| 298.2 | 308 | 41.1 | 3.72 | 0.0104 |
| | 299 | 39.9 | 3.63 | 0.0101 |
| | 593 | 79.1 | 6.89 | 0.0190 |
| | 640 | 85.3 | 7.28 | 0.0201 |
| | 611 | 81.5 | 6.99 | 0.0193 |
| | 730 | 97.3 | 8.37 | 0.0230 |
| | 760[a] | 101.3 | - | 0.0237[a] |

[a] Extrapolated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was passed into a measuring pipet and then into a flask containing water. The flask was shaken until a constant total pressure was achieved. The pressure was measured using a mercury manometer. The solution was analysed by titration using the iodine-thiosulfate procedure.

SOURCE AND PURITY OF MATERIALS:

1. Refrigeration grade from Virginia Smelting Co. No trace of sulfur trioxide detected.
2. Distilled and freshly boiled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta x_{SO_2} = \pm 4\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]

ORIGINAL MEASUREMENTS:

Johnstone, H.F.; Leppla, P.W.

*J. Am. Chem. Soc.* 1934, *56*, 2233-2238.

VARIABLES:

Pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | Partial pressure of sulfur dioxide $10^3 p$/atm | $p$/kPa | Moles of $SO_2$ per 1000g water | Mole fraction of sulfur dioxide $10^3 x_{SO_2}$ |
|---|---|---|---|---|
| 298.2 | 0.27 | 0.027 | 0.002484 | 0.0448 |
| | 1.20 | 0.122 | 0.006203 | 0.1117 |
| | 2.29 | 0.232 | 0.009546 | 0.1720 |
| | 2.67 | 0.271 | 0.01084 | 0.1953 |
| | 6.71 | 0.680 | 0.02059 | 0.3708 |
| | 9.11 | 0.923 | 0.02561 | 0.4612 |
| | 13.50 | 1.368 | 0.03328 | 0.5992 |
| 308.2 | 1.03 | 0.104 | 0.00419 | 0.0755 |
| | 2.49 | 0.252 | 0.00745 | 0.1342 |
| | 4.12 | 0.417 | 0.00999 | 0.1799 |
| | 5.80 | 0.588 | 0.01356 | 0.2442 |
| | 9.55 | 0.968 | 0.01987 | 0.3579 |
| 323.2 | 2.30 | 0.233 | 0.00467 | 0.0841 |
| | 3.83 | 0.388 | 0.00637 | 0.1147 |
| | 5.38 | 0.545 | 0.00838 | 0.1510 |
| | 8.79 | 0.891 | 0.01057 | 0.1904 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The low partial pressure of sulfur dioxide was obtained by using a mixture of nitrogen and sulfur dioxide. This mixture was bubbled through water in a "Pyrex saturator" (Bichowsky and Starch, ref (1)) until equilibrium was reached. Samples of solution were analysed by adding excess iodate and titrating with thiosulfate solution.

SOURCE AND PURITY OF MATERIALS:

1. Stated to be of high purity.
2. Conductivity water, degassed.

ESTIMATED ERROR:

REFERENCES:

1. Bichowsky, F.R.; Starch, H.

   *J. Am. Chem. Soc.* 1915, *37*, 2695.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7746-09-5]
2. Water; $H_2O$; [7732-18-5]

ORIGINAL MEASUREMENTS:

Otuka, Y.

*J. Soc. Chem. Ind. Japan. Suppl.* 1939, *42*, 205B-209B

VARIABLES:

Temperature, pressure

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES: 760 mmHg = 1 atm = 101.325 kPa

| T/K | $p_{Total}$/atm | $p_{SO_2}$/atm | Mole $SO_2$ /$dm^3$ soln | $H$ |
|---|---|---|---|---|
| 373 | 1.72 | 0.73 | 0.1763 | 0.242 |
| | 1.94 | 0.95 | 0.2443 | 0.257 |
| 378 | 2.01 | 0.83 | 0.1728 | 0.208 |
| | 2.26 | 1.08 | 0.2401 | 0.222 |
| 383 | 2.29 | 0.89 | 0.1708 | 0.192 |
| | 2.63 | 1.24 | 0.2352 | 0.190 |
| 388 | 2.70 | 1.05 | 0.1656 | 0.158 |
| | 3.03 | 1.38 | 0.2311 | 0.168 |
| 393 | 3.12 | 1.18 | 0.1616 | 0.137 |
| | 3.50 | 1.56 | 0.2259 | 0.145 |
| 398 | 3.58 | 1.31 | 0.1578 | 0.120 |
| | 4.00 | 1.74 | 0.2210 | 0.127 |
| 403 | 4.10 | 1.45 | 0.1535 | 0.106 |
| | 4.55 | 1.91 | 0.2164 | 0.113 |
| 408 | 4.63 | 1.57 | 0.1502 | 0.096 |
| | 5.12 | 2.07 | 0.2123 | 0.103 |
| 413 | 5.24 | 1.71 | 0.1464 | 0.086 |
| | 5.73 | 2.21 | 0.2087 | 0.094 |
| 418 | 5.91 | 1.85 | 0.1428 | 0.077 |
| | 6.41 | 2.36 | 0.2050 | 0.087 |
| 423 | 6.60 | 1.96 | 0.1400 | 0.071 |
| | 7.08 | 2.46 | 0.2028 | 0.082 |

The author defined the "solubility" as $H = (H_2SO_3)/p_{SO_2}$, the pressure being in atm. $(H_2SO_3)$ evidently means mole $SO_2/dm^3$ of solution. $p_{Total} = p_{SO_2} + p_{H_2O}$ . NOTE: The author refers to "pure sulfurous acid, $H_2SO_3$".

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The total pressure, $p_{Total}$, was determined by means of a glass spring manometer. It was stated that the partial pressures were approximated from the dimensions of the apparatus, but details were not given.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7746-09-5]
2. Water; $H_2O$; [7732-18-5]

ORIGINAL MEASUREMENTS:

Beuschlein, W. L.; Simenson, L. O.
*J. Am. Chem. Soc.*
1940, *62*, 610-2.

VARIABLES:

T/K = 296-386
$P$/kPa = 7-192

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

| t/°C | $T^a$/K | $x_1^{a,b}$ | $P^c$/mmHg | $P^a$/kPa |
|---|---|---|---|---|
| | | 0.51 g $SO_2$/100 g $H_2O$ | | |
| 35.6 | 308.8 | 0.02227 | 49 | 6.53 |
| 41.0 | 314.2 | 0.01914 | 57 | 7.60 |
| 47.0 | 320.2 | 0.01559 | 70 | 9.33 |
| 52.0 | 325.2 | 0.01364 | 80 | 10.67 |
| 62.6 | 335.8 | 0.00925 | 118 | 15.73 |
| 71.0 | 344.2 | 0.00727 | 150 | 20.00 |
| 78.6 | 351.8 | 0.00590 | 185 | 24.66 |
| 85.0 | 358.2 | 0.00506 | 215.5 | 28.73 |
| 92.2 | 365.4 | 0.004364 | 250 | 33.33 |
| 99.0 | 372.2 | 0.003822 | 285.5 | 38.06 |
| 105.2 | 378.4 | 0.003404 | 320.5 | 42.73 |
| 111.8 | 385.0 | 0.003048 | 358 | 47.73 |
| 113.0 | 386.2 | 0.002969 | 367.5 | 49.00 |
| | | 1.09 g $SO_2$/100 g $H_2O$ | | |
| 26.8 | 300.0 | 0.03308 | 70.5 | 9.40 |
| 33.6 | 306.8 | 0.02429 | 96 | 12.80 |
| 39.4 | 312.6 | 0.01873 | 124.5 | 16.60 |
| 44.2 | 317.4 | 0.01586 | 147 | 19.60 |
| 50.6 | 323.8 | 0.01310 | 178 | 23.73 |

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solutions were prepared by passing sulfur dioxide through freshly boiled, distilled water until saturated and then diluting to the desired concentration. Analysis was by running the sulfur dioxide solution into an excess of iodine and back titrating with sodium thiosulfate. Details and a drawing are in the paper.

SOURCE AND PURITY OF MATERIALS:

1. "Refrigeration dry", 99.99 per cent.
2. Distilled.

ESTIMATED ERROR:

$\delta T$/K = ±0.2; $\delta P$/kPa = ±0.07;
$\delta x_1/x_1$ = ±0.03 (compiler's estimate).

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7746-09-5] | Beuschlein, W. L.; Simenson, L. O. |
| 2. Water; $H_2O$; [7732-18-5] | *J. Am. Chem. Soc.* <br> 1940, *62*, 610-2. |

EXPERIMENTAL VALUES:

| t/°C | $T^a$/K | $x_1^{a,b}$ | $P^c$/mmHg | $P^a$/kPa |
|---|---|---|---|---|
| | | 1.09 g $SO_2$/100 g $H_2O$ | | |
| 61.6 | 334.8 | 0.00952 | 245 | 32.66 |
| 67.4 | 340.6 | 0.00831 | 280.5 | 37.40 |
| 73.4 | 346.6 | 0.00712 | 327.5 | 43.66 |
| 79.2 | 352.4 | 0.00627 | 372 | 49.60 |
| 86.4 | 359.6 | 0.005234 | 445.5 | 59.39 |
| 98.4 | 371.6 | 0.004572 | 510 | 67.99 |
| 100.6 | 373.8 | 0.003886 | 600 | 79.99 |
| 106.6 | 379.8 | 0.003491 | 668 | 89.06 |
| | | 4.36 g $SO_2$/100 g $H_2O$ | | |
| 23.2 | 296.4 | 0.02809 | 332 | 44.26 |
| 27.2 | 300.4 | 0.02501 | 373 | 49.73 |
| 30.0 | 303.2 | 0.02221 | 420 | 56.00 |
| 33 | 306.2 | 0.02004 | 465.5 | 62.06 |
| 36 | 309.2 | 0.01818 | 513 | 68.39 |
| 38.2 | 311.4 | 0.01691 | 551.5 | 73.53 |
| 42.2 | 315.4 | 0.01507 | 619 | 82.53 |
| 45.2 | 318.4 | 0.01371 | 680.5 | 90.73 |
| 48.2 | 321.4 | 0.01259 | 741 | 98.79 |
| 52 | 325.2 | 0.01141 | 818 | 109.06 |
| 55.3 | 328.5 | 0.01041 | 896 | 119.46 |
| 58.4 | 331.6 | 0.00961 | 970.5 | 129.39 |
| 61.2 | 334.4 | 0.00900 | 1036.5 | 138.19 |
| 63 | 336.2 | 0.00859 | 1085.5 | 144.72 |
| 67.2 | 340.4 | 0.00777 | 1200.5 | 160.05 |
| 70.8 | 344.0 | 0.00722 | 1292 | 172.25 |
| 72.4 | 345.6 | 0.00705 | 1323.5 | 176.45 |
| | | 7.45 g $SO_2$/100 g $H_2O$ | | |
| 25.2 | 298.4 | 0.02463 | 647 | 86.26 |
| 31.4 | 304.6 | 0.02042 | 780.5 | 104.06 |
| 34.2 | 307.4 | 0.01902 | 838 | 111.72 |
| 37.4 | 310.6 | 0.01741 | 915.5 | 122.06 |
| 41 | 314.2 | 0.01612 | 989 | 131.86 |
| 44 | 317.2 | 0.01491 | 1069 | 142.52 |
| 47.2 | 320.4 | 0.01383 | 1152.5 | 153.65 |
| 50.4 | 323.6 | 0.01269 | 1255.5 | 167.39 |
| 54.4 | 327.6 | 0.01146 | 1391.0 | 185.45 |
| 55.6 | 328.8 | 0.01104 | 1443.5 | 192.45 |

[a] Calculated by compiler.

[b] Mole fraction solubility at 101.325 kPa partial pressure of gas. These values are only reasonable at pressures close to 101.325 kPa.

[c] Partial pressure of $SO_2$.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]

ORIGINAL MEASUREMENTS:

Parkison, R. V.
*Tappi*
1956, *39*, 517-9.

VARIABLES:

$T/K = 283-305$
$P/kPa = 0.08-3.6$

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

| t/°F | $T^a/K$ | $P^b$/atm | $P^{a,b}$/kPa | Solubility/ (lb moles/ $ft^3$) | Solubility$^{a,c}$/ (mol $dm^{-3}$) |
|---|---|---|---|---|---|
| 50 | 283 | 0.000809 | 0.0820 | 0.000511 | 0.00819 |
| | | 0.00193 | 0.196 | 0.000912 | 0.0146 |
| | | 0.00292 | 0.296 | 0.00119 | 0.0191 |
| | | 0.00440 | 0.446 | 0.00144 | 0.0231 |
| | | 0.00480 | 0.486 | 0.00164 | 0.0263 |
| | | 0.00537 | 0.544 | 0.00167 | 0.0268 |
| | | 0.00668 | 0.677 | 0.00212 | 0.0340 |
| | | 0.00916 | 0.928 | 0.00265 | 0.0425 |
| | | 0.00987 | 1.00 | 0.00279 | 0.0447 |
| | | 0.0174 | 1.76 | 0.00441 | 0.0707 |
| | | 0.0185 | 1.88 | 0.00446 | 0.0715 |
| | | 0.0261 | 2.64 | 0.00599 | 0.0960 |
| | | 0.0281 | 2.85 | 0.00622 | 0.0997 |
| | | 0.0332 | 3.36 | 0.00712 | 0.114 |
| | | 0.0350 | 3.55 | 0.00745 | 0.119 |
| 60 | 289 | 0.00659 | 0.668 | 0.00168 | 0.0269 |
| | | 0.00910 | 0.922 | 0.00214 | 0.0343 |
| | | 0.00979 | 0.992 | 0.00225 | 0.0361 |
| 70 | 294 | 0.00102 | 0.103 | 0.000326 | 0.00523 |
| | | 0.00201 | 0.204 | 0.000568 | 0.00911 |
| | | 0.00209 | 0.212 | 0.000642 | 0.0103 |
| | | 0.00465 | 0.472 | 0.00109 | 0.0175 |
| | | 0.00507 | 0.514 | 0.00116 | 0.0186 |

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A nitrogen/sulfur dioxide mixture of varying composition was bubbled through water. The analysis of the gas and liquid phase was done by a modified Palmrose technique (1,2) via a chemical titration. Details are given in the paper.

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. Triple distilled.

ESTIMATED ERROR:

$\delta$Solubility/Solubility = ±0.03 (compiler's estimate);

$\delta T/K = \pm 0.02$.

REFERENCES:

1. Palmrose, G. V. *Paper Trade J.* 1935, *100*, 38-9.
2. White, C. K.; Vivian, J. E.; Whitney, R. P. *Paper Trade J.* 1948, *126*, 26-8.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Water; $H_2O$; [7732-18-5] | Parkison, R. V.<br>*Tappi*<br>1956, *39*, 517-9. |

EXPERIMENTAL VALUES:

| t/°F | $T^a$/K | $P^b$/atm | $P^{a,b}$/kPa | Solubility/ (lb moles/ $ft^3$) | Solubility$^{a,c}$/ (mol $dm^{-3}$) |
|---|---|---|---|---|---|
| 70 | 294 | 0.00660 | 0.669 | 0.00141 | 0.0226 |
| | | 0.00734 | 0.744 | 0.00133 | 0.0213 |
| | | 0.00913 | 0.925 | 0.00176 | 0.0282 |
| | | 0.00983 | 0.996 | 0.00188 | 0.0301 |
| | | 0.0172 | 1.74 | 0.00288 | 0.0462 |
| | | 0.0280 | 2.84 | 0.00417 | 0.0668 |
| | | 0.0349 | 3.54 | 0.00498 | 0.0798 |
| 80 | 263 | 0.00150 | 0.153 | 0.000320 | 0.00513 |
| | | 0.00362 | 0.367 | 0.000580 | 0.00930 |
| | | 0.00469 | 0.475 | 0.000722 | 0.0116 |
| | | 0.00633 | 0.641 | 0.000921 | 0.0148 |
| | | 0.00641 | 0.649 | 0.000918 | 0.0147 |
| | | 0.00812 | 0.823 | 0.00111 | 0.0178 |
| | | 0.00885 | 0.897 | 0.00120 | 0.0192 |
| | | 0.00952 | 0.965 | 0.00126 | 0.0202 |
| | | 0.0110 | 1.11 | 0.00138 | 0.0221 |
| | | 0.0178 | 1.80 | 0.00204 | 0.0327 |
| | | 0.0251 | 2.54 | 0.00265 | 0.0425 |
| | | 0.0336 | 3.40 | 0.00334 | 0.0535 |

[a] Calculated by compiler.

[b] Partial pressure of $SO_2$.

[c] Molar solubility calculated by multiplying previous column by 16.03.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]

ORIGINAL MEASUREMENTS:

Rabe, A. E.; Harris, J. F.
*J. Chem. Engng. Data*
1963, *8*, 333-336.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

| T/K | $p_{SO_2}$/mmHg | $p_{SO_2}$/kPa | Conc. $g_{SO_2}$/100 g $H_2O$ | Mole fraction* of sulfur dioxide |
|---|---|---|---|---|
| 303.15 | 443.5 | 59.13 | 4.46 | 0.01238 |
| | 443.9 | 59.18 | 4.46 | 0.01238 |
| | 442.4 | 58.98 | 4.46 | 0.01238 |
| | 444.5 | 59.26 | 4.48 | 0.01245 |
| | 451.6 | 60.21 | 4.48 | 0.01245 |
| | 308.6 | 41.14 | 3.21 | 0.00894 |
| | 304.9 | 40.65 | 3.21 | 0.00894 |
| | 308.4 | 41.12 | 3.21 | 0.00894 |
| | 309.0 | 41.20 | 3.21 | 0.00894 |
| | 312.0 | 41.60 | 3.21 | 0.00894 |
| | 172.2 | 22.96 | 1.92 | 0.00537 |
| | 181.0 | 24.13 | 1.92 | 0.00537 |
| | 177.0 | 23.60 | 1.92 | 0.00537 |
| | 39.2 | 5.23 | 0.59 | 0.00166 |
| | 42.7 | 5.69 | 0.59 | 0.00166 |
| 313.15 | 624.4 | 83.25 | 4.48 | 0.01245 |
| | 638.8 | 85.17 | 4.48 | 0.01245 |
| | 418.0 | 55.73 | 3.21 | 0.00894 |
| | 420.0 | 56.00 | 3.21 | 0.00894 |
| | 242.0 | 32.26 | 1.92 | 0.00537 |

(cont.)

* calculated by compiler

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Partial vapor pressure of sulfur dioxide above solution containing known masses of sulfur dioxide determined by estimating amount of sulfur dioxide vapor in known volume. Sulfur dioxide estimated by dissolving gas sample up in dilute aqueous acetaldehyde soln. and titrating α-hydroxy sulfonic acid against sodium hydroxide potentiometrically. Details in source.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.02$ or less; $\delta p/p = 0.0044$ (std. dev.).

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Water; $H_2O$; [7732-18-5] | Rabe, A. E.; Harris, J. F.<br>*J. Chem. Engng. Data*<br>1963, *8*, 333-336. |

EXPERIMENTAL VALUES:

| T/K | $p_{SO_2}$/mmHg | $p_{SO_2}$/kPa | Conc. $g_{SO_2}$/100 g $H_2O$ | Mole fraction* of sulfur dioxide |
|---|---|---|---|---|
| 313.15 | 249.0 | 33.20 | 1.92 | 0.00537 |
| | 57.8 | 7.71 | 0.59 | 0.00166 |
| | 60.6 | 8.08 | 0.59 | 0.00166 |
| 323.15 | 583.3 | 77.77 | 3.20 | 0.00892 |
| | 592.9 | 79.05 | 3.20 | 0.00892 |
| | 608.4 | 81.11 | 3.20 | 0.00892 |
| | 583.3 | 77.77 | 3.21 | 0.00894 |
| | 585.7 | 78.09 | 3.21 | 0.00894 |
| | 324.6 | 43.28 | 1.92 | 0.00537 |
| | 328.5 | 43.80 | 1.92 | 0.00537 |
| | 330.9 | 44.12 | 1.92 | 0.00537 |
| | 335.1 | 44.68 | 1.92 | 0.00537 |
| | 85.8 | 11.44 | 0.59 | 0.00166 |
| | 86.7 | 11.56 | 0.59 | 0.00166 |
| 333.15 | 742.0 | 98.93 | 3.21 | 0.00894 |
| | 756.0 | 100.8 | 3.21 | 0.00894 |
| | 447.5 | 59.66 | 1.92 | 0.00537 |
| | 437.1 | 58.28 | 1.92 | 0.00537 |
| | 114.0 | 15.20 | 0.59 | 0.00166 |
| | 116.0 | 15.47 | 0.59 | 0.00166 |
| 343.15 | 151.0 | 20.13 | 0.59 | 0.00166 |
| | 153.0 | 20.40 | 0.59 | 0.00166 |
| 353.15 | 189.0 | 25.20 | 0.59 | 0.00166 |

* calculated by compiler

| T/K | $x_{SO_2}$ [a] |
|---|---|
| 313.15 | 0.01498 |
| 323.15 | 0.01149 |
| 333.15 | 0.00907 |

[a] Interpolated mole fraction solubility at a partial pressure of sulfur dioxide of 101.325 kPa; calculated by compiler.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]

2. Water; $H_2O$; [7732-18-5]

ORIGINAL MEASUREMENTS:

Vosolsobe, J.; Simecek, S.;
Michalek, J.; Kadler, B.

*Chem. Prumysl.*

1965, *15*, 401-404.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

| T/K<br>(T/°C) | $p_{SO_2}$/mmHg | $p$/kPa | g $SO_2$ / 100 g $H_2O$ | $10^3 x_{SO_2}$ |
|---|---|---|---|---|
| 293.2<br>(20) | 14.8 | 1.97 | 0.33 | 0.927 |
| | 29.7 | 3.96 | 0.57 | 1.60 |
| | 44.5 | 5.93 | 0.78 | 2.19 |
| | 59.4 | 7.92 | 1.02 | 2.86 |
| | 74.2 | 9.89 | 1.26 | 3.53 |
| | 89.1 | 11.88 | 1.48 | 4.15 |
| | 126 | 16.80 | 2.04 | 5.70 |
| 303.2<br>(30) | 14.6 | 1.95 | 0.25 | 0.703 |
| | 29.1 | 3.88 | 0.45 | 1.26 |
| | 43.7 | 5.83 | 0.61 | 1.71 |
| | 58.2 | 7.76 | 0.77 | 2.16 |
| | 72.8 | 9.71 | 0.92 | 2.58 |
| | 87.4 | 11.65 | 1.06 | 2.97 |
| | 123.8 | 16.51 | 1.45 | 4.06 |
| 313.2<br>(40) | 14.1 | 1.88 | 0.19 | 0.534 |
| | 28.2 | 3.76 | 0.32 | 0.899 |
| | 43.3 | 5.77 | 0.46 | 1.29 |
| | 57.4 | 7.65 | 0.54 | 1.52 |
| | 70.5 | 9.40 | 0.67 | 1.88 |
| | 84.6 | 11.28 | 0.78 | 2.19 |
| | 119.8 | 15.97 | 1.08 | 3.03 |

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Flow system apparatus in which a sulfur dioxide plus nitrogen gas mixture was bubbled through water. The partial pressure of sulfur dioxide could be varied by changing the composition of the gas mixture. Samples of water saturated with sulfur dioxide were analysed by iosometry.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{SO_2} = \pm 3\%$
(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]

ORIGINAL MEASUREMENTS:

Vosolsobe, J.; Simecek, S.; Michalek, J.; Kadler, B.

*Chem. Prumysl.*

1965, *15*, 401-404.

EXPERIMENTAL VALUES:

| T/K (T/°C) | $p_{SO_2}$/mmHg | $p$/kPa | $\frac{\text{g } SO_2}{\text{100 g } H_2O}$ | $10^3 x_{SO_2}$ |
|---|---|---|---|---|
| 323.2 | 13.3 | 1.77 | 0.16 | 0.450 |
| (50) | 26.7 | 3.56 | 0.26 | 0.731 |
| | 40.0 | 5.33 | 0.34 | 0.955 |
| | 53.4 | 7.12 | 0.42 | 1.18 |
| | 66.7 | 8.89 | 0.50 | 1.40 |
| | 80.1 | 10.68 | 0.60 | 1.68 |
| | 113.5 | 15.13 | 0.80 | 2.24 |
| 333.2 | 12.2 | 1.63 | 0.11 | 0.309 |
| (60) | 24.4 | 3.25 | 0.20 | 0.562 |
| | 36.6 | 4.88 | 0.24 | 0.674 |
| | 48.8 | 6.51 | 0.33 | 0.927 |
| | 61.1 | 8.15 | 0.36 | 1.01 |
| | 73.3 | 9.77 | 0.42 | 1.18 |
| | 103.8 | 13.84 | 0.58 | 1.63 |

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]

ORIGINAL MEASUREMENTS:

Sano, H.; Nakamoto, Y.
*Nippon Kagaku Zasshi*
1968, *89*, 369-373.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

Vapor pressure of water = 0.040 atm

| Absorption coefficient, $S^{a,b}$ | Bunsen coefficient,$^b$ $\alpha$ | Bunsen coefficient,$^c$ $\alpha$ | $\ell^{c,d}$ | Mole ratio | Mole fraction$^e$ |
|---|---|---|---|---|---|
| 29.8 | 28.3 | 25.6 | 24.5 | 0.023 | 0.022 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Determined by static absorption method.

[c] Determined by flow method.

[d] $\alpha = \ell(1 - p_s^\circ)$ where $p_s^\circ$ is the vapor pressure of solvent.

[e] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two techniques were used: (a) static absorption method and (b) flow method. Static method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The flow method consists of passing sulfur dioxide through a micro gas absorption tube and estimating sulfur dioxide by iodometric titration. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$
(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]

ORIGINAL MEASUREMENTS:

Tokunaga, J.

*J. Chem. Engng. Data*

1974, *19*, 162-165.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

| T/K | Solubility[#*] | Ostwald coefficient | Mole fraction[*] of sulfur dioxide, $x_{SO_2}$ |
|---|---|---|---|
| 283.15 | 0.1566 | 56.8 | 0.0422 |
| 293.15 | 0.1090 | 40.9 | 0.0297 |
| 303.15 | 0.0777 | 30.0 | 0.0214 |
| 313.15 | 0.0576 | 22.9 | 0.0159 |

[#] (g of $SO_2$/g $H_2O$).

[*] at partial pressure of 101.3 kPa.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide bubbled through water. Saturated solution analysed by iodometric titration. Details in source.

The apparatus employed was similar to that of Hudson, ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. High purity sample with purity of 99.96 mole per cent.
2. No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{SO_2} = \pm 1\%$ (estimated by compiler).

REFERENCES:

1. Hudson, J. C. *J. Chem. Soc.* 1925, 1332.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7746-09-5]
2. Water; $H_2O$; [7732-18-5]

ORIGINAL MEASUREMENTS:

Lavrova, E. M.; Tudorovskaya, L. L.
*Zhur. Prikl. Khim.*
1977, *50*, 1146-51.

VARIABLES:

T/K = 299-363

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

| t/°C | $T^a$/K | $x_1{}^b$ | wt-%$^c$ |
|---|---|---|---|
| 26 | 299.2 | 0.02387 | 8.00 |
| 40 | 313.2 | 0.01534 | 5.25 |
| 60 | 333.2 | 0.009063 | 3.15 |
| 80 | 353.2 | 0.0059 | 2.08 |
| 90 | 363.2 | 0.00504 | 1.77 |

[a] Calculated by compiler.

[b] Mole fraction solubility at 101.325 kPa partial pressure of gas.

[c] Presumably at 101.325 kPa partial pressure of gas.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Water was saturated with $SO_2$. The liquid phase was analyzed acidimetrically after oxidation of the dissolved $SO_2$ to $SO_3$ by hydrogen peroxide. The paper also reports on $SO_2$ solubilities in aqueous HCl solutions.

SOURCE AND PURITY OF MATERIALS:

1. Obtained by the action of cp $H_2SO_4$ on analytical grade sodium sulfite.
2. No details given.

ESTIMATED ERROR:

T/K = ±0.2; $\delta x_1/x_1$ = ±0.05

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Water; $H_2O$; [7732-18-5] | Douabul, A.; Riley, J.<br>*J. Chem. Engng. Data*, 1979, *24*, 274-276. |
| VARIABLES: | PREPARED BY: |
| Temperature | C.L. Young. |

EXPERIMENTAL VALUES:

| T/K | Solubility $^+$/mol dm$^{-3}$ | Mole fraction of sulfur dioxide, $x_{SO_2}$ |
|---|---|---|
| 278.97 | 2.959 | 0.05685 |
| 283.12 | 2.482 | 0.04693 |
| 288.10 | 2.065 | 0.03876 |
| 292.98 | 1.697 | 0.03168 |
| 298.15 | 1.419 | 0.02644 |
| 303.25 | 1.201 | 0.02224 |

+ Partial pressure of $SO_2$ = 1 atm = 101.3 kPa.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide bubbled through water for 21 hours with gentle stirring. Pressure measured with mercury manometer. Samples of about 60 cm$^3$ were withdrawn and mixed with 150 cm$^3$ of hydrogen peroxide solution. Solution then titrated with carbonate free sodium hydroxide solution.

SOURCE AND PURITY OF MATERIALS:

1. Refrigeration grade obtained from BDH. Mass spectrometric analysis showed its purity was better than 99.9 mole per cent.
2. Distilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.01$; $\delta x_{SO_2} = \pm 0.1\%$

REFERENCES:

| | |
|---|---|
| COMPONENTS:<br>1. Sulfur dioxide; $SO_2$; [7746-09-5]<br>2. Water; $H_2O$; [7732-18-5] | ORIGINAL MEASUREMENTS:<br>Byerley, J. J.; Rempel, G. L.; Le, V. T.<br>*J. Chem. Eng. Data*<br>1980, *25*, 55-6. |
| VARIABLES:<br>T/K = 298-323 | PREPARED BY:<br>R. Battino |

EXPERIMENTAL VALUES:

| t/°C | $T^a$/K | $x_1{}^{a,b}$ | g $SO_2$ $^c$/100 g $H_2O$ |
|---|---|---|---|
| 25 | 298.15 | 0.02265 | 8.24 |
| 50 | 323.15 | 0.01049 | 3.77 |

[a] Calculated by compiler.

[b] Mole fraction solubility at 101.325 kPa partial pressure of gas.

[c] At 101.325 kPa partial pressure of gas.

AUXILIARY INFORMATION

| | |
|---|---|
| METHOD/APPARATUS/PROCEDURE:<br>Sulfur dioxide was bubbled through water and the amount dissolved was determined by titrating excess iodine with standard thiosulfate solution. (The authors also studied the solubility of $SO_2$ in water-acetonitrile solutions.) | SOURCE AND PURITY OF MATERIALS:<br>1. Anhydrous from Union Carbide Canada Ltd.<br>2. Distilled.<br>ESTIMATED ERROR:<br>$\delta T/K = \pm 0.1$; $\delta x_1/x_1 = \pm 0.02$<br>(compiler's estimate).<br>REFERENCES: |

| COMPONENTS: | EVALUATOR: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Seawater | Colin L. Young,<br>School of Chemistry,<br>University of Melbourne,<br>Parkville, Victoria 3052,<br>Australia.<br>December 1981 |

CRITICAL EVALUATION:

This system has been investigated by Douabul and Riley (1) in some detail. Although their data are self-consistent there is some doubt as to absolute accuracy of the measurements since data on the solubility of sulfur dioxide in pure water given in the same appear appear to be at least several per cent in error. (See sulfur dioxide + water evaluation.) The only other measurements on this system are those of Abdulsattar (2) whose data are very limited in scope and are of questionable accuracy, ±15% at the best. Abdulsattar's data are therefore rejected. The solubility of sulfur dioxide in seawater has been calculated by Abdulsattar *et al.* (3) based on a simplified chemical model. However, such calculated data are for a lower partial pressure of sulfur dioxide than used in the experimental work of Douabul and Riley (1). Under these conditions a relatively large proportion of the sulfur dioxide is accounted for in neutralizing the natural alkalinity of the sea water. It should also be pointed out that the data of Douabul and Riley (1) should not be extrapolated to low partial pressures assuming Henry's Law to be obeyed. Such an assumption is not valid in the present context.

References

1. Douabul, A.; Riley, J.
*J. Chem. Eng. Data* 1979, *24*, 274.

2. Abdulsattar, A. H. *M.Sc. Thesis*, University of California,
Berkeley, 1971.

3. Abdulsattar, A. H .; Sridhar, S.; Bromley, L. A.
*Am. Inst. Chem. Engnrs. J.* 1977, *23*, 62.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Seawater

ORIGINAL MEASUREMENTS:

Douabul, A.; Riley, J.

*J. Chem. Engng. Data.* 1979, *24*, 274-276.

VARIABLES:

Temperature, salinity.

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | Salinity /$gkg^{-1}$ | Specific gravity of soln. | Solubility$^{+}$/mol $dm^{-3}$ exptl. | smoothed |
|---|---|---|---|---|
| 278.97 | 0.0 | 1.074 | 2.959 | 2.959 |
| | 10.065 | 1.080 | 2.956 | 2.956 |
| | 20.034 | 1.087 | 2.954 | 2.954 |
| | 30.074 | 1.095 | 2.954 | 2.953 |
| | 40.005 | 1.103 | 2.953 | 2.953 |
| 283.12 | 0.0 | 1.067 | 2.482 | 2.491 |
| | 10.065 | 1.075 | 2.479 | 2.488 |
| | 20.034 | 1.082 | 2.477 | 2.487 |
| | 30.074 | 1.088 | 2.477 | 2.486 |
| | 40.005 | 1.094 | 2.476 | 2.485 |
| 288.10 | 0.0 | 1.055 | 2.065 | 2.047 |
| | 10.065 | 1.063 | 2.062 | 2.044 |
| | 20.034 | 1.071 | 2.061 | 2.042 |
| | 30.074 | 1.078 | 2.060 | 2.042 |
| | 40.005 | 1.085 | 2.059 | 2.041 |
| 292.98 | 0.0 | 1.045 | 1.697 | 1.706 |
| | 10.065 | 1.052 | 1.694 | 1.704 |
| | 20.034 | 1.059 | 1.693 | 1.703 |
| | 30.074 | 1.066 | 1.692 | 1.701 |
| | 40.005 | 1.074 | 1.691 | 1.700 |
| 298.15 | 0.0 | 1.032 | 1.419 | 1.421 |
| | 10.065 | 1.042 | 1.417 | 1.420 |
| | 20.034 | 1.050 | 1.416 | 1.418 |
| | 30.074 | 1.058 | 1.414 | 1.417 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide bubbled through seawater for 21 hours with gentle stirring. Pressure measured with mercury manometer. Samples of about 60 $cm^3$ were withdrawn and mixed with 150 $cm^3$ of hydrogen peroxide solution. Solution then titrated with carbonate free sodium hydroxide solution. Allowance made for acid originally in sample.

SOURCE AND PURITY OF MATERIALS:

1. Refrigeration grade obtained from BDH. Mass spectrometric analysis showed its purity to be better than 99.9 mole per cent.
2. Surface water from Irish sea filtered and samples of salinities ranging from 10-40% prepared by evaporation or dilution with distilled water, acidified to pH 2.8 with sulfuric acid.

ESTIMATED ERROR:

$\delta T/K = \pm 0.01$; $\delta x_{SO_2} = \pm 0.1\%$

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; SO ; [7446-09-5]<br>2. Seawater | Douabul, A.; Riley, J.<br>*J. Chem. Engng. Data.* 1979, *24*, 274-276. |

EXPERIMENTAL VALUES:

| T/K | Salinity, /gkg$^{-1}$ | Specific gravity of soln. | Solubility $^{+}$/mol dm$^{-3}$ exptl. | smoothed |
|---|---|---|---|---|
| 298.15 | 40.005 | 1.064 | 1.414 | 1.416 |
| 303.25 | 0.0 | 1.028 | 1.201 | 1.199 |
| | 10.065 | 1.034 | 1.200 | 1.198 |
| | 20.034 | 1.040 | 1.198 | 1.196 |
| | 30.074 | 1.048 | 1.197 | 1.195 |
| | 40.005 | 1.056 | 1.196 | 1.194 |

\+ Partial pressure of $SO_2$ = 1 atm = 101.3 kPa.

| COMPONENTS: | EVALUATOR: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Water; $H_2O$; [7732-18-5]<br>3. Metallic salts | C. L. Young,*<br>School of Chemistry,<br>University of Melbourne,<br>Parkville, Victoria 3052,<br>Australia.<br>August 1980 |

CRITICAL EVALUATION:

The evaluation of the data for aqueous solutions of 19 salts reported by Fox (1) is uncertain, because of unsatisfactory presentation. Fox expressed the concentration of the salt as "normality," using one half of the molecular weight in the examples of the sulfates of sodium, potassium and ammonium, and of the halides and sulfate of cadmium. The "solubility" was expressed as the Ostwald coefficient, $L$; but it is not absolutely clear if the volume used was that of the original liquid (initial solution of salt) or that of the solution saturated with sulfur dioxide. Densities were not recorded, and therefore mole fractions cannot be accurately estimated. The weights of sulfur dioxide absorbed by a given volume or weight of solution were not reported, although these data were determined. The particular weight was converted into a volume of gas by the use of 22.4 $dm^3$ as the molar volume of sulfur dioxide at 273.15 K and 1 atm; whereas the real volume is 21.87 $dm^3$. This means that the $L$ values as given are about 2% too large.

In Seidell and Linke (2) the data were given (p.1413) as the "Ostwald Solubility Expression ml $SO_2$ at t°, 1 atm per ml solvent". Bancroft and Gould (3) gave a table of Bunsen absorption coefficients for sulfur dioxide and aqueous solutions of sodium and potassium salts restricted to "0.5 molar." These data are based entirely on the Fox data, although this source was not acknowledged. The coefficients for the sulfates, given as for "0.5 molar" are based on Fox's $L$ values for 0.5 *normal*, *i.e.*, 0.25 molar. In Seidell and Linke (p.1414) the Bancroft and Gould list is given as if these were original data.

Hudson's (4) data were presented in the rudimentary form of g $SO_2$/100 g water content for each concentration of salt (only potassium chloride and sodium sulfate were studied) as g salt/100 g of water content. The main uncertainty in the Hudson values lies in the allowance for the vapor pressure of water over the final solution. Data on the lowering of the vapor pressure of water over the aqueous solution of potassium chloride were taken from the work of Tammann (5), and could be as much as 75 mmHg at 363 K. The lowering due to dissolved sulfur dioxide was calculated on the basis of Raoult's law, and was estimated as about 0.1% at 283 K and 1.25% at 363 K. The author believed the corrections to be only approximate, "as there are grounds for believing that sulphur dioxide combines both with the water and with the added salts." Hudson assumed the application of Henry's law (mole ratio form) in the adjustment of the g $SO_2$/100 g $H_2O$ value from the estimated $p_{SO_2}$ to 1 atm. As presented, the data for sodium sulfate solutions did not show the breakdown into $p_{Total}$

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* based on a more detailed evaluation in terms of the R-line approach (11) by W. Gerrard.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Metallic salts

EVALUATOR:

C. L. Young,*
School of Chemistry,
University of Melbourne,
Parkville, Victoria 3052,
Australia.

August 1980

CRITICAL EVALUATION:

and $p_{SO_2}$ because it was concluded that the estimated $p_{SO_2}$ values were within 10 mmHg of 1 atm. Again the adjustment to 1 atm was based on Henry's law (mole ratio form). Attempts to correlate the Hudson data and the Fox data are frustrated by the lack of density data in the Fox work. Hudson stated that the densities of the salt solutions themselves are insufficient, for "considerable expansion of the solutions occurs when sulphur dioxide dissolves."

The evaluation of the data of Conrad and Beuschlein (6) on the CaO-water-$SO_2$ system, and of Conrad and Brice (7) on the MgO-water-$SO_2$ system requires cognition of the purpose of the measurements, and the definition of "total", "combined", and "free" sulfur dioxide, and that a solid phase was present. The amount of sulfur dioxide in the liquid phase at equilibrium was expressed as g $SO_2$/100 g water. The work was done in connection with the use of the "Sulfite Process" in the manufacture of wood pulp. These authors used the following definition decided upon by the Technical Association of Pulp and Paper Institute: "the free $SO_2$ is the actual free $SO_2$ plus half of the $SO_2$ in the bisulfite of calcium (or magnesium), and is more properly called the *available* $SO_2$ as it indicates the $SO_2$ in excess of the amount necessary to form monosulfite." The authors defined the term "combined sulfur dioxide" as that required to form the monosulfite.

Data by White, Vivian and Whitney (8) are for the calcium sulfite system in which there was no solid phase, and the solution may be deemed as unsaturated with respect to the calcium sulfite. These workers stated the partial pressure, $p_{SO_2}$, and they reported data for water itself to show the reliability of their data for the salt solutions.

The data of Domansky and Rendos (9) for dilute solutions of "ammonium bisulfite" are deemed acceptable (see compilation sheets).

The earlier data of Smith and Parkhurst (10), determined in relation to the paper-pulp industry, were based on a combined sulfur dioxide (C) fixed by the "normality" of $Ca(SO_3H)_2$ or $Mg(SO_3H)_2$, and not on $CaSO_3$ as in the later TAPPI definition. In the former definition, the free $SO_2$ is the total (T) $SO_2$ minus the $SO_2$ combined as $Ca(SO_3H)_2$ or $Mg(SO_3H)_2$, and is therefore less than that based on the second definition for the same value of $SO_2$ (T).

References:

1. Fox, C. J. J. *Z. Phys. Chem.* 1902, *41*, 458.
2. Seidell, A.; Linke, W. F. *Solubilities of Inorganic and Organic Compounds*, 1958, 1865.

(cont.)

| COMPONENTS: | EVALUATOR: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Water; $H_2O$; [7732-18-5]<br>3. Metallic salts | C. L. Young, *<br>School of Chemistry,<br>University of Melbourne,<br>Parkville, Victoria 3052,<br>Australia.<br>August 1980 |

CRITICAL EVALUATION:

References (cont.)

3. Bancroft, W. D.; Gould, L. P. *J. Phys. Chem.* 1934, *38*, 197.
4. Hudson, J. C. *J. Chem. Soc.* 1925, *127*, 1332.
5. Tammann, G. *Ann. Phys. Chem.* 1885, [2], *24*, 523.
6. Conrad, F. H.; Beuschlein, W. L. *J. Am. Chem. Soc.* 1934, *56*, 2554.
7. Conrad, F. H.; Brice, D. B. *J. Am. Chem. Soc.* 1948, *70*, 2179.
8. White, C. K.; Vivian, J. E.; Whitney, R. P. *Paper Trade J.* 1948, *126*, 46.
9. Domansky, R.; Rendos, F. *Chem. Zvesti* 1957, *11*, 453-460.
10. Smith, W. T.; Parkhurst, R. B. *J. Am. Chem. Soc.* 1922, *44*, 1918.
11. Gerrard, W. *Solubility of Gases and Liquids*, 1976, Plenum Press, New York.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Hydrogen chloride; HCl; [7647-01-0]

ORIGINAL MEASUREMENTS:

Lavrova, E. M.; Tudorovskaya, G. L.
*Zh. Prikl. Khim.* 1977, *50*, 1146-1151;
*J. Appl. Chem. USSR* 1977, *50*, 1102-1106.

VARIABLES:

Temperature, liquid composition

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

| T/K | Conc. of HCl in absorbing soln. /wt-% | Solubility of sulfur dioxide /wt-% | Mole fraction of sulfur dioxide $x_{SO_2}$ |
|---|---|---|---|
| 299.2 | 0 | 8.00 | 0.02387 |
| 313.2 | | 5.25 | 0.01534 |
| 333.2 | | 3.15 | 0.009063 |
| 353.2 | | 2.08 | 0.0059 |
| 363.2 | | 1.77 | 0.00504 |
| 299.2 | 2.2 | 8.00 | 0.02407 |
| 313.2 | | 5.42 | 0.01603 |
| 333.2 | | 3.40 | 0.0099 |
| 353.2 | | 2.75 | 0.00798 |
| 363.2 | | 2.24 | 0.00647 |
| 299.2 | 4.30 | 7.76 | 0.02354 |
| 313.2 | | 5.25 | 0.01569 |
| 333.2 | | 2.89 | 0.0084 |
| 353.2 | | 2.47 | 0.00723 |
| 363.2 | | 2.24 | 0.00654 |
| 299.2 | 11.0 | 8.40 | 0.02671 |
| 313.2 | | 5.35 | 0.01660 |
| 333.2 | | 3.25 | 0.009353 |
| 353.2 | | 2.50 | 0.00769 |
| 363.2 | | 2.00 | 0.00607 |
| 299.2 | 15.0 | 8.40 | 0.02891 |
| 313.2 | | 5.50 | 0.01750 |
| 333.2 | | 3.48 | 0.01089 |

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide bubbled into hydrochloric acid solution. Solubility determined by acidimetric analysis of liquid phase after oxidation of dissolved sulfur dioxide to sulfuric acid using hydrogen peroxide.

SOURCE AND PURITY OF MATERIALS:

1. Prepared by action of "cp" sulfuric acid on analytical grade sodium sulfite. Dried.
2. No details given.
3. "cp" grade.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta x_{SO_2} = \pm 5\%$.

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Water; $H_2O$; [7732-18-5]<br>3. Hydrogen chloride; HCl; [7647-01-0] | Lavrova, E. M.; Tudorovskaya, G. L.<br>*Zh. Prikl. Khim.* 1977, *50*, 1146-1151;<br>*J. Appl. Chem. USSR* 1977, *50*, 1102-1106. |

EXPERIMENTAL VALUES:

| T/K | Conc. of HCl in absorbing soln. /wt-% | Solubility of sulfur dioxide /wt-% | Mole fraction of sulfur dioxide $x_{SO_2}$ |
|---|---|---|---|
| 353.2 | 15.0 | 2.67 | 0.00830 |
| 363.2 | | 2.06 | 0.00637 |
| 299.2 | 20.0 | 13.65 | 0.0470 |
| 313.2 | | 6.28 | 0.02113 |
| 333.2 | | 4.00 | 0.0130 |
| 353.2 | | 3.60 | 0.01160 |
| 363.2 | | 2.67 | 0.00854 |
| 299.2 | 21.5 | 13.65 | 0.00484 |
| 313.2 | | 6.47 | 0.02199 |
| 333.2 | | 3.72 | 0.01267 |
| 353.2 | | 3.01 | 0.00975 |
| 363.2 | | 2.73 | 0.00880 |
| 299.2 | 24.8 | 18.8 | 0.07154 |
| 313.2 | | 6.14 | 0.02081 |
| 333.2 | | 3.15 | 0.01040 |
| 353.2 | | 2.90 | 0.00956 |
| 363.2 | | 0.909 | 0.00295 |
| 299.2 | 28.0 | 13.7 | 0.05034 |

Smoothing equations of the form

$$\log x_{SO_2} = -A + B/(T/K)$$

were given.

| Conc. of HCl/wt-% | A | B |
|---|---|---|
| 0 | 5.47 | 1.41 |
| 2.2 | 4.77 | 0.937 |
| 4.3 | 4.85 | 0.953 |
| 11.0 | 5.1 | 1.050 |
| 15.0 | 5.1 | 1.051 |
| 22.0 | 5.19 | 1.128 |
| 21.5 | 5.43 | 1.20 |
| 24.8 | 7.8 | 1.96 |

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Sulfuric acid; $H_2SO_4$; [7664-93-9]

ORIGINAL MEASUREMENTS:

Miles, F.D.; Fenton, J.

*J. Chem. Soc.* 1920, *117*, 59-61.

VARIABLES:

Concentration of acid.

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

| T/K | Sulfuric acid per cent | $SO_2$ dissolved by 100 g of acid / g | *Moles $SO_2$ /100 g acid | *Moles $SO_2$/ total number of moles, $H_2SO_4$ + $H_2O$ in 100 g of acid. |
|---|---|---|---|---|
| 293 | 55.1 | 5.13 | 0.0802 | 0.0262 |
| | 59.6 | 4.90 | 0.0766 | 0.0269 |
| | 61.6 | 4.82 | 0.0753 | 0.0273 |
| | 68.9 | 4.16 | 0.0650 | 0.0267 |
| | 74.1 | 3.63 | 0.0567 | 0.0258 |
| | 78.3 | 3.23 | 0.0505 | 0.0252 |
| | 80.2 | 3.12 | 0.0488 | 0.0254 |
| | 82.5 | 2.99 | 0.0467 | 0.0258 |
| | 84.2 | 2.88 | 0.0450 | 0.0259 |
| | 85.3 | 2.83 | 0.0442 | 0.0261 |
| | 85.8 | 2.80 | 0.0438 | 0.0263 |
| | 86.5 | 2.82 | 0.0441 | 0.0270 |
| | 88.1 | 2.9 | 0.0453 | 0.0290 |
| | 90.8 | 3.10 | 0.0484 | 0.0337 |
| | 92.8 | 3.21 | 0.0502 | 0.0372 |
| | 93.7 | 3.27 | 0.0511 | 0.0391 |
| | 94.0 | 3.31 | 0.0517 | 0.0400 |
| | 94.6 | 3.50 | 0.0547 | 0.0432 |
| | 95.5 | 3.69 | 0.0577 | 0.0471 |
| | 95.6 | 3.77 | 0.0589 | 0.0483 |
| | 96.5 | 3.83 | 0.0598 | 0.0508 |
| | 98.0 | 3.98 | 0.0622 | 0.0560 |
| | 98.5 | 4.03 | 0.0630 | 0.0579 |

NOTE: "Sulfuric acid per cent" probably means by weight. The term "acid" refers to the aqueous solution of sulfuric acid.

* Calculated by compiler.

AUXILLIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was passed into the acid (15-20 g), mechanically stirred in a test-tube held in a thermostat. Samples of the saturated solution were withdrawn into small weighed glass bulbs that were sealed, weighed, and opened under (1) *N*-sodium hydroxide, (2) *N*/10-iodine for chemical titrations.

"A correction was applied when the barometer diverged appreciably from 760 mm."

SOURCE AND PURITY OF MATERIALS:

No information given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Water; $H_2O$; [7732-18-5]<br>3. Sulfuric acid; $H_2SO_4$; [7664-93-9] | Cupr, V.<br>*Rec. Trav. Chim.* 1928, *47*, 55-72. |
| VARIABLES:<br>Temperature, concentration of acid. | PREPARED BY:<br>W. Gerrard. |

EXPERIMENTAL VALUES: The values were stated to be for a total pressure of 760 mmHg, i.e., for 1 atm = 101.325 kPa.

| T/K 314.15 | | | T/K 335.15 | | |
|---|---|---|---|---|---|
| Weight of $H_2SO_4$ in 100 g solution / g | Wt. of $SO_2$ /100 g solution of $H_2SO_4$/g | *L* | Weight of $H_2SO_4$ in 100 g solution / g | Wt. of $SO^2$ /100 g solution of $H_2SO_4$/g | *L* |
| 0.00 | 4.88 | 16.9 | 0.00 | 2.16 | 7.42 |
| 0.00 | 4.75 | 16.5 | 0.00 | 2.13 | 7.32 |
| 7.32 | 3.65 | 13.3 | 10.02 | 1.71 | 6.28 |
| 18.07 | 3.35 | 12.8 | 30.26 | 1.26 | 5.25 |
| 18.28 | 3.29 | 12.8 | 30.52 | 1.20 | 5.00 |
| 44.34 | 2.57 | 11.9 | 54.06 | 1.20 | 5.90 |
| 71.86 | 1.68 | 9.47 | 79.07 | 1.19 | 6.95 |
| 79.51 | 1.54 | 9.18 | 84.34 | 1.15 | 6.95 |
| 86.20 | 1.36 | 8.40 | 84.82 | 1.17 | 7.08 |
| 86.54 | 1.45 | 8.96 | 90.73 | 1.19 | 7.36 |
| 86.66 | 1.47 | 9.09 | 91.20 | 1.17 | 7.28 |
| 93.78 | 1.81 | 11.5 | 93.68 | 1.16 | 7.26 |
| 96.65 | 2.06 | 13.1 | 96.10 | 1.16 | 7.29 |
| 97.69 | 2.15 | 13.6 | | | |

The symbol *L* indicates the "absorption coefficient" which appears to be the volume in $cm^3$ (adjusted to 273 K) of $SO_2$ absorbed to give one $cm^3$ of solution saturated with $SO_2$ at 760 mmHg and at the temperature recorded in the table. These were calculated from the weight values and the published densities of aqueous solutions of sulfuric acid. See evaluation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was passed into the aqueous solution in an "absorption apparatus." A sample was withdrawn into a weighed flask for the determination of sulfur dioxide by a chemical titration, using the iodine-thiosulfate technique.

The "absorption coefficient, *L*" was determined by calculation from the weight data. The molar volume of 22400 $cm^3$ appears to have been used to convert weight of $SO_2$ into volume

SOURCE AND PURITY OF MATERIALS:

(1) Sulfur dioxide was obtained from Merck quality sodium sulfite and concentrated sulfuric acid, and passed through the acid.

(2) Water may be taken as of satisfactory purity.

(3) Sulfuric acid was of satisfactory purity.
The solutions were attested volumetrically.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Sulfuric acid; $H_2SO_4$; [7664-93-9]

ORIGINAL MEASUREMENTS:

Lopatto, E.K.; Savinaev, A.M.
*J. Applied Chem. (USSR)* 1934, *7*, 881-886.

VARIABLES:

Concentration of acid, partial pressure of gas.

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

760 mmHg = 1 atm = 101.325 kPa

| Weight % of $H_2SO_4$ in aqueous solution (initial). | *% $SO_2$ in mixture of air + $SO_2$ | % $SO_2$ in aqueous solution of acid at T/K | | | | |
|---|---|---|---|---|---|---|
| | | 293 | 303 | 313 | 323 | 333 |
| 61.59 | 9 | - | 0.345 | 0.262 | 0.194 | 0.153 |
| | 12 | - | 0.587 | 0.449 | 0.314 | 0.250 |
| | 24 | - | 1.990 | 1.495 | 1.00 | 1.730 |
| 66.71 | 7.2 | 0.304 | 0.221 | 0.167 | - | - |
| | 11.2 | - | 0.342 | 0.253 | - | - |
| | 17.6 | 0.809 | 0.560 | 0.401 | - | - |
| | 19.2 | - | 0.569 | 0.486 | - | - |
| | 23.8 | 1.172 | 0.734 | - | - | - |
| | 27.9 | - | 0.891 | 0.726 | - | - |
| | 34.2 | 1.920 | - | - | - | - |
| | 37.6 | 2.058 | 1.317 | 1.043 | - | - |
| 70.74 | 9 | - | 0.255 | 0.175 | 0.137 | 0.104 |
| | 12 | - | 0.362 | 0.270 | 0.199 | 0.162 |
| | 18 | - | 0.522 | 0.420 | 0.344 | 0.271 |
| | 24 | - | 0.744 | 0.542 | 0.418 | 0.355 |
| 73.64 | 9 | - | 0.415 | 0.327 | 0.249 | 0.169 |
| | 12 | - | 0.523 | 0.395 | 0.270 | 0.210 |
| | 24 | - | 0.854 | 0.609 | 0.474 | 0.371 |
| 78.04 | 9 | - | 0.380 | 0.262 | 0.209 | 0.146 |
| | 12 | - | 0.455 | 0.353 | 0.252 | 0.194 |
| | 18 | - | 0.586 | 0.439 | 0.340 | 0.263 |
| | 24 | - | 0.779 | 0.542 | 0.452 | 0.364 |

* By volume

\+ Typographical error in original. Should be 0.730. This error was copied without comment in "Solubilities of Inorganic and Organic Compounds", Seidell, A.; Linke, W.F. 1958-1965.

METHOD/APPARATUS/PROCEDURE:

A mixture of air and sulfur dioxide was passed into the bottom of an absorption tube via a porous plate above which the aqueous solution was held. A thermometer reaching below the liquid was fitted into the tube. The tube was immersed in a thermostat.

SOURCE AND PURITY OF MATERIALS:

May be taken as satisfactory.

ESTIMATED ERROR:

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Water; $H_2O$; [7732-18-5]<br>3. Sulfuric acid; $H_2SO_4$; [7664-93-9] | Johnstone, H.F.; Leppla, P.W.<br>*J. Am. Chem. Soc.* 1934, *56*, 2233-2238 |
| **VARIABLES:** | **PREPARED BY:** |
| Pressure, concentration of acid | W. Gerrard. |

EXPERIMENTAL VALUES:

T/K = 298.15

| Conc. of $H_2SO_4$, /mol kg$^{-1}$ ($H_2O$) | Pressure, $p_{SO_2}$ /atm | Conc. of $SO_2$, /mol kg$^{-1}$ ($H_2O$) | Ratio of conc. of $SO_2/p_{SO_2}$ /mol kg$^{-1}$ atm$^{-1}$ | *Mole fraction $x_{SO_2}$, referred to $H_2O$ (**) |
|---|---|---|---|---|
| 0.0879 | 0.00130 | 0.00193 | 1.485 | 0.0260 |
| 0.0879 | 0.00571 | 0.01129 | 1.977 | 0.0344 |
| 0.0879 | 0.01022 | 0.01878 | 1.838 | 0.0320 |
| 0.5174 | 0.00130 | 0.00161 | 1.238 | 0.0218 |
| 0.5174 | 0.00571 | 0.00796 | 1.394 | 0.0245 |
| 0.5174 | 0.01022 | 0.01345 | 1.316 | 0.0232 |
| 1.103 | 0.00131 | 0.00134 | 1.023 | 0.0181 |
| 1.103 | 0.00573 | 0.00719 | 1.255 | 0.0221 |
| 1.103 | 0.01022 | 0.01253 | 1.226 | 0.0216 |

* Calculated by the compiler

** Assuming all the liquid is pure water.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The low partial pressures of sulfur dioxide were attained by using a mixture of nitrogen and sulfur dioxide, the latter being measured from a gas buret. The sulfur dioxide was passed into a "Pyrex saturator (Bichowsky, and Storch) (1)" until equilibrium was reached, as indicated by concordance of successive analyses Samples were withdrawn for titration with iodine and thiosulfate solutions

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide stated to be of high purity from a tank of the liquid.
2. Conductivity water.
3. Not stated.

ESTIMATED ERROR:

REFERENCES:

1. Bichowsky, F.R.; Storch, H. *J. Am. Chem. Soc.* 1915, *37*, 2695.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Sulfuric acid; $H_2SO_4$; [7664-93-9]

ORIGINAL MEASUREMENTS:

Milbauer, J.

*Bull. Soc. Chim.* 1935, (5), *3*, 221-224

VARIABLES:

Temperature

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

760 mmHg = 1 atm = 101.325 kPa

| T/K | Density of the acid solution, /g cm$^{-3}$ | Weight of $SO_2$ absorbed by 100 g of the original acid solution/g |
|---|---|---|
| 296.15 | 1.824 | 3.075 |
| 303.15 | (90.8% $H_2SO_4$) | 2.270 |
| 323.15 | | 1.525 |
| 373.15 | | 0.436 |
| 423.15 | | 0.171 |
| 473.15 | | 0.053 |
| 510.15 | | 0.040 |
| 298.15 | 1.53 | 3.1582 |
| 318.15 | (62% $H_2SO_4$) | 1.4597 |
| 333.15 | | 1.0200 |
| 353.15 | | 0.5813 |
| 373.15 | | 1.4908 * (Probably meant to be 0.4908) |

* By compiler.

There was no mention of pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was passed into a weighed amount of the aqueous acid solution in a bubbler tube fitted with an inlet tap and an outlet tap. The temperature was stated to be controlled to within ±0.1°C. Pressure was not mentioned. The weight of sulfur dioxide absorbed was determined by a chemical titration using iodine-thiosulfate solutions.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was stated to be "pure," and was dried by sulfuric acid.
2. Distilled water was mentioned in the description of the chemical titration.
3. Presumably good quality sulfuric acid was used.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Sulfuric acid; $H_2SO_4$; [7664-93-9]

ORIGINAL MEASUREMENTS:

Sano, H.; Nakamoto, Y.
*Nippon Kagaku Zasshi*
1968, *89*, 369-373.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

| Absorption coefficient, $S^{a,b}$ | Bunsen coefficient,$^{b}$ $\alpha$ | Bunsen coefficient,$^{c,f}$ $\alpha$ | $\ell^{c,d}$ | Mole ratio | Mole fraction$^{e}$ |
|---|---|---|---|---|---|
| 21.2 | 19.2 | 19.2 | 19.2 | 0.046 | 0.044 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Determined by static absorption method.

[c] Determined by flow method.

[d] $\alpha = \ell(1 - p_s^{\circ})$ where $p_s^{\circ}$ is the vapor pressure of solvent.

[e] Calculated by compiler.

[f] Assuming vapor pressure of sulfuric acid is negligible.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two techniques were used: (a) static absorption method and (b) flow method. Static method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The flow method consists of passing sulfur dioxide through a micro gas absorption tube and estimating sulfur dioxide by iodometric titration. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Sulfuric acid (fuming); $H_2SO_4$; [7664-93-9]

ORIGINAL MEASUREMENTS:

Miles, F.D.; Carson, T.

*J. Chem. Soc.* 1946, 786-790.

VARIABLES:

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

760 mmHg = 1 atm = 101.325 kPa.

| T/K | $SO_3$, % Total | $SO_2$ % | *Mole $SO_2$/ mole $SO_3$ |
|---|---|---|---|
| 293.15 | 80.21 | 3.85 | 0.0600 |
| | 80.37 | 3.81 | 0.0593 |
| | 80.64 | 3.66 | 0.0567 |
| | 80.81 | 3.65 | 0.0565 |
| | 81.63 | 3.88 | 0.0594 |
| | 82.03 | 3.95 | 0.0602 |
| | 82.07 | 3.85 | 0.0586 |
| | 82.12 | 3.91 | 0.0595 |
| | 82.13 | 3.96 | 0.0603 |
| | 82.17 | 3.98 | 0.0605 |
| | 82.53 | 4.66 | 0.0706 |
| | 82.75 | 4.18 | 0.0631 |
| | 82.8 | 4.58 | 0.0691 |
| | 82.85 | 4.33 | 0.0653 |
| | 82.90 | 4.60 | 0.0694 |
| | 82.90 | 4.48 | 0.0675 |
| | 82.91 | 4.28 | 0.0645 |
| | 83.65 | 4.96 | 0.0741 |
| | 84.57 | 5.62 | 0.0831 |
| | 85.77 | 6.18 | 0.0901 |
| | 85.94 | 6.27 | 0.0912 |
| | 86.47 | 6.77 | 0.0979 |
| | 86.49 | 5.99 | 0.0866 |
| | 86.65 | 5.99 | 0.0864 |
| | 86.71 | 7.06 | 0.1018 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The "absorber" was a glass vessel "5 inches by 1.25 inches", closed by a large tap. A gas inlet was attached to the side, and had a perforated end. "Acid or oleum" was weighed in the tube. Sulfur dioxide was passed into the liquid, which was shaken; and saturation was deemed to be complete after 1-2 hours. Samples of the final liquid were obtained by means of capillary-bulb tubes and the sulfur dioxide was determined by iodine-thiosulfate titrations.

The weight of sulfur dioxide was stated to be corrected to correspond with "an atmosphere of dioxide at 760 mm pressure by multiplying each of the experimental values by the factor $760/(P - p)$," $P$ being the atmospheric pressure recorded during the determination, and $p$ being the vapor pressure of sulfuric trioxide over the oleum at the temperature of saturation .

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was used from a cylinder.
2. No information.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Sulfuric acid (fuming); $H_2SO_4$; [7664-93-9]

ORIGINAL MEASUREMENTS:

Miles, F.D.; Carson, T.

*J. Chem. Soc.* 1946, 786-790.

EXPERIMENTAL VALUES: 760mmHg = 1 atm = 101.325 kPa

| T/K | $SO_3$ % Total | $SO_2$ % | *Mole $SO_2$/ mole $SO_3$ |
|---|---|---|---|
| 293.15 | 86.93 | 7.52 | 0.1081 |
| | 87.11 | 6.47 | 0.0928 |
| | 87.90 | 9.06 | 0.1288 |
| | 88.30 | 9.17 | 0.1298 |
| | 88.60 | 9.58 | 0.1352 |
| | 88.90 | 9.41 | 0.1323 |
| | 90.65 | 11.98 | 0.1652 |
| | 90.70 | 12.05 | 0.1661 |
| | 91.10 | 12.17 | 0.1670 |
| | 91.30 | 12.14 | 0.1662 |
| | 93.16 | 18.73 | 0.2513 |
| | 93.30 | 18.93 | 0.2536 |
| | 93.30 | 20.42 | 0.2736 |
| | 93.34 | 20.28 | 0.2716 |
| | 94.20 | 23.31 | 0.3093 |
| | 94.60 | 22.13 | 0.2924 |
| | 95.22 | 25.78 | 0.3384 |
| | 95.02 | 27.58 | 0.3628 |
| | 95.10 | 28.34 | 0.3725 |
| | 95.23 | 28.16 | 0.3696 |
| 313.15 | 56.75 | 1.798 | 0.0396 |
| | 56.90 | 1.747 | 0.0384 |
| | 56.90 | 1.764 | 0.0387 |
| | 57.0 | 1.712 | 0.0375 |
| | 57.05 | 1.702 | 0.0373 |
| | 64.99 | 1.602 | 0.0308 |
| | 65.04 | 1.406 | 0.0270 |
| | 65.13 | 1.431 | 0.0275 |
| | 65.87 | 1.406 | 0.0267 |
| | 73.64 | 1.628 | 0.0276 |
| | 73.70 | 1.634 | 0.0277 |
| | 78.15 | 1.920 | 0.0307 |
| | 78.20 | 1.792 | 0.0286 |
| | 78.20 | 1.928 | 0.0308 |
| | 79.38 | 1.981 | 0.0312 |
| | 79.39 | 2.035 | 0.0320 |
| | 79.52 | 2.050 | 0.0322 |
| | 80.80 | 2.020 | 0.0313 |
| | 80.95 | 2.050 | 0.0317 |
| | 82.70 | 2.468 | 0.0373 |
| | 85.0 | 3.176 | 0.0467 |
| | 85.0 | 3.132 | 0.0461 |
| 333.15 | 57.75 | 0.983 | 0.0213 |
| | 57.9 | 0.986 | 0.0213 |
| | 57.91 | 0.988 | 0.0213 |
| | 65.88 | 0.855 | 0.0162 |
| | 66.03 | 0.834 | 0.0158 |
| | 66.14 | 0.848 | 0.0160 |
| | 66.23 | 0.858 | 0.0162 |
| | 73.75 | 0.949 | 0.0161 |
| | 73.82 | 0.953 | 0.0161 |
| | 73.87 | 0.990 | 0.0168 |
| | 78.22 | 1.196 | 0.0191 |
| | 78.31 | 1.172 | 0.0187 |
| | 79.50 | 1.346 | 0.0212 |
| | 79.57 | 1.337 | 0.0210 |
| | 79.60 | 1.359 | 0.0213 |
| | 79.90 | 1.371 | 0.0214 |
| | 84.30 | 1.625 | 0.0241 |
| | 84.40 | 1.610 | 0.0238 |

* Calculated by compiler

(cont'd)

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Sulfuric acid (fuming); $H_2SO_4$; [7664-93-9]

ORIGINAL MEASUREMENTS:

Miles, F.D.; Carson, T.
*J. Chem. Soc.* 1946, 786-790.

EXPERIMENTAL VALUES:

% Total $SO_3$ = 100 $SO_3/(SO_3 + H_2O)$;

% $SO_2$ = g of $SO_2$ dissolved by 100 g of acid or oleum, corrected for a pressure of 760 mm of $SO_2$.

The authors stated "to obtain a rough check on the applicability of Henry's law, some measurements of the equilibrium absorption from a gas mixture containing 6% of sulfur dioxide were also made." The gas mixture was stated to contain 94% of air, $p_{SO_2}$ then being taken as 0.06 atm.

| T/K | Liquid composition | Solubility at 1 atm $S_1$ | Solubility at 0.06 atm $S_2$ | $S_1$ x 0.06 |
|---|---|---|---|---|
| 293 | 80.2% $H_2SO_4$<br>65.4% total $SO_3$ | 3.10 | 0.187 | 0.186 |
| 313 | | 1.43 | 0.0974 | 0.086 |
| 333 | | 0.85 | 0.0637 | 0.051 |
| 293 | 96.5% $H_2SO_4$ | 3.80 | 0.222 | 0.228 |
| 313 | 78.6% total $SO_3$ | 1.95 | 0.126 | 0.117 |
| 333 | | 1.28 | 0.0863 | 0.0768 |
| 293 | 104% $H_2SO_4$ | 5.70 | 0.342 | 0.342 |
| 313 | 17.8% free $SO_3$ | 2.90 | 0.193 | 0.174 |
| 333 | | 1.74 | 0.120 | 0.105 |

$S_1$ and $S_2$ are g $SO_2$/100 g acid.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Sulfuric acid; $H_2SO_4$; [7664-93-9]

ORIGINAL MEASUREMENTS:

Parkison, R.V.

*TAPPI*, 1956, *39*, (7), 517-519.

VARIABLES:

Temperature, pressure

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES: 760 mmHg = 1 atm = 101.325 kPa

| T/K | $p_{SO_2}$/atm | $SO_2$ /lb mol $ft^{-3}$ | $^*x_{SO_2}$ | $^*x_{SO_2}/p_{SO_2}$ |
|---|---|---|---|---|
| 283.15 | 0.00150 | 0.000255 | 0.0000735 | 0.0467 |
| (50°F) | 0.00505 | 0.000850 | 0.000245 | 0.0463 |
| | 0.0174 | 0.00307 | 0.000885 | 0.0484 |
| | 0.0185 | 0.00329 | 0.000949 | 0.0488 |
| | 0.0261 | 0.00470 | 0.001355 | 0.0493 |
| | 0.0281 | 0.00498 | 0.00144 | 0.0486 |
| | 0.0332 | 0.00588 | 0.00170 | 0.0486 |
| | 0.0350 | 0.00615 | 0.00177 | 0.0483 |
| 294.26 | 0.00153 | 0.000171 | 0.0000493 | 0.0322 |
| (70°F) | 0.00339 | 0.000413 | 0.000119 | 0.0351 |
| | 0.00480 | 0.000503 | 0.000145 | 0.0302 |
| | 0.00662 | 0.000738 | 0.000213 | 0.0321 |
| | 0.00913 | 0.00102 | 0.000294 | 0.0322 |
| | 0.00983 | 0.00115 | 0.000332 | 0.0337 |
| | 0.0182 | 0.00203 | 0.000585 | 0.0322 |
| | 0.0257 | 0.00289 | 0.000833 | 0.0324 |
| | 0.0345 | 0.00380 | 0.00110 | 0.0318 |
| | 0.0349 | 0.00381 | 0.00110 | 0.0315 |
| 305.37 | 0.00633 | 0.000466 | 0.000134 | 0.0212 |
| (90°F) | 0.00641 | 0.000494 | 0.000142 | 0.0222 |
| | 0.00812 | 0.000601 | 0.000173 | 0.0213 |
| | 0.00885 | 0.000600 | 0.000173 | 0.0195 |
| | 0.00952 | 0.000759 | 0.000219 | 0.0230 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A mixture of sulfur dioxide and nitrogen (of desired "solute" concentration) was passed into the "equilibrium"solubility cell by an inlet tube shaped as a funnel at the end under the liquid. A tapped exit for sampling was attached to a bottom corner of the cell. The gas outlet was at the top of the cell. The cell was placed in a thermostat. The gas and liquid were analyzed by the Palmrose technique(1), an iodine-thiosulfate type of titration. The gas mixtures were analyzed by drawing samples into gas weighing balloons of 1 $dm^3$ capacity.

SOURCE AND PURITY OF MATERIALS:

(1) Sulfur dioxide was of refrigerant grade.

(2) Water was "triple-distilled from a Pyrex still."

(3) Probably of good quality.

ESTIMATED ERROR:

REFERENCES:

1. Palmrose, G.V.

*Paper Trade J.* 1935, *100*, No. 3, 38.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Sulfuric acid; $H_2SO_4$; [7664-93-9]

ORIGINAL MEASUREMENTS:

Parkison, R.V.
*TAPPI*, 1956, *39*, (7), 517-519.

EXPERIMENTAL VALUES: 760mmHg = 1 atm = 101.325 kPa.

| T/K | $p_{SO_2}$/atm | $SO_2$ /lb mol $ft^{-3}$ | *$x_{SO_2}$ | *$x_{SO_2}/p_{SO_2}$ |
|---|---|---|---|---|
| 305.37 | 0.0110 | 0.000801 | 0.000231 | 0.0210 |
| (90°F) | 0.0178 | 0.00126 | 0.000363 | 0.0204 |
| | 0.0251 | 0.00205 | 0.000591 | 0.0235 |
| | 0.0336 | 0.00244 | 0.0007035 | 0.0209 |

* Calculated by compiler

Molality of sulfuric acid was 0.058, i.e., 5.684 g $H_2SO_4$ in 1 kg of water. *The approximate mole fraction, $x_{SO_2}$ was referred to 1 cu.ft. of water, taking 3.468 lb. moles of water per cu.ft.

NOTE:

At these low partial pressures the average value of 64.08 was used by Parkison for computing the partial pressure of sulfur dioxide from the analysis of the dry gas. The vapor pressure of water over the solutions of sulfur dioxide was taken to be the same as for pure water.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Water; $H_2O$; [7732-18-5]<br>3. Thiocyanic acid; HCNS; [463-56-9] | Hansen, C.J.<br>*Ber.* 1933, *66* 447-450 |
| VARIABLES: | PREPARED BY:<br>W. Gerrard |

EXPERIMENTAL VALUES:

At 277.65 K, 76.9 g (76 $cm^3$, density = 1.012 g $cm^{-3}$) of solution containing 5.52 g HCNS (0.0936 mole) and 0.20 g "$H_2SO_4$" absorbed 16.9 g $SO_2$(0.264 mole) to give 93.8 g (82.5 $cm^3$, density, 1.14 g $cm^{-3}$). The mole ratio, $SO_2$/HCNS (not given by the author) is 2.821; mole fraction, $x_{SO_2}$ is 0.738.

At 283.15 K, 63.2g (57 $cm^3$, density, 1.11 g $cm^{-3}$) of solution containing 23.8 g HCNS, 0.403 (given by the author as 0.402) mole, absorbed 27.1 g $SO_2$(0.423 mole) to give 90.3 g (72.5 $cm^3$, density, 1.247 g $cm^{-3}$) of final solution. The mole ratio, $SO_2$/HCNS was given as 1.054, the compiler gives 1.050, mole fraction, $x_{SO_2}$ = 0.512.

The total pressure appeared to be an unspecified barometric pressure.

NOTE: The author gave the concentration of the hydrocyanic acid as 46.30% in the second determination; but the concentration should be given as 37.66%.

AUXILIARY INFORMATION

| METHOD/APPARATUS/PROCEDURE: | SOURCE AND PURITY OF MATERIALS: |
|---|---|
| Sulfur dioxide was passed into a known amount of the acid solution in a measuring cylinder. The final solution was weighed, and its volume determined. | 1. The sulfur dioxide was stated to be pure.<br>3. Prepared from barium thiocyanate. |
| | ESTIMATED ERROR: |
| | REFERENCES: |

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Ammonium chloride; $NH_4Cl$; [12125-02-9]

ORIGINAL MEASUREMENTS:

Fox, C.J.J.

*Z. Phys. Chem.* 1902, *41*, 458-482

VARIABLES:

Concentration of salt

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

| T/K | "Normality" | 3 | 2.5 | 2 | 1.5 | 1 | 0.5 |
|---|---|---|---|---|---|---|---|
| 298 | Ostwald coefficient, $L$ ($L$ for water given as 32.76). | 42.78 | 41.37 | 39.76 | 38.06 | 36.37 | 34.58 |

The following arithmetic was shown by the original author:

$a$ = $cm^3$ $SO_2$ (273 K, 760 mmHg) in 1 $cm^3$ of "solution presumably meaning the salt solution before absorption of gas.

$x$ = $cm^3$ of iodine solution containing $s$ equivalents per $dm^3$; 0.001 mole $I_2$ taken to be equivalent to 0.001 mole $SO_2$.

$1/2\ sx = a/22.4$, for one $cm^3$ of the saturated solution. For $c$ $cm^3$ of the solution taken for titration, at T/K and $b$ mmHg pressure, $a = (11.2\ sx)/c$ (T/K / 273 K). The coefficient $L$ was taken to be equal to $a$ $(760/b)$. (See evaluation).

NOTE by compiler: based on the published density of sulfur dioxide, 2.9266 g $dm^{-3}$ at 273.15 K and 1 atm, the molar volume of $SO_2$ is 21.87 $dm^3$ and not 22.4 $dm^3$ under these conditions; therefore all the $L$ values are about 2% too large.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The absorption vessel was fitted with electrodes for the measurement of conductance, data not herein recorded. Sulfur dioxide was passed through the solution to saturation at barometric pressure, the apparatus being held in a thermostat, controlled at 25.05 to 25.1°C, or 35 to 35.05°C. A volume of the saturated solution was withdrawn by pipet (0.9181 to 1.436 $cm^3$), and the amount of $SO_2$ determined by iodine-thiosulfate titration.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide, 99.8% $SO_2$, 0.2% water, commercial.
2. Presumably conductivity grade.
3. Salt of Kahlbaum grade, recrystallised and analytically attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Ammonium bromide; $NH_4Br$; [12124-97-9]

ORIGINAL MEASUREMENTS:

Fox, C.J.J.

*Z. Phys. Chem.* 1902, *41*, 458-482.

VARIABLES:

Concentration of salt

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

| T/K | "Normality" | 3 | 2.5 | 2 | 1.5 | 1 | 0.5 |
|---|---|---|---|---|---|---|---|
| 298 | Ostwald coefficient, *L*<br>(*L* for water given as 32.76) | 52.25 | 49.17 | 46.06 | 42.78 | 39.46 | 36.28 |

The following arithmetic was shown by the original author:

$a$ = $cm^3$ $SO_2$ (273 K, 760 mmHg) in 1 $cm^3$ of "solution", presumably meaning the salt solution before absorption of gas.

$x$ $cm^3$ of iodine solution containing $s$ equivalents per $dm^3$; 0.001 mole $I_2$ taken to be equivalent to 0.001 mole $SO_2$.

$1/2\ sx = a/22.4$, for one $cm^3$ of the saturated solution. For $c$ $cm^3$ of the solution taken for titration, at T/K and $b$ mmHg pressure, $a = (11.2\ sx)/c$ (T/K / 273 K). The coefficient $L$ was taken to be equal to $a$ (760/$b$). (See evaluation).

NOTE by compiler: based on the published density of sulfur dioxide, 2.9266 g $dm^{-3}$ at 273.15 K and 1 atm, the molar volume of $SO_2$ is 21.87 $dm^3$ and not 22.4 $dm^3$ under these conditions; therefore all the $L$ values are about 2% too large.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The absorption vessel was fitted with electrodes for the measurement of conductance, data not herein recorded. Sulfur dioxide was passed through the solution to saturation at barometric pressure, the apparatus being held in a thermostat, controlled at 25.05 to 25.1°C, or 35 to 35.05°C. A volume of the saturated solution was withdrawn by pipet (0.9181 to 1.436 $cm^3$), and the amount of $SO_2$ determined by iodine thiosulfate titration.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide, 99.8% $SO_2$, 0.2% water, commercial.

2. Presumably conductivity grade.

3. Salt of Kahlbaum grade, recrystallized and analytically attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Ammonium sulfate; $(NH_4)_2SO_4$; [7783-20-2]

ORIGINAL MEASUREMENTS:

Fox, C.J.J.

*Z. Phys. Chem.* 1902, *41*, 458-482.

VARIABLES:

Temperature, concentration of salt.

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES: Equivalent taken by the author as 1/2 $(NH_4)_2SO_4$

| T/K | "Normality" | 3 | 2.5 | 2 | 1.5 | 1 | 0.5 |
|---|---|---|---|---|---|---|---|
| 298 | Ostwald coefficient, *L* | 35.96 | 35.47 | 34.95 | 34.34 | 33.82 | 33.35 |
| | (*L* for water given as 32.76) | | | | | | |
| 308 | Ostwald coefficient, *L* | 24.60 | 24.23 | 23.93 | 23.49 | 23.14 | 22.91 |
| | (*L* for water given as 22.43) | | | | | | |

The following arithmetic was shown by the original author:

$a$ = $cm^3$ $SO_2$ (273 K, 760 mmHg) in 1 $cm^3$ of "solution," presumably meaning the salt solution before absorption of gas.

$x$ = $cm^3$ of iodine solution containing $s$ equivalents per $dm^3$ ; 0.001 mole $I_2$ taken to be equivalent to 0.001 mole $SO_2$.

$1/2\ sx = a/22.4$, for one $cm^3$ of the saturated solution. For $c$ $cm^3$ of the solution taken for titration, at T/K and $b$ mmHg pressure, $a = (11.2\ sx)/c$ (T/K / 273 K). The coefficient $L$ was taken to be equal to $a$ $(760/b)$. (See evaluation)

NOTE by compiler: based on the published density of sulfur dioxide, 2.9266 g $dm^{-3}$ at 273.15 K and 1 atm, the molar volume of $SO_2$ is 21.87 $dm^3$ and not 22.4 $dm^3$ under these conditions; therefore all the $L$ values are about 2% too large.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The absorption vessel was fitted with electrodes for the measurement of conductance, data not herein recorded. Sulfur dioxide was passed through the solution to saturation at barometric pressure, the apparatus being held in a thermostat, controlled at 25.05 to 25.1°C, or 35 to 35.05°C. A volume of the saturated solution was withdrawn by pipet (0.9181 to 1.436 $cm^3$), and the amount of $SO_2$ determined by iodine-thiosulfate titration.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide, 99.8% $SO_2$ , 0.2% water, commercial.
2. Presumably conductivity grade.
3. Salt of Kahlbaum grade, recrystallised and analytically attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Ammonium bisulfite; $NH_4HSO_3$; [10192-30-0]

ORIGINAL MEASUREMENTS:

Otuka, Y.

*J. Soc. Chem. Ind.,Japan. Suppl.* 1939, *42*, 205B-20 B

VARIABLES:

Temperature, pressure

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES: 760 mmHg = 1 atm = 101.325 kPa

| T/K | $P_{Total}$/atm | $P_{SO_2}$/atm | Mole $SO_2$/dm$^3$ solution | $H$ |
|---|---|---|---|---|
| 373 | 1.73 | 0.75 | 0.1857 | 0.248 |
| | 1.98 | 1.00 | 0.2518 | 0.252 |
| 378 | 2.03 | 0.87 | 0.1819 | 0.209 |
| | 2.29 | 1.13 | 0.2478 | 0.219 |
| 383 | 2.36 | 0.98 | 0.1788 | 0.183 |
| | 2.66 | 1.28 | 0.2434 | 0.190 |
| 388 | 2.73 | 1.10 | 0.1753 | 0.159 |
| | 3.03 | 1.40 | 0.2399 | 0.171 |
| 393 | 3.13 | 1.21 | 0.1724 | 0.142 |
| | 3.47 | 1.56 | 0.2354 | 0.151 |
| 398 | 3.56 | 1.32 | 0.1693 | 0.128 |
| | 3.95 | 1.72 | 0.2311 | 0.134 |
| 403 | 4.06 | 1.45 | 0.1659 | 0.114 |
| | 4.48 | 1.88 | 0.2269 | 0.121 |
| 408 | 4.61 | 1.59 | 0.1624 | 0.102 |
| | 5.03 | 2.02 | 0.2233 | 0.110 |
| 413 | 5.19 | 1.70 | 0.1598 | 0.094 |
| | 5.61 | 2.14 | 0.2203 | 0.103 |
| 418 | 5.80 | 1.80 | 0.1574 | 0.087 |
| | 6.22 | 2.23 | 0.2180 | 0.098 |
| 423 | 6.42 | 1.85 | 0.1562 | 0.084 |
| | 6.83 | 2.27 | 0.2170 | 0.096 |

"Solution" appears to mean final solution. The author defined the solubility as $H = (H_2SO_3)/p_{SO_2}$, the pressure being in atm. $(H_2SO_3)$ evidently means mole $SO_2$/dm$^3$ of solution. The concentration of $NH_4HSO_3$ was given as 0.3000 mole/dm$^3$. NOTE: The author refers to "pure sulfurous acid, $H_2SO_3$."

METHOD/APPARATUS/PROCEDURE:

The total pressure, $P_{Total}$, was determined by means of a glass spring manometer. It was stated that the partial pressures were approximated from the dimensions of the apparatus, but details were not given.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Ammonium bisulfite; $NH_4HSO_3$; [10192-30-0]

ORIGINAL MEASUREMENTS:

Marriner, D. E.; Whitney, R. P. *Paper Trade J.* 1948, *126* (Tappi section), 52-54.

VARIABLES:

Temperature, pressure

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

760 mmHg = 1 atm = 101.325 kPa.

The liquid concentrations are expressed in g $SO_2$ per 100 g of water. The Total (T) $SO_2$ is all the $SO_2$ absorbed by the original aqueous solution of ammonia. The "Combined" (C) $SO_2$ was defined as that required to convert all "the lime to $CaSO_3$." This presumably means the amount to convert all the ammonia into $(NH_4)SO_3$. The Free $SO_2$ (F) is the difference T - C.

| T/K | $p_{SO_2}$/mmHg | $SO_2$(T) | $SO_2$(C) | T/K | $p_{SO_2}$/mmHg | $SO_2$(T) | $SO_2$(C) |
|---|---|---|---|---|---|---|---|
| 277.65 | 124 | 4.4 | 0.51 | 283.15 | 123 | 3.7 | 0.54 |
| | 367 | 10.3 | 0.47 | | 333 | 7.9 | 0.60 |
| | 560 | 15.2 | 0.49 | | 567 | 12.4 | 0.55 |
| | 655 | 17.9 | 0.50 | | 696 | 14.7 | 0.56 |
| | 119 | 5.1 | 0.97 | | 125 | 4.6 | 1.01 |
| | 354 | 11.3 | 0.95 | | 313 | 8.3 | 0.94 |
| | 569 | 16.5 | 0.99 | | 507 | 12.3 | 1.04 |
| | 162 | 7.1 | 1.40 | | 691 | 15.4 | 0.95 |
| | 388 | 12.6 | 1.50 | | 139 | 5.7 | 1.44 |
| | 580 | 17.6 | 1.40 | | 355 | 9.9 | 1.44 |
| | 686 | 20.2 | 1.35 | | 528 | 13.2 | 1.19 |
| | 117 | 6.8 | 1.93 | | 660 | 15.9 | 1.33 |
| | 350 | 12.5 | 1.93 | | 129 | 6.6 | 1.97 |
| | 548 | 17.2 | 1.97 | | 331 | 10.3 | 1.85 |

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A mixture of sulfur dioxide and nitrogen was passed into aqueous ammonia in a glass cell until equilibrium was reached. Sulfur dioxide in the liquid and in the exit gas was estimated by a chemical tiration – iodine-thiosulfate, see White *et al.* (1). Temperature was controlled to within ± 0.5 °C.

For water at 283.15 K the $SO_2$ (T) ($p_{SO_2}$) were: 2.1 (86); 6.9 (320); 13.9 (678 mmHg).

Total and combined sulfur dioxide were estimated by a modification of the Palmrose technique (2).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide: refrigeration grade.
2. Water: may be taken as pure.
3. Chemically pure ammonia solution was used.

Nitrogen from cylinder was mixed with the sulfur dioxide to obtain mixtures of determined sulfur dioxide content to estimate the $p_{SO_2}$.

ESTIMATED ERROR:

REFERENCES:

1. White, C. K. Jr.; Vivian, J. E.; Whitney, R. P. *Ann. Meet. Tech. Ass. Pulp and Paper Industry*, Feb. 1948.
2. Palmrose, G. V. *Paper Trade J.* 1935, *100*, 38.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Ammonium bisulfite; $NH_4HSO_3$; [10192-30-0]

ORIGINAL MEASUREMENTS:

Marriner, D. E.; Whitney, R. P. *Paper Trade J.* 1948, *126*, (Tappi section), 52-54.

EXPERIMENTAL VALUES:

| T/K | $p_{SO_2}$/mmHg | $SO_2$(T) | $SO_2$(C) | T/K | $p_{SO_2}$/mmHg | $SO_2$(T) | $SO_2$(C) |
|---|---|---|---|---|---|---|---|
| 283.15 | 518 | 13.9 | 2.00 | 298.15 | 119 | 2.5 | 0.51 |
| | 663 | 16.8 | 1.67 | | 329 | 4.9 | 0.52 |
| 291.15 | 117 | 2.9 | 0.57 | | 565 | 7.3 | 0.57 |
| | 562 | 9.3 | 0.56 | | 706 | 9.2 | 0.58 |
| | 736 | 11.6 | 0.49 | | 116 | 3.3 | 0.90 |
| | 132 | 3.7 | 1.00 | | 335 | 5.7 | 0.98 |
| | 360 | 6.7 | 0.81 | | 532 | 8.1 | 1.07 |
| | 551 | 9.8 | 1.00 | | 696 | 9.6 | 0.90 |
| | (?)00 | 2.7 | 1.35 | | 117 | 4.1 | 1.40 |
| | 115 | 4.4 | 1.35 | | 343 | 6.6 | 1.36 |
| | 364 | 7.7 | 1.36 | | 544 | 8.8 | 1.42 |
| | 552 | 10.5 | 1.38 | | 692 | 10.5 | 1.40 |
| | 706 | 12.7 | 1.34 | | (?)00 | 3.8 | 1.95 |
| | 175 | 6.2 | 1.93 | | 116 | 5.2 | 1.96 |
| | 420 | 9.8 | 1.93 | | 365 | 7.9 | 1.98 |
| | 610 | 13.0 | 2.00 | | 558 | 10.1 | 2.04 |
| | | | | | 710 | 11.7 | 2.04 |

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Ammonium bisulfite; $NH_4SO_3H$; [7803-63-6]

ORIGINAL MEASUREMENTS:

Domansky, R.; Rendos, F.

*Chem. Zvesti*

1957, *11*, 453-460.

VARIABLES:

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

760 mmHg = 1 atm = 101.325 kPa

The values of $SO_2$/g (T, total), (C, combined as $NH_4SO_3H$), (F, free = T - C) were given in the original table (as shown in the table here) were for $SO_2$ absorbed by 100 g water at $p_{SO_2}$ = 600 mmHg. The treatment seems to imply that there is a linear change of the weight of $SO_2$ absorbed with pressure; therefore it may be taken that weight of $SO_2$ absorbed for $p_{SO_2}$ = 1 atm may be approximately calculated by multiplying the stated value by 1.267.

| "Concentration of ammonia" * | | 0% | 0.5% | 1.0% | 1.5% | 2.0% |
|---|---|---|---|---|---|---|
| | | | $SO_2$/g per 100 g water | | | |
| T/K | | | | | | |
| 288.15 | T | 10.3 | 11.20 | 12.80 | 14.65 | 17.90 |
| | C | - | 1.90 | 3.80 | 5.70 | 7.60 |
| | F | 10.3 | 9.30 | 9.05 | 8.95 | 10.3 |
| 293.15 | T | 8.50 | 9.70 | 11.55 | 13.20 | 15.65 |
| | C | - | 1.90 | 3.80 | 5.70 | 7.60 |
| | F | 8.50 | 7.80 | 7.75 | 7.50 | 8.05 |
| 298.15 | T | 7.5 | 8.5 | 10.25 | 11.95 | 14.40 |
| | C | - | 1.90 | 3.80 | 5.70 | 7.60 |
| | F | 7.5 | 6.60 | 6.45 | 6.25 | 6.75 |
| 303.15 | T | 6.1 | 7.50 | 8.90 | 11.05 | 13.50 |
| | C | - | 1.90 | 3.80 | 5.70 | 7.60 |
| | F | 6.1 | 5.60 | 5.10 | 5.35 | 5.90 |

* appears to be wt-%.

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

An absorption vessel was fitted with a stirrer, a manometer, one limb bent to pass just through the vessel cover, and the other limb open to the atmosphere, a tapped inlet tube, and a tapped outlet tube, each just passing through the cover of the vessel, for the passage of $SO_2$, and a thermometer. The absorption vessel was immersed in a thermostat. A stoppered sampling tube also passed through the cover and ended well below the surface of the solution in the vessel. The weight of $SO_2$ in a withdrawn sample was determined by an iodine-thiosulfate titration.

SOURCE AND PURITY OF MATERIALS:

It is probable that the components were of acceptable purity for the purpose of the measurements.

ESTIMATED ERROR:

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Water; $H_2O$; [7732-18-5]<br>3. Ammonium bisulfite; $NH_4SO_3H$; [7803-63-6] | Domansky, R.; Rendos, F.<br>*Chem. Zvesti*<br>1957, *11*, 453-460. |

EXPERIMENTAL VALUES:

Four small diagrams were given, each for one of the stated concentrations of ammonia, and each showing plots of $p_{SO_2}$ (mmHg) *vs.* $SO_2$/100 g of ammonia solution for each of the four temperatures stated. All the lines appear to be linear, and the value of g $SO_2$ for 600 mmHg corresponds closely with the appropriate value of $SO_2$/g (T) in the table. In each diagram, the four lines terminate on the base line ($p_{SO_2}$ = 0) at the following values of g $SO_2$/100 g ammonia solution: 1.9 (0.5% ammonia); 3.8 (1.0% $NH_3$); 5.7 (1.5% $NH_3$); and 7.6 (2.0% $NH_3$), and these values are recorded in the table as $SO_2$/g (C), *i.e.*, combined as $NH_4SO_3H$.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Ammonium nitrate; $NH_4NO_3$; [6484-52-2]

ORIGINAL MEASUREMENTS:

Fox, C.J.J.

*Z. Phys. Chem.* 1902, *41*, 458-482

VARIABLES:

Temperature, concentration of salt

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

| T/K | "Normality" | 3 | 2.5 | 2 | 1.5 | 1 | 0.5 |
|---|---|---|---|---|---|---|---|
| 298 | Ostwald coefficient, *L* | 39.14 | 38.01 | 37.27 | 36.28 | 35.07 | 33.96 |
| | (*L* for water given as 32.76) | | | | | | |
| 308 | Ostwald coefficient, *L* | 27.43 | 26.66 | 25.57 | 24.78 | 24.23 | 23.35 |
| | (*L* for water given as 22.43) | | | | | | |

The following arithmetic was shown by the original author:

$a$ = cm$^3$ $SO_2$ (273 K, 760 mmHg) in 1 cm$^3$ of "solution," presumably meaning the salt solution before absorption of gas.

$x$ = cm$^3$ of iodine solution containing $s$ equivalents per dm$^3$; 0.001 mole $I_2$ taken to be equivalent to 0.001 mole $SO_2$.

$1/2\ sx = a/22.4$, for one cm$^3$ of the saturated solution. For $c$ cm$^3$ of the solution taken for titration, at T/K and $b$ mmHg pressure, $a = (11.2\ sx)/c$ (T/K / 273 K). The coefficient $L$ was taken to be equal to $a$ $(760/b)$. (See evaluation)

NOTE by compiler: based on the published density of sulfur dioxide, 2.9266 g dm$^{-3}$ at 273.15 K and 1 atm, the molar volume of $SO_2$ is 21.87 dm$^3$ and not 22.4 dm$^3$ under these conditions; therefore all the $L$ values are about 2% too large.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The absorption vessel was fitted with electrodes for the measurement of conductance, data not herein recorded. Sulfur dioxide was passed through the solution to saturation at barometric pressure, the apparatus being held in a thermostat, controlled at 25.05 to 25.1°C, or 35 to 35.05°C. A volume of the saturated solution was withdrawn by pipet (0.9181 to 1.436 cm$^3$), and the amount of $SO_2$ determined by iodine-thiosulfate titration.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide, 99.8% $SO_2$, 0.2% water, commercial.
2. Presumably conductivity grade.
3. Salt of Kahlbaum grade, recrystallised and analytically attested.

ESTIMATED ERROR:

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Water; $H_2O$; [7732-18-5]<br>3. Ammonium thiocyanate; $NH_4CNS$; [1762-95-4] | Fox, C.J.J.<br>*Z. Phys. Chem.* 1902, *41*, 458-482. |
| VARIABLES: | PREPARED BY: |
| Concentration of salt | W. Gerrard. |

EXPERIMENTAL VALUES:

| T/K | "Normality" | 3 | 2.5 | 2 | 1.5 | 1 | 0.5 |
|---|---|---|---|---|---|---|---|
| 298 | Ostwald coefficient, $L$ | 61.46 | 57.01 | 52.26 | 47.26 | 42.74 | 37.78 |

($L$ for water given as 32.76)

The following arithm tic was shown by the original author:

$a$ = $cm^3$ $SO_2$ (273 K, 760 mmHg) in 1 $cm^3$ of "solution," presumably meaning the salt solution before absorption of gas.

$x$ = $cm^3$ of iodine solution containing $s$ equivalents per $dm^3$; 0.001 mole $I_2$ taken to be equivalent to 0.001 mole $SO_2$.

$1/2\ sx = a/22.4$, for one $cm^3$ of the saturated solution. For $c$ $cm^3$ of the solution taken for titration, at T/K and $b$ mmHg pressure, $a = (11.2\ sx)/c$ (T/K / 273 K). The coefficient $L$ was taken to be equal to $a$ (760/$b$). (See evaluation).

NOTE: by compiler: based on the published density of sulfur dioxide, 2.9266 g $dm^{-3}$ at 273.15 K and 1 atm, the molar volume of $SO_2$ is 21.87 $dm^3$ and not 22.4 $dm^3$ under these conditions; therefore all the $L$ values are about 2% too large.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The absorption vessel was fitted with electrodes for the measurement of conductance, data not herein recorded. Sulfur dioxide was passed through the solution to saturation at barometric pressure, the apparatus being held in a thermostat, controlled at 25.05 to 25.1°C, or 35 to 35.05°C. A volume of the saturated solution was withdrawn by pipet (0.9181 to 1.436 $cm^3$), and the amount of $SO_2$ determined by iodine-thiosulfate titration.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide, 99.8% $SO_2$, 0.2% water, commercial.
2. Presumably conductivity grade.
3. Salt of Kahlbaum grade, recrystallised and analytically attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; ]7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Thiocyanic acid, ammonium salt
   Ammonium thiocyanate; $NH_4CNS$; [1762-95-4]

ORIGINAL MEASUREMENTS:

Hansen, C. J.

*Ber.* 1933, *66B*, 447-450.

VARIABLES:

Temperature

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | Conc. of soln. g salt/ g soln. | Wt. of soln.† /g | Wt. of soln. /g | Vol. of soln.† /cm$^3$ | Vol. of soln. /cm$^3$ | Wt. of $SO_2$ absorbed /g | Mole ratio $SO_2$/ $NH_4CNS$ |
|---|---|---|---|---|---|---|---|
| 290.15 | 0.5 | 60 | 86.0 | 53 | 68 | 26.01 | 1.028 |
| 286.65 | 0.5 | 60 | 91.0 | 53 | 70.5 | 31.0 | 1.226 |
| 281.85 | 0.5 | 60 | 97.9 | 53 | 73.5 | 37.9 | 1.499 |
| 276.15 | 0.5 | 60 | 109.6 | 53 | 80.5 | 49.6 | 1.962 |

The total pressure appears to have been unspecified barometric pressure.

† Before adsorption of sulfur dioxide.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A known amount of the salt solution was treated in a measuring cylinder with pure sulfur dioxide. The final solution was weighed, and its volume measured, and the weight of sulfur dioxide absorbed was thereby determined. It appears that the first temperature was 17 °C, and then the passage of $SO_2$ was continued to get results for the lower temperatures.

SOURCE AND PURITY OF MATERIALS:

1. Pure $SO_2$ was stated to be used.
2. and 3. Not specified; but may be taken of satisfactory purity.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. "Basic aluminium sulfate" (approx. $Al_2(SO_4)_3 + Al_2O_3$)

ORIGINAL MEASUREMENTS:

Applebey, M.P.

*J. Soc. Chem. Ind. (Chem. Ind.) Trans.* 1937, *56*, 139-146.

VARIABLES:

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

760 mmHg = 1 atm = 101.325 kPa

Data were presented only as a small diagram showing plots of ("%$SO_2$ by volume in the gas phase") vs ("g $SO_2$ by 100 ml of absorbent solution"). The compiler has interpreted the %$SO_2$ by volume as the partial pressure, $p_{SO_2}$, of $SO_2$ in atm, and has read the following data from the plots.

| No. of solution. | T/K | $p_{SO_2}$/atm | g $SO_2$/100 ml |
|---|---|---|---|
| 1 | 293 | 0.01 | 4.7 |
| | | 0.02 | 5.5 |
| | | 0.03 | 6.0 |
| | | 0.04 | 6.3 |
| | | 0.05 | 6.7 |
| | | 0.06 | 7.0 |
| | | 0.07 | 7.2 |
| | | 0.08 | 7.4 |
| | | 0.09 | 7.6 |
| | | 0.10 | 7.8 |
| 2 | 293 | 0.01 | 6.1 |
| | | 0.02 | 7.1 |
| | | 0.03 | 7.7 |
| | | 0.04 | 8.1 |
| | | 0.05 | 8.4 |
| | | 0.06 | 8.8 |
| | | 0.07 | 8.95 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

None were given. The purpose of the measurements was in connection with the recovery of sulfur from smelter gases.

SOURCE AND PURITY OF MATERIALS:

None given.

ESTIMATED ERROR:

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Water; $H_2O$; [7732-18-5]<br>3. "Basic aluminium sulfate"(approx. $Al_2(SO_4)_3 + Al_2O_3$ | Applebey, M.P.<br>*J. Soc. Chem. Ind. (Chem. Ind.) Trans.* 1937, *56*, 139-146. |

EXPERIMENTAL VALUES:

| No. of solution | T/K | $p_{SO_2}$/atm | g $SO_2$/100 ml |
|---|---|---|---|
| 2 | 293 | 0.08 | 9.2 |
| | | 0.09 | 9.4 |
| | | 0.10 | 9.6 |
| 2 | 298 | 0.01 | 5.6 |
| | | 0.02 | 6.5 |
| | | 0.03 | 7.05 |
| | | 0.04 | 7.45 |
| | | 0.05 | 7.85 |
| | | 0.06 | 8.05 |
| | | 0.07 | 8.3 |
| | | 0.08 | 8.6 |
| | | 0.09 | 8.8 |
| | | 0.10 | 8.95 |
| 2 | 303 | 0.01 | 5.0 |
| | | 0.02 | 5.9 |
| | | 0.03 | 6.5 |
| | | 0.04 | 6.9 |
| | | 0.05 | 7.2 |
| | | 0.06 | 7.45 |
| | | 0.07 | 7.7 |
| | | 0.08 | 7.9 |
| | | 0.09 | 8.05 |
| | | 0.10 | 8.2 |
| 3 | 293 | 0.01 | 6.9 |
| | | 0.02 | 8.3 |
| | | 0.03 | 9.05 |
| | | 0.04 | 9.55 |
| | | 0.05 | 9.85 |
| | | 0.06 | 10.1 |
| | | 0.07 | 10.35 |
| | | 0.08 | 10.65 |
| | | 0.09 | 10.8 |
| | | 0.10 | 11.05 |

The solution was described as "basic aluminium sulphate solution," the composition being defined as follows:

| Solution No. | "Alumina" g/100 ml | | | "Basicity" |
|---|---|---|---|---|
| | Free | Combined | Total | |
| 1 | 3.44 | 6.61 | 10.05 | 34.2 |
| 2 | 4.00 | 5.82 | 9.82 | 40.8 |
| 3 | 4.55 | 5.32 | 9.87 | 46.1 |

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Calcium sulfite; $CaSO_3$; [10257-55-3]

ORIGINAL MEASUREMENTS:

White, C.K., Jr.; Vivian, J.E.; Whitney, R.P.

*Paper Trade Journal* 1948, *126*, (20), 46-48.

VARIABLES:

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

760 mmHg = 1 atm = 101.325 kPa

| T/K | Wt. of $SO_2$(C) /g | Wt. of $SO_2$(T) /g | Partial Pressure $p_{SO_2}$ /mmHg | Mole fraction $^*x_{SO_2}$ |
|---|---|---|---|---|
| 283.15 | 0 | 1.98 | 75 | 0.0056 |
| | | 6.70 | 311 | 0.0185 |
| | | 7.54 | 353 | 0.0208 |
| | | 10.53 | 510 | 0.0288 |
| | | 15.45 | 751 | 0.0416 |
| | 0.65 | 2.10 | 50 | 0.00408 |
| | | 2.23 | 55 | 0.00442 |
| | | 3.54 | 118 | 0.00806 |
| | | 3.81 | 126 | 0.00881 |
| | | 5.25 | 204 | 0.0128 |
| | | 7.53 | 324 | 0.0190 |
| | | 9.05 | 405 | 0.0231 |
| | | 15.80 | 757 | 0.0409 |
| | 1.20 | 2.69 | 19 | 0.00417 |
| | | 3.61 | 67 | 0.00673 |
| | | 4.60 | 122 | 0.00947 |
| | | 7.35 | 276 | 0.0170 |
| | | 7.94 | 304 | 0.0186 |
| | | 12.51 | 564 | 0.0308 |
| | | 12.85 | 583 | 0.0315 |
| | | 16.03 | 748 | 0.0400 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A mixture of nitrogen and sulfur dioxide was passed into a cell containing water and calcium hydroxide until all the calcium hydroxide had disappeared. The final temperature was controlled to within ±0.05°C. Samples of the solution and effluent gas were taken in evacuated weighing bulbs. Total sulfur dioxide in the liquid was determined by a modified Palmrose technique (1) entailing an iodine-thiosulfate titration. From the weight of the calcium hydroxide added the combined sulfur dioxide could be determined. The pressure of the sulfur dioxide was calculated from the analysis, utilizing the measured total pressure, and correcting for deviations from the perfect gas laws.

SOURCE AND PURITY OF MATERIALS:

(1) The sulfur dioxide was of refrigeration grade.

(2) Water was presumably of satisfactory purity.

(3) C.P. calcium hydroxide was used.

ESTIMATED ERROR:

REFERENCES:

(1) Palmrose, G.V.; *Paper Trade J.* 1935, *100*, No. 3, 38.

See also Whitney, R.P.; Vivian, J.E. *Ind. Eng. Chem.* 1941, *33*, 741.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Water; $H_2O$; [7732-18-5]<br>3. Calcium sulfite; $CaSO_3$; [10257-55-3] | White, C.K., Jr.; Vivian, J.E.; Whitney, R.P.<br>*Paper Trade Journal*, <u>1948</u>, *126*, (20), 46-48. |

EXPERIMENTAL VALUES:

| T/K | Wt. of $SO_2$(C) /g | Wt. of $SO_2$(T) /g | Partial Pressure $p_{SO_2}$ /mmHg | Mole fraction $^*x_{SO_2}$ |
|---|---|---|---|---|
| 283.15 | 2.10 | 5.80 | 94 | 0.0103 |
| | | 8.33 | 246 | 0.0169 |
| | | 12.24 | 479 | 0.0277 |
| | | 17.10 | 763 | 0.0405 |
| 291.15 | 0 | 4.03 | 250 | 0.0112 |
| | | 6.21 | 403 | 0.0172 |
| | | 11.20 | 743 | 0.0305 |
| | 0.65 | 1.74 | 37 | 0.00306 |
| | | 3.21 | 140 | 0.00714 |
| | | 7.84 | 477 | 0.0198 |
| | | 11.79 | 749 | 0.0304 |
| | 1.20 | 2.86 | 38 | 0.00465 |
| | | 4.39 | 153 | 0.00889 |
| | | 7.89 | 415 | 0.0185 |
| | | 12.36 | 748 | 0.0304 |
| | 2.10 | 5.03 | 71 | 0.00817 |
| | | 5.89 | 146 | 0.0105 |
| | | 6.87 | 233 | 0.0132 |
| | | 10.62 | 541 | 0.0234 |
| | | 13.45 | 759 | 0.0309 |
| 298.15 | 0 | 2.26 | 169 | 0.00632 |
| | | 5.34 | 444 | 0.0148 |
| | | 8.64 | 724 | 0.0237 |
| | 0.65 | 2.06 | 76 | 0.00395 |
| | | 3.05 | 167 | 0.00670 |
| | | 5.40 | 385 | 0.0132 |
| | | 9.32 | 742 | 0.0238 |
| | 1.20 | 2.90 | 53 | 0.00476 |
| | | 3.82 | 144 | 0.00731 |
| | | 5.91 | 347 | 0.0128 |
| | | 10.01 | 741 | 0.0242 |
| | 2.10 | 5.05 | 98 | 0.00823 |
| | | 5.70 | 168 | 0.0100 |
| | | 8.35 | 448 | 0.0173 |
| | | 11.26 | 739 | 0.0251 |

* Calculated by compiler.

Weights of $SO_2$ are for (c) "combined as $CaSO_3$" and (T) total per 100 g of water at $p_{SO_2}$.

"Free $SO_2$" = (T-C)/g. Mole fraction is for free $SO_2$.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Calcium bisulfite; $Ca(HSO_3)_2$; [13780-03-5]

ORIGINAL MEASUREMENTS:

Otuka, Y.

*J. Soc. Chem. Ind. Japan. Suppl.* 1939, *42*, 205B-207B.

VARIABLES:

Temperature, pressure

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

760 mmHg = 1 atm = 101.325 kPa

| T/K | $p_{Total}$/atm | $p_{SO_2}$/atm | Mole $SO_2$/$dm^3$ solution | $H$ |
|---|---|---|---|---|
| 373 | 2.90 | 1.93 | 0.4192 | 0.217 |
| | 3.27 | 2.30 | 0.5189 | 0.226 |
| | 3.63 | 2.67 | 0.6099 | 0.228 |
| 378 | 3.28 | 2.12 | 0.4130 | 0.195 |
| | 3.68 | 2.53 | 0.5118 | 0.202 |
| | 4.07 | 2.92 | 0.6023 | 0.206 |
| 383 | 3.69 | 2.32 | 0.4071 | 0.175 |
| | 4.13 | 2.76 | 0.5048 | 0.183 |
| | 4.54 | 3.18 | 0.5949 | 0.187 |
| 388 | 4.14 | 2.52 | 0.4012 | 0.159 |
| | 4.61 | 2.99 | 0.4980 | 0.166 |
| | 5.05 | 3.44 | 0.5878 | 0.171 |
| 393 | 4.52 | 2.62 | 0.3982 | 0.152 |
| | 5.12 | 3.22 | 0.4916 | 0.153 |
| | 5.59 | 3.70 | 0.5809 | 0.157 |
| 398 | 5.03 | 2.81 | 0.3927 | 0.140 |
| | 5.67 | 3.46 | 0.4849 | 0.140 |
| | 6.17 | 3.97 | 0.5739 | 0.145 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The total vapor pressure, $p_{Total}$, was determined by means of a glass spring manometer. It was stated that the partial pressures were approximated from the dimensions of the apparatus, but details were not given.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Calcium bisulfite; $Ca(HSO_3)_2$; [13780-03-5]

ORIGINAL MEASUREMENTS:

Otuka, Y.

*J. Soc. Chem. Ind. Japan. Suppl.* 1939, *42*, 205B-207B

EXPERIMENTAL VALUES: 760 mmHg = 1 atm = 101.325 kPa

| T/K | $p_{Total}$/atm | $p_{SO_2}$/atm | Mole $SO_2$/$dm^3$ solution | $H$ |
|---|---|---|---|---|
| 403 | 5.58 | 2.99 | 0.3877 | 0.130 |
| | 6.25 | 3.67 | 0.4792 | 0.130 |
| | 6.79 | 4.22 | 0.5674 | 0.134 |
| 408 | 6.16 | 3.16 | 0.3831 | 0.121 |
| | 6.86 | 3.88 | 0.4735 | 0.122 |
| | 7.45 | 4.48 | 0.5607 | 0.125 |
| 413 | 6.77 | 3.31 | 0.3792 | 0.114 |
| | 7.51 | 4.06 | 0.4688 | 0.115 |
| | 8.15 | 4.72 | 0.5548 | 0.117 |
| 418 | 7.43 | 3.46 | 0.3752 | 0.108 |
| | 8.21 | 4.26 | 0.4636 | 0.109 |
| | 8.90 | 4.94 | 0.5488 | 0.110 |
| 423 | 8.13 | 3.59 | 0.3720 | 0.103 |
| | 8.96 | 4.44 | 0.4592 | 0.103 |
| | 9.69 | 5.19 | 0.5438 | 0.105 |

"Solution" appears to mean the final solution.

The author defined the "solubility" as $H = (H_2SO_3)/p_{SO_2}$, $p_{SO_2}$ in atm. $(H_2SO_3)$ evidently means moles $SO_2/dm^3$ of solution.

The concentration of $HSO_3$ was given as 0.1476 mol $dm^{-3}$ for the first two values of $H$ at each temperature and 0.1481 for the third value of $H$ at each temperature.

NOTE: The author refers to "pure sulfurous acid, $H_2SO_3$."

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Calcium bisulfite from CaO + water + $SO_2$.

ORIGINAL MEASUREMENTS:

Conrad, F.H.; Beuschlein, W.L.

*J. Am. Chem. Soc.* 1934, *56*, 2554-2562.

VARIABLES:

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

| T/K | Total Pressure /mmHg | g $SO_2$/100 g water Total | Combined | Free | Free $SO_2$ *Mole ratio | *Mole fraction |
|---|---|---|---|---|---|---|
| 288.15 | 22 | 1.83 | 0.89 | 0.94 | 0.0026 | 0.0026 |
| | 49 | 3.99 | 1.85 | 2.14 | 0.0060 | 0.0060 |
| | 115 | 7.47 | 3.12 | 4.35 | 0.0122 | 0.0121 |
| | 154 | 8.72 | 3.51 | 5.21 | 0.0147 | 0.0144 |
| | 263 | 11.00 | 4.23 | 6.77 | 0.0190 | 0.0187 |
| | 408 | 13.76 | 4.78 | 8.98 | 0.0253 | 0.0246 |
| | 517 | 15.92 | 5.47 | 10.45 | 0.0294 | 0.0285 |
| | 761 | 19.25 | 5.95 | 13.30 | 0.0374 | 0.0361 |
| 298.15 | 40 | 1.91 | 0.91 | 1.00 | 0.0028 | 0.0028 |
| | 52 | 2.81 | 1.33 | 1.48 | 0.00416 | 0.00414 |
| | 136 | 5.55 | 2.43 | 3.12 | 0.00877 | 0.00870 |
| | 254 | 8.37 | 3.14 | 5.23 | 0.0147 | 0.0145 |
| | 461 | 11.52 | 4.06 | 7.46 | 0.0210 | 0.0205 |
| | 594 | 13.28 | 4.59 | 8.69 | 0.0244 | 0.0238 |
| | 756 | 15.38 | 5.12 | 10.26 | 0.0289 | 0.0281 |
| | 763 | 15.16 | 4.88 | 10.30 | 0.0290 | 0.0282 |
| 308.15 | 761 | 12.02 | 4.03 | 7.99 | 0.0225 | 0.0220 |

* Calculated by compiler.

NOTE: A solid phase, referred to as calcium oxide was present. The liquid phase was looked upon as a saturated solution of calcium (cont'd)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was passed into a measuring pipet, and then into a flask containing "calcium oxide" and water. The flask was shaken until a constant total pressure was achieved. The total pressure was measured by a manometer containing mercury. The system was allowed to settle, and a sample of the clear liquid, above the solid phase, was withdrawn into a weighed pipet for chemical titration by the iodine-thiosulfate procedure. The temperature of the thermostat was regulated to within 0.05°C. The total, free and combined sulfur dioxide were determined by the method of Hohn (see Ref. 2).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was of "refrigeration grade." and was passed through concentrated sulfuric acid before absorption.
2. Water was freshly distilled.
3. Calcium oxide was obtained by the ignition of "C.P. analysed" calcium oxalate monohydrate.

ESTIMATED ERROR:

REFERENCES:

1. Technical Association of Pulp and Paper Institute Standards, "*Analysis of Bisulfite Cooking Liquor*", T604m, 1931, December,24.
2. Birchard, W.H. *Paper Industry*, 1926, *8*, 793.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Water; $H_2O$; [7732-18-5]<br>3. Calcium bisulfite from CaO + water + $SO_2$. | Conrad, F.H.; Beuschlein, W.L.<br>*J. Am. Chem. Soc.* 1934, *56*, 2554-2562. |

EXPERIMENTAL VALUES: (Cont'd)

bisulfite, $Ca(SO_3H)_2$. "Free $SO_2$" is defined by the Technical Association of Pulp and Paper Institute (1) "as the actual free $SO_2$ plus half of the $SO_2$ in the bisulfite of calcium and is more properly called the 'available $SO_2$' as it indicates $SO_2$ in excess of the amount necessary to form monosulfite". "The combined $SO_2$" is that required to form the monosulfite, $CaSO_3$; the total $SO_2$ is the sum of these. The total, free and combined $SO_2$ were estimated by the method of Hohn, as described by Birchard (2).

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Calcium bisulfite; $Ca(HSO_3)_2$; [13780-03-5]
or Magnesium bisulfite; $Mg(HSO_3)_2$; [13774-25-9]

ORIGINAL MEASUREMENTS:

Chodakov, K. V. *Bumaznaja Promyslennost* 1937 (No. 9), 33-38.

VARIABLES:

Temperature, pressure, concentration

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

1 atm = 101.325 kPa

*Calculated by compiler: mole fraction, $x_{SO_2}$, is based on the supposition that the liquid is 100 $cm^3$ of water. The weights are given as g in 100 $cm^3$ of final solution. C $SO_2$ is combined $SO_2$ equivalent to $Ca(HSO_3)_2$: F $SO_2$ is free $SO_2$, from Total (T)-C: $p_{SO_2}$ is the pressure in atm, from the % by volume in the gas phase.

| T/K | Base /g | $p_{SO_2}$ /atm | $SO_2$,T /g | $SO_2$,F /g | $SO_2$ mole | $x_{SO_2}$* |
|---|---|---|---|---|---|---|
| 297.15 | CaO 1.40 g | 0.089 | 4.26 | 1.06 | 0.0166 | 0.0030 |
| | | 0.264 | 5.66 | 2.46 | 0.0384 | 0.0069 |
| | | 0.441 | 7.01 | 3.81 | 0.0595 | 0.0106 |
| | | 0.616 | 8.48 | 5.29 | 0.0827 | 0.0147 |
| | | 0.662 | 8.48 | 5.28 | 0.0825 | 0.0146 |
| | | 0.850 | 10.16 | 6.96 | 0.109 | 0.0192 |
| 297.15 | Dolomite equivalent to CaO, 1.40 g | 0.063 | 3.98 | 0.78 | 0.0122 | 0.0022 |
| | | 0.052 | 4.00 | 0.80 | 0.0125 | 0.0023 |
| | | 0.231 | 5.31 | 2.11 | 0.0330 | 0.0059 |
| | | 0.278 | 5.79 | 2.59 | 0.0405 | 0.0072 |
| | | 0.525 | 7.60 | 4.40 | 0.0688 | 0.0122 |
| | | 0.700 | 9.02 | 5.82 | 0.0909 | 0.0161 |
| | | 0.820 | 9.90 | 6.70 | 0.105 | 0.0185 |

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide in the liquid and in the vapor phase was determined by an iodine titration.
One half of $SO_2$ present as bisulfite was determined by titration with alkali.

SOURCE AND PURITY OF MATERIALS:

May be taken as of satisfactory purity.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Calcium bisulfite; $Ca(HSO_3)_2$; [13780-03-5]
or Magnesium bisulfite; $Mg(HSO_3)_2$; [13774-25-9]

ORIGINAL MEASUREMENTS:

Chodakov, K. V. *Bumaznaja Promyslennost* 1937 (No. 9), 33-38.

EXPERIMENTAL VALUES:

| T/K | Base /g | $p_{SO_2}$ /atm | $SO_2$,T /g | $SO_2$,F /g | $SO_2$ mole | $x_{SO_2}^*$ |
|---|---|---|---|---|---|---|
| 297.15 | MgO equivalent to CaO 1.45 g | 0.091 | 4.16 | 0.85 | 0.0133 | 0.0024 |
| | | 0.092 | 4.35 | 1.04 | 0.0163 | 0.0029 |
| | | 0.316 | 5.98 | 2.67 | 0.0417 | 0.0075 |
| | | 0.451 | 7.10 | 3.79 | 0.0592 | 0.0106 |
| | | 0.483 | 7.20 | 3.89 | 0.0608 | 0.0108 |
| | | 0.645 | 8.64 | 5.33 | 0.0833 | 0.0148 |
| | | 0.770 | 9.38 | 6.07 | 0.0948 | 0.0168 |
| | | 0.882 | 10.47 | 7.16 | 0.112 | 0.0197 |
| | | 0.888 | 10.56 | 7.25 | 0.113 | 0.0200 |
| 297.15 | Wt. of CaO/g | 0.05 | 1.79 | 0.65 | | |
| | 0.5 | 0.14 | 2.70 | 1.56 | | |
| | | 0.34 | 4.32 | 3.18 | | |
| | | 0.48 | 5.60 | 4.46 | | |
| | | 0.69 | 7.29 | 6.15 | | |
| | | 0.87 | 8.64 | 7.50 | | |
| | 1.0 | 0.07 | 3.07 | 0.78 | | |
| | | 0.24 | 4.64 | 2.35 | | |
| | | 0.48 | 6.40 | 4.11 | | |
| | | 0.49 | 6.62 | 4.33 | | |
| | | 0.78 | 8.90 | 6.61 | | |
| | | 0.84 | 9.05 | 6.76 | | |
| | 1.4 | 0.06 | 3.98 | 0.78 | | |
| | | 0.05 | 4.00 | 0.80 | | |
| | | 0.23 | 5.31 | 2.11 | | |
| | | 0.28 | 5.79 | 2.59 | | |
| | | 0.53 | 7.60 | 4.40 | | |
| | | 0.70 | 9.03 | 5.83 | | |
| | | 0.82 | 9.90 | 6.70 | | |
| | 2.0 | 0.065 | 5.28 | 0.71 | | |
| | | 0.17 | 6.00 | 1.43 | | |
| | | 0.25 | 6.66 | 2.09 | | |
| | | 0.47 | 8.30 | 3.73 | | |
| | | 0.56 | 8.99 | 4.42 | | |
| | | 0.82 | 10.90 | 6.33 | | |
| | | 0.84 | 11.07 | 6.50 | | |
| 313.15 | 1.0 | 0.16 | 3.50 | 1.21 | | |
| | | 0.31 | 4.13 | 1.84 | | |
| | | 0.38 | 4.67 | 2.38 | | |
| | | 0.60 | 5.63 | 3.34 | | |
| | | 0.62 | 5.70 | 3.41 | | |
| | | 0.87 | 6.88 | 4.59 | | |
| 333.15 | 1.0 | 0.08 | 3.07 | 0.78 | | |
| | | 0.19 | 3.42 | 1.13 | | |
| | | 0.39 | 4.00 | 1.71 | | |
| | | 0.75 | 5.12 | 2.83 | | |
| 353.15 | 1.0 | 0.15 | 3.07 | 0.78 | | |
| | | 0.22 | 3.32 | 1.03 | | |
| | | 0.29 | 3.52 | 1.23 | | |
| | | 0.34 | 3.68 | 1.39 | | |
| | | 0.47 | 3.84 | 1.55 | | |
| 279.15 | 1.0 | 0.055 | 3.71 | 1.42 | | |
| | | 0.07 | 3.90 | 1.61 | | |
| | | 0.08 | 4.20 | 1.91 | | |
| | | 0.17 | 5.63 | 3.34 | | |

(cont.)

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Calcium bisulfite; $Ca(HSO_3)_2$; [13780-03-5]
or Magnesium bisulfite; $Mg(HSO_3)_2$; [13774-25-9]

ORIGINAL MEASUREMENTS:

Chodakov, K. V. *Bumaznaja Promyslennost* 1937 (No. 9), 33-38.

EXPERIMENTAL VALUES:

| T/K | Base /g | $SO_2$ /atm | $SO_{2,T}$ /g | $SO_{2,F}$ /g | $SO_2$ mole | $x^*_{SO_2}$ |
|---|---|---|---|---|---|---|
| | Wt. of CaO | | | | | |
| 279.15 | 1.0 | 0.39 | 8.64 | 6.35 | | |
| | | 0.39 | 8.75 | 6.46 | | |
| | | 0.65 | 11.80 | 9.51 | | |
| | | 0.62 | 12.00 | 9.71 | | |
| | | 0.83 | 15.00 | 12.71 | | |
| | | 0.91 | 16.00 | 13.71 | | |
| | 1.4 | 0.025 | 4.44 | 1.24 | | |
| | | 0.02 | 4.48 | 1.28 | | |
| | | 0.06 | 5.18 | 1.98 | | |
| | | 0.155 | 6.56 | 3.36 | | |
| | | 0.27 | 8.29 | 5.09 | | |
| | | 0.44 | 10.60 | 7.40 | | |
| | | 0.67 | 13.44 | 10.24 | | |
| | | 0.72 | 14.70 | 11.50 | | |
| | | 0.78 | 15.30 | 12.10 | | |
| | | 0.855 | 16.20 | 13.00 | | |
| 313.15 | 1.4 | 0.06 | 3.65 | 0.45 | | |
| | | 0.25 | 4.58 | 1.38 | | |
| | | 0.47 | 5.65 | 2.45 | | |
| | | 0.84 | 7.36 | 4.16 | | |
| | | 0.88 | 7.52 | 4.32 | | |
| 333.15 | 1.4 | 0.09 | 3.78 | 0.58 | | |
| | | 0.29 | 4.54 | 1.34 | | |
| | | 0.64 | 5.44 | 2.24 | | |
| | | 0.79 | 5.92 | 2.72 | | |
| 353.15 | 1.4 | 0.17 | 3.84 | 0.64 | | |
| | | 0.11 | 3.48 | 0.28 | | |
| | | 0.28 | 4.16 | 0.96 | | |
| | | 0.48 | 4.48 | 1.28 | | |

COMPONENTS:

1 Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Thiocyanic acid, calcium salt, (Calcium thiocyanate); $Ca(CNS)_2$; [2092-16-2]

ORIGINAL MEASUREMENTS:

Hansen, C.J.

*Ber*, 1933, *66B*, 447-450

VARIABLES:

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

At 280.15 K, 81.65 g of the original solution containing 22.07 g of calcium thiocyanate (volume = 70 $cm^3$, density = 1.167 g $cm^{-3}$, moles, as $Ca(CNS)_2$ = 0.141, but given by the author as 0.2828. based on one half of $Ca(CNS)_2$) absorbed 21.25 g $SO_2$, 0.332 mole, to give 102.9 g, and 82.3 $cm^3$ of solution (final), density = 1.25 g $cm^{-3}$. The mole ratio $SO_2/Ca(CNS)_2$ is therefore = 0.332/0.141 = 2.355, mole fraction, $x_{SO_2}$, = 0.702. The author gave the mole ratio as 1.175, based on one half of the molecular formula, $Ca(CNS)_2$. The pressure was presumably the unspecified barometric pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A known amount of salt solution was treated in a measuring cylinder with sulfur dioxide. The final solution was weighed and its volume determined.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was stated to be pure.

2. and 3. May be assumed to be of satisfactory purity.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Magnesium bisulfite from MgO + water + $SO_2$

ORIGINAL MEASUREMENTS:

Conrad, F.H.; Brice, D.B.

*J. Am. Chem. Soc.* 1948, *70*, 2179-2182.

VARIABLES:

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

| T/K | Total pressure /mmHg | g $SO_2$/100 g water Total | Combined | Free | Free $SO_2$ *Mole ratio | *Mole fraction |
|---|---|---|---|---|---|---|
| 288.15 | 75.5 | 30.4 | 15.7 | 14.7 | 0.0413 | 0.0397 |
| | 87.5 | 28.05 | 14.75 | 13.3 | 0.0374 | 0.0361 |
| | 110.7 | 29.65 | 15.05 | 14.6 | 0.0411 | 0.0395 |
| | 156.8 | 32.9 | 16.9 | 16.0 | 0.0450 | 0.0431 |
| | 162.3 | 31.4 | 16.55 | 14.85 | 0.0418 | 0.0401 |
| | 245.5 | 39.9 | 21.0 | 18.9 | 0.0532 | 0.0505 |
| | 419.3 | 46.9 | 23.55 | 23.35 | 0.0657 | 0.0616 |
| | 448.7 | 44.8 | 22.4 | 22.4 | 0.0630 | 0.0593 |
| | 726.8 | 54.6 | 27.8 | 26.8 | 0.0754 | 0.0701 |
| | 730.3 | 53.3 | 26.75 | 26.55 | 0.0747 | 0.0695 |
| 298.15 | 130.2 | 28.2 | 14.2 | 14.0 | 0.0394 | 0.0379 |
| | 154.4 | 28.0 | 14.85 | 13.15 | 0.0370 | 0.0365 |
| | 213.2 | 35.6 | 18.2 | 17.4 | 0.0489 | 0.0467 |
| | 264.3 | 35.2 | 17.9 | 17.3 | 0.0487 | 0.0464 |
| | 288.0 | 37.5 | 18.75 | 18.75 | 0.0527 | 0.0500 |
| | 326.5 | 40.7 | 20.35 | 20.35 | 0.0572 | 0.0541 |
| | 410.9 | 42.1 | 21.3 | 20.8 | 0.0585 | 0.0553 |
| | 560.7 | 50.2 | 25.4 | 24.9 | 0.0700 | 0.0654 |
| | 638.4 | 51.6 | 26.3 | 25.3 | 0.0712 | 0.0665 |
| | 726.8 | 50.7 | 25.85 | 24.85 | 0.0699 | 0.0653 |
| | 728.4 | 52.0 | 26.2 | 25.8 | 0.0726 | 0.0677 |
| 308.15 | 728.7 | 50.1 | 25.7 | 25.8 | 0.0726 | 0.0677 |

* calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

As described by Conrad and Beuschlein (1).

NOTE: For definition of "total", "combined" and "free" sulfur dioxide see Ref. (1).

Sulfur dioxide was passed into a suspension of magnesium oxide in water. The solution was deemed to be a saturated solution of sulfur dioxide in a saturated solution of magnesium bisulfite. A solid phase was present, and a sample of the clear liquid phase was removed for chemical titrations.

SOURCE AND PURITY OF MATERIALS:

(1) Sulfur dioxide was of refrigeration grade, see ref. (1)

(2) Water was freshly distilled, see ref. (1).

(3) Magnesium oxide was "C.P. analyzed."

ESTIMATED ERROR:

REFERENCES:

1. Conrad, F.H.; Beuschlein, W.L. *J. Am. Chem. Soc.* 1934, *56*, 2554.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7746-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Cadmium chloride; $CdCl_2$; [10043-52-4]

ORIGINAL MEASUREMENTS:

Fox, C.J.J.

*Z. Phys. Chem.* 1902, *41*, 458-482.

VARIABLES:

Temperature, concentration of salt

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

Equivalent taken by authors as $\frac{1}{2}CdCl_2$

| T/K | "Normality" | 3 | 2.5 | 2 | 1.5 | 1 | 0.5 |
|---|---|---|---|---|---|---|---|
| 298 | Ostwald coefficient, $L$ | 26.06 | 27.09 | 28.16 | 29.46 | 30.55 | 31.66 |
| | ($L$ for water given as | 32.76) | | | | | |
| 308 | Ostwald coefficient, $L$ | 18.68 | 19.23 | 20.02 | 20.55 | 21.23 | 21.73 |
| | ($L$ for water given as | 22.43) | | | | | |

The following arithmetic was shown by the original author:

$a$ = $cm^3$ $SO_2$ (273 K, 760 mmHg) in 1 $cm^3$ of "solution," presumably meaning the salt solution before absorption of gas.

$x$ = $cm^3$ of iodine solution containing $s$ equivalents per $dm^3$; 0.001 mole $I_2$ taken to be equivalent to 0.001 mole $SO_2$.

$1/2\ sx = a/22.4$, for one $cm^3$ of the saturated solution. For $c$ $cm^3$ of the solution taken for titration, at T/K and $b$ mmHg pressure, $a = (11.2\ sx)/c\ (T/K\ /\ 273\ K)$. The coefficient $L$ was taken to be equal to $a\ (760/b)$. (See evaluation).

NOTE by compiler: based on the published density of sulfur dioxide, 2.9266 g $dm^{-3}$ at 273.15 K and 1 atm, the molar volume of $SO_2$ is 21.87 $dm^3$ and not 22.4 $dm^3$ under these conditions; therefore all the $L$ values are about 2% too large.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The absorption vessel was fitted with electrodes for the measurement of conductance, data not herein recorded. Sulfur dioxide was passed through the solution to saturation at barometric pressure, the apparatus being held in a thermostat, controlled at 25.05 to 25.1°C, or 35 to 35.05°C. A volume of the saturated solution was withdrawn by pipet (0.9181 to 1.436 $cm^3$), and the amount of $SO_2$ determined by iodine-thiosulfate titration.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide, 99.8% $SO_2$, 0.2% water, commercial.
2. Presumably conductivity grade.
3. Salt of Kahlbaum grade, recrystallised and analytically attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Cadmium bromide; $CdBr_2$; [7789-42-6]

ORIGINAL MEASUREMENTS:

Fox, C.J.J.

*Z. Phys. Chem.* 1902, *41*, 458-482.

VARIABLES:

Temperature, concentration of salt.

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES: Equivalent taken by the author as 1/2 $CdBr_2$

| T/K | "Normality" | 3 | 2.5 | 2 | 1.5 | 1 | 0.5 |
|---|---|---|---|---|---|---|---|
| 298 | Ostwald coefficient, $L$ | 27.46 | 28.15 | 29.27 | 30.17 | 31.01 | 31.91 |
| | ($L$ for water given as | 32.76) | | | | | |
| 308 | Ostwald coefficient, $L$ | 19.17 | 19.70 | 20.60 | 20.81 | 31.46 | 21.88 |
| | ($L$ for water given as | 22.43) | | | | | |

The following arithmetic was shown by the original author:

$a$ = $cm^3$ $SO_2$ (273 K, 760 mmHg) in 1 $cm^3$ of "solution," presumably meaning the salt solution before absorption of gas.

$x$ = $cm^3$ of iodine solution containing $s$ equivalents per $dm^3$; 0.001 mole $I_2$ taken to be equivalent to 0.001 mole $SO_2$.

$1/2\ sx = a/22.4$, for one $cm^3$ of the saturated solution. For $c$ $cm^3$ of the solution taken for titration, at T/K and $b$ mmHg pressure, $a = (11.2\ sx)/c$ (T/K / 273 K). The coefficient $L$ was taken to be equal to $a$ $(760/b)$. (See evaluation).

NOTE by compiler: based on the published density of sulfur dioxide, 2.9266 g $dm^{-3}$ at 273.15 K and 1 atm, the molar volume of $SO_2$ is 21.87 $dm^3$ and not 22.4 $dm^3$ under these conditions; therefore all the $L$ values are about 2% too large.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The absorption vessel was fitted with electrodes for the measurement of conductance, data not herein recorded. Sulfur dioxide was passed through the solution to saturation at barometric pressure, the apparatus being held in a thermostat, controlled at 25.05 to 25.1°C, or 35 to 35.05°C. A volume of the saturated solution was withdrawn by pipet (0.9181 to 1.436 $cm^3$), and the amount of $SO_2$ determined by iodine-thiosulfate titration.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide, 99.8% $SO_2$, 0.2% water, commercial.
2. Presumably conductivity grade.
3. Salt of Kahlbaum grade, recrystallised and analytically attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Cadmium iodide; $CdI_2$; [7790-80-9]

ORIGINAL MEASUREMENTS:

Fox, C.J.J.

*Z. Phys. Chem.* 1902, *41*, 458-482.

VARIABLES:

Temperature, concentration of salt

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES: Equivalent taken by the author as 1/2 $CdI_2$

| T/K | "Normality" | 3 | 2.5 | 2 | 1.5 | 1 | 0.5 |
|---|---|---|---|---|---|---|---|
| 298 | Ostwald coefficient, $L$ | 35.77 | 34.98 | 34.74 | 34.16 | 33.76 | 33.27 |
| | ($L$ for water given as | 32.76) | | | | | |
| 308 | Ostwald coefficient, $L$ | 24.30 | 23.99 | 23.71 | 23.38 | 23.06 | 22.75 |
| | ($L$ for water given as | 22.43) | | | | | |

The following arithmetic was shown by the original author:

$a$ = $cm^3$ $SO_2$ (273 K, 760 mmHg) in 1 $cm^3$ of "solution," presumably meaning the salt solution before absorption of gas.

$x$ = $cm^3$ of iodine solution containing $s$ equivalents per $dm^3$; 0.001 mole $I_2$ taken to be equivalent to 0.001 mole $SO_2$.

$1/2\ sx = a/22.4$, for one $cm^3$ of the saturated solution. For $c$ $cm^3$ of the solution taken for titration, at T/K and $b$ mmHg pressure, $a = (11.2\ sx)/c\ (T/K\ /\ 273\ K)$. The coefficient $L$ was taken to be equal to $a\ (760/b)$. (See evaluation).

NOTE by compiler: based on the published density of sulfur dioxide, 2.9266 g $dm^{-3}$ at 273.15 K and 1 atm, the molar volume of $SO_2$ is 21.87 $dm^3$ and not 22.4 $dm^3$ under these conditions; therefore all the $L$ values are about 2% too large.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The absorption vessel was fitted with electrodes for the measurement of conductance, data not herein recorded. Sulfur dioxide was passed through the solution to saturation at barometric pressure the apparatus being held in a thermostat, controlled at 25.05 to 25.1°C or 35 to 35.05°C. A volume of the saturated solution was withdrawn by pipet (0.9181 to 1.436 $cm^3$), and the amount of $SO_2$ determined by iodine-thiosulfate titration.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide, 99.8% $SO_2$, 0.2% water, commercial.
2. Presumably conductivity grade.
3. Salt of Kahlbaum grade, recrystallised and analytically attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Cadmium sulfate; $CdSO_4$; [10124-36-4]

ORIGINAL MEASUREMENTS:

Fox, C.J.J.

*Z. Phys. Chem.* 1902, *41*, 458-482.

VARIABLES:

Temperature, concentration of salt

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES: Equivalent given by the author as 1/2 $CdSO_4$

| T/K | "Normality" | 3 | 2.5 | 2 | 1.5 | 1 | 0.5 |
|---|---|---|---|---|---|---|---|
| 298 | Ostwald coefficient, $L$ | 23.76 | 25.14 | 26.58 | 28.24 | 29.71 | 31.11 |
| | ($L$ for water given as | 32.76) | | | | | |
| 308 | Ostwald coefficient, $L$ | 16.25 | 17.41 | 18.31 | 19.42 | 20.43 | 21.45 |
| | ($L$ for water given as | 22.43) | | | | | |

The following arithmetic was shown by the original author:

$a$ = $cm^3$ $SO_2$ (273 K, 760 mmHg) in 1 $cm^3$ of "solution," presumably meaning the salt solution before absorption of gas.

$x$ = $cm^3$ of iodine solution containing $s$ equivalents per $dm^3$; 0.001 mole $I_2$ taken to be equivalent to 0.001 mole $SO_2$.

$1/2\ sx = a/22.4$, for one $cm^3$ of the saturated solution. For $c$ $cm^3$ of the solution taken for titration, at T/K and $b$ mmHg pressure, $a = (11.2\ sx)/c$ (T/K / 273 K). The coefficient $L$ was taken to be equal to $a$ $(760/b)$. (See evaluation)

NOTE by compiler: based on the published density of sulfur dioxide, 2.9266 g $dm^{-3}$ at 273.15 K and 1 atm, the molar volume of $SO_2$ is 21.87 $dm^3$ and not 22.4 $dm^3$ under these conditions; therefore all the $L$ values are about 2% too large.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The absorption vessel was fitted with electrodes for the measurement of conductance, data not herein recorded Sulfur dioxide was passed through the solution to saturation at barometric pressure, the apparatus being held in a thermostat, controlled at 25.05 to 25.1°C or 35 to 35.05°C. A volume of the saturated solution was withdrawn by pipet (0.9181 to 1.436 $cm^3$), and the amount of $SO_2$ determined by iodine-thiosulfate titration.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide, 99.8% $SO_2$, 0.2% water, commercial.
2. Presumably conductivity grade.
3. Salt of Kahlbaum grade, re-crystallised and analytically attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Zinc sulfate; $ZnSO_4$; [7733-02-0]

ORIGINAL MEASUREMENTS:

Jager (Jaeger), L.

*Chem. Prumysl.* 1957, *7*, 601-602.

VARIABLES:

Temperature, concentration of salt

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

760 mmHg = 1 atm = 101.325 kPa

| T/K | g $ZnSO_4$/dm$^3$ | g $SO_2$/dm$^3$ |
|---|---|---|
| 293 | 88.1 | 84.2 |
| | 119.0 | 79.6 |
| | 156.0 | 74.3 |
| | 194.0 | 69.2 |
| | 232.5 | 63.5 |
| | 284.0 | 55.1 |
| | 320.5 | 48.1 |
| 303 | 28.75 | 67.8 |
| | 59.5 | 65.6 |
| | 58.9 | 65.4 |
| | 87.5 | 62.8 |
| | 125.7 | 59.9 |
| | 114.0 | 58.9 |
| | 156.0 | 55.1 |
| | 156.0 | 55.1 |
| | 199.2 | 50.6 |
| | 194.8 | 49.4 |
| | 231.0 | 46.2 |
| | 229.0 | 45.8 |
| | 286.0 | 41.3 |
| | 316.0 | 37.5 |
| 313 | 32.6 | 50.6 |
| | 30.3 | 49.9 |
| | 54.2 | 49.0 |
| | 56.7 | 49.6 |
| | 90.4 | 47.1 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Amount of sulfur dioxide absorbed at the total pressure of about 1 atm was determined by iodimetric titration. The temperature was controlled to within ±0.1°C.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide may be taken as of satisfactory purity.
2. As for (1).
3. As for (1). Content in solution was determined by chelatometric titration.

ESTIMATED ERROR:

REFERENCES:

| COMPONENTS | ORIGINAL MEASUREMENTS |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Water; $H_2O$; [7732-18-5]<br>3. Zinc sulfate; $ZnSO_4$; [7733-02-0] | Jager (Jaeger), L.<br>*Chem. Prumysl.* 1957, *7*, 601-602. |

EXPERIMENTAL VALUES: 760 mmHg = 1 atm = 101.325 kPa

| T/K | g $ZnSO_4$/dm$^3$ | g $SO_2$/dm$^3$ |
|---|---|---|
| 313 | 159.5 | 42.3 |
| | 157.8 | 41.6 |
| | 237.0 | 35.8 |
| | 279.0 | 32.5 |
| | 282.0 | 32.7 |
| | 322.0 | 29.4 |
| 323 | 28.1 | 37.4 |
| | 26.8 | 36.9 |
| | 65.1 | 36.8 |
| | 66.2 | 37.2 |
| | 98.2 | 35.5 |
| | 98.2 | 35.5 |
| | 160.5 | 31.7 |
| | 161.2 | 31.9 |
| | 198.2 | 30.6 |
| | 284.5 | 25.6 |
| | 284.5 | 25.6 |
| | 321.5 | 22.9 |
| 343 | 31.7 | 21.9 |
| | 31.7 | 21.9 |
| | 62.9 | 22.1 |
| | 160.0 | 20.7 |
| | 160.5 | 20.6 |
| | 188.5 | 19.5 |
| | 188.4 | 19.5 |
| | 258.0 | 17.6 |
| | 331.0 | 15.2 |
| | 331.0 | 15.2 |
| 363 | 60.0 | 9.08 |
| | 60.1 | 9.08 |
| | 140.3 | 9.92 |
| | 140.2 | 9.92 |
| | 220.5 | 9.78 |
| | 220.0 | 9.77 |
| | 295.0 | 8.37 |
| | 352.5 | 7.67 |
| 373 | 70.1 | 3.46 |
| | 124.0 | 2.69 |
| | 124.1 | 2.69 |
| | 245.0 | 3.71 |
| | 293.5 | 3.46 |

NOTE: g $SO_2$/dm$^3$ presumably means g $SO_2$ absorbed by 1 dm$^3$ of the original solution of the salt.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Zinc bisulfite; $Zn(HSO_3)_2$; [15457-98-4]
4. Zinc sulfate; $ZnSO_4$; [7733-02-0]

ORIGINAL MEASUREMENTS:

Peisakhov, I. L.; Karmazina, V. D.

*Zh. Priklad. Khim.* 1959, *32*, 70-78.

VARIABLES:

Temperature, concentration of components 3 and 4

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

760 mmHg = 1 atm = 101.325 kPa

$SO_2$(T) = total sulfur dioxide

$SO_2$(F) = free sulfur dioxide

$\rho$ = density of solution

| Expt. | Conc. of $Zn(HSO_3)_2$ /g dm$^{-3}$ | Conc. of $ZnSO_4$ /g dm$^{-3}$ | $SO_2$(T) /g dm$^{-3}$ | $SO_2$(F) /g dm$^{-3}$ | $\rho$ /g cm$^{-3}$ | T/K | $p_{SO_2}$ /mmHg |
|---|---|---|---|---|---|---|---|
| 1 | 5.31 | 4.52 | 2.98 | 0 | 1.006 | 293 | 0.057 |
| | | | | | | 313 | 0.126 |
| | | | | | | 323 | 0.160 |
| | | | | | | 333 | 0.241 |
| | | log $p_{SO_2}$/mmHg = 3.94 - 1520/(T/K) | | | | | |
| 2 | 10.2 | 3.52 | 5.84 | 0 | 1.009 | 293 | 0.149 |
| | | | | | | 313 | 0.393 |
| | | | | | | 323 | 0.597 |
| | | | | | | 333 | 0.954 |
| | | log $p_{SO_2}$/mmHg = 4.88 - 1960/(T/K) | | | | | |
| 3 | 13.9 | 8.1 | 7.97 | 0.19 | 1.016 | 293 | 0.465 |
| | | | | | | 313 | 0.679 |

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Nitrogen from a cylinder was passed through a rheometer, and then through five consecutive absorption flasks containing the solution, the procedure being that of Kuzminykh and Kuznetsova (1). Presumably the sulfur dioxide solution was prepared separately. The absorption flasks were held in a thermostat. The pressure, $p_{SO_2}$ was measured by the

determination of the volume content of the gas emerging from the last flask, iodine titrations being used. Likewise the sulfur dioxide content of the solutions in the last three flasks was determined. To obtain a pulp of solid zinc sulfite, crystals of the latter were added to each flask. The rate of passage of nitrogen was 0.5 liter/minute.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

REFERENCES:

1. Kuzminykh, I. N.; Kuznetsova, A. G. *Zh. Priklad. Khim.* 1954, *27*, 816.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Water; $H_2O$; [7732-18-5]<br>3. Zinc bisulfite; $Zn(HSO_3)_2$; [15457-98-4]<br>4. Zinc sulfate; $ZnSO_4$; [7733-02-0] | Peisakhov, I. L.; Karmazina, V. D.<br>*Zh. Priklad. Khim.* 1959, *32*, 70-78. |

EXPERIMENTAL VALUES:

| Expt. | Conc. of $Zn(HSO_3)_2$ /g $dm^{-3}$ | Conc. of $ZnSO_4$ /g $dm^{-3}$ | $SO_2$(T) /g $dm^{-3}$ | $SO_2$(F) /g $dm^{-3}$ | ρ /g $cm^{-3}$ | T/K | $p_{SO_2}$ /mmHg |
|---|---|---|---|---|---|---|---|
| 3 | 13.9 | 8.1 | 7.97 | 0.19 | 1.016 | 323 | 1.29 |
| | | | | | | 333 | 2.00 |
| | | $\log p_{SO_2}/\text{mmHg} = 6.43 - 2040/(T/K)$ | | | | | |
| 4 | 13.9 | 4.44 | 7.83 | 0 | 1.012 | 293 | 0.302 |
| | | | | | | 313 | 0.767 |
| | | | | | | 323 | 1.26 |
| | | | | | | 333 | 2.02 |
| | | $\log p_{SO_2}/\text{mmHg} = 6.23 - 2040/(T/K)$ | | | | | |
| 5 | 24.2 | 3.71 | 14.0 | 0.26 | 1.018 | 293 | 1.68 |
| | | | | | | 313 | 3.34 |
| | | | | | | 323 | 4.61 |
| | | | | | | 333 | 8.77 |
| | | $\log p_{SO_2}/\text{mmHg} = 7.28 - 2110/(T/K)$ | | | | | |
| 6 | 25.6 | 6.6 | 15.0 | 0.58 | 1.025 | 293 | 1.67 |
| | | | | | | 313 | 3.74 |
| | | | | | | 323 | 5.70 |
| | | | | | | 333 | 7.62 |
| | | $\log p_{SO_2}/\text{mmHg} = 5.77 - 1620/(T/K)$ | | | | | |
| 7 | 39.3 | 11.4 | 23.65 | 1.54 | 1.041 | 293 | 3.8 |
| | | | | | | 313 | 8.52 |
| | | | | | | 323 | 12.2 |
| | | | | | | 333 | 18.5 |
| | | $\log p_{SO_2}/\text{mmHg} = 6.04 - 1600/(T/K)$ | | | | | |
| 8 | 41.4 | 9.35 | 25.0 | 1.73 | 1.04 | 293 | 3.6 |
| | | | | | | 313 | 9.34 |
| | | | | | | 323 | 14.57 |
| | | | | | | 333 | 19.73 |
| | | $\log p_{SO_2}/\text{mmHg} = 6.92 - 1865/(T/K)$ | | | | | |
| 9. | 5.56 | 24.8 | 3.36 | 0.23 | 1.026 | 293 | 0.206 |
| | | | | | | 313 | 0.319 |
| | | | | | | 323 | 0.356 |
| | | | | | | 333 | 0.50 |
| | | $\log p_{SO_2}/\text{mmHg} = 2.22 - 880/(T/K)$ | | | | | |
| 10 | 41.3 | 26.8 | 23.7 | 0.45 | 1.051 | 293 | 6.70 |
| | | | | | | 313 | 13.2 |
| | | | | | | 323 | 16.8 |
| | | | | | | 333 | 21.5 |
| | | $\log p_{SO_2}/\text{mmHg} = 5.06 - 1240/(T/K)$ | | | | | |

(cont.)

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Zinc bisulfite; $Zn(HSO_3)_2$; [15457-98-4]
4. Zinc sulfate; $ZnSO_4$; [7733-02-0]

ORIGINAL MEASUREMENTS:

Peisakhov, I. L.; Karmazina, V. D.
*Zh. Priklad. Khim.* <u>1959</u>, *32*, 70-78.

EXPERIMENTAL VALUES:

| Expt. | Conc. of $Zn(HSO_3)_2$ /g $dm^{-3}$ | Conc. of $ZnSO_4$ /g $dm^{-3}$ | $SO_2$(T) /g $dm^{-3}$ | $SO_2$(F) /g $dm^{-3}$ | $\rho$ /g $cm^{-3}$ | T/K | $p_{SO_2}$ /mmHg |
|---|---|---|---|---|---|---|---|
| 11 | 3.86 | 55.0 | 2.21 | 0.32 | 1.055 | 293 | 0.07 |
| | | | | | | 313 | 0.134 |
| | | | | | | 323 | 0.175 |
| | | | | | | 333 | 0.259 |
| | | $\log p_{SO_2}/\text{mmHg} = 1.85 - 850/(T/K)$ | | | | | |
| 12 | 6.14 | 53.2 | 3.5 | 0.05 | 1.057 | 293 | 0.363 |
| | | | | | | 313 | 0.723 |
| | | | | | | 323 | 0.843 |
| | | | | | | 333 | 1.035 |
| | | $\log p_{SO_2}/\text{mmHg} = 3.5 - 1150/(T/K)$ | | | | | |
| 13 | 42.3 | 49.6 | 25.0 | 1.15 | 1.080 | 293 | 8.44 |
| | | | | | | 313 | 15.7 |
| | | | | | | 323 | 20.5 |
| | | | | | | 333 | 27.5 |
| | | $\log p_{SO_2}/\text{mmHg} = 5.38 - 1300/(T/K)$ | | | | | |
| 14 | 3.64 | 88.2 | 2.63 | 0.58 | 1.088 | 293 | 0.256 |
| | | | | | | 313 | 0.289 |
| | | | | | | 323 | 0.30 |
| | | | | | | 333 | 0.395 |
| 15 | 3.64 | 88.2 | 2.63 | 0.58 | 1.088 | 293 | 0.188 |
| | | | | | | 313 | 0.258 |
| | | | | | | 323 | 0.311 |
| | | | | | | 333 | 0.468 |
| 14 and 15 | | $\log p_{SO_2}/\text{mmHg} = 2.09 - 830/(T/K)$ | | | | | |
| 16 | 10.9 | 82.6 | 6.9 | 1.21 | 1.090 | 293 | 0.948 |
| | | | | | | 313 | 1.78 |
| | | | | | | 323 | 2.52 |
| | | | | | | 333 | 3.58 |
| | | $\log p_{SO_2}/\text{mmHg} = 4.76 - 1400/(T/K)$ | | | | | |
| 17 | 22.9 | 82.0 | 13.7 | 1.02 | 1.10 | 293 | 2.68 |
| | | | | | | 313 | 5.46 |
| | | | | | | 323 | 6.96 |
| | | | | | | 333 | 9.41 |
| | | $\log p_{SO_2}/\text{mmHg} = 4.92 - 1320/(T/K)$ | | | | | |
| 18 | 35.4 | 77.5 | 22.2 | 2.3 | 1.106 | 293 | 9.35 |
| | | | | | | 313 | 16.77 |
| | | | | | | 323 | 18.73 |
| | | | | | | 333 | 21.3 |
| 19 | 35.4 | 77.5 | 22.2 | 2.3 | 1.106 | 293 | 8.64 |
| | | | | | | 313 | 14.78 |
| | | | | | | 323 | 17.6 |
| | | | | | | 333 | 22.3 |
| 18 and 19 | | $\log p_{SO_2}/\text{mmHg} = 3.88 - 850/(T/K)$ | | | | | |

(cont.)

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Zinc bisulfite; $Zn(HSO_3)_2$; [15457-98-4]
4. Zinc sulfate; $ZnSO_4$; [7733-02-0]

ORIGINAL MEASUREMENTS:

Peisakhov, I. L.; Karmazina, V. D.

*Zh. Priklad. Khim.* 1959, *32*, 70-78.

EXPERIMENTAL VALUES:

| Expt. | Conc. of $Zn(HSO_3)_2$ /g $dm^{-3}$ | Conc. of $ZnSO_4$ /g $dm^{-3}$ | $SO_2$(T) /g $dm^{-3}$ | $SO_2$(F) /g $dm^{-3}$ | ρ /g $cm^{-3}$ | T/K | $p_{SO_2}$ /mmHg |
|---|---|---|---|---|---|---|---|
| 20 | 3.64 | 104 | 2.06 | 0 | 1.088 | 293 | 0.187 |
| | | | | | | 313 | 0.299 |
| | | | | | | 323 | 0.329 |
| | | | | | | 333 | 0.472 |
| | | $\log p_{SO_2}$/mmHg = 2.68 - 1000/(T/K) | | | | | |
| 21 | 5.67 | 103 | 3.44 | 0.24 | 1.099 | 293 | 0.373 |
| | | | | | | 313 | 0.726 |
| | | | | | | 323 | 0.933 |
| | | | | | | 333 | 1.25 |
| | | $\log p_{SO_2}$/mmHg = 4.01 - 1300/(T/K) | | | | | |
| 22 | 42.7 | 101.4 | 24.5 | 0.45 | 1.122 | 293 | 7.83 |
| | | | | | | 313 | 17.0 |
| | | | | | | 323 | 22.5 |
| | | | | | | 333 | 32.5 |
| | | $\log p_{SO_2}$/mmHg = 6.16 - 1550/(T/K) | | | | | |
| 23 | 3.28 | 194 | 3.01 | 1.65 | 1.825 | 293 | 0.274 |
| | | | | | | 313 | 0.573 |
| | | | | | | 323 | 0.740 |
| | | | | | | 333 | 1.08 |
| | | $\log p_{SO_2}$/mmHg = 4.38 - 1450/(T/K) | | | | | |
| 24 | 38.1 | 198 | 21.5 | 0 | 1.216 | 293 | 5.93 |
| | | | | | | 313 | 14.94 |
| | | | | | | 323 | 20.53 |
| | | | | | | 333 | 28.7 |
| | | $\log p_{SO_2}$/mmHg = 6.66 - 1700/(T/K) | | | | | |

The smoothing equations given were calculated by the authors. Care should be taken in using these equations as there are significant discrepancies between values calculated from the equations and the experimental values. The equations for experiments nos. 2, 4, 9 and 24 appear to be in error.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Sodium chloride; NaCl; [7647-14-5]

ORIGINAL MEASUREMENTS:

Fox, C.J.J.

*Z. Phys. Chem.* 1902, *41*, 458-482.

VARIABLES:

Concentration of salt.

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | "Normality" | 3 | 2,5 | 2 | 1.5 | 1 | 0.5 |
|---|---|---|---|---|---|---|---|
| 298 | Ostwald coefficient, *L*<br>(*L* for water given as 32.76) | 31.36 | 31.51 | 31.76 | 31.96 | 32.25 | 32.46 |

The following arithmetic was shown by the original author:

$a$ = $cm^3$ $SO_2$ (273 K, 760 mmHg) in 1 $cm^3$ of "solution," presumably meaning the salt solution before absorption of gas.

$x$ = $cm^3$ of iodine solution containing $s$ equivalents per $dm^3$; 0.001 mole $I_2$ taken to be equivalent to 0.001 mole $SO_2$.

$1/2\ sx = a/22.4$, for one $cm^3$ of the saturated solution. For $c$ $cm^3$ of the solution taken for titration, at T/K and $b$ mmHg pressure, $a = (11.2\ sx)/c$ (T/K / 273 K). The coefficient $L$ was taken to be equal to $a$ $(760/b)$. (See evaluation).

NOTE by compiler: based on the published density of sulfur dioxide, 2.9266 g $dm^{-3}$ at 273.15 K and 1 atm, the molar volume of $SO_2$ is 21.87 dm and not 22.4 $dm^3$ under these conditions; therefore all the $L$ values are about 2% too large.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The absorption vessel was fitted with electrodes for the measurement of conductance, data not herein recorded. Sulfur dioxide was passed through the solution to saturation at barometric pressure, the apparatus being held in a thermostat, controlled at 25.05 to 25.1°C, or 35 to 35.05°C. A volume of the saturated solution was withdrawn by pipet (0.9181 to 1.436 $cm^3$), and the amount of $SO_2$ determined by iodine-thiosulfate titration.

SOURCE AND PURITY OF MATERIALS:

(1) Sulfur dioxide, 99.8 $SO_2$, 0.2% water, commercial.

(2) Presumably conductivity grade.

(3) Salt of Kahlbaum grade, recrystallised and analytically attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Sodium bromide; NaBr; [7647-15-6]

ORIGINAL MEASUREMENTS:

Fox, C.J.J.

*Z. Phys. Chem.* 1902, *41*, 458-482

VARIABLES:

Concentration of salt

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | "Normality" | 3 | 2.5 | 2 | 1.5 | 1 | 0.5 |
|---|---|---|---|---|---|---|---|
| 298 | Ostwald coefficient, $L$ ($L$ for water given as 32.76) | 37.74 | 36.84 | 36.26 | 35.27 | 34.54 | 33.76 |

The following arithmetic was shown by the original author:

$a$ = $cm^3$ $SO_2$(273 K, 760 mmHg) in 1 $cm^3$ of "solution," presumably meaning the salt solution before absorption of gas.

$x$ = $cm^3$ of iodine solution containing $s$ equivalents per $dm^3$ ; 0.001 mole $I_2$ taken to be equivalent to 0.001 mole $SO_2$.

1/2 $sx = a/22.4$, for one $cm^3$ of the saturated solution. For $c$ $cm^3$ of the solution taken for titration, at T/K and $b$ mmHg pressure, $a = (11.2\ sx)/c$ (T/K / 273 K). The coefficient $L$ was taken to be equal to $a$ (760/$b$). (See evaluation).

NOTE by compiler: based on the published density of sulfur dioxide, 2.9266 g $dm^{-3}$ at 273.15 K and 1 atm, the molar volume of $SO_2$ is 21.87 $dm^3$ and not 22.4 $dm^3$ under these conditions; therefore all the $L$ values are about 2% too large.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The absorption vessel was fitted with electrodes for the measurement of conductance, data not herein recorded. Sulfur dioxide was passed through the solution to saturation at barometric pressure, the apparatus being held in a thermostat, controlled at 25.05 to 25.1°C, or 35 to 35.05°C. A volume of the saturated solution was withdrawn by pipet (0.9181 to 1.436 $cm^3$ ), and the amount of $SO_2$ determined by iodine-thiosulfate titration.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide, 99.8% $SO_2$, 0.2% water, commercial.
2. Presumably conductivity grade.
3. Salt of Kahlbaum grade, recrystallised and analytically attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Sodium sulfate; $Na_2SO_4$; [7757-82-6]

ORIGINAL MEASUREMENTS:

Fox, C.J.J.

*Z. Phys. Chem.* 1902, *41*, 458-482.

VARIABLES:

Temperature, concentration of salt.

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES: Equivalent taken by the author as 1/2 $Na_2SO_4$

| T/K | "Normality" | 3 | 2.5 | 2 | 1.5 | 1 | 0.5 |
|---|---|---|---|---|---|---|---|
| 298 | Ostwald coefficient, *L* | 28.44 | 28.66 | 29.51 | 30.45 | 31.14 | 31.96 |
| | (*L* for water given as 32.76) | | | | | | |
| 308 | Ostwald coefficient, *L* | 19.27 | 19.79 | 20.20 | 20.81 | 21.35 | 21.88 |
| | (*L* for water given as 22.43) | | | | | | |

The following arithmetic was shown by the original author:

$a$ = $cm^3$ $SO_2$ (273 K, 760 mmHg) in 1 $cm^3$ of "solution," presumably meaning the salt solution before absorption of gas.

$x$ = $cm^3$ of iodine solution containing $s$ equivalents per $dm^3$ ; 0.001 mole $I_2$ taken to be equivalent to 0.001 mole $SO_2$ .

$1/2\ sx = a/22.4$, for one $cm^3$ of the saturated solution. For $c$ $cm^3$ of the solution taken for titration, at T/K and $b$ mmHg pressure, $a = (11.2\ sx)/c$ (T/K / 273 K). The coefficient $L$ was taken to be equal to $a$ $(760/b)$ (See evaluation).

NOTE by compiler: based on the published density of sulfur dioxide, 2.9266 g $dm^{-3}$ at 273.15 K and 1 atm, the molar volume of $SO_2$ is 21.87 $dm^3$ and not 22.4 $dm^3$ under these conditions; therefore all the $L$ values are about 2% too large.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The absorption vessel was fitted with electrodes for the measurement of conductance, data not herein recorded. Sulfur dioxide was passed through the solution to saturation at barometric pressure, the apparatus being held in a thermostat, controlled at 25.05 to 25.1°C, or 35 to 35.05°C. A volume of the saturated solution was withdrawn by pipet (0.9181 to 1.436 $cm^3$), and the amount of $SO_2$ determined by iodine-thiosulfate titration.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide, 99.8% $SO_2$, 0.2% water, commercial.
2. Presumably conductivity grade.
3. Salt of Kahlbaum grade, recrystallised and analytically attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Sodium sulfate; $Na_2SO_4$; [7757-82-6]

ORIGINAL MEASUREMENTS:

Hudson, J.C.
*J. Chem. Soc.* 1925, *127*, 1332-1347

VARIABLES:

Temperature, concentration of salt

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES: 760 mmHg = 1 atm = 101.325 kPa

| T/K | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 293.15 | g salt/100 g water | 0 | 1.94 | 4.93 | 7.95 | 10.00 | 15.00 | 20.00 |
| | g $SO_2$ 100 g water | 10.64 | 10.66 | 10.57 | 10.36 | 10.07 | 9.66 | 9.17 |
| | *Mole ratio | 0.0299 | 0.0300 | 0.0297 | 0.0291 | 0.0283 | 0.0272 | 0.0258 |
| | *$x_{SO_2}$ | 0.0290 | 0.0291 | 0.0289 | 0.0283 | 0.0275 | 0.0265 | 0.0252 |
| 303.15 | g salt/100 g water | 0 | 2.04 | 3.99 | 5.47 | 7.83 | 10.00 | 20.01 |
| | g $SO_2$/100 g water | 7.608 | 7.709 | 7.776 | 7.773 | 7.716 | 7.586 | 7.006 |
| | *Mole ratio | 0.0214 | 0.0217 | 0.0219 | 0.0219 | 0.0217 | 0.0213 | 0.0197 |
| | *$x_{SO_2}$ | 0.0209 | 0.0212 | 0.0214 | 0.0214 | 0.0212 | 0.0209 | 0.0193 |
| 313.15 | g salt/100 g water | 0 | 2.49 | 5.04 | 7.95 | 10.00 | 14.94 | 20.01 |
| | g $SO_2$/100 g water | 5.585 | 5.812 | 5.910 | 5.927 | 5.882 | 5.802 | 5.630 |
| | *Mole ratio | 0.0157 | 0.0163 | 0.0166 | 0.0167 | 0.0165 | 0.0163 | 0.0158 |
| | *$x_{SO_2}$ | 0.0155 | 0.0160 | 0.0163 | 0.0164 | 0.0162 | 0.0160 | 0.0156 |
| 323.15 | g salt/100 g water | 0 | 2.49 | 5.04 | 10.04 | 14.94 | 19.99 | |
| | g $SO_2$/100 g water | 4.214 | 4.508 | 4.678 | 4.728 | 4.730 | 4.648 | |
| | *Mole ratio | 0.01185 | 0.0127 | 0.0132 | 0.0133 | 0.0133 | 0.0131 | |
| | *$x_{SO_2}$ | 0.0117 | 0.0125 | 0.0130 | 0.0131 | 0.0131 | 0.0129 | |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was bubbled through a weighed amount of salt solution in a tube immersed in a thermostat. The pressure was measured on a manometer. The saturated solution was weighed and the $SO_2$ content was determined by an iodine titration. It was stated that the calculated value of the partial pressure of the gas over the solution was within 10 mmHg of 760 mmHg; the final weight of gas was given as for 760 mmHg "on the basis of Henry's law." A tentative allowance was made for the lowering of the vapor pressure of water by the dissolved salt and gas.

* Calculated by compiler

SOURCE AND PURITY OF MATERIALS:

(1) Sulfur dioxide was from a cylinder; the purity was stated to be high; the chief impurity being water, less than 0.4%.

(2) and (3) may be taken as of analytical purity.

ESTIMATED ERROR:

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Water; $H_2O$; [7732-18-5]<br>3. Sodium bisulfate; $NaHSO_4$; [7681-38-1] | Kobe, K.A.; Kenton, F.H.<br>*Ind. Eng. Chem.,Anal. Edit.* 1938, *10*, 76-77. |
| VARIABLES: | PREPARED BY: W. Gerrard. |

EXPERIMENTAL VALUES:

760 mmHg = 1 atm = 101.325 kPa

$T/K = 298.15 \quad p_{SO_2} = 760$ mmHg.

The aqueous solution was made up by dissolving 200 g anhydrous sodium sulfate in 800 g of distilled water, and adding 40 cm of "concentrated, 36*N* sulfuric acid."

| Volume of solution (original) / $cm^3$ | Volume of gas absorbed /$cm^3$ | Volume of gas dissolved in one volume of solution | Bunsen coefficient $\alpha$ |
|---|---|---|---|
| 9.54 | 131.2 | 13.6 | 12.5 |
| 24.54 | 392.2 | | |

NOTE: The absorption coefficient, 13.6, is based on the volume of the final solution; the so-called Bunsen coefficient, $\alpha$, was obtained by 13.6 x (273/298) = 12.46. However, the Bunsen $\alpha$ is usually referred to the volume of the original liquid, and not the final volume. The following results are supplied by compiler.

$131.2/9.54 = 13.75 : \alpha = 12.60$
$329.2/24.54 = 13.41 : \alpha = 12.29$

AUXILIARY INFORMATION

| METHOD/APPARATUS/PROCEDURE: | SOURCE AND PURITY OF MATERIALS: |
|---|---|
| A mine-air buret was used. See Ref. (1). | 1. Not specified.<br>2. and 3. Analytical grade compounds were used. |
| | ESTIMATED ERROR: |
| | REFERENCES:<br>1. Kobe, K.A.; Williams, J.S. *Ind.Eng.Chem.Anal.Ed.* 1935, *7*, 37. |

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Sodium bisulfite; $NaHSO_3$; [7631-90-5]

ORIGINAL MEASUREMENTS:

Otuka, Y.

*J. Soc. Chem. Ind. Japan.,Suppl.* 1939, *42*, 205B-209B

VARIABLES:

Temperature, pressure

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES: 760 mmHg = 1 atm = 101.325 kPa

| T/K | $p_{\text{Total}}$/atm | $p_{SO_2}$/atm | Moles $SO_2$/dm$^3$ solution | *H* |
|---|---|---|---|---|
| 373 | 1.58 | 0.60 | 0.1594 | 0.266 |
| | 1.94 | 0.97 | 0.2670 | 0.275 |
| 378 | 1.86 | 0.69 | 0.1563 | 0.226 |
| | 2.27 | 1.11 | 0.2618 | 0.236 |
| 383 | 2.18 | 0.80 | 0.1531 | 0.191 |
| | 2.62 | 1.25 | 0.2567 | 0.205 |
| 388 | 2.55 | 0.91 | 0.1498 | 0.165 |
| | 2.99 | 1.36 | 0.2529 | 0.186 |
| 393 | 2.94 | 1.02 | 0.1468 | 0.144 |
| | 3.43 | 1.52 | 0.2479 | 0.163 |
| 398 | 3.37 | 1.13 | 0.1438 | 0.127 |
| | 3.90 | 1.67 | 0.2432 | 0.146 |
| 403 | 3.83 | 1.22 | 0.1413 | 0.116 |
| | 4.41 | 1.81 | 0.2387 | 0.132 |
| 408 | 4.35 | 1.33 | 0.1384 | 0.104 |
| | 4.98 | 1.98 | 0.2336 | 0.118 |
| 413 | 4.96 | 1.47 | 0.1347 | 0.092 |
| | 5.56 | 2.09 | 0.2304 | 0.110 |
| 418 | 5.55 | 1.54 | 0.1331 | 0.086 |
| | 6.15 | 2.17 | 0.2282 | 0.105 |
| 423 | 6.14 | 1.56 | 0.1328 | 0.085 |
| | 6.75 | 2.20 | 0.2274 | 0.103 |

"Solution" appears to mean the final solution. The author defined the "solubility" as $H = (H_2SO_3)/p_{SO_2}$, the pressure being in atm. $(H_2SO_3)$ evidently means moles $SO_2$/dm$^3$ of solution. The concentration of $NaHSO_3$ was given as 0.3000 mol/dm$^{-3}$. NOTE: The author refers to "pure sulfurous acid, $H_2SO_3$."

METHOD/APPARATUS/PROCEDURE:

The total vapor pressure, $p_{\text{Total}}$, was determined by means of a glass spring manometer. It was stated that the partial pressures were approximated from the dimensions of the apparatus, but details were not given.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Water; $H_2O$; [7732-18-5]<br>3. Sodium bisulfite; $NaHSO_3$; [7631-90-5] | Kubelka, V.<br>*Chem. Zvesti* 1959, *13*, 430-435. |
| VARIABLES: | PREPARED BY: |
| Temperature, concentration | W. Gerrard |

EXPERIMENTAL VALUES:

760 mmHg = 1 atm = 101.325 kPa

Solubility was expressed as g $SO_2$/100 g of solution at 760 mmHg.

| "Normality" of $NaHSO_3$ | | T/K 293 | 303 | 313 | 333 | 353 | 363 |
|---|---|---|---|---|---|---|---|
| 0.2 | $SO_2$, Total | 10.71 | 7.80 | 5.69 | 3.53 | 1.68 | 1.44 |
| | Combined | 1.26 | 1.26 | 1.26 | 1.26 | 1.26 | 1.26 |
| | Free | 9.45 | 6.54 | 4.43 | 2.27 | 0.42 | 0.18 |
| 0.3 | T | 11.31 | | 6.38 | 4.17 | | 2.33 |
| | C | 2.10 | | 2.10 | 2.10 | | 2.10 |
| | F | 9.21 | | 4.28 | 2.07 | | 0.23 |
| 0.5 | T | 11.85 | | 6.89 | 5.14 | | 3.43 |
| | C | 3.13 | | 3.13 | 3.13 | | 3.13 |
| | F | 8.72 | | 3.76 | 2.01 | | 0.30 |
| 1.0 | T | 14.27 | | 9.66 | 7.62 | | 6.98 |
| | C | 6.12 | | 6.12 | 6.12 | | 6.12 |
| | F | 8.15 | | 3.54 | 1.50 | | 0.86 |
| 2.0 | T | 18.70 | | 15.20 | 13.27 | | 12.43 |
| | C | 11.72 | | 11.72 | 11.72 | | 11.72 |
| | F | 7.98 | | 3.48 | 1.55 | | 0.71 |

For each normality a small diagram was given to show that for a stated temperature the plot of $p_{SO_2}$ vs. g, $SO_2$(Total)/100 g solution was linear, although the numerical data were not given. These lines were presumably used to indicate the g $SO_2$(Total) for 1 atm.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method of Domansky and Rendos (1) was used. The sulfur dioxide was determined by an iodine titration.

SOURCE AND PURITY OF MATERIALS:

1. May be taken of satisfactory purity.

2 and 3. Sodium carbonate was used as a basis of the sodium bisulfite.

ESTIMATED ERROR:

REFERENCES:

1. Domansky, R.; Rendos, F. *Chem. Zvesti* 1957, *11*, 453.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Sodium thiocyanate; NaCNS; [540-72-7]

ORIGINAL MEASUREMENTS:

Fox, C.J.J.

*Z. Phys. Chem.* 1902, *41*, 458-482.

VARIABLES:

Concentration of salt.

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | "Normality" | 3 | 2.5 | 2 | 1.5 | 1 | 0.5 |
|---|---|---|---|---|---|---|---|
| 298 | Ostwald coefficient, $L$ | 48.34 | 45.86 | 43.37 | 40.78 | 38.24 | 35.44 |

($L$ for water given as 32.76)

The following arithmetic was shown by the original author:

$a$ = $cm^3$ $SO_2$ (273 K, 760 mmHg) in 1 $cm^3$ of "solution," presumably meaning the salt solution before absorption of gas.

$x$ = $cm^3$ of iodine solution containing $s$ equivalents per $dm^3$; 0.001 mole $I_2$ taken to be equivalent to 0.001 mole $SO_2$.

$1/2\ sx = a/22.4$, for one $cm^3$ of the saturated solution. For $c$ $cm^3$ of the solution taken for titration, at T/K and $b$ mmHg pressure, $a = (11.2\ sx)/c$ (T/K / 273 K). The coefficient $L$ was taken to be equal to $a$ (760/$b$). (See evaluation).

NOTE by compiler: based on the published density of sulfur dioxide, 2.9266 g $dm^{-3}$ at 273.15 K and 1 atm, the molar volume of $SO_2$ is 21.87 $dm^3$ and not 22.4 $dm^3$ under these conditions; therefore all the $L$ values are about 2% too large.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The absorption vessel was fitted with electrodes for the measurement of conductance, data not herein recorded. Sulfur dioxide was passed through the solution to saturation at barometric pressure, the apparatus being held in a thermostat, controlled at 25.05 to 25.1°C, or 35 to 35.05°C. A volume of the saturated solution was withdrawn by pipet (0.9181 to 1.436 $cm^3$), and the amount of $SO_2$ determined by iodine-thiosulfate titration.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide, 99.8% $SO_2$, 0.2% water commercial.

2. Presumably conductivity grade.

3. Salt of Kahlbaum grade, recrystallised and analytically attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Sodium thiocyanate; NaCNS; [540-72-7]

ORIGINAL MEASUREMENTS:

Hansen, C.J.

*Ber.* <u>1933</u>, *66B*, 447-450.

VARIABLES:

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

At 282.15 K, 106.3 g of the original solution containing 28.75 g NaCNS (27% by weight, d = 1.13 g $cm^{-3}$), i.e. 0.355 mole, and 94 $cm^3$, absorbed 29.9 g $SO_2$ , presumably at a total pressure equal to the unspecified barometric pressure. The number of moles of $SO_2$ was stated to be 0.477, whereas, the correct value is 0.467. The mole ratio, $SO_2$/NaCNS was correctly stated to be 1.32. The mole fraction, $x_{SO_2}$, calculated by compiler is 0.569

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A known amount of salt solution was treated in measuring cylinder with sulfur dioxide. The final solution was weighed, and its volume determined.

SOURCE AND PURITY OF MATERIALS:

1. Pure sulfur dioxide was stated to be used.

2. and 3. Satisfactory purity may be assumed.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Potassium chloride; KCl; [7447-40-7]

ORIGINAL MEASUREMENTS:

Fox, C.J.J.

*Z. Phys. Chem.* 1902, *41*, 458-482

VARIABLES:

Temperature, concentration of salt

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | "Normality" | 3 | 2.5 | 2 | 1.5 | 1 | 0.5 |
|---|---|---|---|---|---|---|---|
| 298 | Ostwald coefficient, *L* | 42.27 | 40.96 | 39.32 | 37.76 | 36.05 | 34.42 |
| | (*L* for water given as | 32.76) | | | | | |
| 308 | Ostwald coefficient, *L* | 30.02 | 28.93 | 27.94 | 26.54 | 25.15 | 23.74 |
| | (*L* for water given as | 22.43) | | | | | |

The following arithmetic was shown by the original author:

$a$ = $cm^3$ $SO_2$ (273 K, 760 mmHg) in 1 $cm^3$ of "solution," presumably meaning the salt solution before absorption of gas.

$x$ = $cm^3$ of iodine solution containing $s$ equivalents per $dm^3$; 0.001 mole $I_2$ taken to be equivalent to 0.001 mole $SO_2$.

$1/2\ sx = a/22.4$, for one $cm^3$ of the saturated solution. For $c$ $cm^3$ of the solution taken for titration, at T/K and $b$ mmHg pressure, $a = (11.2\ sx)/c\ (T/K\ /\ 273\ K)$. The coefficient $L$ was taken to be equal to $a\ (760/b)$. (See evaluation).

NOTE by compiler: based on the published density of sulfur dioxide, 2.9266 g $dm^{-3}$ at 273.15 K and 1 atm, the molar volume of $SO_2$ is 21.87 $dm^3$ and not 22.4 $dm^3$ under these conditions; therefore all the $L$ values are about 2% too large.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The absorption vessel was fitted with electrodes for the measurement of conductance, data not herein recorded. Sulfur dioxide was passed through the solution to saturation at barometric pressure, the apparatus being held in a thermostat, controlled at 25.05 to 25.1°C, or 35 to 35.05°C. A volume of the saturated solution was withdrawn by pipet (0.9181 to 1.436 $cm^3$), and the amount of $SO_2$ determined by iodine-thiosulfate titration.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide, 99.8% $SO_2$, 0.2% water, commercial.
2. Presumably conductivity grade.
3. Salt of Kahlbaum grade, recrystallised and analytically attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Potassium chloride; KCl [7447-40-7]

ORIGINAL MEASUREMENTS:

Hudson, J.C.

*J. Chem. Soc.* 1925, *127*, 1332-1347

VARIABLES:

Temperature, concentration of salt

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES: 1 atm = 760 mmHg = 101.325 kPa

| T/K | $p_{\text{Total}}$ /mmHg | $p_{SO_2}$ /mmHg | $y_{\text{KCl}}$ /g | $S_1$ /g | $S$ /g | *Mole ratio $SO_2/H_2O$ | *Mole fraction 1 atm, $x_{SO_2}$ |
|---|---|---|---|---|---|---|---|
| 283.15 | | | 0 | | 15.39 | 0.0433 | 0.0415 |
| | 780.3 | 772.0 | 5.55 | 17.32 | 17.05 | 0.0479 | 0.0458 |
| | 780.3 | 772.2 | 10.22 | 18.88 | 18.58 | 0.0522 | 0.0497 |
| | 766.2 | 758.3 | 15.85 | 20.23 | 20.28 | 0.0570 | 0.0539 |
| | 766.2 | 758.4 | 20.78 | 21.92 | 21.96 | 0.0618 | 0.0582 |
| | 768.2 | 761.4 | 29.90 | 25.45 | 25.40 | 0.0714 | 0.0667 |
| 288.15 | | | 0 | | 12.66 | 0.0356 | 0.0344 |
| | 772.2 | 760.8 | 10.39 | 15.30 | 15.32 | 0.0431 | 0.0413 |
| | 771.9 | 761.0 | 19.91 | 17.67 | 17.64 | 0.0496 | 0.0473 |
| | 772.2 | 761.9 | 30.71 | 20.64 | 20.59 | 0.0579 | 0.0547 |
| 293.15 | | | 0 | | 10.64 | 0.0299 | 0.0290 |
| | 773.9 | 757.9 | 5.14 | 11.60 | 11.62 | 0.0327 | 0.0317 |
| | 774.6 | 758.9 | 10.30 | 12.50 | 12.52 | 0.0352 | 0.0340 |
| | 778.0 | 761.7 | 15.61 | 13.58 | 13.55 | 0.0381 | 0.0367 |
| | 774.0 | 759.4 | 24.98 | 15.37 | 15.38 | 0.0433 | 0.0415 |
| | 779.0 | 764.8 | 30.38 | 16.76 | 16.65 | 0.0468 | 0.0447 |
| 303.05 | | | 0 | | 7.58 | 0.0213 | 0.0209 |
| | 788.6 | 759.3 | 5.19 | 8.204 | 8.21 | 0.0231 | 0.0226 |
| | 789.4 | 760.7 | 10.11 | 8.810 | 8.80 | 0.0247 | 0.0241 |
| | 784.0 | 756.7 | 20.82 | 10.00 | 10.05 | 0.0283 | 0.0275 |
| | 782.8 | 756.8 | 29.86 | 11.21 | 11.26 | 0.0317 | 0.0307 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was bubbled through the weighed amount of salt solution in a tube immersed in a thermostat, and attached to a manometer assembly for the measurement of the total pressure at the saturation stage. After saturation, the tube was weighed and the sulfur dioxide content determined by oxidation with hydrogen peroxide in sodium hydroxide solution, and the gravimetric estimation of sulfate as barium sulfate.

For the estimation of the vapor pressure of water over the solution, see end of the complete table.

SOURCE AND PURITY OF MATERIALS:

(1) Sulfur dioxide was from a cylinder; the purity was stated to be high, the chief impurity being water, less than 0.4%.

(2) and (3) may be taken as analytically pure.

ESTIMATED ERROR:

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Water; $H_2O$; [7732-18-5]<br>3. Potassium chloride; KCl; [7447-40-7] | Hudson, J.C.<br>*J. Chem. Soc.* <u>1925</u>, *127*, 1332-1347. |

EXPERIMENTAL VALUES: 1 atm = 760 mmHg = 101.325 kPa

| T/K | $p_{Total}$ /mmHg | $p_{SO_2}$ /mmHg | $y_{KCl}$ /g | $S_1$ /g | $S$ /g | *Mole ratio $SO_2/H_2O$ | *Mole fraction 1 atm, $x_{SO_2}$ |
|---|---|---|---|---|---|---|---|
| 313.15 | | | 0 | | 5.54 | 0.0156 | 0.0154 |
| | 816.7 | 764.3 | 5.17 | 5.994 | 5.96 | 0.0168 | 0.0165 |
| | 818.1 | 766.9 | 10.20 | 6.380 | 6.32 | 0.0178 | 0.0175 |
| | 810.4 | 759.2 | 10.40 | 6.380 | 6.39 | 0.0180 | 0.0177 |
| | 818.1 | 768.1 | 15.44 | 6.869 | 6.675 | 0.0188 | 0.0185 |
| | 810.4 | 761.6 | 20.14 | 7.086 | 7.07 | 0.0199 | 0.0195 |
| | 803.7 | 756.0 | 24.83 | 7.415 | 7.45 | 0.0210 | 0.0206 |
| | 803.7 | 757.0 | 28.95 | 7.721 | 7.75 | 0.0218 | 0.0213 |
| 321.30 | | | 0 | | 4.39 | 0.0123 | 0.0122 |
| | 841.8 | 761.7 | 5.06 | 4.712 | 4.70 | 0.0132 | 0.0130 |
| | 841.8 | 763.6 | 10.14 | 4.968 | 4.945 | 0.0139 | 0.0137 |
| | 826.9 | 750.7 | 15.82 | 5.180 | 5.24 | 0.0147 | 0.0145 |
| | 839.8 | 765.7 | 21.11 | 5.521 | 5.48 | 0.0154 | 0.0152 |
| | 826.9 | 754.0 | 25.09 | 5.703 | 5.74 | 0.0161 | 0.0159 |
| | 839.8 | 769.7 | 32.72 | 6.258 | 6.18 | 0.0174 | 0.0171 |
| 333.15 | | | 0 | | 3.25 | 0.0091 | 0.0090 |
| | 889 | 746 | 5.30 | 3.384 | 3.45 | 0.0097 | 0.0096 |
| | 888 | 748 | 10.67 | 3.468 | 3.52 | 0.0099 | 0.0098 |
| | 896 | 763.5 | 21.12 | 3.943 | 3.92 | 0.0110 | 0.0109 |
| | 890.5 | 764 | 30.98 | 4.258 | 4.24 | 0.0119 | 0.0118 |
| 343.15 | | | 0 | | 2.61 | 0.0073 | 0.00725 |
| | 969 | 747.5 | 8.74 | 2.756 | 2.80 | 0.0079 | 0.0078 |
| | 960.5 | 752 | 21.68 | 3.016 | 3.05 | 0.0086 | 0.0085 |
| | 960 | 757 | 30.73 | 3.251 | 3.26 | 0.0092 | 0.0091 |
| 353.15 | | | 0 | | 2.13 | 0.0060 | 0.0060 |
| | 958 | 620 | 8.66 | 1.850 | 2.27 | 0.0064 | 0.0063 |
| | 961 | 643 | 21.35 | 2.043 | 2.415 | 0.0068 | 0.0067 |
| | 961 | 656 | 29.68 | 2.179 | 2.52 | 0.0071 | 0.0070 |
| 363.15 | | | 0 | | 1.81 | 0.0051 | 0.0051 |
| | 967.5 | 468 | 9.23 | 1.142 | 1.855 | 0.0052 | 0.0052 |
| | 958 | 482 | 19.49 | 1.248 | 1.97 | 0.0055 | 0.0055 |
| | 965.5 | 520 | 32.75 | 1.445 | 2.11 | 0.0059 | 0.0059 |

* Calculated by compiler.

$p_{Total}$ = total pressure.

$p_{SO_2}$ = partial pressure of $SO_2$.

$y_{KCl}$ = g of KCl in 100 g of water.

"Solubility" $S_1$ = g of $SO_2$ per 100 g of water at $p_{SO_2}$

$S$ = g of $SO_2$ per 100 g of water at 760 mmHg

$S = S_1 \times 760/p_{SO_2}$

Allowance for the vapor pressure of water, $p_w$. It was assumed that lowering of the vapor pressure of water was equal to the sum of the depressions that would be caused by $SO_2$ and salt separately. Data for for the salt were taken from the literature; the lowering due to the gas was estimated by Raoult's law on the assumption that water is bimolecular. The correction was deemed to be small, 0.1% at 283 K, 1.25% at 363 K. Uncertainty was attributed to the combination of sulfur dioxide with water and with the salt, see the evaluation.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Potassium bromide; KBr; [7758-02-3]

ORIGINAL MEASUREMENTS:

Fox, C.J.J.

*Z. Phys. Chem.* 1902, *41*, 458-482.

VARIABLES:

Temperature, concentration of salt

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | "Normality" | 3 | 2.5 | 2 | 1.5 | 1 | 0.5 |
|---|---|---|---|---|---|---|---|
| 298 | Ostwald coefficient, $L$ | 52.26 | 48.87 | 44.96 | 42.41 | 39.11 | 35.94 |
| | ($L$ for water given as | 32.76) | | | | | |
| 308 | Ostwald coefficient, $L$ | 36.14 | 34.12 | 31.93 | 29.64 | 27.49 | 24.83 |
| | ($L$ for water given as | 22.43) | | | | | |

The following arithmetic was shown by the original author:

$a$ = $cm^3$ $SO_2$ (273 K, 760 mmHg) in 1 $cm^3$ of "solution," presumably meaning the salt solution before absorption of gas.

$x$ = $cm^3$ of iodine solution containing $s$ equivalents per $dm^3$; 0.001 mole $I_2$ taken to be equivalent to 0.001 mole $SO_2$.

$1/2\ sx = a/22.4$, for one $cm^3$ of the saturated solution. For $c$ $cm^3$ of the solution taken for titration, at T/K and $b$ mmHg pressure, $a = (11.2\ sx)/c$ (T/K / 273 K). The coefficient $L$ was taken to be equal to $a$ $(760/b)$. (See evaluation).

NOTE by compiler: based on the published density of sulfur dioxide, 2.9266 g $dm^{-3}$ at 273.15 K and 1 atm, the molar volume of $SO_2$ is 21.87 $dm^3$ and not 22.4 $dm^3$ under these conditions; therefore all the $L$ values are about 2% too large.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The absorption vessel was fitted with electrodes for the measurement of conductance, data not herein recorded Sulfur dioxide was passed through the solution to saturation at barometric pressure, the apparatus being held in a thermostat, controlled at 25.05 to 25.1°C or 35 to 35.05°C. A volume of the saturated solution was withdrawn by pipet (0.9181 to 1.436 $cm^3$), and the amount of $SO_2$ determined by iodine-thiosulfate titration.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide, 99.8% $SO_2$, 0.2% water commercial.
2. Presumably conductivity grade.
3. Salt of Kahlbaum grade, recrystallised and analytically attested.

ESTIMATED ERROR:

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Water; $H_2O$; [7732-18-5]<br>3. Potassium iodide; KI; [7681-11-0] | Fox, C.J.J.<br>*Z. Phys. Chem.* 1902, *41*, 458-482. |
| VARIABLES: | PREPARED BY: |
| Temperature, concentration of salt. | W. Gerrard. |

EXPERIMENTAL VALUES:

| T/K | "Normality" | 3 | 2.5 | 2 | 1.5 | 1 | 0.5 |
|---|---|---|---|---|---|---|---|
| 298 | Ostwald coefficient, *L* | 68.36 | 62.63 | 56.75 | 50.58 | 44.76 | 38.66 |
| | (*L* for water given as | 32.76) | | | | | |
| 308 | Ostwald coefficient, *L* | 45.43 | 41.87 | 38.04 | 34.64 | 30.25 | 26.30 |
| | (*L* for water given as | 22.43) | | | | | |

The following arithmetic was shown by the original author:

$a$ = $cm^3$ $SO_2$ (273 K, 760 mmHg) in 1 $cm^3$ of "solution," presumably meaning the salt solution before absorption of gas.

$x$ = $cm^3$ of iodine solution containing $s$ equivalents per $dm^3$; 0.001 mole $I_2$ taken to be equivalent to 0.001 mole $SO_2$.

$1/2\ sx = a/22.4$, for one $cm^3$ of the saturated solution. For $c$ $cm^3$ of the solution taken for titration, at T/K and $b$ mmHg pressure, $a = (11.2\ sx)/c$ (T/K / 273 K). The coefficient $L$ was taken to be equal to $a$ $(760/b)$. (See evaluation).

NOTE by compiler: based on the published density of sulfur dioxide, 2.9266 g $dm^{-3}$ at 273.15K and 1 atm, the molar volume of $SO_2$ is 21.87 $dm^3$ and not 22.4 $dm^3$ under these conditions; therefore all the $L$ values are about 2% too large.

AUXILIARY INFORMATION

| METHOD/APPARATUS/PROCEDURE: | SOURCE AND PURITY OF MATERIALS: |
|---|---|
| The absorption vessel was fitted with electrodes for the measurement of conductance, data not herein recorded. Sulfur dioxide was passed through the solution to saturation at barometric pressure, the apparatus being held in a thermostat, controlled at 25.05 to 25.1°C, or 35 to 35.05°C. A volume of the saturated solution was withdrawn by pipet (0.9181 to 1.436 $cm^3$), and the amount of $SO_2$ determined by iodine-thiosulfate titration. | 1. Sulfur dioxide, 99.8% $SO_2$, 0.2% water, commercial.<br>2. Presumably conductivity grade.<br>3. Salt of Kahlbaum grade, recrystallised and analytically attested.<br>ESTIMATED ERROR:<br>REFERENCES: |

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Potassium sulfate; $K_2SO_4$; [7778-80-5]

ORIGINAL MEASUREMENTS:

Fox, C.J.J.

*Z. Phys. Chem.* 1902, *41*, 458-482.

VARIABLES:

Concentration of salt

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES: Equivalent taken by the author as 1/2 $K_2SO_4$

| T/K | "Normality" | 1 | 0.5 |
|---|---|---|---|
| 298 | Ostwald coefficient, *L*<br>(*L* for water given as 32.76). | 33.61 | 33.20 |

The following arithmetic was shown by the original author:

$a$ = $cm^3$ $SO_2$ (273 K, 760 mmHg) in 1 $cm^3$ of "solution," presumably meaning the salt solution before absorption of gas.

$x$ = $cm^3$ of iodine solution containing $s$ equivalents per $dm^3$; 0.001 mole $I_2$ taken to be equivalent to 0.001 mole $SO_2$.

$1/2\ sx = a/22.4$, for one $cm^3$ of the saturated solution. For $c$ $cm^3$ of the solution taken for titration, at T/K and $b$ mmHg pressure, $a = (11.2\ sx)/c$ (T/K / 273 K). The coefficient $L$ was taken to be equal to $a$ $(760/b)$. (See evaluation).

NOTE by compiler: based on the published density of sulfur dioxide, 2.9266 g $dm^{-3}$ at 273.15K and 1 atm, the molar volume of $SO_2$ is 21.87 $dm^3$ and not 22.4 $dm^3$ under these conditions; therefore all the $L$ values are about 2% too large.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The absorption vessel was fitted with electrodes for the measurement of conductance, data not herein recorded. Sulfur dioxide was passed through the solution to saturation at barometric pressure, the apparatus being held in a thermostat, controlled at 25.05 to 25.1°C, or 35 to 35.05°C. A volume of the saturated solution was withdrawn by pipet (0.9181 to 1.436 $cm^3$), and the amount of $SO_2$ determined by iodine-thiosulfate titration.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide, 99.8% $SO_2$, 0.2% water, commercial.
2. Presumably conductivity grade.
3. Salt of Kahlbaum grade, recrystallised and analytically attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Potassium nitrate; $KNO_3$; [7757-79-1]

ORIGINAL MEASUREMENTS:

Fox, C.J.J.

*Z. Phys. Chem.* 1902, *41*, 458-482.

VARIABLES:

Temperature, concentration of salt

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

| T/K | "Normality" | 3 | 2.5 | 2 | 1.5 | 1 | 0.5 |
|---|---|---|---|---|---|---|---|
| 298 | Ostwald coefficient, *L* | 38.52 | 37.57 | 36.66 | 35.77 | 34.79 | 33.80 |
| | (*L* for water given as | 32.76) | | | | | |
| 308 | Ostwald coefficient, *L* | 27.33 | 26.54 | 25.72 | 24.79 | 24.03 | 23.27 |
| | (*L* for water given as | 22.43) | | | | | |

The following arithmetic was shown by the original author:

$a$ = $cm^3$ $SO_2$ (273 K, 760 mmHg) in 1 $cm^3$ of "solution," presumably meaning the salt solution before absorption of gas.

$x$ = $cm^3$ of iodine solution containing $s$ equivalents per $dm^3$; 0.001 mole $I_2$ taken to be equivalent to 0.001 mole $SO_2$.

$1/2\ sx = a/22.4$, for one $cm^3$ of the saturated solution. For $c$ $cm^3$ of the solution taken for titration, at T/K and $b$ mmHg pressure, $a = (11.2\ sx)/c$ (T/K /273 K). The coefficient $L$ was taken to be equal to $a$ $(760/b)$. (See evaluation.)

NOTE by compiler: based on the published density of sulfur dioxide, 2.9266 g $dm^{-3}$ at 273.15 K and 1 atm, the molar volume of $SO_2$ is 21.87 $dm^3$ and not 22.4 $dm^3$ under these conditions; therefore all the $L$ values are about 2% too large.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The absorption vessel was fitted with electrodes for the measurement of conductance, data not herein recorded. Sulfur dioxide was passed through the solution to saturation at barometric pressure, the apparatus being held in a thermostat, controlled at 25.05 to 25.1°C, or 35 to 35.05°C. A volume of the saturated solution was withdrawn by pipet (0.9181 to 1.436 $cm^3$), and the amount of $SO_2$ determined by iodine-thiosulfate titration.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide, 99.8% $SO_2$, 0.2% water, commercial.
2. Presumably conductivity grade.
3. Salt of Kahlbaum grade, recrystallised and analytically attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Potassium thiocyanate; KCNS; [333-20-0]

ORIGINAL MEASUREMENTS:

Fox, C.J.J.

*Z. Phys. Chem.* 1902, *41*, 458-482.

VARIABLES:

Temperature, concentration of salt.

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | "Normality" | 3.0 | 2.5 | 2.0 | 1.5 | 1.0 | 0.5 |
|---|---|---|---|---|---|---|---|
| 298 | Ostwald coefficient, $L$ | 61.26 | 55.87 | 51.86 | 47.02 | 42.38 | 37.57 |
|  | ($L$ for water given as | 32.76) |  |  |  |  |  |
| 308 | Ostwald coefficient, $L$ | 42.94 | 38.13 | 35.05 | 32.03 | 28.79 | 25.63 |
|  | ($L$ for water given as | 22.43) |  |  |  |  |  |

The following arithmetic was shown by the original author:

$a$ = $cm^3$ $SO_2$ (273 K, 760 mmHg) in 1 $cm^3$ of "solution," presumably meaning the salt solution before absorption of gas.

$x$ = $cm^3$ of iodine solution containing $s$ equivalents per $dm^3$; 0.001 mole $I_2$ taken to be equivalent to 0.001 mole $SO_2$ .

$1/2\ sx = a/22.4$, for one $cm^3$ of the saturated solution. For $c$ $cm^3$ of the solution taken for titration, at T/K and $b$ mmHg pressure, $a = (11.2\ sx)/c$ (T/K / 273 K). The coefficient $L$ was taken to be equal to $a$ $(760/b)$. (See evaluation).

NOTE by compiler: based on the published density of sulfur dioxide, 2.9266 g $dm^{-3}$ at 273.15 K and 1 atm, the molar volume of $SO_2$ is 21.87 $dm^3$ and not 22.4 $dm^3$ under these conditions; therefore all the $L$ values are about 2% too large.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The absorption vessel was fitted with electrodes for the measurement of conductance, data not herein recorded. Sulfur dioxide was passed through the solution to saturation at barometric pressure, the apparatus being held in a thermostat, controlled at 25.05 to 25.1°C, or 35 to 35.05°C. A volume of the saturated solution was withdrawn by pipet (0.9181 to 1.436 $cm^3$), and the amount of $SO_2$ determined by iodine-thiosulfate titration.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide, 99.8% $SO_2$, 0.2% water, commercial.
2. Presumably conductivity grade.
3. Salt of Kahlbaum grade, recrystallised and analytically attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Potassium thiocyanate; KCNS; [333-20-0]

ORIGINAL MEASUREMENTS:

Hansen, C.J.

*Ber*, 1933, *66B*, 447-450.

VARIABLES:

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

At 281.15 K, 50 g of the original solution of potassium thiocyanate (25 g, 0.258 moles) absorbed 32.2 g $SO_2$ to give 82.2 g of final solution of 58 $cm^3$ (density, * 1.42 g $cm^{-3}$. The mole ratio, $SO_2$/KCNS was given as 0.503/0.258 = 1.95; mole fraction, $x_{SO_2}$, calculated by compiler is 0.661.

*The density was given as 1.48.

At 285.15 K 60 g of the original solution containing 50 g of KCNS (0.515 mole) absorbed 52.5 g of $SO_2$(0.820 mole) to give 112.5 g (68 $cm^3$, density 1.65 g $cm^{-3}$) of final solution. The mole ratio, $SO_2$/KCNS was given as 0.820/0.515 = 1.59. The corresponding mole fraction, $x_{SO_2}$, = 0.614.

The total pressure appears to have been the unspecified barometric pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A known amount of the salt solution was treated in a measuring cylinder with sulfur dioxide. The final solution was weighed, and its volume was determined.

SOURCE AND PURITY OF MATERIALS:

1. Pure $SO_2$ was stated to be used.

2. and 3. Satisfactory purity may be assumed.

ESTIMATED ERROR:

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Water; $H_2O$; [7732-18-5]<br>3. Trichloromethane (Chloroform); $CHCl_3$; [75-43-4] | McCrae, J.; Wilson, W. E.<br>*Z. anorg. Chem.* 1903, *35*, 11-15. |
| VARIABLES: | PREPARED BY: |
|  | W. Gerrard |

EXPERIMENTAL VALUES:

T/K = 293.15

| Water phase |  |  | Chloroform phase |  |  |  |
|---|---|---|---|---|---|---|
| g $SO_2$/$dm^3$ (soln.) $c_1$ | *Equiv. $SO_2$/$dm^3$ (soln.) $e_1$ | $x_{SO_2}$ ** (water) | g $SO_2$/$dm^3$ (soln.) $c_2$ | *Equiv. $SO_2$/$dm^3$ (soln.) $e_2$ | $x_{SO_2}$ ** ($CHCl_3$) | $e_1/e_2$ |
| 1.738 | 0.05426 | 0.000489 | 1.123 | 0.03505 | 0.00140 | 1.55 |
| 1.753 | 0.05473 |  | 1.122 | 0.03503 |  | 1.56 |
| 2.326 | 0.07263 |  | 1.704 | 0.05320 |  | 1.37 |
| 2.346 | 0.07324 |  | 1.703 | 0.05320 |  | 1.38 |
| 2.628 | 0.08206 |  | 1.897 | 0.05924 |  | 1.38 |
| 3.039 | 0.09488 |  | 2.395 | 0.07478 |  | 1.27 |
| 3.058 | 0.09548 |  | 2.385 | 0.07447 |  | 1.28 |
| 3.686 | 0.1151 |  | 3.063 | 0.09563 |  | 1.20 |
| 3.735 | 0.1166 |  | 3.062 | 0.09561 |  | 1.22 |
| 4.226 | 0.1319 |  | 3.626 | 0.1132 |  | 1.17 |
| 5.269 | 0.1645 |  | 4.798 | 0.1498 |  | 1.10 |
| 5.372 | 0.1678 |  | 4.813 | 0.1503 |  | 1.12 |
| 6.588 | 0.2057 |  | 6.183 | 0.1930 |  | 1.07 |
| 31.92 | 0.9968 | 0.0089 | 33.84 | 1.056 | 0.0407 | 0.94 |
| 33.26 | 1.038 | 0.0093 | 37.25 | 1.163 | 0.0445 | 0.89 |

* As 1/2 $SO_2$.

** The mole fraction, $x_{SO_2}$, water, is based on 1 $dm^3$ of water, *i.e.*, on the assumption that there was no change in volume when $SO_2$ dissolved. Likewise for $CHCl_3$.

AUXILIARY INFORMATION

| METHOD/APPARATUS/PROCEDURE: | SOURCE AND PURITY OF MATERIALS: |
|---|---|
| A freshly prepared aqueous solution (50 $cm^3$) of sulfur dioxide was shaken thoroughly with chloroform (50 $cm^3$) in a separatory funnel in a thermostat at 293 K. The amount of $SO_2$ absorbed at equilibrium in a measured volume of each liquid phase was determined by titration (iodine-thiosulfate).<br>NOTE: Pressure was not mentioned. The results merely provide so-called distribution coefficients as ratios of mole/l in the aqueous phase/ mole/l in the chloroform phase for a range of concentrations in the aqueous phase. | Not specified.<br>ESTIMATED ERROR:<br>REFERENCES: |

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Trichloromethane (Chloroform); $CHCl_3$; [75-43-4]
3. Water; $H_2O$; [7732-18-5]
4. Hydrogen chloride; HCl; [7647-01-0]

ORIGINAL MEASUREMENTS:

McCrae, J.; Wilson, W. E.

*Z. anorg. Chem.* 1903, *35*, 11-15.

VARIABLES:

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

T/K = 293.15 * As 1/2 $SO_2$

| *N* HCl | Aqueous phase | | Chloroform phase | | |
|---|---|---|---|---|---|
| | g $SO_2$/dm$^3$ (soln.) $c_1$ | *Equiv. $SO_2$/dm$^3$ (soln.) $e_1$ | g $SO_2$/dm$^3$ (soln.) $c_2$ | *Equiv. $SO_2$/dm$^3$ (soln.) $e_2$ | Distribution Coefficient $e_1/e_2$ |
| 0.05 | 1.86 | 0.0581 | 1.46 | 0.0456 | 1.28 |
| 0.05 | 3.076 | 0.0960 | 2.830 | 0.0884 | 1.08 |
| 0.05 | 4.277 | 0.1336 | 4.07 | 0.1271 | 1.04 |
| 0.05 | 5.340 | 0.1667 | 5.420 | 0.1692 | 0.96 |
| 0.1 | 1.25 | 0.0390 | 1.410 | 0.0440 | 0.88 |
| 0.1 | 1.324 | 0.0413 | 1.416 | 0.0442 | 0.93 |
| 0.1 | 2.78 | 0.0868 | 3.080 | 0.0962 | 0.90 |
| 0.1 | 3.86 | 0.1199 | 4.08 | 0.1275 | 0.94 |
| 0.1 | 5.161 | 0.1612 | 5.715 | 0.1784 | 0.90 |
| 0.2 | 1.268 | 0.0396 | 1.509 | 0.0471 | 0.84 |
| 0.2 | 1.914 | 0.0597 | 2.274 | 0.0710 | 0.84 |
| 0.2 | 2.464 | 0.0769 | 3.040 | 0.0949 | 0.81 |
| 0.2 | 3.967 | 0.1239 | 4.898 | 0.1530 | 0.81 |
| 0.4 | 1.202 | 0.0375 | 1.614 | 0.0504 | 0.79 |
| 0.4 | 1.894 | 0.0591 | 2.263 | 0.0706 | 0.83 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A freshly prepared aqueous solution of sulfur dioxide and HCl was shaken thoroughly with chloroform in a separatory funnel in a thermostat at 293.15 K. After attainment of equilibrium, the amount of sulfur dioxide in each phase was determined by iodine-thiosulfite titrations. NOTE: Pressure was not mentioned. The results merely provide so-called distribution coefficients as ratios of mole/l in the aqueous phase divided by mole/l in the chloroform phase, for a range of concentrations in the aqueous phase.

SOURCE AND PURITY OF MATERIALS:

Not specified.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur Dioxide, $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Methanol; $CH_4O$; [67-56-1]

ORIGINAL MEASUREMENTS:

Tokunaga, J.

*J. Chem. Engng. Data.* 1974, *19*,

162-165.

VARIABLES:

Temperature

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | Mole fraction of alcohol in soln. (before absorption). | Total Pressure $P$/bar | Partial pressure of sulfur dioxide $P$/bar | $S^{\S}$ | $S_{o}^{+}$ |
|---|---|---|---|---|---|
| 283.15 | 0.0000 | 1.024 | 1.012 | 15.66 | 15.66 |
| | 0.0608 | 1.030 | 1.013 | 16.06 | 16.06 |
| | 0.0813 | 1.032 | 1.013 | 16.92 | 16.91 |
| | 0.1415 | 1.044 | 1.019 | 20.55 | 20.42 |
| | 0.2066 | 1.043 | 1.015 | 25.04 | 24.98 |
| | 0.3428 | 1.045 | 1.015 | 43.60 | 43.50 |
| | 0.4161 | 1.053 | 1.017 | 51.75 | 51.53 |
| | 0.4620 | 1.056 | 1.019 | 56.63 | 56.26 |
| | 0.5862 | 1.049 | 1.010 | 75.96 | 76.17 |
| | 0.6792 | 1.063 | 1.023 | 91.79 | 90.85 |
| | 0.7490 | 1.058 | 1.016 | 97.44 | 97.07 |
| | 0.8694 | 1.066 | 1.024 | 112.18 | 110.97 |
| | 0.9263 | 1.059 | 1.016 | 120.38 | 120.02 |
| | 1.0000 | 1.060 | 1.015 | 131.85 | 131.56 |
| 293.15 | 0.0000 | 1.036 | 1.013 | 10.90 | 10.90 |
| | 0.0107 | 1.037 | 1.013 | 10.45 | 10.44 |
| | 0.0675 | 1.048 | 1.014 | 11.14 | 11.12 |
| | 0.1835 | 1.061 | 1.011 | 14.48 | 14.51 |
| | 0.2659 | 1.074 | 1.016 | 19.05 | 18.99 |
| | 0.3503 | 1.076 | 1.011 | 24.51 | 24.56 |
| | 0.4233 | 1.082 | 1.013 | 31.41 | 31.40 |
| | 0.5080 | 1.084 | 1.022 | 38.64 | 38.27 |

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Sulfur dioxide bubbled through aqueous solution. Saturated solution analysed by iodometric titration. Details in source. Partial pressure of sulfur dioxide calculated from known vapor pressure of water + alcohol mixture and assuming Raoult's law for the lowering of vapor pressure of aqueous alcohol solution owing to dissolved sulfur dioxide.

SOURCE AND PURITY OF MATERIALS:

1. High purity sample with purity of 99.96 mole per cent.
2. No details given.
3. Fractionated.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.001$;

$\delta x_{SO_2} = \pm 1\%$. (estimated by compiler)

REFERENCES:

COMPONENTS :

1. Sulfur Dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Methanol; $CH_4O$; [67-56-1]

ORIGINAL MEASUREMENTS:

Tokunaga, J.

*J. Chem. Engng. Data*, 1974, *19*, 162-165.

EXPERIMENTAL VALUES :

| T/K | Mole fraction of alcohol in soln. (before absorption). | Total pressure $P$/bar | Partial pressure of sulfur dioxide $P$/bar | $S^§$ | $S_0^+$ |
|---|---|---|---|---|---|
| 293.15 | 0.5798 | 1.095 | 1.019 | 45.87 | 45.58 |
| | 0.6694 | 1.097 | 1.018 | 53.02 | 52.74 |
| | 0.7638 | 1.096 | 1.014 | 63.57 | 63.44 |
| | 0.8996 | 1.089 | 1.002 | 75.33 | 76.15 |
| | 1.0000 | 1.102 | 1.012 | 86.11 | 86.19 |
| 303.15 | 0.0000 | 1.057 | 1.016 | 7.79 | 7.77 |
| | 0.0811 | 1.079 | 1.014 | 8.35 | 8.33 |
| | 0.1890 | 1.102 | 1.011 | 10.80 | 10.88 |
| | 0.2849 | 1.120 | 1.010 | 14.13 | 14.16 |
| | 0.4193 | 1.132 | 1.010 | 21.18 | 21.23 |
| | 0.4679 | 1.133 | 1.006 | 23.41 | 23.56 |
| | 0.6197 | 1.147 | 1.009 | 32.69 | 32.82 |
| | 0.6760 | 1.153 | 1.009 | 35.69 | 35.79 |
| | 0.7506 | 1.157 | 1.008 | 40.36 | 40.53 |
| | 0.8734 | 1.168 | 1.011 | 49.09 | 49.19 |
| | 0.9673 | 1.169 | 1.007 | 56.60 | 56.92 |
| | 1.0000 | 1.180 | 1.014 | 57.63 | 57.53 |
| 313.15 | 0.0000 | 1.086 | 1.013 | 5.76 | 5.76 |
| | 0.0830 | 1.125 | 1.011 | 6.26 | 6.26 |
| | 0.1402 | 1.153 | 1.016 | 7.22 | 7.20 |
| | 0.3185 | 1.201 | 1.012 | 11.98 | 11.98 |
| | 0.4041 | 1.221 | 1.015 | 14.88 | 14.85 |
| | 0.5332 | 1.242 | 1.017 | 20.94 | 20.85 |
| | 0.5822 | 1.240 | 1.007 | 22.21 | 22.33 |
| | 0.6354 | 1.232 | 1.010 | 24.69 | 24.75 |
| | 0.6740 | 1.262 | 1.016 | 26.33 | 26.23 |
| | 0.7957 | 1.271 | 1.010 | 31.96 | 32.05 |
| | 0.8400 | 1.288 | 1.011 | 33.56 | 33.62 |
| | 0.9165 | 1.290 | 1.013 | 37.46 | 37.44 |
| | 1.0000 | 1.301 | 1.013 | 40.82 | 40.80 |

$S^§$ - grams of sulfur dioxide per 100 grams of solution (solute gas free) at total pressure.

$S_0^+$ - grams of sulfur dioxide per 100 grams of solution (solute gas free) at 1 atm. partial pressure.

Original gives pressure in units of mmHg

760 mmHg = 1 atm = 1.01325 bar

COMPONENTS:

(1) Sulfur dioxide, $SO_2$; [7466-09-5]
(2) Water, $H_2O$; [7732-18-5]
(3) Acetonitrile; $C_2H_3N$; [75-05-8]

ORIGINAL MEASUREMENTS:

Byerley, J.J.; Rempel, G.L.; Le, V.T

*J. Chem. Eng. Data.* 1980,*25*, 55-56

VARIABLES:

T/K: 298.15, 323.15
Total p/kPa 101.3 (1 atm)
$CH_3CN$/wt% 0-100

PREPARED BY:

H.L. Clever

EXPERIMENTAL VALUES:

| Liquid components | | 298.15 K $SO_2$ solubility,[d] g/100g | | | 323.15 K $SO_2$ solubility, g/100g |
|---|---|---|---|---|---|
| $CH_3CN$ Wt % | $H_2O$ Wt % | Single phase | Two phase $CH_3CN$ rich | Two phase $H_2O$ rich | single phase |
| 0 | 100 | 8.24 | | | 3.77 |
| 5 | 95 | 8.37 | | | - |
| 10 | 90 | 9.03 | | | 3.95 |
| 15 | 85 | 10.0 | | | - |
| 20 | 80 | b | a | a | 5.08 |
| 30 | 70 | b | 59.4 (0.25)[c] | 12.4 (0.74)[c] | 6.85 |
| 40 | 60 | b | 59.4 (0.45) | 12.4 (0.55) | 8.33 |
| 50 | 50 | b | 59.4 (0.60) | 12.4 (0.40) | 11.09 |
| 60 | 40 | b | 59.4 (0.74) | 12.4 (0.25) | 13.75 |
| 70 | 30 | b | 59.4 (0.87) | 12.4 (0.13) | 15.60 |
| 80 | 20 | b | a | a | 18.67 |
| 90 | 10 | 73.8 | | | 23.10 |
| 95 | 5 | 78.7 | | | - |
| 100 | 0 | 84.6 | | | 25.64 |

a. Phase separation. ill defined reading to poor reproducibility.

b. Two phases.

c. Number in c) is the phase fraction. The total composition of the $CH_3CN$ rich phase is 12.9 wt% $H_2O$, 37.3 wt % $SO_2$, and 49.8 wt % acetonitrile with density 0.975 g cm$^{-3}$. The water rich phase is 73.0 wt % $H_2O$, 11.0 wt % $SO_2$ and 16.0 wt % acetonitrile with density 1.005 g cm$^{-3}$

d. The $SO_2$ solubility is expressed as g $SO_2$/100 g of gas free solution.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The mixed solvent was placed in a 50 ml water jacketted buret. Sulfur dioxide was bubbled at a rate of 60 ml m$^{-1}$ from the bottom of the buret. A spiral condenser at the top prevented excessive loss of acetonitrile. The sulfur dioxide concentration after saturation was measured by titrating excess iodine with standard thiosulfate solution using starch as the indicator. In the cases where there was phase separation upon saturation with $SO_2$, the composition of both phases was determined by gas chromatography. The column, 0.91m long and 0.4 cm i.d., stainless steel was packed with 50-80 mesh Porapak Q. The carrier gas was a helium hydrogen mixture.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide. Union Carbide Canada. Ltd. Anhydrous.
2. Water, distilled, carbon dioxide free.
3. Acetonitrile. J.T. Baker Co. Reagent grade. Used as received.

ESTIMATED ERROR:

$\delta T/K = 0.1$

REFERENCES:

COMPONENTS:

1. Sulfur Dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Ethanol; $C_2H_6O$; [64-17-5]

ORIGINAL MEASUREMENTS:

Tokunaga, J.

*J. Chem. Engng. Data.* 1974, *19*, 162-165.

VARIABLES:

Temperature

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | Mole fraction of alcohol in soln. (before adsorption). | Total Pressure P/bar | Partial pressure of sulfur dioxide P/bar | $S^§$ | $S^+_o$ |
|---|---|---|---|---|---|
| 283.15 | 0.0000 | 1.024 | 1.012 | 15.66 | 15.66 |
| | 0.0628 | 1.029 | 1.012 | 14.44 | 14.45 |
| | 0.0986 | 1.035 | 1.016 | 14.87 | 14.82 |
| | 0.1722 | 1.036 | 1.014 | 20.18 | 20.15 |
| | 0.2423 | 1.036 | 1.014 | 26.88 | 26.84 |
| | 0.3325 | 1.037 | 1.013 | 35.76 | 35.73 |
| | 0.3827 | 1.039 | 1.015 | 39.73 | 39.62 |
| | 0.4728 | 1.038 | 1.014 | 47.06 | 46.98 |
| | 0.6010 | 1.038 | 1.015 | 57.08 | 56.94 |
| | 0.6650 | 1.043 | 1.019 | 60.83 | 60.46 |
| | 0.7955 | 1.036 | 1.014 | 65.55 | 65.44 |
| | 0.8730 | 1.034 | 1.012 | 67.60 | 67.61 |
| | 1.0000 | 1.034 | 1.014 | 70.58 | 70.50 |
| 293.15 | 0.0000 | 1.036 | 1.013 | 10.90 | 10.90 |
| | 0.0563 | 1.048 | 1.015 | 9.21 | 9.19 |
| | 0.0986 | 1.043 | 1.005 | 9.78 | 9.86 |
| | 0.2168 | 1.043 | 0.998 | 15.08 | 15.30 |
| | 0.2781 | 1.064 | 1.017 | 19.00 | 18.92 |
| | 0.3399 | 1.064 | 1.016 | 23.09 | 23.00 |
| | 0.4753 | 1.060 | 1.013 | 30.88 | 30.88 |
| | 0.5923 | 1.059 | 1.012 | 35.73 | 35.76 |
| | 0.6832 | 1.062 | 1.015 | 39.15 | 39.06 |

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Sulfur dioxide bubbled through aqueous solution. Saturated solution analysed by iodometric titration. Details in source.

The partial pressure of sulfur dioxide was calculated from the known vapor pressure of water + alcohol mixture and assuming Raoults law for the lowering of vapor pressure due to dissolution of sulfur dioxide

SOURCE AND PURITY OF MATERIALS:

1. High purity sample with purity of 99.96 mole per cent.
2. No details given.
3. Fractionated.

ESTIMATED ERROR:

$\delta T$/K = ±0.1; $\delta P$/bar = ±0.001;
$\delta x_{SO_2}$ = ±1%. (estimated by compiler).

REFERENCES:

| COMPONENTS : | ORIGINAL MEASUREMENTS : |
|---|---|
| 1. Sulfur Dioxide; $SO_2$; [7446-09-5] | Tokunaga, J. |
| 2. Water; $H_2O$; [7732-18-5] | *J. Chem. Engng. Data.* 1974, *19*, |
| 3. Ethanol; $C_2H_6O$; [64-17-5] | 162-165. |

EXPERIMENTAL VALUES:

| T/K | Mole fraction of alcohol in soln. (before adsorption). | Total pressure P/bar | Partial pressure of sulfur dioxide P/bar | $S^{\S}$ | $S_o^+$ |
|---|---|---|---|---|---|
| 293.15 | 0.7927 | 1.059 | 1.014 | 42.37 | 42.33 |
| | 0.8941 | 1.059 | 1.014 | 44.91 | 44.83 |
| | 1.0000 | 1.059 | 1.016 | 46.95 | 46.81 |
| 303.15 | 0.0000 | 1.057 | 1.016 | 7.79 | 7.77 |
| | 0.0651 | 1.074 | 1.010 | 6.63 | 6.44 |
| | 0.1159 | 1.080 | 1.007 | 7.22 | 7.27 |
| | 0.1992 | 1.093 | 1.012 | 10.32 | 10.32 |
| | 0.3004 | 1.096 | 1.011 | 14.20 | 14.22 |
| | 0.3663 | 1.101 | 1.014 | 16.46 | 16.43 |
| | 0.4684 | 1.102 | 1.014 | 19.98 | 19.96 |
| | 0.5004 | 1.100 | 1.011 | 20.47 | 20.49 |
| | 0.6082 | 1.102 | 1.013 | 23.04 | 23.02 |
| | 0.7307 | 1.101 | 1.013 | 26.21 | 26.19 |
| | 0.8182 | 1.099 | 1.011 | 28.10 | 28.14 |
| | 0.8807 | 1.098 | 1.011 | 28.79 | 28.84 |
| | 0.9551 | 1.098 | 1.013 | 30.33 | 30.32 |
| | 1.0000 | 1.101 | 1.017 | 31.76 | 31.62 |
| 313.15 | 0.0000 | 1.086 | 1.013 | 5.76 | 5.76 |
| | 0.0644 | 1.118 | 1.007 | 5.29 | 5.32 |
| | 0.1035 | 1.135 | 1.012 | 5.99 | 6.09 |
| | 0.1900 | 1.156 | 1.019 | 7.99 | 7.94 |
| | 0.3000 | 1.157 | 1.011 | 10.01 | 10.02 |
| | 0.3982 | 1.159 | 1.009 | 12.60 | 12.64 |
| | 0.5111 | 1.159 | 1.004 | 15.07 | 15.19 |
| | 0.6055 | 1.168 | 1.013 | 17.13 | 17.12 |
| | 0.7294 | 1.167 | 1.011 | 18.30 | 18.32 |
| | 0.8205 | 1.169 | 1.014 | 20.33 | 20.31 |
| | 0.9152 | 1.167 | 1.013 | 21.69 | 21.68 |
| | 1.0000 | 1.164 | 1.012 | 23.80 | 23.80 |

$S^{\S}$ - grams of sulfur dioxide per 100 grams of solution (solute gas free) at total pressure.

$S_o^+$ - grams of sulfur dioxide per 100 grams of solution (solute gas free) at 1 atm. partial pressure.

Original gives pressure in units of mmHg

760 mmHg = 1 atm = 1.01325 bar

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7746-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Sulfinybismethane,( Dimethylsulfoxide); $C_2H_6OS$; [67-68-5]

ORIGINAL MEASUREMENTS:

Smedslund, T.H.

*Finska Kemistsamfundets Medd.* 1950, *59*, 40-43.

VARIABLES:

Temperature

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

Dimethylsulfoxide containing "10%" water.

| T/K | $SO_2$, Weight % | Presumably for total pressure of 1 atm. |
|---|---|---|
| 292.15 | 54.3 | |
| 350.15 | 22.1 | |
| 408.15 | 6.0 | |
| 420.15 | 2.5 | |
| 293.15 | 5.2 | $p_{SO_2}$ = 11.2 mmHg |
| 293.15 | 12.1 | $p_{SO_2}$ = 31 mmHg |
| 293.15 | 16.1 | $p_{SO_2}$ = 46 mmHg |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The first set of data are for saturation at 1 atm; details are not available for the second set.

SOURCE AND PURITY OF MATERIALS:

(1) Information not available

(2) Dimethylsulfoxide was prepared by the catalytic oxidation of dimethyl sulfide in the vapor state (1). The purified product had b.p. 63°C/6 mmHg.

ESTIMATED ERROR:

REFERENCES:

1. Smedslund, T.H. *U.S. Patent*, 2,581,050, 1952

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. 1-Propanol; $C_3H_8O$; [71-23-8]

ORIGINAL MEASUREMENTS:

Tokunaga, J.

*J. Chem. Engng. Data.* 1974, *19*, 162-165.

VARIABLES:

Temperature

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | Mole fraction of alcohol in soln. (before adsorption). | Total Pressure $P$/bar | Partial Pressure of sulfur dioxide $P$/bar | $S^{\S}$ | $S_o^+$ |
|---|---|---|---|---|---|
| 283.15 | 0.0000 | 1.024 | 1.024 | 15.66 | 15.66 |
| | 0.0124 | 1.030 | 1.017 | 14.59 | 14.52 |
| | 0.0352 | 1.027 | 1.013 | 14.28 | 14.28 |
| | 0.0651 | 1.026 | 1.011 | 15.51 | 15.53 |
| | 0.1036 | 1.030 | 1.011 | 19.02 | 19.04 |
| | 0.2000 | 1.028 | 1.012 | 26.56 | 26.58 |
| | 0.3026 | 1.027 | 1.012 | 33.27 | 33.29 |
| | 0.3960 | 1.027 | 1.013 | 38.36 | 38.35 |
| | 0.4986 | 1.027 | 1.013 | 42.09 | 42.06 |
| | 0.5927 | 1.027 | 1.014 | 45.54 | 45.46 |
| | 0.7068 | 1.025 | 1.013 | 47.80 | 47.77 |
| | 0.8160 | 1.023 | 1.012 | 48.96 | 48.97 |
| | 0.9286 | 1.023 | 1.014 | 49.52 | 49.43 |
| | 1.0000 | 1.020 | 1.013 | 49.63 | 49.60 |
| 293.15 | 0.0000 | 1.036 | 1.013 | 10.90 | 10.90 |
| | 0.0218 | 1.040 | 1.013 | 9.96 | 9.95 |
| | 0.0501 | 1.042 | 1.013 | 10.16 | 10.15 |
| | 0.0922 | 1.045 | 1.014 | 12.24 | 12.22 |
| | 0.1882 | 1.051 | 1.019 | 17.22 | 17.11 |
| | 0.2172 | 1.044 | 1.013 | 18.21 | 18.21 |
| | 0.2967 | 1.044 | 1.014 | 21.04 | 21.02 |

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Sulfur dioxide bubbled through aqueous solution. Saturated solution analysed by iodometric titration. Details in source.

The partial pressure of sulfur dioxide was calculated from the known vapor pressure of water + alcohol mixture and assuming Raoults law for the lowering of vapor pressure due to dissolution of sulfur dioxide.

SOURCE AND PURITY OF MATERIALS:

1. High purity sample with purity of 99.96 mole per cent.
2. No details given.
3. Fractionated.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.001$; $\delta x_{SO_2} = \pm 1\%$. (estimated by compiler).

REFERENCES:

COMPONENTS :

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. 1-Propanol; $C_3H_8O$; [71-23-8]

ORIGINAL MEASUREMENTS :

Tokunaga, J.

*J. Chem. Engng. Data.* 1974, *19*,

162-165

EXPERIMENTAL VALUES :

| T/K | Mole fraction of alcohol in soln. (before adsorption). | Total pressure $P$/bar | Partial pressure of sulfur dioxide $P$/bar | $S^{\S}$ | $S_o^+$ |
|---|---|---|---|---|---|
| 293.15 | 0.3980 | 1.044 | 1.014 | 24.28 | 24.24 |
| | 0.4846 | 1.043 | 1.014 | 26.55 | 26.50 |
| | 0.5960 | 1.041 | 1.013 | 28.47 | 28.47 |
| | 0.6948 | 1.038 | 1.013 | 29.38 | 29.39 |
| | 0.7860 | 1.036 | 1.013 | 30.27 | 30.27 |
| | 0.8941 | 1.033 | 1.013 | 30.37 | 30.36 |
| | 1.0000 | 1.027 | 1.012 | 30.68 | 30.68 |
| 303.15 | 0.0000 | 1.057 | 1.017 | 7.79 | 7.77 |
| | 0.0223 | 1.064 | 1.014 | 7.34 | 7.34 |
| | 0.0516 | 1.069 | 1.014 | 8.04 | 8.03 |
| | 0.0761 | 1.071 | 1.012 | 8.79 | 8.80 |
| | 0.1964 | 1.073 | 1.014 | 12.78 | 12.77 |
| | 0.3009 | 1.058 | 1.000 | 15.28 | 15.49 |
| | 0.3976 | 1.071 | 1.014 | 17.67 | 17.66 |
| | 0.4900 | 1.068 | 1.012 | 18.98 | 18.99 |
| | 0.5984 | 1.066 | 1.012 | 20.43 | 20.45 |
| | 0.7077 | 1.065 | 1.014 | 21.32 | 21.29 |
| | 0.7732 | 1.061 | 1.013 | 21.53 | 21.53 |
| | 0.9026 | 1.052 | 1.013 | 21.91 | 21.92 |
| | 1.0000 | 1.044 | 1.013 | 22.05 | 22.06 |
| 313.15 | 0.0000 | 1.087 | 1.014 | 5.76 | 5.76 |
| | 0.0186 | 1.085 | 1.009 | 5.57 | 5.60 |
| | 0.0355 | 1.107 | 1.012 | 5.59 | 5.60 |
| | 0.0763 | 1.116 | 1.016 | 6.49 | 6.47 |
| | 0.1043 | 1.119 | 1.014 | 7.21 | 7.20 |
| | 0.1974 | 1.119 | 1.014 | 9.30 | 9.30 |
| | 0.2992 | 1.118 | 1.013 | 11.22 | 11.22 |
| | 0.3950 | 1.116 | 1.013 | 12.39 | 12.39 |
| | 0.4994 | 1.116 | 1.015 | 13.60 | 13.58 |
| | 0.6068 | 1.112 | 1.014 | 14.53 | 14.52 |
| | 0.7108 | 1.106 | 1.014 | 15.15 | 15.14 |
| | 0.7824 | 1.097 | 1.010 | 15.54 | 15.59 |
| | 0.9112 | 1.088 | 1.015 | 15.69 | 15.66 |
| | 1.0000 | 1.071 | 1.013 | 15.95 | 15.95 |

$S^{\S}$ - grams of sulfur dioxide per 100 grams of solution (solute gas free) at total pressure.

$S_o^+$ - grams of sulfur dioxide per 100 grams of solution (solute gas free) at 1 atm. partial pressure.

Original gives pressure in units of mmHg

760 mmHg = 1 atm = 1.01325 bar

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Alkanes

Colin L. Young,
School of Chemistry,
University of Melbourne,
Parkville, Victoria 3052,
Australia.

November 1980

CRITICAL EVALUATION:

Although these systems have been investigated by several workers, there are very serious discrepancies between solubilities reported by different authors. The most extensive studies are those of Makranczy *et al.* (1) and Sololev *et al.* (2) and values of their mole fraction solubilities at 298.15 K and 101.3 kPa are contrasted below.

| Alkane | $x_{SO_2}$ (Sololev *et al.*) | $x_{SO_2}$ (Makranczy *et al.*) |
|---|---|---|
| Octane | 0.0319 | 0.0586 |
| Dodecane | 0.0378 | 0.0662 |
| Hexadecane | - | 0.0745 |
| Heptadecane | 0.0372 | - |

The evaluator is of the opinion that the values of Sololev *et al.* (2) are probably in error whereas those of Makranczy *et al.* (1) are moderately reliable. The value of Gerrard (3) for decane at 293.15 K and 273.15 K extrapolate to 298.15 K to give a value of about 35% higher than the value of Makranczy *et al.* (1). The mole fraction solubilities for hexadecane of Tremper and Prausnitz (4), Lenoir *et al.* (5), Sano (6) and Makranczy *et al.* (1) agree within about 15% whereas the value of Sololev *et al.* (2) is approximately have of the average value of the other workers.

Therefore the values of Sololev *et al.* (2) and Gerrard (3) are classified as doubtful whereas those of Makranczy *et al.* (1), Lenoir *et al.* (5), Sano (6) and Tremper and Prausnitz (4) are classified as tentative.

The data of Makranczy *et al.* for the alkanes can be represented as a function of carbon number, $C_n$, by the equation

$$\ln x_{SO_2} = 0.02933C_n - 3.068$$

well within the experimental error of 3 per cent. A plot of $\ln x_{SO_2}$ against $C_n$ is given on the following page.

The value of Lenoir *et al.* (5) was determined from gas chromatographic retention volume data and is effectively at infinite dilution of sulfur dioxide. The extrapolation to 101.3 kPa pressure assumes Henry's law holds up to that pressure and consequently involves considerable approximation.

The data presented by Komissarov *et al.* (7) on the system sulfur dioxide + tetradecane appears to be greatly in error, the mole fraction solubility calculated from their data being about double the value of Makranczy *et al.* (1).

## References

1. Makranczy, J.; Megyerg-Balog, K.; Rusz, L.; Patyi, L. *Hung. J. Ind. Chem.* 1976, *4*, 269.
2. Sololev, I. A.; Kukarin, V. A.; Dzhagatspanyan, R. V.; Kosorotov, V. I.; Zogarets, P. A.; Popov, A. I. *Khim. Prom.* 1970, *46*, 668.
3. Gerrard, W. *Solubility of Gases and Liquids*, Plenum Press, New York, 1976, p.239.
4. Tremper, K. K.; Prausnitz, J. M. *J. Chem. Engng. Data* 1976, *21*, 295.
5. Lenoir, J. Y.; Renault, P.; Renon, H. *J. Chem. Engng. Data* 1971, *16*, 340.
6. Sano, H. *Nippon Kagaku Zasshi* 1968, *89*, 362.
7. Komissarov, V. D.; Saitova, M. A.; Timirova, R. G. *Khim. Prom.* 1973, *49*, 738.

| COMPONENTS: | EVALUATOR: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Alkanes | Colin L. Young,<br>School of Chemistry,<br>University of Melbourne,<br>Parkville, Victoria 3052,<br>Australia.<br>November 1980 |

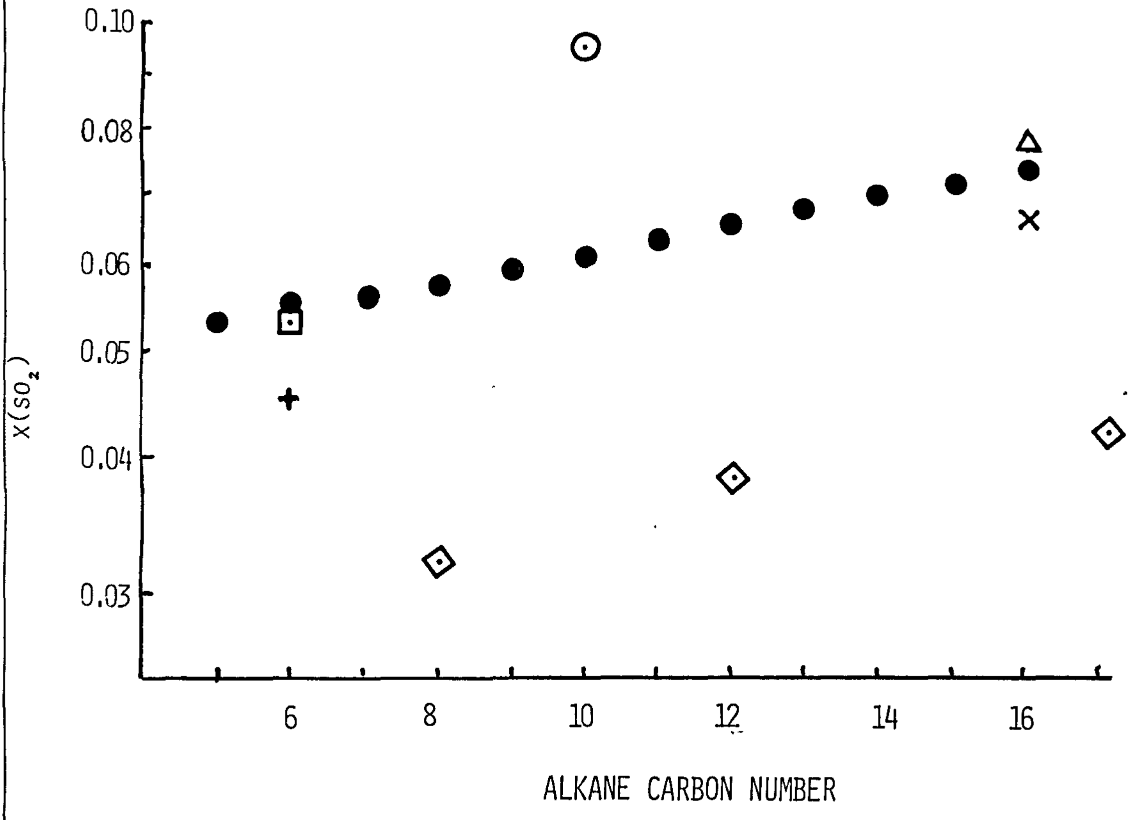

Figure 1. Comparison of mole fraction solubilities for sulfur dioxide in alkanes.

- ● Makranczy, Megyery-Balog, Rusz and Patyi (1)
- ⊙ Gerard (3)
- ◈ Sololev, Kukarin, Dzhagatspanyan, Kosorotov, Zogarets and Popov (2)
- ⊡ Patyi, Furmer, Makranczy, Sadilenko, Stepanova and Berengarten
- △ Lenoir, Renault, Renon (5)
- × Tremper and Prausnitz (4)
- + Sano (6)

COMPONENTS:

1. Sulfur Dioxide; $SO_2$; [7446-09-5];
2. Pentane; $C_5H_{12}$; [109-66-0]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Megyery-Balog, K.; Rusz, L.; Patyi, L.
*Hung. J. Ind. Chem.* 1976, *4(2)*, 269-280.

VARIABLES:
T/K: 298.15 - 313.15
$P$/kPa: 101.325 (1 atm)

PREPARED BY:

S. A. Johnson/ H. L. Clever

EXPERIMENTAL VALUES:

| T/K | Mole fraction $x_{SO_2}$ | Bunsen coefficient $\alpha$ | Ostwald coefficient L |
|---|---|---|---|
| 298.15 | 0.0543 | 10.880 | 11.876 |
| 313.15 | 0.0402 | 7.76 | 8.90 |

Mole fractions and Bunsen coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Apparently the volumetric apparatus described in ref. (1) was modified for use at temperatures above 0° C. The apparatus was designed to be operated at a partial pressure of sulfur dioxide of 760 torr.

SOURCE AND PURITY OF MATERIALS:

Analytical grade reagents of Hungarian and foreign origin were used (both liquids and gases). No further information.

ESTIMATED ERROR:

$\delta x_{SO_2}/x_{SO_2} = \pm 0.03$.

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszprêmi Vegyipari Egyetem Köslemênyei* 1957, *1*, 55; *CA 55*, 3175h.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Hexane; $C_6H_{14}$; [110-54-3]

ORIGINAL MEASUREMENTS:

Sano, H.
*Nippon Kagaku Zasshi*
1968, *89*, 362-368.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

Vapor pressure of hexane, $p_s^\circ$ = 0.240 atm

| Absorption coefficient, $S^{a,b}$ | Bunsen coefficient,[b] $\alpha$ | Bunsen coefficient,[c] $\alpha$ | $\ell^{c,d}$ | Mole ratio | Mole fraction[e] |
|---|---|---|---|---|---|
| 6.8 | 8.1 | 8.2 | 6.5 | 0.047 | 0.0449 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature at a total pressure of 1 atmosphere.

[b] Determined by static absorption method.

[c] Determined by flow method.

[d] $\alpha = \ell(1 - p_s^\circ)$ where $p_s^\circ$ is vapor pressure of solvent.

[e] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two techniques were used: (a) static absorption method and (b) flow method. Static method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The flow method consists of passing sulfur dioxide through a micro gas absorption tube and estimating sulfur dioxide by iodometric titration. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur Dioxide; $SO_2$; [7446-09-5]<br>2. Hexane; $C_6H_{14}$; [110-54-3] | Makranczy, J.; Megyery-Balog, K.; Rusz, L.; Patyi, L.<br>*Hung. J. Ind. Chem.* 1976, *4(2)*, 269-280. |
| VARIABLES:<br>$T$/K: 298.15 - 313.15<br>$P$/kPa: 101.325 (1 atm) | PREPARED BY:<br>S. A. Johnson/ H. L. Clever |

EXPERIMENTAL VALUES:

| T/K | Mole fraction $x_{SO_2}$ | Bunsen coefficient $\alpha$ | Ostwald coefficient L |
|---|---|---|---|
| 298.15 | 0.0562 | 9.964 | 10.876 |
| 313.15 | 0.0408 | 7.00 | 8.02 |

Mole fractions and Bunsen coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Apparently the volumetric apparatus described in ref.(1) was modified for use at temperatures above 0° C. The apparatus was designed to be operated at a partial pressure of sulfur dioxide of 760 torr.

SOURCE AND PURITY OF MATERIALS:

Analytical grade reagents of Hungarian and foreign origin were used (both liquids and gases). No further information.

DATA CLASS:

ESTIMATED ERROR:

$\delta x_{SO_2}/x_{SO_2} = \pm 0.03$.

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszprémi Vegyipari Egyetem Közleményei* 1957, *1*, 55; *CA 55*, 3175h.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Hexane; $C_6H_{14}$; [110-54-3]

ORIGINAL MEASUREMENTS:

Patyi, L.; Furmer, I. E. Makranczy, J.; Sadilenko, A. S.; Stepanova, Z. G.; Berengarten, M. G.

*Zh. Prikl. Khim.* 1978, *51*, 1296-1300.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

| T/K | $\alpha^{\dagger}$ | Mole fraction of sulfur dioxide at a partial pressure of 101.325 kPa $x_{SO_2}$ |
|---|---|---|
| 298.15 | 9.38 | 0.05336 |

† volume of gas (measured at 101.325 kPa and 273.15 K) dissolved by one volume of hexane.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method. Pressure measured when known amounts of gas were added, in increments, to a known amount of liquid in a vessel of known dimensions. Corrections were made for the partial pressure of solvent. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

Purity better than 99 mole per cent as determined by gas chromatography.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta\alpha = \pm 4\%$ or less.

REFERENCES:

1. Bodor, E.; Bor, G. J.; Mohai, B.; Sipos, G. *Veszpremi. Vegyip. Egy. Kosl.* 1957, *1*, 55.

COMPONENTS:

1. Sulfur Dioxide; $SO_2$; [7446-09-5]

2. Heptane; $C_7H_{16}$; [142-82-5]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Megyery-Balog, K.; Rusz, L.; Patyi, L.
*Hung. J. Ind. Chem.* 1976, *4(2)*, 269-280.

VARIABLES:

T/K: 298.15 - 313.15
$P$/kPa: 101.325 (1 atm)

PREPARED BY:

S. A. Johnson / H. L. Clever

EXPERIMENTAL VALUES:

| T/K | Mole fraction $x_{SO_2}$ | Bunsen coefficient $\alpha$ | Ostwald coefficient L |
|---|---|---|---|
| 298.15 | 0.0567 | 8.969 | 9.790 |
| 313.15 | 0.0417 | 6.40 | 7.34 |

Mole fractions and Bunsen coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Apparently the volumetric apparatus described in ref.(1) was modified for use at temperatures above 0°C. The apparatus was designed to be operated at a partial pressure of sulfur dioxide of 760 torr.

SOURCE AND PURITY OF MATERIALS:

Analytical grade reagents of Hungarian and foreign origin were used (both liquids and gases). No further information.

ESTIMATED ERROR:

$\delta x_{SO_2}/x_{SO_2} = \pm 0.03$.

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszprémi Vegyipari Egyetem Közleményei* 1957, *1*, 55; *CA 55*, 3175h.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]

2. Octane; $C_8H_{18}$; [111-65-9]

ORIGINAL MEASUREMENTS:

Sobolev, I.A.; Kukarin, V.A.;
Dzhagatspanyan, R.V.; Kosorotov, V.I.
Zogorets, P.A.; Popov, A.I.

*Khim. Prom.* 1970, *46*, 668-70.

VARIABLES:

Temperature.

PREPARED BY:

C.L. Young.

EXPERIMENTAL VALUES:

| T/K | Solubility,* $S$ /mol $l^{-1}$ | Mole fraction of sulfur dioxide in in liquid, $x_{SO_2}$ + |
|---|---|---|
| 283.15 | 0.283 | 0.044 |
| 288.15 | 0.254 | 0.040 |
| 293.15 | 0.227 | 0.036 |
| 298.15 | 0.201 | 0.032 |
| 303.15 | 0.182 | 0.029 |

\+ calculated by compiler.

* at atmospheric pressure.

$\ln S = 830/(T/K) - 6.35$ (where $S$ is in units of mol $l^{-1}$ $atm^{-1}$).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Bubbler method. Samples of saturated liquid taken and added to sodium hydroxide solution and then excess alkali back titrated.

SOURCE AND PURITY OF MATERIALS:

1. Purity at least 95 mole per cent.

2. Chemically pure. Dried.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta$(Solubility) = ±2%; $\delta x_{SO_2} = \pm 0.001$, (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur Dioxide; $SO_2$; [7446-09-5]

2. Octane; $C_8H_{18}$; [111-65-9]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Megyery-Balog, K.; Rusz, L.; Patyi, L.

*Hung. J. Ind. Chem.* 1976, *4(2)*, 269-280.

VARIABLES:

T/K: 298.15 - 313.15

*P*/kPa: 101.325 (1 atm)

PREPARED BY:

S. A. Johnson / H. L. Clever

EXPERIMENTAL VALUES:

| T/K | Mole fraction $x_{SO_2}$ | Bunsen coefficient $\alpha$ | Ostwald coefficient L |
|---|---|---|---|
| 298.15 | 0.0583 | 8.330 | 9.092 |
| 313.15 | 0.0429 | 5.95 | 6.82 |

Mole fractions and Bunsen coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Apparently the volumetric apparatus described in ref.(1) was modified for use at temperatures above 0°C. The apparatus was designed to be operated at a partial pressure of sulfur dioxide of 760 torr.

SOURCE AND PURITY OF MATERIALS:

Analytical grade reagents of Hungarian and foreign origin were used (both liquids and gases). No further information.

ESTIMATED ERROR:

$\delta x_{SO_2}/x_{SO_2} = \pm 0.03$.

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszprêmi Vegyipari Egyetem Közleményei* 1957, *1*, 55; *CA 55*, 3175h.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 2,2,4-Trimethylpentane; $C_8H_{18}$; [540-84-1]

ORIGINAL MEASUREMENTS:

Sobolev, I.A.; Kukarin, V.A.; Dzhagatspanyan, R.V.; Kosorotov, V.I; Zogorets, P.A.; Popov, A.I.

*Khim. Prom.* 1970, *46*, 668-70.

VARIABLES:

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | Solubility*, $S$ /mol $l^{-1}$ | Mole fraction of sulfur dioxide+ $x_{SO_2}$ |
|---|---|---|
| 293.15 | 0.223 | 0.0355 |

* at atmospheric pressure

\+ calculated by compiler

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Bubbler method. Samples of saturated liquid taken and added to sodium hydroxide solution and then excess alkali back titrated

SOURCE AND PURITY OF MATERIALS:

1. Purity at least 95 mole per cent.
2. Chemically pure. Dried.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta$(Solubility) = ±2%; $\delta x_{SO_2} = \pm 0.001$; (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 2,2,4-Trimethylpentane; $C_8H_{18}$; [540-84-1]

ORIGINAL MEASUREMENTS:

Nitta, T.; Kido. O.; Katayama, T.;

*J. Chem. Engng. Japan*, 1976, *9*,317-8.

VARIABLES:

Pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | $P$/bar | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ |
|---|---|---|
| 293.15 | 0.7021 | 0.0445 |
| | 1.031 | 0.0710 |
| | 1.516 | 0.1184 |
| | 2.042 | 0.1847 |
| | 2.521 | 0.2706 |
| | 2.796 | 0.3362 |
| | 3.170 | 0.6412 |
| | 3.193 | 0.7897 |
| | 3.200 | 0.8506 |

AUXILIARY INFORMATION

METHOD:

Static method liquid phase composition estimated by iodometry. Few details given in source. Method similar to that used in ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Seitetsu Chemical Co.sample, purity better than 99.9 mole per cent.
2. Nakarai Chemicals Ltd. sample, guaranteed grade.

ESTIMATED ERROR:

$\delta T$/K = ±0.1; $\delta P$/bar = ±0.001 (below 1.3 bar) ±0.005 (above 1.3 bar); $\delta x_{SO_2}$ = 1.5%

REFERENCES:

Quitzich, K.; Ulbrecht, H.; Geiseler, G.

*Z. Physik Chem.* 1967, *234*, 33.

COMPONENTS:

1. Sulfur Dioxide; $SO_2$; [7446-09-5]

2. Nonane; $C_9H_{20}$; [111-84-2]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Megyery-Balog, K.; Rusz, L.; Patyi, L.

*Hung. J. Ind. Chem.* 1976, *4(2)*, 269-280.

VARIABLES:

T/K: 298.15 - 313.15

$P$/kPa: 101.325 (1 atm)

PREPARED BY:

S. A. Johnson / H. L. Clever

EXPERIMENTAL VALUES:

| T/K | Mole fraction $x_{SO_2}$ | Bunsen coefficient $\alpha$ | Ostwald coefficient L |
|---|---|---|---|
| 298.15 | 0.0602 | 7.840 | 8.558 |
| 313.15 | 0.0441 | 5.58 | 6.40 |

Mole fractions and Bunsen coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Apparently the volumetric apparatus described in ref.(1) was modified for use at temperatures above 0°C. The apparatus was designed to be operated at a partial pressure of sulfur dioxide of 760 torr.

SOURCE AND PURITY OF MATERIALS:

Analytical grade reagents of Hungarian and foreign origin were used (both liquids and gases). No further information.

ESTIMATED ERROR:

$\delta x_{SO_2}/x_{SO_2} = \pm 0.03$.

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszprêmi Vegyipari Egyetem Köslemênyei* 1957, *1*, 55; *CA 55*, 3175h.

COMPONENTS:

1. Sulfur Dioxide; $SO_2$; [7446-09-5]

2. Decane; $C_{10}H_{22}$; [124-18-5]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Megyery-Balog, K.; Rusz, L.; Patyi, L.
*Hung. J. Ind. Chem.* 1976, *4(2)*, 269-280.

VARIABLES:

T/K: 298.15 - 313.15
$P$/kPa: 101.325 (1 atm)

PREPARED BY:

S. A. Johnson/ H. L. Clever

EXPERIMENTAL VALUES:

| T/K | Mole fraction $x_{SO_2}$ | Bunsen coefficient $\alpha$ | Ostwald coefficient L |
|---|---|---|---|
| 298.15 | 0.0620 | 7.430 | 8.110 |
| 313.15 | 0.0456 | 5.30 | 6.08 |

Mole fractions and Bunsen coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Apparently the volumetric apparatus described in ref.(1) was modified for use at temperatures above 0°C. The apparatus was designed to be operated at a partial pressure of sulfur dioxide of 760 torr.

SOURCE AND PURITY OF MATERIALS:

Analytical grade reagents of Hungarian and foreign origin were used (both liquids and gases). No further information.

ESTIMATED ERROR:

$\delta x_{SO_2}/x_{SO_2} = \pm 0.03.$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszprêmi Vegyipari Egyetem Köslemênyei* 1957, *1*, 55; *CA 55*, 3175h.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Decane; $C_{10}H_{22}$; [124-18-5] or Decahydronaphthalene; (Decalin); $C_{10}H_{18}$; [91-17-8] or 1,2,3,4-Tetrahydronaphthalene; (Tetralin); $C_{10}H_{12}$; [119-64-2]

ORIGINAL MEASUREMENTS:

Gerrard, W. *"Solubility of Gases and Liquids,"* Plenum Press, New York, 1976, p.239.

VARIABLES:

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

| T/K | Weight of Component(2) g | Weight of $SO_2$ absorbed,g | Mole ratio $SO_2$ /Comp.(2) | Mole fraction $x_{SO_2}$ |
|---|---|---|---|---|
| | | Decane | | |
| | | | (Total pressure, 1 atm) | |
| 273.15 | 3.8122 | 0.3040 | 0.179 | 0.151 |
| 293.15 | 3.8122 | 1.7832 | 0.105 | 0.095 |
| | | (cis-trans) Decalin | | |
| | | | (Total pressure, 1 atm) | |
| 293.15 | 7.2121 | 0.2090 | 0.062 | 0.060 |
| | | Tetralin | | |
| | | | (Total pressure, 1 atm) | |
| 293.15 | 7.5100 | 1.0732 | 0.295 | 0.228 |

760 mmHg = 1 atm = 101.325 kPa

AUXILIARY INFORMATION

METHOD:

Sulfur dioxide was bubbled into a weighed amount of component (2) in a bubbler tube. The amount of gas absorbed was determined by re-weighing the tube. The total pressure was barometric, very nearly 1 atm. See ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was the best grade contained in a small cylinder. Its high degree of purity was attested by the measurement of vapor pressure from 258-268 K.

2. The best commercial specimen was purified and attested.

ESTIMATED ERROR:

REFERENCES:

1. Gerrard, W. *J. Appl. Chem. Biotechnol.* 1972, *22*, 623.

COMPONENTS:

1. Sulfur Dioxide; $SO_2$; [7446-09-5]

2. Undecane; $C_{11}H_{24}$; [1120-21-4]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Megyery-Balog, K.; Rusz, L.; Patyi, L.

*Hung. J. Ind. Chem.* 1976, *4(2)*, 269-280.

VARIABLES:

T/K: 298.15 - 313.15

$P$/kPa: 101.325 (1 atm)

PREPARED BY:

S. A. Johnson / H. L. Clever

EXPERIMENTAL VALUES:

| T/K | Mole fraction $x_{SO_2}$ | Bunsen coefficient $\alpha$ | Ostwald coefficient L |
|---|---|---|---|
| 298.15 | 0.0647 | 7.170 | 7.826 |
| 313.15 | 0.0471 | 5.07 | 5.81 |

Mole fractions and Bunsen coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Apparently the volumetric apparatus described in ref.(1) was modified for use at temperatures above 0°C. The apparatus was designed to be operated at a partial pressure of sulfur dioxide of 760 torr.

SOURCE AND PURITY OF MATERIALS:

Analytical grade reagents of Hungarian and foreign origin were used (both liquids and gases). No further information.

ESTIMATED ERROR:

$\delta x_{SO_2}/x_{SO_2} = \pm 0.03$.

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszprémi Vegyipari Egyetem Köslemény ei* 1957, *1*, 55; *CA 55*, 3175h.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]

2. Dodecane; $C_{12}H_{26}$; [112-40-3]

ORIGINAL MEASUREMENTS:

Sobolev, I.A.; Kukarin, V.A.; Dzhagatspanyan, R.V.; Kosorotov, V.I. Zogorets, P.A.; Popov, A.I.

*Khim. Prom.* 1970, *46*, 668-670.

VARIABLES:

Temperature

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | Solubility*, $S$ /mol $l^{-1}$ | Mole fraction of+ sulfur dioxide in liquid, $x_{SO_2}$ |
|---|---|---|
| 283.15 | 0.243 | 0.052 |
| 288.15 | 0.214 | 0.046 |
| 293.15 | 0.191 | 0.042 |
| 298.15 | 0.172 | 0.038 |
| 303.15 | 0.153 | 0.034 |

\+ calculated by compiler.

* at atmospheric pressure (authors claim linear relationship between pressure and solubility up to 1 atmosphere partial pressure of $SO_2$)

$\ln S = 852 / (T/K) - 6.50$ (where $S$ is in units of mol $l^{-1}atm^{-1}$)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Bubbler method. Samples of saturated liquid taken and added to sodium hydroxide solution and then excess alkali back titrated

SOURCE AND PURITY OF MATERIALS:

1. Purity at least 95 mole per cent.

2. Chemically pure. Dried.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta$(Solubility) = ±2%; $\delta x_{SO_2} = \pm 0.001$; (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur Dioxide; $SO_2$; [7446-09-5]

2. Dodecane; $C_{12}H_{26}$; [112-40-3]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Magyery-Balog, K.; Rusz, L.; Patyi, L.

*Hung. J. Ind. Chem.* 1976, *4(2)*, 269-280.

VARIABLES:

T/K: 298.15 - 313.15

$P$/kPa: 101.325 (1 atm)

PREPARED BY:

S. A. Johnson / H. L. Clever

EXPERIMENTAL VALUES:

| T/K | Mole fraction $x_{SO_2}$ | Bunsen coefficient $\alpha$ | Ostwald coefficient $L$ |
|---|---|---|---|
| 298.15 | 0.0662 | 6.820 | 7.444 |
| 313.15 | 0.0484 | 4.85 | 5.56 |

Mole fractions and Bunsen coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Apparently the volumetric apparatus described in ref.(1) was modified for use at temperatures above 0°C. The apparatus was designed to be operated at a partial pressure of sulfur dioxide of 760 torr.

SOURCE AND PURITY OF MATERIALS:

Analytical grade reagents of Hungarian and foreign origin were used (both liquids and gases). No further information.

ESTIMATED ERROR:

$\delta x_{SO_2}/x_{SO_2} = \pm 0.03$.

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszprêmi Vegyipari Egyetem Köslemếnyei* 1957, *1*, 55; *CA 55*, 3175h.

COMPONENTS:

1. Sulfur Dioxide; $SO_2$; [7446-09-5]

2. Tridecane; $C_{13}H_{28}$; [629-50-5]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Megyery-Balog, K.; Rusz, L.; Patyi, L.
*Hung. J. Ind. Chem.* 1976, *4(2)*, 269-280.

VARIABLES:

T/K: 298.15 - 313.15
$P$/kPa: 101.325 (1 atm)

PREPARED BY:

S. A. Johnson/ H. L. Clever

EXPERIMENTAL VALUES:

| T/K | Mole fraction $x_{SO_2}$ | Bunsen coefficient $\alpha$ | Ostwald coefficient L |
|---|---|---|---|
| 298.15 | 0.0682 | 6.580 | 7.182 |
| 313.15 | 0.0500 | 4.68 | 5.36 |

Mole fractions and Bunsen coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Apparently the volumetric apparatus described in ref.(1) was modified for use at temperatures above 0°C. The apparatus was designed to be operated at a partial pressure of sulfur dioxide of 760 torr.

SOURCE AND PURITY OF MATERIALS:

Analytical grade reagents of Hungarian and foreign origin were used (both liquids and gases). No further information.

ESTIMATED ERROR:

$\delta x_{SO_2}/x_{SO_2} = \pm 0.03$.

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszprémi Vegyipari Egyetem Kösleményei* 1957, *1*, 55; *CA 55*, 3175h.

COMPONENTS:

1. Sulfur Dioxide; $SO_2$; [7446-09-5]

2. Tetradecane; $C_{14}H_{30}$; [629-59-4]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Megyery-Balog, K.; Rusz, L.; Patyi, L.

*Hung. J. Ind. Chem.* 1976, *4(2)*, 269-280.

VARIABLES:

$T$/K: 298.15 - 313.15

$P$/kPa: 101.325 (1 atm)

PREPARED BY:

S. A. Johnson/ H. L. Clever

EXPERIMENTAL VALUES:

| $T$/K | Mole fraction $x_{SO_2}$ | Bunsen coefficient $\alpha$ | Ostwald coefficient $L$ |
|---|---|---|---|
| 298.15 | 0.0702 | 6.360 | 6.942 |
| 313.15 | 0.0514 | 4.52 | 5.18 |

Mole fractions and Bunsen coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Apparently the volumetric apparatus described in ref.(1) was modified for use at temperatures above 0°C. The apparatus was designed to be operated at a partial pressure of sulfur dioxide of 760 torr.

SOURCE AND PURITY OF MATERIALS:

Analytical grade reagents of Hungarian and foreign origin were used (both liquids and gases). No further information.

ESTIMATED ERROR:

$\delta x_{SO_2}/x_{SO_2} = \pm 0.03$.

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszprêmi Vegyipari Egyetem Közleményei* 1957, *1*, 55; *CA 55*, 3175h.

COMPONENTS:

1. Sulfur Dioxide; $SO_2$; [7446-09-5]

2. Pentadecane; $C_{15}H_{32}$; [629-62-9]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Megyery-Balog, K.; Rusz, L.; Patyi, L.

*Hung. J. Ind. Chem.* 1976, *4(2)*, 269-280.

VARIABLES:

T/K: 298.15 - 313.15

$P$/kPa: 101.325 (1 atm)

PREPARED BY:

S. A. Johnson / H. L. Clever

EXPERIMENTAL VALUES:

| T/K | Mole fraction $x_{SO_2}$ | Bunsen coefficient $\alpha$ | Ostwald coefficient L |
|---|---|---|---|
| 298.15 | 0.0722 | 6.170 | 6.735 |
| 313.15 | 0.0531 | 4.40 | 5.04 |

Mole fractions and Bunsen coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Apparently the volumetric apparatus described in ref.(1) was modified for use at temperatures above 0°C. The apparatus was designed to be operated at a partial pressure of sulfur dioxide of 760 torr.

SOURCE AND PURITY OF MATERIALS:

Analytical grade reagents of Hungarian and foreign origin were used (both liquids and gases).
No further information.

ESTIMATED ERROR:

$\delta x_{SO_2}/x_{SO_2} = \pm 0.03$.

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszprémi Vegyipari Egyetem Közleményei* 1957, *1*, 55; *CA 55*, 3175h.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]

2. Hexadecane; $C_{16}H_{34}$; [544-76-3]

ORIGINAL MEASUREMENTS:

Tremper, K.K.; Prausnitz, J.M.

*J. Chem. Engng. Data* 1976, *21*, 295-9

VARIABLES:

Temperature

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | Henry's Constant[a] /atm | Mole fraction[b] of sulfur dioxide at 1 atm partial pressure, $x_{SO_2}$ |
|---|---|---|
| 300 | 15.1 | 0.0662 |
| 325 | 22.3 | 0.0448 |
| 350 | 30.8 | 0.0325 |
| 375 | 40.2 | 0.0249 |
| 400 | 50.1 | 0.0200 |
| 425 | 60.1 | 0.0166 |
| 450 | 69.8 | 0.0143 |
| 475 | 77.1 | 0.0130 |

a. Authors stated measurements were made at several pressures and values of solubility used were all within the Henry's-Law region.

b. Calculated by compiler assuming linear relationship between mole fraction and pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE

Volumetric apparatus similar to that described by Dymond and Hildebrand (1). Pressure measured with a null detector and precision gauge. Details in ref. (2).

NOTE

It was stated that "while all measurements were made at low pressures, experiments were made at several pressures. The total pressures were always less than 1000 mm Hg and usually much less."

SOURCE AND PURITY OF MATERIALS:

Solvent degassed, no other details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta x_{SO_2} = \pm 1\%$.

REFERENCES:

1. Dymond, J.; Hildebrand, J.H. *Ind. Eng. Chem. Fundam.* 1967, *6*, 130.
2. Cukor, P.M.; Prausnitz, J.M. *Ind. Eng. Chem. Fundam.* 1971, *10*, 638.

COMPONENTS:

1. Sulfur Dioxide; $SO_2$; [7446-09-5]

2. Hexadecane; $C_{16}H_{34}$; [544-76-3]

ORIGINAL MEASUREMENTS:

Makranczy, J.; Megyery-Balog, K.; Rusz, L.; Patyi, L.

*Hung. J. Ind. Chem.* 1976, *4(2)*, 269-280.

VARIABLES:

T/K: 298.15 - 313.15

$P$/kPa: 101.325 (1 atm)

PREPARED BY:

S. A. Johnson / H. L. Clever

EXPERIMENTAL VALUES:

| T/K | Mole fraction $x_{SO_2}$ | Bunsen coefficient $\alpha$ | Ostwald coefficient L |
|---|---|---|---|
| 298.15 | 0.0745 | 6.020 | 6.571 |
| 313.15 | 0.0545 | 4.27 | 4.90 |

Mole fractions and Bunsen coefficients were calculated by the compiler.

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Apparently the volumetric apparatus described in ref.(1) was modified for use at temperatures above 0°C. The apparatus was designed to be operated at a partial pressure of sulfur dioxide of 760 torr.

SOURCE AND PURITY OF MATERIALS:

Analytical grade reagents of Hungarian and foreign origin were used (both liquids and gases). No further information.

ESTIMATED ERROR:

$\delta x_{SO_2}/x_{SO_2} = \pm 0.03.$

REFERENCES:

1. Bodor, E.; Bor, Gy.; Mohai, B.; Sipos, G. *Veszprêmi Vegyipari Egyetem Közleményei* 1957, *1*, 55; *CA 55*, 3175h.

COMPONENTS:

1. Sulfur dioxide, $SO_2$; [7446-09-5]
2. Hexadecane; $C_{16}H_{34}$; [544-76-3]
   or
   Heptadecane; $C_{17}H_{36}$; [629-78-7]

ORIGINAL MEASUREMENTS:

Lenoir, J-Y.; Renault, P.; Renon, H.

*J. Chem. Eng. Data.* <u>1971</u>, *16*, 340-342

VARIABLES:

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

| SOLVENT | T/K | HENRY'S CONSTANT $H_{SO_2}$/ATM | MOLE FRACTION AT 1 ATM * |
|---|---|---|---|
| Hexadecane | 298 | 12.9 | 0.0775 |
| Heptadecane | 323 | 16.4 | 0.0610 |

* Calculated by compiler assuming a linear function of $p_{SO_2}$ vs $x_{SO_2}$, i.e. $x_{SO_2}$ (1 atm) = $1/H_{SO_2}$.

The authors gave "Henry's constant" as $H_{SO_2} = \lim\limits_{x_{SO_2} \to 0} \frac{f_{SO_2}(P,T)}{x_{SO_2}}$

$x_{SO_2}$ is the mole fraction. $f_{SO_2}$ is the fugacity of $SO_2$ "in the equilibrium condition" of pressure and temperature. $H_{SO_2}$ is related to experimental chromatographic parameters based on the number of moles of solvent in the column, and the absolute retention time of the solute. Helium was the carrier gas.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A conventional gas-liquid chromatographic unit was used. The chromatograph was an IGC 12 M Intersmat model, equipped with a thermal conductivity detector. The temperature control was stated to be within ±0.1° C. The pressure drop in the column, was measured by a mercury manometer. Helium was the carrier gas.

There is serious uncertainty in the estimation of accuracy.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was provided by l'Air Liquide, and had a stated purity of 99.9%. It was used as provided.
2. Provided by Touzart & Matignon and Serlabo, and stated to have a minimum purity of 99%. Distillation was carried out when necessary, and the refractive index was measured.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Heptadecane; $C_{17}H_{36}$; [629-78-7]

ORIGINAL MEASUREMENTS:

Sobolev, I.A.; Kukarin, V.A.; Dzhagatspanyan, R.V.; Kosorotov,V.I.; Zogorets, P.A.; Popov, A.I.;

*Khim, Prom.* 1970, *46*, 668-70

VARIABLES:

Temperature

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | Solubility*, $S$ /mol $l^{-1}$ | Mole fraction of+ sulfur dioxide in liquid, $x_{SO_2}$ |
|---|---|---|
| 303.15 | 0.124 | 0.037 |
| 313.15 | 0.104 | 0.031 |
| 323.15 | 0.0902 | 0.027 |
| 333.15 | 0.0768 | 0.023 |

\+ calculated by compiler.

* at atmospheric pressure.

$\ln S = 565/(T/K) - 5.67$ (where $S$ is in units of mol $l^{-1}$ $atm^{-1}$).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Bubbler method. Samples of saturated liquid taken and added to sodium hydroxide solution and then excess alkali back titrated.

SOURCE AND PURITY OF MATERIALS:

1. Purity at least 95 mole per cent.
2. Chemically pure. Dried.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta$(Solubility) = ±2%; $\delta x_{SO_2} = \pm 0.001$; (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Cyclohexane; $C_6H_{12}$; [110-82-7]
   Decahydronaphthalene (*decalin*); $C_{10}H_{18}$; [91-17-8]
   1,2,3,4-Tetrahydronaphthalene (*tetralin*); $C_{10}H_{12}$; [119-64-2]

ORIGINAL MEASUREMENTS:

Sano, H.
*Nippon Kogaku Zasshi*
1968, *89*, 362-368.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

Vapor pressure of cyclohexane, $p_s^\circ$ = 0.140 atm

| Absorption coefficient, $S^{a,b}$ | Bunsen coefficient,$^b$ $\alpha$ | Bunsen coefficient,$^{c,f}$ $\alpha$ | $\ell^{c,d}$ | Mole ratio | Mole fraction$^e$ |
|---|---|---|---|---|---|
| | | Cyclohexane | | | |
| 8.0 | 8.5 | 8.6 | 7.25 | 0.041 | 0.0394 |
| | | Decahydronaphthalene (mixed isomers) | | | |
| 7.0 | 6.4 | 6.2 | 6.2 | 0.045 | 0.0431 |
| | | 1,2,3,4-Tetrahydronaphthalene | | | |
| 45.6 | 41.4 | 42.0 | 42.0 | 0.253 | 0.202 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.
[b] Determined by static absorption method.
[c] Determined by flow method.
[d] $\alpha = \ell(1 - p_s^\circ)$ where $p_s^\circ$ is the vapor pressure of solvent.
[e] Calculated by compiler.
[f] Assuming vapor pressure of decahydronaphthalene and tetrahydronaphthalene are negligible.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two techniques were used: (a) static absorption method and (b) flow method. Static method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The flow method consists of passing sulfur dioxide through a micro gas absorption tube and estimating sulfur dioxide by iodometric titration. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Cyclohexane; $C_6H_{12}$; [110-82-7]

ORIGINAL MEASUREMENTS:

Patyi, L.; Furmer, I. E.; Makranczy, J.; Sadilenko, A. S.; Stepanova, Z. G.; Berengarten, M. G.

*Zh. Prikl. Khim.* 1978, *51*, 1296-1300.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

| T/K | $\alpha^{\dagger}$ | Mole fraction of sulfur dioxide at a partial pressure of 101.325 kPa $x_{SO_2}$ |
|---|---|---|
| 298.15 | 10.71 | 0.06251 |

† volume of gas (measured at 101.325 kPa and 273.15 K) dissolved by one volume of cyclohexane.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method. Pressure measured when known amounts of gas were added, in increments, to a known amount of liquid in a vessel of known dimensions. Corrections were made for the partial pressure of solvent. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

Purity better than 99 mole per cent as determined by gas chromatography.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta\alpha = \pm 4\%$ or less.

REFERENCES:

1. Bodor, E.; Bor, G. J.; Mohai, B,; Sipos. G. *Veszpremi. Vegyip. Egy. Kozl.* 1957, *1*, 55.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]

2. Cyclohexane, $C_6H_{12}$; [110-82-7]

ORIGINAL MEASUREMENTS:

Benoit, R.L.; Milanova, E.

*Can. J. Chem.*, 1979, *57*, 1319-1323

VARIABLES:

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | Henry's law constant + $H$/atm |
|---|---|
| 298.15 | 28.3 |

+ Defined in original as

$$H = \frac{\text{partial pressure of sulfur dioxide}}{\text{mole fraction of sulfur dioxide}}$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Few details given. Pressure measured with quartz spiral gauge. Partial pressure calculated assuming Raoult's law. Concentration of sulfur dioxide determined by iodometric titration. Concentration of sulfur dioxide ranged from 0.05 to 0.10 mol $l^{-1}$

SOURCE AND PURITY OF MATERIALS:

1. Anhydrous sample from Canadian Liquid Air, purity 99.98 mole per cent.

2. Dried over 4A molecular sieve

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta H/\text{atm} = \pm 4\%$
(estimated by compiler)

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Decahydronaphthalene, (decalin); $C_{10}H_{18}$; [91-17-8] | Weissenberger, G,; Hadwiger, H.<br>*Z. angew. Chem.* 1927, *40*, 734-736. |
| VARIABLES: | PREPARED BY:<br>W. Gerrard |

EXPERIMENTAL VALUES:

| T/K | Volume of Comp. (2)/$cm^3$ | Volume of $SO_2$ absorbed/$cm^3$ | *Mole ratio $SO_2$/Comp. (2) | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|---|
| | | | (pressure assumed to be barometric) | |
| 293.15 | 157.5<br>("Molar volume") | 1181.25 | 0.0503 | 0.0479 |

* Calculated by compiler

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Used an absorption vessel of 200 $cm^3$ capacity, and a vessel with a two-way tap. Simply stated that the absorptiometer was like that used by Manchot, but the reference was not cited; probably ref. (1).

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

REFERENCES:

1. Manchot, W. *Z. anorg. Chem.* 1924, *141*, 38.

COMPONENTS:

1. Sulfur dioxide, $SO_2$; [7446-09-5]
2. Decahydronaphthalene, (decalin); $C_{10}H_{18}$; [91-17-8]

ORIGINAL MEASUREMENTS:

Lenoir, J-Y.; Renault, P.; Renon, H.

*J. Chem. Eng. Data* 1971, *16*, 340-342.

VARIABLES:

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

760 mmHg = 1 atm = 101.325 kPa.

| T/K | Henry's constant $H_{SO_2}$/atm | *Mole fraction at 1 atm |
|---|---|---|
| 298 | 18.8 | 0.0532 |
| 323 | 25.6 | 0.0391 |

* Calculated by compiler assuming a linear function of $p_{SO_2}$ vs $x_{SO_2}$, i.e. $x_{SO_2}$ (1 atm) = $1/H_{SO_2}$.

The authors gave "Henry's constant" as $$H_{SO_2} = \lim_{x_{SO_2} \to 0} \frac{f_{SO_2}(P,T)}{x_{SO_2}}$$

$x_{SO_2}$ is the mole fraction. $f_{SO_2}$ is the fugacity of $SO_2$ "in the equilibrium condition"of pressure and temperature. $H_{SO_2}$ is related to experimental chromatographic parameters based on the number of moles of solvent in the column, and the absolute retention time of the solute. Helium was the carrier gas.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A conventional gas-liquid chromatographic unit was used. The chromatograph was an IGC 12M Intersmat model equipped with a thermal conductivity detector. The temperature control was stated to be within ±0.1°C. The pressure drop in the column was measured by a mercury manometer. Helium was the carrier gas.

There is serious uncertainty in the estimation of accuracy.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was provided by l'Air Liquide, and had a stated purity of 99.9%. It was used as provided.
2. Provided by Touzart & Matignon and Serlabo, and stated to have a minimum purity of 99%. Distillation was carried out when necessary, and the refractive index was measured.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Aromatic hydrocarbons and Hydronaphthalenes

EVALUATOR:

Colin L. Young,
School of Chemistry,
University of Melbourne,
Parkville, Victoria 3052,
Australia.

November 1980

CRITICAL EVALUATION:

Benzene; $C_6H_6$; [71-43-2]

This system has been studied by six groups. Lloyd's (1) data for benzene are in the form of concentration of sulfur dioxide in units of grams per litre of solution for a total pressure equal to the barometric pressure. The calculated mole fraction is based on the assumption that the volume of solution after absorption is the same as that before absorption. Calculation of the mole fraction at a partial pressure of sulfur dioxide of 101.3 kPa (1 atm) entails further uncertainty as the partial pressure of benzene becomes larger and increasingly uncertain for the higher temperatures.

Ipatiev and Monroe (2) made measurements at pressures between 120 kPa and 250 kPa for temperatures between 298 K and 300 K. The most extensive data for this system are those of Horiuti (3) who studied the system at temperatures between 283.15 K and 333.15 K. The table below compares the mole fraction solubility from the six groups extrapolated, where necessary, to 298.15 K and a partial pressure of 101.3 kPa. The data of Horiuti (3) were used to give an approximate estimate of the temperature dependence of the solubility for the purpose of this extrapolation. The data of Benoit and Milanova (4) were determined at low pressure and the mole fraction at a partial pressure of 101.3 kPa was obtained assuming Henry's law is obeyed. There is reasonable agreement between the data of Lloyd (1), Horiuti (3), Benoit and Milanova (4), Sano (6) and Ipatiev and Monroe (2). The result of Patyi *et al.* (5) is about 10 per cent smaller and is classified as doubtful.

Mole fraction solubility at 298 K and 101.3 kPa partial pressure

| | |
|---|---|
| Patyi *et al.* (5) | 0.2020 |
| Benoit and Milanova (4) | 0.2217 |
| Lloyd (1) | 0.21 |
| Horiuti (3) | 0.23 |
| Ipatiev and Monroe (2) | 0.23 |
| Sano (6) | 0.21 |

Although Horiuti (3) and Ipatiev and Monroe (2) data agree at 298 K and 101.3 kPa when the complete mole fraction data at 298 K are plotted against pressure, the plot of Horiuti, which covers the pressure range up to 135 kPa total pressure, has a slightly different slope from that obtained by plotting Ipatiev and Monroe's data. Therefore no data are recommended but the data of Horiuti (3), Ipatiev and Monroe (2), Lloyd (1), Sano (6), and Benoit and Milanova (4) are all classified as tentative.

Methylbenzene; $C_7H_8$; [108-88-3]

This system has been studied in detail by Lorimer *et al.* (7) at 227.6 K, 237.4 K and 249.8 K. In this temperature range sulfur dioxide is a liquid at atmospheric pressure. (The normal boiling point is

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Aromatic hydrocarbons and Hydronaphthalenes

EVALUATOR:

Colin L. Young,
School of Chemistry,
University of Melbourne,
Parkville, Victoria 3052,
Australia.

November 1980

CRITICAL EVALUATION:

∿ 263 K.) Lloyd's data (1) cover the temperature range 293.15 K to 333.15 K. Since conversion of the mass of sulfur dioxide per unit volume of solution to a mole fraction value required an approximation for the density of solution, Lloyd's data must be assessed with caution. Gerrard (8) has determined the solubility of sulfur dioxide at 273.15 K and a total pressure of 101.3 kPa. The mole fraction solubility value of Sano (6) is somewhat (∿ 10 per cent) larger than the value of Lloyd at the same temperature. However, in view of the different range of temperature covered it is impossible to make any *precise* comparisons between the work of the four groups. The results of Lorimer *et al.* (7) appear to be self-consistent and are probably the most accurate and therefore are classified as tentative. The data of Sano (6), Gerrard (8) and Lloyd (1) are probably less reliable.

1,3-Dimethylbenzene; $C_8H_{10}$; [108-38-3]

This system has also been studied by Lorimer *et al.* (7) at 227.6 K, 237.4 K and 249.9 K and by Gerrard (9) over the temperature range 273.15 to 298.15 K. In this case there is better agreement between these two groups' results than in the case of methylbenzene and both are classified as tentative. The isolated value of Sano (6) for a mixture or xylenes appears to be slightly small compared with the value obtained by extrapolation of the values of Gerrard (9) to the same temperature.

1,3,5-Trimethylbenzene; $C_9H_{12}$; [108-67-8]

This system has also been investigated by Lorimer *et al.* (7) at -27.6 K, 237.4 K and 250.0 K and by Gerrard (9) over the temperature range 273.15 to 293.15 K. The temperature dependence of Gerrard's data indicates that the mole fraction solubility at the temperatures studied by Lorimer *et al.* (7) would be less than that given by Raoult's law, whereas the opposite was found experimentally. This could arise because of small errors in weighing in Gerrard's measurements when large amounts of gas are absorbed. The data of both groups are classified as tentative but the measurement of Gerrard at 273.15 K is doubtful.

1,1'-Methylenebis(1-methylethyl)benzene; $C_{19}H_{24}$; [25566-92-1]
1,1'-Methylenebis(methylbenzene); $C_{15}H_{16}$; [1335-47-3]

The solubility of sulfur dioxide in these two compounds has been studied by Gel'perin *et al.* (10). The temperature dependence of the solubility is more or less as would be expected for a system which shows only moderate deviations from Raoult's law. In the absence of any other evidence as to the reliability of these data, they are classified as tentative.

| COMPONENTS: | EVALUATOR: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Aromatic hydrocarbons and Hydronaphthalenes | Colin L. Young<br>School of Chemistry,<br>University of Melbourne,<br>Parkville, Victoria 3052,<br>Australia.<br>November 1980 |

CRITICAL EVALUATION:

Hydronaphthalenes

The mole fraction solubility of sulfur dioxide in tetrahydronaphthalene given by Gerrard (9) at 293.15 K and 101.3 kPa total pressure is 0.228 and 0.202 at 303 K and a partial pressure of 101.3 kPa according to Sano (6), where as Weissenberger and Hadwiger (11) reported that the solubility of sulfur dioxide in this compound was too small to be of consequence. Gerrard's value for decahydronaphthalene is 0.060 at 298.15 K and 101.3 kPa total pressure whereas the value based on Weissenberger and Hadwiger's primary data is 0.0479 under the same conditions. Sano (6) obtained a value at 303 K and 101.3 kPa of 0.0431. It is to be expected that the value for decahydronaphthalene should be much less than that for the tetrahydro-compound (*cf.* the solubility in cyclohexane which is much smaller than in benzene). It is therefore suggested that the data of Weissenberger and Hadwiger should be rejected. Lenoir *et al.* (12) gave solubility data at 298 K which, with some approximation, lead to a mole fraction solubility of sulfur dioxide in decahydronaphthalene of 0.053. In view of the approximation made, this must be regarded as in good agreement with Gerrard's value.

Turpentine

Gerrard's mole fraction solubility values for pinene (representing turpentine) are 0.200 at 273 K and 0.110 at 293 K for a total pressure of 101.3 kPa. Weissenberger and Hadwiger's (11) value of 0.055 for turpentine at 293 K appears to be unacceptable.

References

1. Lloyd, S. J. *J. Phys. Chem.* 1918, *22*, 300.
2. Ipatiev, V. N.; Monroe, G. S. *Ind. Eng. Chem. Anal. Ed.* 1942, *14*, 166.
3. Horiuti, J. *Sci. Pap. Inst. Phys. Chem. Res. Tokyo* 1931, *17*, 125.
4. Benoit, R. L.; Milanova, E. *Can. J. Chem.* 1979, *57*, 1319.
5. Patyi, L.; Furmer, I. E.; Makranczy, J.; Sadilenko, A. S.; Stepanova , Z. G.; Berengarten, M. G. *Zh. Prikl. Khim.* 1978, *51*, 1296.
6. Sano, H. *Nippon Kagaku Zasshi* 1968, *89*, 362.
7. Lorimer, J. W.; Smith, B. C.; Smith, G. H. *J. C. S. Faraday I* 1975, *71*, 2232.
8. Gerrard, W. *J. Appl. Chem. Biotechnol.* 1972, *22*, 623.
9. Gerrard, W. *Solubility of Gases and Liquids*, Plenum Press, New York, 1976, p.239.
10. Gel'perin, N. I.; Matveev, I. G.; Bil'shau, K. V. *Zh. Prikl. Khim.* 1958, *31*, 1323.
11. Weissenberger, G.; Hadwiger, H. Z. *Angew. Chem.* 1927, *40*, 734.
12. Lenoir, J.-Y.; Renault, P.; Renon, H. *J. Chem. Engng. Data* 1971, *16*, 340.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]

2. Benzene; $C_6H_6$; [71-43-2]

ORIGINAL MEASUREMENTS:

Lloyd, S.J.

*J. Phys. Chem.* 1918, *22*, 300-302.

VARIABLES:

Temperature

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

*Speculative values

| T/K | Weight of $SO_2$ per $dm^3$ of solution /g. | *Mole ratio, $SO_2$/ Comp. (2) | *Mole fraction (as for 1 atm) $x_{SO_2}$ |
|---|---|---|---|
| 303.15 | 127.5 | 0.210 | 0.174 |
| 313.15 | 82.9 | 0.131 | 0.115 |
| 323.15 | 60.3 | 0.093 | 0.085 |
| 333.15 | 34.0 | 0.052 | 0.049 |

760 mmHg = 1 atm = 101.325 kPa.

* Calculated by compiler by assuming that the volume of solution is the same as the volume of the component (2) before absorption of gas.

AUXILIARY INFORMATION

METHOD:/APPARATUS/PROCEDURE:

Gas was bubbled through component (2) in a long graduated tube of small diameter. After equilibrium had been attained at a total pressure of about 1 atm (barometric pressure, 756-760 mmHg), the volume of the solution (about 5 $cm^3$) was measured, and the weight of absorbed sulfur dioxide was determined by an iodometric titration.

SOURCE AND PURITY OF MATERIALS:

(1) Prepared from concentrated sulfuric acid and a saturated aqueous solution of sodium bisulfite. Dried by sulfuric acid and phosphorus pentoxide.

(2) Distilled, dried by calcium chloride, and redistilled before use.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]

2. Benzene; $C_6H_6$; [71-43-2]

ORIGINAL MEASUREMENTS:

Horiuti, J.,
*Sci. Pap. Inst. Phys. Chem. Res. (Jpn.)*, 1931/32, *17*, 125-256.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

| T/K | $P^{\S}$/bar | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ | T/K | $P^{\dagger}$/bar | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ | Ostwald coefficient, L |
|---|---|---|---|---|---|---|
| 298.15 | 0.1248 | 0.0000 | 283.15 | 0.9749 | 0.3764 | 126.4 |
| | 0.3833 | 0.0592 | 288.15 | 0.9592 | 0.3107 | 103.2 |
| | 0.3921 | 0.0618 | 293.15 | 0.9390 | 0.2549 | 84.81 |
| | 0.6577 | 0.1247 | 298.15 | 0.9136 | 0.2079 | 70.01 |
| | 0.6730 | 0.1275 | 303.15 | 0.8829 | 0.1722 | 59.50 |
| | 0.8842 | 0.1783 | 308.15 | 0.8452 | 0.1405 | 50.37 |
| | 0.9350 | 0.1910 | 313.15 | 0.7999 | 0.1139 | 43.01 |
| | 1.078 | 0.2252 | 318.15 | 0.7457 | 0.0921 | 37.25 |
| | 1.147 | 0.2401 | 323.15 | 0.6806 | 0.0737 | 32.63 |
| | 1.230 | 0.2605 | 328.15 | 0.6062 | 0.0570 | 28.28 |
| | 1.301 | 0.2796 | 333.15 | 0.5172 | 0.0435 | 25.36 |
| | 1.348 | 0.2909 | | | | |

§ total pressure.

† partial pressure, total pressure = 1 atmosphere = $1.01325 \times 10^5$ Pa.

Ostwald coefficient (as $x \rightarrow 0$, T/K = 298.15) = 60.3.

Henry's law constant, d$p$/d$x$ (as $x \rightarrow 0$, T/K = 298.15) = 3454 mmHg = 4.605 bar.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Apparatus consisted of a gas buret, a solvent reservoir, and an absorption pipet. Dry gas introduced into degassed solvent. System mixed using a magnetic stirrer until saturation occurred. Care was taken to prevent solvent vapor from mixing with gas in the gas buret. Volume of gas determined from gas buret reading; volume of liquid determined from height of meniscus in the absorption pipet.

SOURCE AND PURITY OF MATERIALS:

1. Sample obtained from Nippon Sulphuric Acid Manufacturing Co. Dried and fractionated several times.

2. Merck, extra pure sulfur-free sample refluxed over sodium amalgam. B. pt. 80.18 °C.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.001$;

$\delta x_{SO_2} = \pm 0.001$ (estimated by compiler)

REFERENCES:

| | |
|---|---|
| COMPONENTS:<br>1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Benzene; $C_6H_6$; [71-43-2] | ORIGINAL MEASUREMENTS:<br>Ipatieff, V.N.; Monroe, G.S.<br>*Ind. Eng. Chem. Anal. Edn.* 1942, *14*, 166-171. |
| VARIABLES:<br>Pressure | PREPARED BY:<br>C.L. Young |

EXPERIMENTAL VALUES:

| t/°C | T/K | Total pressure $p$/atm | $p$/kPa | Solubility g $SO_2$/100g $H_2O$ | Mole fraction of sulfur dioxide, $x_{SO_2}$ * |
|---|---|---|---|---|---|
| 26 | 299 | 1.20 | 1.22 | 24.7 | 0.231 |
| 26 | 299 | 1.75 | 1.77 | 37.6 | 0.314 |
| 27 | 300 | 2.40 | 2.43 | 84.8 | 0.508 |
| 25 | 298 | 2.65 | 2.69 | 125.5 | 0.605 |

* calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Rotating bomb of 3.5 $dm^3$ capacity. Pressure measured with a Bourdon gauge and temperature measured with thermocouple. Samples of liquid phase analysed by removing sulfur dioxide by a stream of air and absorption into potassium hydroxide solution. Benzene determined gravimetrically.

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. Baker C.P. thiophene free sample, $n^{20}_D$ 1.5012.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Benzene; $C_6H_6$; [71-43-2]
   Methylbenzene (*toluene*); $C_7H_8$; [108-88-3]
   Dimethylbenzene (*xylene, mixture of isomers*); $C_8H_{10}$; [1330-20-7]

ORIGINAL MEASUREMENTS:

Sano, H.
*Nippon Kagaku Zasshi*
1968, *89*, 362-368.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303
Vapor pressure of benzene, $p_s^\circ$ = 0.117 atm
Vapor pressure of methylbenzene, $p_s^\circ$ = 0.037 atm
Vapor pressure of dimethylbenzene (mixture of isomers), $p_s^\circ$ = 0.013 atm

| Absorption coefficient, $S^{a,b}$ | Bunsen coefficient,[b] $\alpha$ | Bunsen coefficient,[c] $\alpha$ | $\ell^{c,d}$ | Mole ratio | Mole fraction[e] |
|---|---|---|---|---|---|
| | | Benzene | | | |
| 52.0 | 53.4 | 54.2 | 45.2 | 0.213 | 0.176 |
| | | Methylbenzene | | | |
| 61.8 | 58.0 | 59.2 | 56.2 | 0.276 | 0.216 |
| | | Dimethylbenzene | | | |
| 58.05 | 53.5 | 54.1 | 53.8 | 0.294 | 0.227 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Determined by static absorption method.

[c] Determined by flow method.

[d] $\alpha = \ell(1 - p_s^\circ)$ where $p_s^\circ$ is the vapor pressure of solvent.

[e] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two techniques were used: (a) static absorption method and (b) flow method. Static method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The flow method consists of passing sulfur dioxide through a micro gas absorption tube and estimating sulfur dioxide by iodometric titration. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$
(estimated by compiler).

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Benzene; $C_6H_6$; [71-43-2] | Patyi, L.; Furmer, I. E.; Makranczy, J.; Sadilenko, A. S.; Stepanova, Z. G.; Berengarten, M. G.<br>*Zh. Prikl. Khim.* <u>1978</u>, *51*, 1296-1300. |
| VARIABLES: | PREPARED BY:<br>C. L. Young |

EXPERIMENTAL VALUES:

| T/K | $\alpha^{\dagger}$ | Mole fraction of sulfur dioxide at a partial pressure of 101.325 kPa $x_{SO_2}$ |
|---|---|---|
| 298.15 | 62.05 | 0.2020 |

† volume of gas (measured at 101.325 kPa and 273.15 K) dissolved by one volume of benzene.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Volumetric method. Pressure measured when known amounts of gas were added, in increments, to a known amount of liquid in a vessel of known dimensions. Corrections were made for the partial pressure of solvent. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

Purity better than 99 mole per cent as determined by gas chromatography.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta\alpha = \pm 4\%$ or less.

REFERENCES:

1. Bodor, E.; Bor, G. J.; Mohai, B.; Sipos, G. *Veszpremi. Vegyip. Egy. Kozl.* <u>1957</u>, *1*, 55.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Benzene; $C_6H_6$; [71-43-2]

ORIGINAL MEASUREMENTS:

Benoit, R.L.; Milanova, E.

*Can. J. Chem.*, 1979, *57*, 1319-1323

VARIABLES:

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | Henry's law constant$^+$ $H$/atm |
|---|---|
| 298.15 | 4.51 |

$^+$ Defined in original as

$$H = \frac{\text{partial pressure of sulfur dioxide}}{\text{mole fraction of sulfur dioxide}}$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Few details given. Pressure measured with quartz spiral gauge. Partial pressure calculated assuming Raoults law. Concentration of sulfur dioxide determined by iodometric titration. Concentration of sulfur dioxide ranged from 0.05 to 0.2 mol $l^{-1}$

SOURCE AND PURITY OF MATERIALS:

1. Anhydrous sample from Canadian Liquid Air, purity 99.98 mole per cent.

2. Dried over 4A molecular sieve

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta H/\text{atm} = \pm 4\%$ (estimated by compiler)

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]

2. Methylbenzene; $C_7H_8$; [108-88-3]

ORIGINAL MEASUREMENTS:

Lloyd, S.J.

*J. Phys. Chem.* 1918, *22*, 300-302.

VARIABLES:

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | Weight of $SO_2$ per $dm^3$ of solution /g. | *Speculative values<br>*Mole ratio, $SO_2$/Comp. (2) | *Mole fraction (as for 1 atm) $x_{SO_2}$ |
|---|---|---|---|
| 293.15 | 217.5 | 0.482 | 0.325 |
| 298.15 | 170.4 | 0.354 | 0.261 |
| 303.15 | 124.4 | 0.244 | 0.196 |
| 313.15 | 93.6 | 0.178 | 0.151 |
| 323.15 | 77.2 | 0.145 | 0.127 |
| 333.15 | 54.7 | 0.101 | 0.092 |

760 mmHg = 1 atm = 101.325 kPa

* Calculated by compiler by assuming that the volume of solution is the same as the volume of the component (2) before absorption of gas.

AUXILIARY INFORMATION

METHOD:/APPARATUS/PROCEDURE:

Gas was bubbled through component (2) in a long graduated tube of small diameter. After equilibrium had been attained at a total pressure of about 1 atm (barometric pressure, 756-760 mmHg), the volume of the solution (about 5 $cm^3$) was measured, and the weight of absorbed sulfur dioxide was determined by an iodometric titration.

SOURCE AND PURITY OF MATERIALS:

(1) Prepared from concentrated sulfuric acid and a saturated aqueous solution of sodium bisulfite. Dried by sulfuric acid and phosphorus pentoxide.

(2) Distilled, dried by calcium chloride and redistilled before use.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Methylbenzene (toluene); $C_7H_8$; [108-88-3]

ORIGINAL MEASUREMENTS:

Gerrard, W.

*J. Appl. Chem. Biotechnol.* 1972, *22*, 623-650.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

760 mmHg = 1 atm = 101.325 kPa

| T/K | Pressure, total /mmHg | Mole ratio $SO_2$/toluene | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| 273.15 | 760 | 1.82 | 0.646 |

* Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was bubbled into a weighed amount of component (2) in a bubbler tube as described in detail, diagram given, in the original paper. The amount of gas absorbed at equilibrium and at the observed temperature and pressure was weighed. By means of a manometer assembly, to which the bubbler tube was attached, the weight of gas absorbed at successively lower pressure was measured. Eventually the pressure was reduced to that of the component (2). The refractive index, and the infrared spectrum of the residue showed it to be essentially pure component (2).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was the best grade contained in a small cylinder. Its high purity was attested by the measurement of vapor pressure from 258 to 268 K.
2. The best obtainable specimen was carefully purified and rigorously attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Methylbenzene, (Toluene); $C_7H_8$; [108-88-3]

ORIGINAL MEASUREMENTS:

Lorimer, J.W.; Smith, B.C.; Smith, G.H.

*J.C.S. Faraday I*, 1975, *71*, 2232-50.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | $p$/mmHg $^a$ | $p$/kPa $^{a,b}$ | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ | in vapor, $y_{SO_2}$ |
|---|---|---|---|---|
| 227.6 | 0.42 | 0.056 | 0.0000 | 0.000 |
| | 7.88 | 1.051 | 0.0864 | 0.952 |
| | 14.83 | 1.977 | 0.1949 | 0.979 |
| | 30.19 | 4.025 | 0.2879 | 0.991 |
| | 43.59 | 5.812 | 0.3834 | 0.995 |
| | 61.73 | 8.230 | 0.5135 | 0.997 |
| | 75.19 | 10.025 | 0.6031 | 0.998 |
| | 81.78 | 10.903 | 0.6557 | 0.999 |
| | 93.38 | 12.450 | 0.7623 | 0.999 |
| | 104.17 | 13.888 | 0.8812 | 1.000 |
| | 116.67 | 15.555 | 1.0000 | 1.000 |
| 237.4 | 0.83 | 0.111 | 0.0000 | 0.000 |
| | 14.48 | 1.931 | 0.0830 | 0.948 |
| | 30.55 | 4.073 | 0.1850 | 0.979 |
| | 56.03 | 7.470 | 0.2794 | 0.990 |
| | 78.34 | 10.444 | 0.3625 | 0.994 |
| | 110.59 | 14.744 | 0.4904 | 0.997 |
| | 131.91 | 17.587 | 0.5900 | 0.998 |
| | 143.80 | 19.172 | 0.6369 | 0.998 |
| | 166.33 | 22.176 | 0.7517 | 0.999 |
| | 186.12 | 24.814 | 0.8782 | 0.999 |
| | 208.43 | 27.788 | 1.0000 | 1.000 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static vapor-liquid equilibrium apparatus. Total pressure measured using mercury manometers and cathetometer. Temperature measured using a sulfur dioxide vapor pressure thermometer. Some details in source, together with activity coefficients. Vapor compositions calculated from the total vapor pressure and liquid composition using Barker's technique (ref. 1).

SOURCE AND PURITY OF MATERIALS:

No details given

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/kPa = \pm 0.01$; $\delta x_{SO_2}$, $\delta y_{SO_2} = \pm 1\%$.

REFERENCES:

1. Barker, J. A. *Aust. J. Chem.* 1953, *6*, 207.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7746-09-5]<br>2. Methylbenzene, (Toluene); $C_7H_8$; [108-88-3] | Lorimer, J.W.; Smith, B.C.; Smith, G.H.<br>*J.C.S. Faraday I*, 1975, *71*, 2232-50 |

EXPERIMENTAL VALUES:

| T/K | $p$/mmHg [a] | $p$/kPa [a,b] | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ | Mole fraction of sulfur dioxide in vapor, $y_{SO_2}$ |
|---|---|---|---|---|
| 249.8 | 1.85 | 0.247 | 0.0000 | 0.000 |
| | 28.82 | 3.842 | 0.0762 | 0.941 |
| | 65.48 | 8.730 | 0.1745 | 0.977 |
| | 107.02 | 14.268 | 0.2632 | 0.988 |
| | 139.74 | 18.630 | 0.3248 | 0.992 |
| | 202.40 | 26.984 | 0.4525 | 0.995 |
| | 245.28 | 32.701 | 0.5585 | 0.997 |
| | 265.84 | 35.442 | 0.5947 | 0.997 |
| | 306.92 | 40.919 | 0.7289 | 0.998 |
| | 363.40 | 48.449 | 0.8695 | 0.999 |
| | 405.40 | 54.049 | 1.0000 | 1.000 |

[a] total pressure.

[b] calculated by compiler.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]

2. 1,3-Dimethylbenzene, (*m*-xylene); $C_8H_{10}$; [108-38-3]

ORIGINAL MEASUREMENTS:

Gerrard, W.

*J. Appl. Chem. Biotechnol.* 1972, *22*, 623-650.

VARIABLES:

Temperature

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | Pressure, total /mmHg | Mole ratio $SO_2$/Xylene. | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| 273.15 | 765 | 2.15 | 0.683 |
| 283.15 | 765 | 0.895 | 0.472 |
| 293.15 | 765 | 0.51 | 0.338 |
| 298.15 | 765 | 0.40 | 0.286 |

760 mmHg = 1 atm = 101.325 kPa.

* Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was bubbled into a weighed amount of component (2) in a bubbler tube as described in detail, diagram given, in the original paper. The amount of gas absorbed at equilibrium and at the observed temperature and pressure was weighed. By means of a manometer assembly, to which the bubbler tube was attached, the weight of gas absorbed at successively lower pressure was measured. Eventually the pressure was reduced to that of the component (2). The refractive index, and the infrared spectrum of the residue showed it to be essentially pure component (2).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was the best grade contained in a small cylinder. Its high purity was attested by the measurement of vapor pressure from 258 to 268 K.
2. The best obtainable specimen was carefully purified and rigorously attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 1,3-Dimethylbenzene, (*m*-xylene); $C_8H_{10}$; [108-38-3]

ORIGINAL MEASUREMENTS:

Lorimer, J.W.; Smith, B.C.; Smith, G.H.

*J.C.S. Faraday I*, 1975, *71*, 2232-50

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | $p$/mmHg$^a$ | $p$/kPa$^{a,b}$ | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ | Mole fraction of sulfur dioxide in vapor, $y_{SO_2}$ |
|---|---|---|---|---|
| 227.6 | 0.22 | 0.029 | 0.0000 | 0.000 |
| | 7.63 | 1.017 | 0.0893 | 0.974 |
| | 16.04 | 2.138 | 0.2020 | 0.989 |
| | 23.95 | 3.193 | 0.3040 | 0.994 |
| | 38.22 | 5.096 | 0.3695 | 0.997 |
| | 52.36 | 6.981 | 0.4704 | 0.998 |
| | 67.18 | 8.957 | 0.5724 | 0.999 |
| | 80.23 | 10.696 | 0.6250 | 0.999 |
| | 93.14 | 12.418 | 0.7595 | 1.000 |
| | 105.16 | 14.020 | 0.8760 | 1.000 |
| | 116.67 | 15.555 | 1.0000 | 1.000 |
| 237.4 | 0.35 | 0.047 | 0.0000 | 0.000 |
| | 14.58 | 1.944 | 0.0854 | 0.978 |
| | 30.57 | 4.076 | 0.1955 | 0.991 |
| | 46.76 | 6.234 | 0.2962 | 0.995 |
| | 67.73 | 9.030 | 0.3516 | 0.997 |
| | 92.90 | 12.386 | 0.4525 | 0.998 |
| | 121.07 | 16.141 | 0.5565 | 0.999 |
| | 134.04 | 17.871 | 0.6046 | 0.999 |
| | 166.71 | 22.226 | 0.7477 | 1.000 |
| | 188.58 | 25.142 | 0.8725 | 1.000 |
| | 209.13 | 27.882 | 1.0000 | 1.000 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static vapor-liquid equilibrium apparatus. Total pressure measured using mercury manometers and cathetometer. Temperature measured using a sulfur dioxide vapor pressure thermometer. Some details in source, together with activity coefficients. Vapor compositions calculated from the total vapor pressure and liquid composition using Barker's technique (ref. 1).

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/kPa = \pm 0.01$; $\delta x_{SO_2}, \delta y_{SO_2} = \pm 1\%$.

REFERENCES:

1. Barker, J. A. *Aust. J. Chem.* 1953, *6*, 207.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. 1,3-Dimethylbenzene, (*m*-xylene); $C_8H_{10}$; [108-38-3] | Lorimer, J.W.; Smith, B.C.; Smith, G.H.<br>*J.C.S. Faraday I*, 1975, *71*, 2232-50. |

EXPERIMENTAL VALUES:

| T/K | $p$/mmHg[a] | $p$/kPa[a,b] | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ | Mole fraction of sulfur dioxide in vapor, $y_{SO_2}$ |
|---|---|---|---|---|
| 249.9 | 0.47 | 0.063 | 0.0000 | 0.000 |
| | 28.21 | 3.761 | 0.0779 | 0.985 |
| | 60.19 | 8.025 | 0.1826 | 0.994 |
| | 92.18 | 12.290 | 0.2805 | 0.996 |
| | 119.30 | 15.905 | 0.3188 | 0.997 |
| | 168.48 | 22.462 | 0.4163 | 0.999 |
| | 222.02 | 29.600 | 0.5233 | 0.999 |
| | 240.60 | 32.077 | 0.5560 | 0.999 |
| | 312.50 | 41.663 | 0.7195 | 1.000 |
| | 363.18 | 48.420 | 0.8639 | 1.000 |
| | 408.08 | 54.405 | 1.0000 | 1.000 |

[a] total pressure.

[b] calculated by compiler.

**COMPONENTS:**

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 1,3,5-Trimethylbenzene, (mesitylene); $C_9H_{12}$; [108-67-8]

**ORIGINAL MEASUREMENTS:**

Lorimer, J.W.; Smith, B.C.; Smith, G.H.

*J.C.S. Faraday I*, 1975, *71*, 2232-50.

**VARIABLES:**

Temperature, pressure

**PREPARED BY:**

C.L. Young

**EXPERIMENTAL VALUES:**

| T/K | $p$/mmHg[a] | $p$/kPa[a,b] | Mole fraction of sulfur dioxide in liquid, $y_{SO_2}$ | in vapor, $y_{SO_2}$ |
|---|---|---|---|---|
| 227.6 | 0.17 | 0.023 | 0.0000 | 0.000 |
| | 6.53 | 0.871 | 0.1124 | 0.977 |
| | 14.13 | 1.884 | 0.1940 | 0.990 |
| | 24.29 | 3.238 | 0.2956 | 0.995 |
| | 38.56 | 5.141 | 0.3970 | 0.998 |
| | 55.12 | 7.349 | 0.4882 | 0.999 |
| | 73.35 | 9.779 | 0.5903 | 0.999 |
| | 86.89 | 11.584 | 0.6860 | 1.000 |
| | 100.25 | 13.366 | 0.7975 | 1.000 |
| | 108.69 | 14.491 | 0.9012 | 1.000 |
| | 116.67 | 15.555 | 1.0000 | 1.000 |
| 237.4 | 0.23 | 0.031 | 0.0000 | 0.000 |
| | 12.57 | 1.676 | 0.1084 | 0.984 |
| | 25.30 | 3.373 | 0.1880 | 0.993 |
| | 46.06 | 6.141 | 0.2868 | 0.997 |
| | 66.72 | 8.895 | 0.3781 | 0.998 |
| | 95.21 | 12.694 | 0.4682 | 0.999 |
| | 127.27 | 16.968 | 0.5725 | 0.999 |
| | 149.09 | 19.877 | 0.6604 | 1.000 |
| | 176.06 | 23.473 | 0.7845 | 1.000 |
| | 195.12 | 26.014 | 0.8977 | 1.000 |
| | 208.65 | 27.818 | 1.0000 | 1.000 |

AUXILIARY INFORMATION

**METHOD/APPARATUS/PROCEDURE:**

Static vapor-liquid equilibrium apparatus. Total pressure measured using mercury manometers and cathetometer. Temperature measured using a sulfur dioxide vapor pressure thermometer. Some details in source, together with activity coefficients. Vapor compositions calculated from the total vapor pressure and liquid composition using Barker's technique (ref. 1).

**SOURCE AND PURITY OF MATERIALS:**

No details given.

**ESTIMATED ERROR:**

$\delta T/K = \pm 0.1$; $\delta p/kPa = \pm 0.01$; $\delta x_{SO_2}$, $\delta y_{SO_2} = \pm 1\%$.

**REFERENCES:**

1. Barker, J. A. *Aust. J. Chem.* 1953, *6*, 207.

| COMPONENTS | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. 1,3,5-Trimethylbenzene, (mesitylene); $C_9H_{12}$; [108-67-8] | Lorimer, J.W.; Smith, B.C.; Smith, G.H.<br>*J.C.S. Faraday I*, 1975, *71*, 2232-50. |

EXPERIMENTAL VALUES:

| T/K | $p$/mmHg [a] | $p$/kPa [a,b] | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ | in vapor, $y_{SO_2}$ |
|---|---|---|---|---|
| 250.0 | 0.48 | 0.064 | 0.0000 | 0.000 |
| | 25.29 | 3.372 | 0.1004 | 0.983 |
| | 50.73 | 6.763 | 0.1742 | 0.992 |
| | 89.13 | 11.883 | 0.2676 | 0.996 |
| | 119.25 | 15.899 | 0.3403 | 0.998 |
| | 170.08 | 22.675 | 0.4267 | 0.999 |
| | 231.39 | 30.849 | 0.5328 | 0.999 |
| | 264.15 | 35.217 | 0.5987 | 0.999 |
| | 334.28 | 44.567 | 0.7490 | 1.000 |
| | 377.45 | 50.323 | 0.8888 | 1.000 |
| | 410.55 | 54.735 | 1.0000 | 1.000 |

[a] total pressure.

[b] calculated by compiler.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 1,3,5-Trimethylbenzene, (Mesitylene); $C_9H_{12}$; [526-73-8]

ORIGINAL MEASUREMENTS:

Gerrard, W. *"Solubility of Gases and Liquids,"* Plenum Press, New York, 1976, p.239.

VARIABLES:

Temperature

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | Weight of Component(2) | Weight of $SO_2$ absorbed, g | Mole ratio $SO_2$ /Comp.(2) | Mole fraction $x_{SO_2}$ |
|---|---|---|---|---|
| | | | (Total pressure, 1 atm) | |
| 273.15 | 3.8690 | 3.5828 | 1.740 | 0.635 |
| 283.15 | 3.8690 | 1.9450 | 0.944 | 0.485 |
| 293.15 | 3.8690 | 1.2539 | 0.610 | 0.380 |

760 mmHg = 1 atm = 101.325 kPa.

AUXILIARY INFORMATION

METHOD:

Sulfur dioxide was bubbled into a weighed amount of component (2) in a bubbler tube. The amount of gas absorbed was determined by re-weighing the tube. The total pressure was barometric, very nearly 1 atm. See ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was the best grade contained in a small cylinder. Its high degree of purity was attested by the measurement of vapor pressure from 258-268 K.
2. The best commercial specimen was purified and attested.

ESTIMATED ERROR:

REFERENCES:

1. Gerrard, W. *J. Appl. Chem. Biotechnol.* 1972, *22*, 623.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Bis(1-methylethyl)benzene, (diisopropylbenzene); $C_{12}H_{18}$; [25321-09-9]

ORIGINAL MEASUREMENTS:

Gel'perin, N. I.; Matveev, I. G.; Bil'shau, K. V.

*Zh. Prikl. Khim.*

1958, *31*, 1323-1332.

VARIABLES:

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

760 mmHg = 1 atm = 101.325 kPa

| T/K | g $SO_2$/100 g Comp. (2) | *Mole ratio $SO_2$/Comp. (2) | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| 277.65 | 26.5 | 0.672 | 0.402 |
| 298.15 | 10.7 | 0.271 | 0.213 |
| 315.15 | 7.5 | 0.190 | 0.160 |

* Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The amount of gas absorbed "at normal pressure" was determined by weighing, to constant weight. The data expressed as g $SO_2$/100 g component (2) were stated to agree to within 1-2% with the data obtained by titration with 0.1 *N* potassium hydroxide solution to a phenolphthalein end-point.

SOURCE AND PURITY OF MATERIALS:

1. Simply referred to as "concentrated 100%" sulfur dioxide.
2. Fraction from a cracking plant.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 1,1'-Methylenebismethylbenzene (Ditotylmethane); $C_{15}H_{16}$; (a mixture of *o*-, *m*-, and *p*- isomers of constant composition); [1335-47-3]

ORIGINAL MEASUREMENTS:

Gel'perin, N. I.; Matveev, I. G.; Bil'shau, K. V.

*Zh. Prikl. Khim.* 1958, *31*, 1323-1332.

VARIABLES:

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES: The original data appear to be for 1 atm.
760 mmHg = 1 atm = 101.325 kPa.

| T/K | g $SO_2$ for 100 g of Comp.(2) | *Mole ratio $SO_2$/Comp.(2) | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| 277.65 | 59 | 1.810 | 0.644 |
| 282.15 | 45 | 1.380 | 0.580 |
| 290.65 | 19.9 | 0.610 | 0.379 |
| 298.15 | 14.5 | 0.445 | 0.308 |
| 307.65 | 10.8 | 0.331 | 0.249 |
| 315.15 | 9.17 | 0.281 | 0.220 |
| 327.65 | 5.92 | 0.182 | 0.154 |
| 333.15 | 5.19 | 0.159 | 0.137 |
| 338.15 | 3.96 | 0.121 | 0.108 |
| 343.15 | 3.79 | 0.116 | 0.104 |
| 348.15 | 3.27 | 0.100 | 0.0912 |
| 362.65 | 2.06 | 0.0632 | 0.0594 |
| 403.15 | 1.65 | 0.0506 | 0.0482 |
| 413.15 | 0.95 | 0.0291 | 0.0283 |

Presumably to demonstrate the effect of a change in partial pressure of $SO_2$, a mixture of air and $SO_2$ of stated % $SO_2$ by volume was used. It appeared to be understood that $y/100$ was the partial pressure of $SO_2$ in atm, $y$ being the % by volume of $SO_2$ in the $SO_2$ + air mixture. Data are given below.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The amount of gas absorbed "at normal pressure" was determined by weighing, to constant weight. The data, expressed as g $SO_2$/100 g component (2), were stated to agree to within 1-2% with the data obtained by titration with 0.1 *N* potassium hydroxide solution to a phenolphthalein end-point.

SOURCE AND PURITY OF MATERIALS:

1. Simply referred to as "concentrated 100%" sulfur dioxide.
2. From the method of preparation ditolylmethane was a mixture of *o*-, *m*-, and *p*- isomers of constant composition. Various properties such as density, viscosity, and vapor pressure were stated.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 1,1'-Methylenebismethylbenzene (Ditotylmethane); $C_{15}H_{16}$; (a mixture of *o*-, *m*-, and *p*- isomers of constant composition); [1335-47-3]

ORIGINAL MEASUREMENTS:

Gel'perin, N. I.; Matveev, I. G.; Bil'shau, K. V.

*Zh. Prikl. Khim.* 1958, *31*, 1323-1332.

| T/K | *y* | Solubility /(g $SO_2$/ 100 g solvent) | Mole ratio * $SO_2$/solvent | Mole fraction * $x_{SO_2}$ |
|---|---|---|---|---|
| 276.15 | 57.75 | 21.9 | 0.672 | 0.402 |
| 287.65 | | 14.2 | 0.436 | 0.303 |
| 298.95 | | 9.14 | 0.280 | 0.219 |
| 308.75 | | 6.46 | 0.198 | 0.165 |
| 322.15 | | 4.22 | 0.129 | 0.115 |
| 347.15 | | 2.32 | 0.0712 | 0.0664 |
| 276.65 | 21.00 | 9.68 | 0.297 | 0.229 |
| 287.65 | | 5.69 | 0.175 | 0.149 |
| 298.15 | | 3.8 | 0.117 | 0.105 |
| 308.75 | | 3.02 | 0.0926 | 0.0848 |
| 322.75 | | 1.97 | 0.0604 | 0.0570 |
| 347.75 | | 0.94 | 0.0288 | 0.0280 |
| 281.65 | 7.08 | 2.95 | 0.0905 | 0.0830 |
| 287.65 | | 1.92 | 0.0589 | 0.0556 |
| 299.15 | | 1.34 | 0.0411 | 0.0395 |
| 309.15 | | 0.932 | 0.0286 | 0.0278 |
| 316.95 | | 0.716 | 0.0220 | 0.0215 |
| 329.45 | | 0.516 | 0.0158 | 0.0156 |
| 339.15 | | 0.408 | 0.0125 | 0.0124 |
| 348.35 | | 0.354 | 0.0109 | 0.0107 |
| 293.15 | 1.7 | 0.385 | 0.0118 | 0.0117 |
| 298.15 | | 0.32 | 0.00982 | 0.0972 |
| 308.15 | | 0.180 | 0.00552 | 0.00549 |

* Calculated by compiler.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. (1-Methylethyl)-1,1′-methylene-bisbenzene, (Dicumylmethane), (diisopropylphenylmethane); $C_{19}H_{24}$; [25566-92-1] | Gel'perin, N.I.; Matveev, I.G.; Bil'shau, K.V.<br>*Zh. Prikl. Khim.* <u>1958</u>, *31*, 1323-1332. |
| VARIABLES: | PREPARED BY:<br>W. Gerrard. |

EXPERIMENTAL VALUES: 760 mmHg = 1 atm = 101.325 kPa.

| T/K | g $SO_2$/100 g component (2) | *Mole ratio $SO_2$/Comp. (2) | *Mole fraction $x_{SO_2}$ | (Appears to be for 1 atm) |
|---|---|---|---|---|
| 276.15 | 35.2 | 1.389 | 0.581 | |
| 277.65 | 29.2 | 1.152 | 0.535 | |
| 282.15 | 21.5 | 0.848 | 0.459 | |
| 290.65 | 13.3 | 0.525 | 0.344 | |
| 298.15 | 10.8 | 0.426 | 0.299 | |
| 307.65 | 8.25 | 0.326 | 0.246 | |
| 315.15 | 7.58 | 0.299 | 0.230 | |
| 327.65 | 3.87 | 0.153 | 0.132 | |
| 338.15 | 3.54 | 0.140 | 0.123 | |
| 348.15 | 2.62 | 0.103 | 0.0934 | |
| 362.65 | 1.65 | 0.0651 | 0.0611 | |

Presumably to demonstate the effect of a change in partial pressure of $SO_2$, a mixture of air and $SO_2$ of stated % $SO_2$ by volume was used. It appeared to be understood that $y$/100 was the partial pressure in atm of $SO_2$ in these mixtures, $y$ being the % $SO_2$ by volume. Data are given on continuation sheet.

AUXILIARY INFORMATION

| METHOD/APPARATUS/PROCEDURE: | SOURCE AND PURITY OF MATERIALS: |
|---|---|
| The amount of gas absorbed "at normal pressure" was determined by weighing, to constant weight. The data expressed as g $SO_2$/100 g component (2) were stated to agree to within 1-2% with the data obtained by titration with 0.1*N* potassium hydroxide solution to a phenolphthalein end-point. | 1. Simply referred to as "concentrated 100%" sulfur dioxide.<br>2. From the method of preparation component (2) was a mixture of *o*-, *m*- and *p*- isomers of constant composition. |
| | ESTIMATED ERROR: |
| | REFERENCES: |

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. (1-Methylethyl)-1,1´-methylene-bisbenzene, (Dicumylmethane), (diisopropyl-phenylmethane); $C_{19}H_{24}$; [25566-92-1]

ORIGINAL MEASUREMENTS:

Gel'perin, N.I.; Matveev, I.G.; Bil'shau, K.V.

*Zh. Prikl. Khim.* 1958, *31*,1323-1332

EXPERIMENTAL VALUES: 760 mmHg = 1 atm = 101.325 kPa.

| T/K | $y$ | Solubility /($gSO_2$/100g solvent) | Mole ratio* $SO_2$/Solvent | Mole fraction* $x_{SO_2}$ |
|---|---|---|---|---|
| 276.15 | 57.75 | 14.9 | 0.588 | 0.370 |
| 287.65 | | 10.8 | 0.426 | 0.299 |
| 298.95 | | 6.62 | 0.261 | 0.207 |
| 308.75 | | 4.77 | 0.188 | 0.158 |
| 322.15 | | 3.18 | 0.125 | 0.112 |
| 347.15 | | 1.80 | 0.0710 | 0.0663 |
| 276.65 | 21.00 | 6.95 | 0.274 | 0.215 |
| 287.95 | | 4.74 | 0.187 | 0.158 |
| 298.15 | | 3.11 | 0.123 | 0.109 |
| 308.75 | | 2.21 | 0.0872 | 0.0802 |
| 322.75 | | 1.46 | 0.0576 | 0.0550 |
| 347.75 | | 0.70 | 0.0276 | 0.0269 |
| 281.65 | 7.08 | 2.17 | 0.0856 | 0.0789 |
| 287.65 | | 1.55 | 0.0612 | 0.0576 |
| 299.15 | | 1.058 | 0.0417 | 0.0401 |
| 309.15 | | 0.721 | 0.0284 | 0.0277 |
| 316.95 | | 0.589 | 0.0232 | 0.0227 |
| 329.45 | | 0.393 | 0.0155 | 0.0153 |
| 339.15 | | 0.328 | 0.0129 | 0.0128 |
| 348.35 | | 0.275 | 0.0109 | 0.0107 |
| 293.45 | 1.7 | 0.321 | 0.0127 | 0.0125 |
| 298.15 | | 0.26 | 0.0103 | 0.0102 |
| 308.15 | | 0.119 | 0.0047 | 0.0047 |

* Calculated by compiler.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Pinene; $C_{10}H_{16}$; (isomer not specified, used as representing turpentine).

ORIGINAL MEASUREMENTS:

Gerrard, W. *"Solubility of Gases and Liquids,"* Plenum Press, New York, 1976, p. 239.

VARIABLES:

Temperature

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

| T/K | Weight of Pinene g. | Weight of $SO_2$ absorbed,g | Mole ratio $SO_2$ /Pinene | Mole fraction $x_{SO_2}$ |
|---|---|---|---|---|
| | | | (Total Pressure, 1 atm) | |
| 273.15 | 3.4166 | 0.4009 | 0.250 | 0.200 |
| 293.15 | 3.4166 | 0.2201 | 0.124 | 0.110 |

760 mmHg = 1 atm = 101.325 kPa.

AUXILIARY INFORMATION

METHOD:

Sulfur dioxide was bubbled into a weighed amount of component (2) in a bubbler tube. The amount of gas absorbed was determined by re-weighing the tube. The total pressure was barometric, very nearly 1 atm. See ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was the best grade contained in a small cylinder. Its high degree of purity was attested by the measurement of vapor pressure from 258-268 K.
2. The best commercial specimen was purified and attested.

ESTIMATED ERROR:

REFERENCES:

1. Gerrard, W. *J. Appl. Chem. Biotechnol.* 1972, *22*, 623

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Terpentin | Weissenberger, G.; Hadwiger, H.<br>*Z. Angew. Chem.* 1927, *40*, 734-736. |
| VARIABLES: | PREPARED BY:<br>W. Gerrard |

EXPERIMENTAL VALUES:

| T/K | Volume of component (2) /cm$^3$ | Volume of $SO_2$ absorbed, /cm$^3$ | *Mole ratio $SO_2$/Comp. (2) (pressure assumed to be barometric). | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|---|
| 293 | 1 | 8.3 | **0.056 | 0.053 |

* Calculated by compiler

** Based on pinene.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Used an absorption vessel of 200cm$^3$ capacity, and a vessel with a two-way tap.

Simply stated that the absorptionmeter was like that used by Manchot, but the reference was not cited, probably ref. (1).

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

REFERENCES:

1. Manchot, W. *Z. anorg. Chem.* 1924, *141*, 38.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Hydroterpin.

ORIGINAL MEASUREMENTS:

Weissenberger, G.; Hadwiger, H.

*Z. angew. Chem.* 1927, *40*, 734-736.

VARIABLES:

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

(pressure assumed to be barometric)

| T/K | Volume of component (2) /$cm^3$ | Volume of $SO_2$ absorbed, /$cm^3$ | *Mole ratio $SO_2$/Comp.(2) | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|---|
| 293.15 | 1 | 14.3<br>14.8 | ** 0.108 | 0.097 |

* Calculated by compiler

** "Hydroterpin" was stated to be obtained by the hydrogenation of "Terpentinol" In *Chem. Abs.* *21*, 3052, the compound is named hydroterpinol.

The authors state that 1 g has a volume of 1.133$cm^3$. The mole ratio given above is based on an assumed molar weight of 154, the assumed formula being $C_{10}H_{18}O$.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Used an absorption vessel of 200$cm^3$ capacity, and a vessel with a two-way tap.

Simply stated that the absorptiometer was like that used by Manchot, but the reference was not cited, probably ref. (1).

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

REFERENCES:

1. Manchot, W. *Z. anorg. Chem.* 1924, *141*, 38.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Kerosene (petroleum, boiling range unspecified).

ORIGINAL MEASUREMENTS:

Yuferev, R.F.; Maluigin, P.V.

*Z. Chim. Prom.* 1930, *7*, 553-555

VARIABLES:

Temperature

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | Weight of $SO_2$ per $cm^3$ of solvent g | Volume of $SO_2$ per $cm^3$ of solvent $cm^3$ | * Mole fraction, $x_{SO_2}$, approximate, based on an assumed molecular weight of 200, and a density of 0.7 for the solvent. |
|---|---|---|---|
| 273.15 | 0.0771 | 26.98 | 0.256 |
| 292.15 | 0.0439 | 15.36 | 0.164 |
| Kerosene saturated with water | | | |
| 273.15 | 0.0801 | 28.03 | |
| 292.15 | 0.04472 | 15.65 | |

*Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was passed through the kerosene (5 $cm^3$) until saturation was reached. The whole was then transferred to an aqueous solution of $I_2$ + KI. The formed sulfuric acid was determined gravimetrically. The pressure was probably barometric.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was dried by sulfuric acid.
2. Kerosene was dried over sodium, and, without distillation, was stored over sodium.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Soft paraffin (see note).

ORIGINAL MEASUREMENTS:

Sobolev, I.A.; Kukarin, V.A.; Dzhagatspanyan, R.V.; Kosorotov, V.I.; Zogorets, P.A.; Popov, A.I.

*Khim. Prom.* 1970, *46*, 668-70.

VARIABLES:

Temperature

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | Solubility*, $S$ /mol $l^{-1}$ |
|---|---|
| 303.15 | 0.15 |
| 313.15 | 0.128 |
| 323.15 | 0.115 |
| 333.15 | 0.0937 |

* at atmospheric pressure (authors claim linear relationship between pressure and solubility up to 1 atmosphere partial pressure of $SO_2$)

$\ln S = 690/(T/K) - 5.98$ (where $S$ is in units of mol $l^{-1}atm^{-1}$)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Bubbler method. Samples of saturated liquid taken and added to sodium hydroxide solution and then excess alkali back titrated.

NOTE: Mixture of $C_{12}$-$C_{22}$ hydrocarbons (86.7% normal paraffins, 11.3% branched paraffins, 0.4% aromatic and 1.6% naphthenic hydrocarbons).

SOURCE AND PURITY OF MATERIALS:

1. Purity at least 95 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta$(Solubility) = ±2% (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Methanol; $CH_4O$; [67-56-1]

EVALUATOR:

Colin L. Young,
School of Chemistry,
University of Melbourne,
Parkville, Victoria, 3052
AUSTRALIA

June, 1981

CRITICAL EVALUATION:

The data of Lobry de Bruyn (1) and that of Gerrard (2) are in reasonable agreement and are deemed acceptable. These data are for a total pressure of 1 atmosphere. The vapor pressures of pure methanol are 29.6 mmHg (273 K) 54.7 mmHg (283 K) 96.0 mmHg (293. K) 160.0 (303 K) 260.5 mmHg (313 K). Obviously as the temperature increases there will be an increasingly important difference between the mole fraction at 1 atmosphere total pressure and 1 atmosphere partial pressure. Bekarek and Hala (3) give their data as mole fractions in gas and liquid phases for a series of total pressures, these being considerable less than 1 atmoshpere. It is possible to calculate so called Henry's constants from these data (see Table 1) by assuming the partial pressure of methanol in the vapor phase is equal to the vapor pressure of pure methanol times the mole fraction in the liquid phase. From inspection of Table 1 it is immediately apparent that in the present situation these vary and there is not a linear relationship between partial pressure and mole fraction of gas dissolved in the liquid.

Table 1. Henry's law constants calculated from the data of Bekarek and Hala (3)

| T/K | $p$/mmHg | $x_{SO_2}$ | $y_{SO_2}$ | H/atm | $H^{-1}/atm^{-1}$ |
|---|---|---|---|---|---|
| 293.2 | 101.40 | 0.0043 | 0.0508 | 1.580 | 0.634 |
| | 136.20 | 0.0314 | 0.3100 | 1.769 | 0.565 |
| 303.2 | 169.40 | 0.0050 | 0.0542 | 2.416 | 0.414 |
| | 294.30 | 0.0619 | 0.4370 | 2.734 | 0.366 |
| 313.2 | 278.60 | 0.0058 | 0.0567 | 3.641 | 0.275 |
| | 418.70 | 0.0518 | 0.3990 | 4.144 | 0.236 |

Tokunaga (4) reported data for pure water, pure methanol and mixtures of these, as grams of sulfur dioxide "per 100g of solution (solute gas free) at 1 atm. partial pressure". The evaluator has calculated the mole fractions for 1 atm partial pressure as follows: 283.15K (0.397); 293.15K (0.301); 303.15 (0.223); 313.15K (0.169). There is fair agreement of these data for a partial pressure of 1 atmosphere with those of Lobry de Bruyn (1) and Gerrard (2) at 283.15 K for a total pressure of 1 atmosphere. The increasing difference between partial and total pressure causes the two lines to diverge more and more as the temperature increases. The datum of Sano and Nakamoto (5) is considerably smaller than those of Gerrard (2) and Lobry de Bruyn (1) and is classified as doubtful.

REFERENCES:

1. Lobry de Bruyn, C.A. *Rec. Trav. Chim.* 1892, *11*, 112.
2. Gerrard, W. *J. Appl. Chem. Biotechnol.* 1972, *22*, 623.
3. Bekarek, V.; Hala, E. *Coll. Czech. Chem. Comm.* 1968 *33*, 2598.
4. Tokunaga, J. *J. Chem. Eng. Data.* 1974, *19*, 162.
5. Sano, H.; Nakamoto, Y. *Nippon Kagaku Zasshi* 1968, *89*, 369.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Methanol; $CH_4O$; [67-56-1] | Lobry de Bruyn, C.A.<br>(a) *Rec.Trav.Chim.* 1892, *11*, 112-157.<br>(b) *Z.Phys. Chem.* 1892, *10*, 782-789. |
| VARIABLES: | PREPARED BY:<br>W. Gerrard. |

EXPERIMENTAL VALUES:

| | T/K | Weight %, $SO_2$ | Mole ratio, $ROH/SO_2$ | *Mole ratio $SO_2/ROH$ | Mole fraction* $x_{SO_2}$ |
|---|---|---|---|---|---|
| Ref. (a) | 273.15 | 71.1 | 0.81 | 1.23 | 0.552 |
| | 280.15 | 59.9 | 1.33 | 0.747 | 0.428 |
| | 285.45 | 52.2 | 1.83 | 0.546 | 0.353 |
| | 290.95 | 44 | 2.55 | 0.393 | 0.282 |
| | 299.15 | 31.7 | 4.25 | 0.232 | 0.188 |
| Ref. (b) | 273.15 | 247 g $SO_2$/100 g $CH_3OH$ | | 1.235 | 0.553 |
| | 299.15 | 47 g $SO_2$/100 g $CH_3OH$ | | 0.235 | 0.190 |

(The primary data for the expression in (b) were probably the same as in (a).)

* Calculated by compiler, from wt %.

Total pressure = atmospheric pressure.

AUXILIARY INFORMATION

| METHOD/APPARATUS/PROCEDURE: | SOURCE AND PURITY OF MATERIALS: |
|---|---|
| The dry gas was passed into a weighed amount of methanol in a bulb of 2-3 $cm^3$ capacity until equilibrium had been reached at the observed temperature and at a total pressure (barometric, 760-770 mmHg). The bulb was sealed "a la lampe", and weighed. A titration was also mentioned, but the statement is vague. | 1. Simply stated that the dry gas was used.<br>2. It was stated that the pure alcohol was used. |
| | ESTIMATED ERROR: |
| | REFERENCES: |

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Methanol; $CH_4O$; [67-56-1]
   Ethanol; $C_2H_6O$; [64-17-5]

ORIGINAL MEASUREMENTS:

Sano, H.; Nakamoto, Y.
*Nippon Kagaku Zasshi*
1968, *89*, 369-373.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

Vapor pressure of methanol = 0.125 atm
Vapor pressure of ethanol = 0.069 atm

| Absorption coefficient, $S^{a,b}$ | Bunsen coefficient,[b] $\alpha$ | Bunsen coefficient,[c] $\alpha$ | $\ell^{c,d}$ | Mole ratio | Mole fraction[e] |
|---|---|---|---|---|---|
| | | Methanol | | | |
| 116.2 | 122.1 | 124.5 | 99.9 | 0.241 | 0.194 |
| | | Ethanol | | | |
| 88.1 | 85.9 | 84.0 | 75.9 | 0.227 | 0.185 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Determined by static absorption method.

[c] Determined by flow method.

[d] $\alpha = \ell(1 - p_s^\circ)$ where $p_s^\circ$ is the vapor pressure of solvent.

[e] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two techniques were used: (a) static absorption method and (b) flow method. Static method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The flow method consists of passing sulfur dioxide through a micro gas absorption tube and estimating sulfur dioxide by iodometric titration. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Methanol; $CH_4O$; [67-56-1]

ORIGINAL MEASUREMENTS:

Bekarek, V.; Hala, E.
*Coll. Czech. Chem. Comm.* 1968, *33*, 2598-2607.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | P/Torr + | P/kPa + | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ | in gas, $y_{SO_2}$ |
|---|---|---|---|---|
| 293.2 | 101.40 | 13.519 | 0.0043 | 0.0508 |
| | 109.10 | 14.545 | 0.0111 | 0.1230 |
| | 113.50 | 15.132 | 0.0144 | 0.1570 |
| | 136.20 | 18.159 | 0.0314 | 0.3100 |
| 303.2 | 169.40 | 22.585 | 0.0050 | 0.0542 |
| | 182.6 | 24.34 | 0.0118 | 0.1230 |
| | 183.00 | 24.398 | 0.0122 | 0.1260 |
| | 186.00 | 24.798 | 0.0135 | 0.1390 |
| | 208.6 | 27.81 | 0.0248 | 0.239 |
| | 234.20 | 31.224 | 0.0375 | 0.3310 |
| | 294.30 | 39.237 | 0.0619 | 0.4370 |
| 313.2 | 278.60 | 37.144 | 0.0058 | 0.0576 |
| | 298.30 | 39.770 | 0.0134 | 0.1280 |
| | 300.80 | 40.103 | 0.0139 | 0.1320 |
| | 344.50 | 45.930 | 0.0288 | 0.2480 |
| | 418.70 | 55.822 | 0.0518 | 0.3990 |

\+ Total pressure
760 Torr = 760 mmHg = 1 atm = 101.325 kPa

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A modified Gillespie still was used. Sulfur dioxide in liquid and gaseous phases estimated by iodometric titration. A small bulb containing a sample of the solution (0.5 - 1g) was broken in a solution of iodine and potassium iodide. Details in source and ref. (1). Same data given in ref. (2).

SOURCE AND PURITY OF MATERIALS:

1. Dried with sulfuric acid and phosphorus pentoxide.
2. Analytical grade, fractionally distilled; $d_{20}^{4}$ = 0.7915.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/kPa = \pm 0.1\%$
$\delta x_{SO_2}$, $\delta y_{SO_2} = \pm 0.5\%$.
(estimated by compiler.

REFERENCES:

1. Dvorak, K.; Boublik, T. *Coll. Czech. Chem. Comm.* 1963, *28*, 1252.
2. Bekarek, V.; Hala, E. *Coll. Czech. Chem. Comm.* 1968, *33*, 2608.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Methanol; $CH_4O$; [67-56-1]
3. 2-Propanone (Acetone); $C_3H_6O$; [67-64-1]

ORIGINAL MEASUREMENTS:

Bekarek, V.

*Coll. Czech. Chem. Comm.* 1968, *33*, 2608-2619.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| | | | Mole fractions | | | |
|---|---|---|---|---|---|---|
| | | | in liquid | | in gas | |
| T/K | p/Torr | p/kPa | $x_{SO_2}$ | $x_{C_3H_6O}$ | $y_{SO_2}$ | $y_{C_3H_6O}$ |
| 293.2 | 161.80 | 21.572 | 0.0407 | 0.1500 | 0.2330 | 0.2380 |
| | 174.20 | 23.225 | 0.0547 | 0.1050 | 0.3450 | 0.1640 |
| | 198.70 | 26.491 | 0.0732 | 0.3600 | 0.2670 | 0.3880 |
| | 206.00 | 27.464 | 0.0797 | 0.2010 | 0.3840 | 0.2390 |
| | 222.30 | 29.638 | 0.0918 | 0.0942 | 0.5216 | 0.1090 |
| | 245.70 | 32.757 | 0.1410 | 0.5790 | 0.3960 | 0.4460 |
| 303.2 | 278.00 | 37.064 | 0.0449 | 0.2620 | 0.1880 | 0.3300 |
| | 264.70 | 35.290 | 0.0457 | 0.0975 | 0.2950 | 0.1550 |
| | 268.80 | 35.837 | 0.0462 | 0.1570 | 0.2510 | 0.2260 |
| | 311.60 | 41.543 | 0.0722 | 0.2120 | 0.3330 | 0.2510 |
| | 316.50 | 42.197 | 0.0737 | 0.1280 | 0.4100 | 0.1600 |
| | 335.70 | 44.756 | 0.0930 | 0.4190 | 0.3010 | 0.3950 |
| | 403.20 | 53.756 | 0.1620 | 0.5900 | 0.4340 | 0.4180 |
| 313.2 | 390.20 | 52.022 | 0.0348 | 0.1440 | 0.1930 | 0.2160 |
| | 390.20 | 52.022 | 0.0590 | 0.1920 | 0.2800 | 0.2430 |
| | 452.50 | 60.328 | 0.0579 | 0.3140 | 0.2200 | 0.3560 |
| | 533.00 | 71.060 | 0.0915 | 0.1420 | 0.4520 | 0.1510 |
| | 524.10 | 69.874 | 0.1020 | 0.4190 | 0.3200 | 0.3660 |
| | 583.50 | 77.794 | 0.1190 | 0.2440 | 0.4600 | 0.2110 |
| | 634.20 | 84.553 | 0.1800 | 0.6020 | 0.4690 | 0.4150 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A modified Gillespie still was used. Sulfur dioxide in liquid and gaseous phases estimated by iodometric titration. Details in source and ref. (1).

To determine the acetone concentration a bulb containing (0.5 - 1.0g) of mixture was broken in a solution containing iodine just sufficient to convert sulfur dioxide to sulfuric acid. Acetone was then determined by Messinger's method (ref.(2))

SOURCE AND PURITY OF MATERIALS:

1. Dried with sulfuric acid and phosphorus pentoxide.
2. Analytical grade, fractionally distilled; $d_{20}^{4}$ = 0.7915.
3. Analytical grade, fractionally distilled; $d_{20}^{4}$ = 0.7902.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/kPa = \pm 0.1\%$; $\delta x_{SO_2}$, $\delta x_{C_3H_6O}$, $\delta y_{SO_2}$, $\delta y_{C_3H_6O}$ = ±1%. (estimated by compiler).

REFERENCES:

1. Dvorak, K.; Boublik, T. *Coll. Czech. Chem. Comm.* 1963, *28*, 1252.
2. Goodwin, L.F.; *J. Am. Chem. Soc.*, 1920, *42*, 39.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Methanol; $CH_4O$; [67-56-1]
3. Acetic acid, methyl ester (Methyl acetate); $C_3H_6O_2$; [79-20-9]

ORIGINAL MEASUREMENTS:

Bekarek, V.

*Coll. Czech. Chem. Comm.* 1968, *33*, 2608-2619

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| | | | Mole fractions | | | |
|---|---|---|---|---|---|---|
| | | | in liquid | | in gas | |
| $T$/K | $p$/Torr | $p$/kPa | $x_{SO_2}$ | $x_{C_3H_6O_2}$ | $y_{SO_2}$ | $y_{C_3H_6O_2}$ |
| 293.2 | 131.00 | 17.465 | 0.0130 | 0.0544 | 0.1070 | 0.2000 |
| | 134.80 | 17.972 | 0.0144 | 0.0591 | 0.1130 | 0.2100 |
| | 153.00 | 20.398 | 0.0245 | 0.0939 | 0.1630 | 0.2620 |
| | 148.00 | 19.732 | 0.0249 | 0.0685 | 0.1850 | 0.2230 |
| | 158.80 | 21.172 | 0.0107 | 0.1970 | 0.0552 | 0.4300 |
| | 160.60 | 21.412 | 0.0390 | 0.0572 | 0.2870 | 0.1640 |
| | 181.10 | 24.145 | 0.0448 | 0.1570 | 0.2420 | 0.3070 |
| | 223.80 | 29.838 | 0.0853 | 0.2660 | 0.3530 | 0.3290 |
| 303.2 | 222.10 | 29.611 | 0.0162 | 0.0653 | 0.1210 | 0.2060 |
| | 234.10 | 31.211 | 0.0112 | 0.1170 | 0.0693 | 0.3100 |
| | 228.00 | 30.397 | 0.0173 | 0.0696 | 0.1230 | 0.2160 |
| | 246.60 | 32.877 | 0.0300 | 0.0747 | 0.2060 | 0.2040 |
| | 260.60 | 34.744 | 0 0306 | 0.1170 | 0.1820 | 0.2650 |
| | 269.50 | 35.930 | 0.0447 | 0.0594 | 0.3080 | 0.1540 |
| | 306.50 | 40.863 | 0.0547 | 0.1820 | 0.2650 | 0.3150 |
| | 368.30 | 49.103 | 0.0936 | 0.2140 | 0.3960 | 0.2610 |
| 313.2 | 358.90 | 47.849 | 0.0123 | 0.0960 | 0.0802 | 0.2540 |
| | 367.70 | 49.023 | 0.0207 | 0.0799 | 0.1360 | 0.2130 |
| | 357.00 | 47.596 | 0.0210 | 0.0847 | 0.1350 | 0.2200 |
| | 399.40 | 53.249 | 0.0358 | 0.0692 | 0.2350 | 0.1740 |
| | 428.10 | 57.075 | 0.0374 | 0.1410 | 0.2010 | 0.2580 |
| | 440.50 | 58.729 | 0.0521 | 0.0573 | 0.3360 | 0.1170 |
| | 508.30 | 67.768 | 0.0699 | 0.2320 | 0.2900 | 0.3100 |
| | 597.10 | 79.607 | 0.1080 | 0.1870 | 0.4450 | 0.2110 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A modified Gillespie still was used. Sulfur dioxide in liquid and gaseous phases estimated by iodometric titration. Details in source and ref. (1).

To determine the concentration of methyl acetate, a bulb containing a sample of saturated solution was broken in a known amount of sodium hydroxide soln., heated to hydrolyse the ester, sulfur dioxide oxidised to sulfuric acid and the excess alkali was back titrated

SOURCE AND PURITY OF MATERIALS:

1. Dried with sulfuric acid and phosphorus pentoxide.
2. Analytical grade, fractionally distilled, $d^4_{20}$ = 0.7915.
3. Added to 5 per cent acetic anhydride and fractionally distilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/kPa = \pm 0.1\%$. $\delta x_{SO_2}$, $\delta x_{C_3H_8O_2}$, $\delta y_{SO_2}$, $\delta y_{C_3H_8O_2} = \pm 1\%$ (estimated by compiler).

REFERENCES:

1. Dvorak, K.; Boublik, T. *Coll. Czech. Chem. Comm.* 1963, *28*, 1252.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Methanol; $CH_4O$; [67-56-1]

ORIGINAL MEASUREMENTS:

Gerrard, W.

*J. Appl. Chem. Biotechnol.*

1972, *22*, 623-650.

VARIABLES:

Temperature

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

| T/K | *P*/kPa | Mole ratio $SO_2/CH_4O$ | * Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| 273.15 | 101.3 | 1.23 | 0.581 |
| 283.15 | | 0.620 | 0.383 |
| 293.15 | | 0.355 | 0.262 |
| 298.15 | | 0.27 | 0.21 |

* Calculated by compiler.

*P* is the total pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was bubbled into a weighed amount of component 2 in a bubbler tube as described in detail, diagram given, in the original paper. The amount of gas absorbed at equilibrium and at the observed temperature and pressure was weighed. By means of a manometer assembly, to which the bubbler tube was attached, the weight of gas absorbed at successively lower pressure was measured. Eventually the pressure was reduced to that of the component 2. The refractive index, and the infrared spectrum of the residue showed it to be essentially pure component 2.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was the best grade contained in a small cylinder. Its high purity was attested by the measurement of vapor pressure from 258 to 268 K.
2. The best obtainable specimen was carefully purified and rigorously attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Ethanol; $C_2H_6O$; [64-17-5]

EVALUATOR:

Colin L. Young
School of Chemistry,
University of Melbourne
Parkville, Victoria, 3052
AUSTRALIA

June, 1981

CRITICAL EVALUATION:

The mole fraction values based on the data of Carius (1), Lobry de Bruyn (2) and Gerrard (3) are for a total pressure of 1 atmosphere. It is again important to distinguish between measurements reported for a total pressure of 1 atmosphere and a partial pressure of 1 atmosphere particularly at the higher temperatures. The vapor pressure of pure ethanol are 12.2 mmHg (273K); 23.8 mmHg (283K); 44.0 mmHg (293K) 78.1 mmHg (303K) and 133.5 mmHg (313K). The data of Tokunaga (4) are for a partial pressure of 1 atm. There is fair agreement between the data of Tokunaga (4) and the above three sets of data at 273 to 283 K. The data of Barclay and Butler (5) are for low partial pressures of sulfur dioxide. These data cannot be extrapolated up to 1 atmosphere pressure because there is not a linear relationship between pressure and mole fraction i.e. Henry's law is not obeyed up to 1 atmosphere. This point is also obvious when the data of Nitta *et al* (6) are considered. These workers studied the mixture over the whole composition range at 293.15K. The data of Yuferev and Maluigin (7) are in reasonable agreement with the data from references (1), (2), (3), (4) and (6) if it is assumed the mole fraction solubility refers to 101.3kPa total pressure. The data of Nitta *et al* (6) are thought to be most reliable at 293.15K whereas those of Gerrard (3) are the most reliable at the lower temperatures. The data of de Saussure (8) are of historical interest only. The mole fraction solubility of Sano and Nakamoto (9) is slightly smaller than the value obtained by extrapolation of the data of Gerrard (3) to 303 K.

REFERENCES:

1. Carius, L. *Annalen*, 1855, *94*, 129.
2. Lobry de Bruyn, C.A. *Rec. Trav. Chim.* 1892, *11*, 112 and *Z. Phys. Chem.* 1892, *10*, 782.
3. Gerrard, W. *J. Appl. Chem. Biotechnol.* 1972, *22*, 623.
4. Tokunaga, J. *J. Chem. Eng. Data.* 1974, *19*, 162.
5. Barclay, I.M.; Butler, J.A.V.; *Trans Faraday Soc.* 1938. *34*, 1445
6. Nitta, T.; Itami, J.; Katayama, T.; *J. Chem. Engng. Japan.* 1973, *6*, 303.
7. Yuferev, R.F.; Maluigan, P.V. *Z. Chim. Prom.* 1930, *7*, 553.
8. de Saussure, T. *Gilbert's Annalen der Physik.* 1814, *47*, 113. *Annals of Phil*, 1815, *6*, 241.
9. Sano, H.; Nakamoto, Y. *Nippon Kagaku Zasshi* 1968, *89*, 369.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Ethanol: $C_2H_6O$; [64-17-5]

ORIGINAL MEASUREMENTS:

Carius, L. *Annalen*, 1855, *94*,129-166

VARIABLES:

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES: 760 mmHg = 1 atm = 101.325 kPa

Absorption coefficient, Ab.Coef., is the volume of sulfur dioxide absorbed by 1 volume of ethanol or solution at a total pressure of 1 atm. The Ab. coef. refers to the volume of gas after adjustment to 273.15 K. To convert the Ab.coef. into the mole ratio, M.R., the molar volume of sulfur dioxide was taken to be 21887 $cm^3$ at 273.15 K and 1 atm, based on the published density of the gas at 273.15 K and 1 atm. The density of ethanol at the stated temperature was that cited by Timmermans (1). Carius gave a table showing the Ab.Coef. for a saturated solution; the data are combined in the table given here. Carius also gave a table showing density of the solution at a stated temperature, shown below.

| T/K | Ab.Coef. $m^3/m^3$ (soln) | Ab.Coef.$m^3/m^3$ (ethanol) | * M.R. $SO_2$/EtOH | *Mole fraction $x_{SO_2}$ | T/K | Density of saturated solution $g/cm^3$ |
|---|---|---|---|---|---|---|
| 276.35 | 188.34 | 276.76 | 0.720 | 0.419 | 277.15 | 1.0622 |
| 278.95 | 170.67 | 239.66 | 0.625 | 0.385 | 284.75 | 0.9880 |
| 284.15 | 135.48 | 176.93 | 0.464 | 0.317 | 289.15 | 0.9527 |
| 287.15 | 120.00 | 149.98 | 0.395 | 0.283 | 293.25 | 0.9402 |
| 290.15 | 106.03 | 129.33 | 0.342 | 0.255 | 296.65 | 0.9282 |
| 293.15 | 96.34 | 114.50 | 0.304 | 0.233 | | |
| 297.55 | 84.03 | 97.43 | 0.260 | 0.206 | | |

*Calculated by compiler.

Carius plotted the Ab.coef.(volume of saturated solution) vs temperature, and read off values for each degree from 273 to 298 K. These were tabulated and attached to a smoothing equation. From the densities of the saturated solutions, a table showing the Ab.coef. for the volume of alcohol itself was constructed. Again, from a plot of Ab.coef.(ethanol) vs temperature,a table showing the value at each degree was given, and accompanied by a smoothing equation which is not correct.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The amount of sulfur dioxide absorbed was determined by iodometry. The Bunsen absorptiometer was mentioned.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was stated to be dry.
2. Ethanol was water free, density 0.792 $g/cm^3$ at 293 K.

ESTIMATED ERROR:

REFERENCES:

1. Timmermans, J. "*Physico-chemical Constants of Pure Organic Compounds*," Elsevier, New York, 1950.

| | |
|---|---|
| COMPONENTS:<br>1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Ethanol; $C_2H_6O$: [64-17-5] | ORIGINAL MEASUREMENTS:<br>Lobry de Bruyn, C.A.<br>(a) *Rec. Trav. Chim.* 1892, *11*, 112-157.<br>(b) *Z. Phys. Chem.* 1892, *10*, 782-789. |
| VARIABLES: | PREPARED BY:<br>W. Gerrard. |

EXPERIMENTAL VALUES:

| | T/K | Weight % $SO_2$ | Mole ratio ROH / $SO_2$ | *Mole ratio $SO_2$/ROH | Mole fraction* $x_{SO_2}$ |
|---|---|---|---|---|---|
| Ref. (a) | 273.15 | 53.3 | 1.21 | 0.827 | 0.453 |
| | 280.15 | 45 | 1.70 | 0.588 | 0.370 |
| | 285.45 | 39.9 | 2.09 | 0.477 | 0.323 |
| | 291.35 | 32.8 | 2.85 | 0.351 | 0.260 |
| | 299.15 | 24.4 | 4.31 | 0.232 | 0.188 |
| Ref. (b) | 273.15 | 115 g $SO_2$ / 100 g ROH | | 0.827 | 0.453 |
| | 299.15 | 32.3g $SO_2$/ 100 g ROH | | 0.232 | 0.188 |

(The primary data for expression (b) were probably the same as in (a).)

* Calculated by compiler.

Total pressure = atmospheric pressure.

AUXILIARY INFORMATION

| | |
|---|---|
| METHOD/APPARATUS/PROCEDURE:<br>The dry gas was passed into a weighed amount of ethanol in a bulb of 2-3 $cm^3$ capacity until equilibrium had been reached at the observed temperature, and at a total pressure, barometric, 760-770 mmHg. The bulb was sealed "a la lampe," and weighed. A titration was mentioned, but the statement is vague. | SOURCE AND PURITY OF MATERIALS:<br>1. Simply stated that the dry gas was used.<br>2. Probably purified. |
| | ESTIMATED ERROR: |
| | REFERENCES: |

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Ethanol; $C_2H_6O$; [64-1705] | Yuferev, R.F.; Maluigin, P.V.<br>*Z. Chim. Prom.* <u>1930</u>, *7*, 553-555. |
| VARIABLES: | PREPARED BY: |
| Temperature | W. Gerrard |

EXPERIMENTAL VALUES:

| T/K | Weight of $SO_2$ per $cm^3$ of solvent g. | Volume of $SO_2$ per $cm^3$ of solvent $cm^3$ | *Mole ratio $SO_2$/ethanol | Mole fraction $x_{SO_2}$ |
|---|---|---|---|---|
| 273.15 | 0.9528 | 333.48 | 0.851 | 0.461 |
| 292.65 | 0.3036 | 106.26 | 0.276 | 0.216 |
| "Wet" ethanol | | | | |
| 273.15 | 0.9758 | 341.53 | | |
| 292.65 | 0.3066 | 107.31 | | |

* Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was passed into 5 $cm^3$ of liquid (component 2) until saturated. The whole solution was then transferred to a stoppered flask containing an aqueous solution of $I_2$ + KI. The sulfuric acid formed was determined gravimetrically. The total pressure was presumably 1 atm; but this was not stated.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide dried by sulfuric acid.
2. Heated over calcium oxide, distilled, and stored over pulverized calcium.

   ("Wet" ethanol was ethanol dried over calcium oxide, but not distilled.)

ESTIMATED ERROR:

REFERENCES:

| | |
|---|---|
| COMPONENTS:<br>1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Ethanol; $C_2H_6O$; [64-17-5] | ORIGINAL MEASUREMENTS:<br>Barclay, I.M.; Butler, J.A.V.;<br>*Trans. Faraday. Soc.* 1938,*34*,1445-1454. |
| VARIABLES: | PREPARED BY:<br>W. Gerrard |

EXPERIMENTAL VALUES:

| T/K | Pressure, $p_{SO_2}$, mmHg. | Mole fraction $x_{SO_2}$ | $p_{SO_2}/x_{SO_2}$ mmHg* |
|---|---|---|---|
| 298.15 | 4.731 | 0.002223 | 2129 |
| | 4.699 | 0.002206 | 2130 |
| 308.15 | 6.85 | 0.002259 | 3035 |
| | 6.74 | 0.002224 | 3029 |

760 mmHg = 1 atm = 101.325 kPa.

AUXILIARY INFORMATION

| | |
|---|---|
| METHOD: /APPARATUS/PROCEDURE:<br>Dry nitrogen was passed through a bubbler containing the solution at a stated T/K. The saturated vapor emerging was condensed in a tube cooled by solid carbon dioxide and ether. The amount of sulfur dioxide in the condensate was determined by an iodemetric titration. | SOURCE AND PURITY OF MATERIALS:<br>Stated that the materials were carefully purified and dried.<br>Ethanol had b.p. 78.47°C at 1 atm. |
| | ESTIMATED ERROR: |
| | REFERENCES: |

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Ethanol; $C_2H_6O$; [64-17-5]

ORIGINAL MEASUREMENTS:

Gerrard, W.

*J. Appl. Chem. Biotechnol.* 1972, *22*, 623-650.

VARIABLES:

Temperature

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

| T/K | *P*/kPa | Mole ratio $SO_2$ / ROH | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| 273.15 | 102.5 | 1.10 | 0.524 |
| 283.15 | | 0.564 | 0.361 |
| 293.15 | | 0.357 | 0.263 |

* Calculated by compiler.

*P* is the total pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was bubbled into a weighed amount of component (2) in a bubbler tube as described in detail, diagram given, in the original paper. The amount of gas absorbed at equilibrium and at the observed temperature and pressure was weighed. By means of a manometer assembly, to which the bubbler tube was attached, the weight of gas absorbed at successively lower pressure was measured. Eventually the pressure was reduced to that of the component (2). The refractive index, and the infrared spectrum of the residue showed it to be essentially pure component (2).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was the best grade contained in a small cylinder. Its high purity was attested by the measurement of vapor pressure from 258 to 268 K.
2. The best obtainable specimen was carefully purified and rigorously attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Ethanol; $C_2H_6O$; [64-17-5]

ORIGINAL MEASUREMENTS:

Nitta, T.; Itami, J.; Katayama, T.,

*J. Chem. Engng Japan*, 1973, *6*, 303-9.

VARIABLES:

Pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

| T/K | $p$/mmHg$^+$ | $p$/kPa$^+$ | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ |
|---|---|---|---|
| 293.15 | 414.8 | 55.30 | 0.1415 |
| | 796.6 | 106.2 | 0.2516 |
| | 1223 | 163.1 | 0.3866 |
| | 1379 | 183.9 | 0.4468 |
| | 1438 | 191.7 | 0.4705 |
| | 1526 | 203.4 | 0.5042 |
| | 1694 | 225.8 | 0.5847 |
| | 1739 | 231.8 | 0.5881 |
| | 1846 | 246.1 | 0.6507 |
| | 2052 | 273.6 | 0.7580 |
| | 2236 | 298.1 | 0.8617 |
| | 2452 | 326.9 | 1.000 |

$^+$ Total pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell with magnetic stirrer. After equilibrium established, pressure measured with Bourdon gauge and approximately 2 $cm^3$ of liquid analysed by iodometric titration.

SOURCE AND PURITY OF MATERIALS:

1. Seitetsu Chemical Co. sample purity better than 99.9 mole per cent.
2. Nakarai Chemicals spectrograde sample.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta p/kPa = \pm 0.5$;

$\delta x_{SO_2} = \pm 1\%$ (estimated by compiler)

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Ethanol; $C_2H_6O$; [64-17-5]
   (containing water, *d*, 0.84)

ORIGINAL MEASUREMENTS:

de Saussure, T.

*Gilbert's Annalen der Physik* 1814, *47*, 113-183.

*Annals of Phil.* 1815, *6*, No. 4, 241.

VARIABLES:

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

291.15 K — 100 volumes of ethanol absorb 11577 volumes of sulfur dioxide at, presumably, the barometric pressure. If these were the data for pure ethanol, the mole ratio would be 0.272, and the mole fraction, $x_{SO_2}$, would be 0.214 (calculated by compiler).

NOTE: — The data for water are: 100 volumes of water absorb 4378 volumes of sulfur dioxide at barometric pressure. The mole ratio is 0.338, and the mole fraction, $x_{SO_2}$, is 0.0327 (calculated by compiler).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The ethanol was freed as much as possible from air by boiling. The gas was held over mercury in a tube of 4 cm internal diameter. The alcohol was added, and the tube was shaken. The final volume was read after several days.

SOURCE AND PURITY OF MATERIALS:

No specific information.

ESTIMATED ERROR:

REFERENCES:

| COMPONENTS: | EVALUATOR: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Organic compounds containing oxygen | C. L. Young,<br>School of Chemistry,<br>University of Melbourne,<br>Parkville, Victoria 3052,<br>Australia.<br>November 1982 |

CRITICAL EVALUATION:

In general the measurements on these systems are such that a detailed critical evaluation of each system is not possible.

1-Octanol; $C_8H_{18}O$; [111-87-5]

Gerrard's (1) values of the mole fraction solubility extrapolated to 303 K give a value which is significantly larger than that found by Sano and Nakamoto (2) but it is difficult to assess which is the more accurate. A comparison of the mole fraction solubilities for the alkanes determined by Makranczy *et al.* (3) with data for decane (Gerrard) and hexane (Sano) suggests Gerrard's value (5) to be high and Sano's (4) to be low.

1,2-Ethanediol; $C_2H_6O_2$; [107-21-1]

This system has been investigated by four groups of workers (1,2, 6,7). The results of Foote and Fleisher (6) and Gerrard (1) are consistent but the degree of overlap in experimental conditions is small. The value of Sano and Nakamoto (2) is again significantly smaller than the value obtained by extrapolation of Gerrard's data.

2-Propanone; $C_3H_6O$; [67-64-1]

This system has been investigated by five groups (4, 8-11) but detailed comparisons between sets of data are difficult to make in view of the different range of temperatures employed. The data of Bekarek and Hala (10) are in general agreement with those of Horiuti (9). The isolated value of Sano (4) appears to be consistent with those of Bekarek and Hola although extrapolation over such a large range of pressure could obscure any discrepancy. The data of Lorimer *et al.* (11) cannot be meaningfully compared in detail with other data on this system because of the differences in temperature.

Acetic acid, methyl ester; $C_3H_6O_3$; [79-20-9]

The data of Horiuti (9) at 298.15 K and Bekarek and Hala (10) at 293.2, 303.2 and 313.2 K are consistent and are both classified as tentative. The isolated value of Sano (4) appears to be slightly low compared to a value obtained by extrapolation of the data of Bekarek and Hala (10).

Acetic anhydride; $C_4H_6O_3$; [108-24-7]

The mole fraction solubilities of Lloyd (12) for this system are considerably lower than the values at comparable temperatures and pressures obtained by Gerrard (1) and Sano (4) and are almost certainly in error. The isolated value of Sano (4) appears to be somewhat low when compared with Gerrard's (1) values. The data of Nitta, Kido and

(cont.)

| COMPONENTS: | EVALUATOR: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Organic compounds containing oxygen | Colin L. Young,<br>School of Chemistry,<br>University of Melbourne,<br>Parkville, Victoria 3052,<br>Australia.<br>November 1982 |

CRITICAL EVALUATION:

Katayama (13) are consistent with those of Gerrard (1).

4-Methyl-1,3-dioxolan-2-one (*Propylene carbonate*); $C_4H_6O_3$; [108-32-7]

The data of Lenoir *et al.* (7) and Benoit and Milanova (14) on this system were both determined at low partial pressures of sulfur dioxide. There is a discrepancy of about 25 per cent between the values of the Henry's law constant obtained by these workers at 298 K.

1,1'-Oxybisethane (*Diethyl ether*); $C_4H_{10}O$; [60-29-7]

There is reasonable agreement between the data of Nitta *et al.* (13) at 293.15 K and the value of Yuferev and Maluigin (15) at 291.65 K. The value of Sano (4) at 303 K appears to be too high.

Cyclohexanone; $C_6H_{10}O$; [108-94-1]

The value of Weissenberger and Hadwiger (16) at 293.15 K is much too low to be consistent with the data of Sano (4) at 303 K and that of Gerrard (5) at 283.15 K and 293.15 K and is almost certainly in error. Sano's value is somewhat lower than would be expected from any reasonable extrapolation of Gerrard's values but it is not possible to state which of the values are in error.

1,7,7-Trimethylbicyclo[2.2.1]heptan-2-one (*Camphor*); $C_{10}H_{16}O$; [464-49-3]

The data of Bineau (17) and the isolated values of Schulze (8) and Sano (5) are consistent within ±8 per cent.

References

1. Gerrard, W. *J. Appl. Chem. Biotechnol.* 1972, *22*, 623.
2. Sano, H.; Nakamoto, Y. *Nippon Kagaku Zasshi* 1968, *89*, 369.
3. Makranczy, J.; Megyery-Balog, K.; Rusz, L.; Patyi, L. *Hung. J. Ind. Chem.* 1976, *4*, 269.
4. Sano, H. *Nippon Kagaku Zasshi* 1968, *89*, 362.
5. Gerrard, W. *Solubility of Gases and Liquids*, Plenum Press, New York, 1976, p.239.
6. Foote, H. W.; Fleisher, J. *J. Am. Chem. Soc.* 1934, *56*, 870.
7. Lenoir, J.-Y.; Renault, P.; Renon, H. *J. Chem. Engng. Data* 1971, *16*, 340.
8. Schulze,H. *J. Prakt. Chem.* 1881, *24*, 168.
9. Horiuti, J. *Sci. Pap. Inst. Phys. Chem. Res. (Jpn.)* 1931/32, *17*, 125.
10. Bekarek, V.; Hala, E. *Coll. Czech. Chem. Comm.* 1968, *33*, 2598.
11. Lorimer, J. W.; Smith, B. C.; Smith, G. H. *J. C. S. Faraday I* 1975, *71*, 2232.

(cont.)

| COMPONENTS: | EVALUATOR: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Organic compounds containing oxygen | Colin L. Young,<br>School of Chemistry,<br>University of Melbourne,<br>Parkville, Victoria 3052,<br>Australia.<br>November 1982 |

CRITICAL EVALUATION:

References (cont.)

12. Lloyd, S. J. *J. Phys. Chem.* 1918, *22*, 200.
13. Nitta, T.; Kido, O.; Katayama, T. *J. Chem. Engng. Japan* 1976, *9*, 317.
14. Benoit, R. L.; Milanova, E. *Can. J. Chem.* 1979, *57*, 1319.
15. Yuferev, R. F.; Maluigin, P. V. *Z. Chim. Prom.* 1930, *7*, 553.
16. Weissenberger, G.; Hadwiger, H. *Z. angew. Chem.* 1927, *40*, 734.
17. Bineau, A. *Ann. Chim. Phys.* 1848 (3), *24*, 326.

COMPONENTS:

1. Sulfur dioxide; $CO_2$; [7446-09-5]
2. 2-Propanol; $C_3H_8O$; [67-63-0]
   2-Methyl-2-propanol (*tert*-butanol); $C_4H_{10}O$; [75-65-0]

ORIGINAL MEASUREMENTS:

Sano, H.; Nakamoto, Y.
*Nippon Kagaku Zasshi*
1968, *89*, 369-373.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

Vapor pressure of 2-Propanol = 0.035 atm
Vapor pressure of 2-Methyl-2-propanol = 0.041 atm
Vapor pressure of 1-Butanol = 0.008 atm

| Absorption coefficient, $S^{a,b}$ | Bunsen coefficient,$^{b}$ $\alpha$ | Bunsen coefficient,$^{c}$ $\alpha$ | $\ell^{c,d}$ | Mole ratio | Mole fraction$^{e}$ |
|---|---|---|---|---|---|
| | | 2-Propanol | | | |
| 53.9 | 50.7 | 52.6 | 48.6 | 0.184 | 0.155 |
| | | 2-Methyl-2-propanol | | | |
| 47.9 | 45.7 | 45.4 | 42.2 | 0.191 | 0.160 |
| | | 1-Butanol | | | |
| 53.8 | 45.5 | 49.2 | 48.4 | 0.203 | 0.169 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Determined by static absorption method.

[c] Determined by flow method.

[d] $\alpha = \ell(1 - p_s^\circ)$ where $p_s^\circ$ is the vapor pressure of solvent.

[e] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two techniques were used: (a) static absorption method and (b) flow method. Static method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrcally. The flow method consists of passing sulfur dioxide through a micro gas absorption tube and estimating sulfur dioxide by iodometric titration. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 3-Methyl-1-butanol (iso-amyl alcohol); $C_5H_{12}O$; [123-51-3]
   1-Hexanol; $C_6H_{14}O$; [111-27-3]
   1-Octanol; $C_8H_{18}O$; [111-87-5]

ORIGINAL MEASUREMENTS:

Sano, H.; Nakamoto, Y.
*Nippon Kagaku Zasshi*
1968, *89*, 369-373.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

Vapor pressure of 3-Methyl-1-butanol = 0.006 atm
Vapor pressure of 1-Hexanol = 0.004 atm

| Absorption coefficient, $s^{a,b}$ | Bunsen coefficient,$^{b}$ α | Bunsen coefficient,$^{c,f}$ α | $\ell^{c,d}$ | Mole ratio | Mole fraction$^{e}$ |
|---|---|---|---|---|---|
| | | 3-Methyl-1-butanol | | | |
| 40.9 | 37.4 | 37.5 | 37.4 | 0.183 | 0.155 |
| | | 1-Hexanol | | | |
| 41.5 | 37.9 | 37.7 | 37.6 | 0.212 | 0.175 |
| | | 1-Octanol | | | |
| 28.7 | 26.1 | 25.5 | 25.5 | 0.183 | 0.155 |

[a] Volume of sulfur dioxide absorted by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Determined by static absorption method.

[c] Determined by flow method.

[d] $\alpha = \ell(1 - p^\circ_s)$ where $p^\circ_s$ is the vapor pressure of solvent.

[e] Calculated by compiler.

[f] Assuming the vapor pressure of 1-octanol is negligible.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two techniques were used: (a) static absorption method and (b) flow method. Static method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The flow method consists of passing sulfur dioxide through a micro gas absorption tube and estimating sulfur dioxide by iodometric titration. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide, $SO_2$; [7446-09-5]
2. 1-Heptanol; $C_7H_{16}O$; [111-70-6]

ORIGINAL MEASUREMENTS:

Albright, L.F.; Shannon, P.T.;
Yu, S.-N.; Chueh, P.L.
*Chem. Engng. Prog. Symp. Ser.* 1963,
*59*, (44), 66-74.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | $P$/bar | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ |
|---|---|---|
| 298.15 | 2.04 | 0.377 |
| | 3.01 | 0.626 |
| | 3.48 | 0.831 |
| 310.93 | 2.76 | 0.363 |
| | 2.83 | 0.373 |
| | 3.85 | 0.482 |
| | 4.39 | 0.617 |
| | 5.21 | 0.831 |
| | 5.55 | 0.874 |
| 338.71 | 5.36 | 0.363 |
| | 8.43 | 0.589 |
| | 10.96 | 0.825 |
| 366.48 | 8.54 | 0.343 |
| | 14.17 | 0.586 |
| | 20.13 | 0.824 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell fitted with Bourdon pressure gauge. Temperature measured with mercury in glass thermometer. The equipment used in this investigation was stated to be similar to that used in previous studies, (1), (2).

SOURCE AND PURITY OF MATERIALS:

1. and 2. Commercial grade samples no other details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/\text{bar} = \pm 0.3$;
$\delta x_{SO_2} = \pm 1\%$.

REFERENCES:

1. Albright, L. F.; Shannon, P. T.; Terrier, F.; Chueh, P. L. *Am. Inst. Chem. Engrs. J.* 1962, *8*, 668.
2. Albright, L. F.; Buclez, P. C.; Pluche, C. R.; Doody, T. C. *ASHRAE Trans.* 1960, *66*, 423.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 1-Octanol; $C_8H_{18}O$; [111-87-5]

ORIGINAL MEASUREMENTS:

Gerrard, W.

*J. Appl. Chem. Biotechnol.*

1972, *22*, 623-650.

VARIABLES:

Temperature

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

760 mmHg = 1 atm = 101.325 kPa

| T/K | $P$/kPa | Mole ratio $SO_2$ /ROH | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| 273.15 | 101.3 | 0.710 | 0.415 |
| 283.15 | | 0.412 | 0.292 |
| 293.15 | | 0.292 | 0.226 |
| 298.15 | | 0.250 | 0.200 |

* Calculated by compiler.

$P$ is the total pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was bubbled into a weighed amount of component (2) in a bubbler tube as described in detail, diagram given, in the original paper. The amount of gas absorbed at equilibrium and at the observed temperature and pressure was weighed. By means of a manometer assembly, to which the bubbler tube was attached, the weight of gas absorbed at successively lower pressure was measured. Eventually the pressure was reduced to that of the component (2). The refractive index, and the infrared spectrum of the residue showed it to be essentially pure component (2).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was the best grade contained in a small cylinder. Its high purity was attested by the measurement of vapor pressure from 258 to 268 K.
2. The best obtainable specimen was carefully purified and rigorously attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Cyclohexanol; $C_6H_{12}O$; [108-93-0]
   Benzenemethanol (Benzyl alcohol); $C_7H_8O$; [100-51-6]

ORIGINAL MEASUREMENTS:

Sano, H.; Nakamoto, Y.
*Nippon Kagaku Zasshi*
1968, *89*, 369-373.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

Vapor pressure of cyclohexanol = 0.001 atm

| Absorption coefficient, $S^{a,b}$ | Bunsen coefficient,$^b$ $\alpha$ | Bunsen coefficient,$^{c,f}$ $\alpha$ | $\ell^{c,d}$ | Mole ratio | Mole fraction$^e$ |
|---|---|---|---|---|---|
| | | Cyclohexanol | | | |
| 38.0 | 34.6 | 34.3 | 34.3 | 0.160 | 0.139 |
| | | Benzenemethanol | | | |
| 66.3 | 60.3 | 59.5 | 59.5 | 0.280 | 0.219 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Determined by static absorption method.

[c] Determined by flow method.

[d] $\alpha = \ell(1 - p_s^\circ)$ where $p_s^\circ$ is the vapor pressure of solvent.

[e] Calculated by compiler.

[f] Assuming the vapor pressure of benzenemethanol is negligible.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two techniques were used: (a) static absorption method and (b) flow method. Static method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The flow method consists of passing sulfur dioxide through a micro gas absorption tube and estimating sulfur dioxide by iodometric titration. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Cyclohexanol; $C_6H_{12}O$; [108-93-0] | Gerrard, W. "*Solubility of Gases and Liquids*," Plenum Press, New York, 1976, p.239 |
| VARIABLES: | PREPARED BY:<br>W. Gerrard. |

EXPERIMENTAL VALUES:

| T/K | Weight of Component(2) g | Weight of $SO_2$ absorbed, g | Mole ratio $SO_2$ /Comp.(2) | Mole fraction $x_{SO_2}$ |
|---|---|---|---|---|
| | | | (Total pressure = 1 atm) | |
| 293.15 | 2.5570 | 0.4489 | 0.275 | 0.216 |

760 mmHg = 1 atm = 101.325 kPa.

AUXILIARY INFORMATION

METHOD:

Sulfur dioxide was bubbled into a weighed amount of component (2) in a bubbler tube. The amount of gas absorbed was determined by re-weighing the tube. The total pressure was barometric, very nearly 1 atm. See ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was the best grade contained in a small cylinder. Its high degree of purity was attested by the measurement of vapor pressure from 258-268 K.
2. The best commercial specimen was purified and attested.

ESTIMATED ERROR:

REFERENCES:

1. Gerrard, W. *J. Appl. Chem. Biotechnol.* 1972, *22*, 623.

|  |  |
|---|---|
| COMPONENTS:<br>1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Formic acid; $CH_2O_2$; [64-18-6]<br>or<br>Acetic acid, $C_2H_4O_2$; [64-19-7] | ORIGINAL MEASUREMENTS:<br>Schulze, H.;<br>*J. Prakt. Chem.* 1881, *24*, 168-183. |
| VARIABLES: | PREPARED BY:<br>W. Gerrard. |

EXPERIMENTAL VALUES:

760 mmHg = 101.325 kPa.

| T/K | Weight of $SO_2$/ g of comp. (2) g | *Mole ratio $SO_2$/Comp. (2) | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| | Formic Acid | | |
| 273.15 | 0.821 | 0.590 | 0.371 |
| | Acetic Acid | | |
| 273.15 | 0.961 | 0.901 | 0.474 |

Pressure of $SO_2$ stated to be 725 mmHg.

1 volume of formic acid absorbed 351 volumes of $SO_2$

1 volume of acetic acid absorbed 318 volumes of $SO_2$

* Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The gas was passed into a known weight of formic acid in a long thin walled test-tube fitted with a rubber stopper carrying an inlet and an outlet tube. The tube was cooled by melting snow. The amount of gas absorbed was determined by weighing.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$ [7446-09-5]
2. Water; $H_2O$; [7732-18-5]
3. Acetic acid; $C_2H_4O_2$; [64-19-7]

ORIGINAL MEASUREMENTS:

Cupr, V.

*Rec. Trav. Chim.*

1928, *47*, 55-72.

VARIABLES:

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

1 atm = 760 mmHg = 101.325 kPa

The absorption coefficient, designated by Cupr as *L*, appears to be the Bunsen coefficient; but there is some doubt about the use of the term "solution", which could mean the aqueous solution of acetic acid, i.e., taken as the original liquid; the initial water itself would then be simply the original liquid for that data, and the final acetic acid itself would be the original liquid for its data. However, Seidell and Linke (1) define this *L* as "cc. $SO_2$ per 1 cc sat. sol." when reporting this work.

T/K = 300.15 Total pressure = 1 atm

| Concentration of acetic acid in aqueous solution % * | $SO_2$ in g absorbed by 100 g of acetic acid solution (liquid indicated in col. 1) | "Absorption coefficient" *L* |
|---|---|---|
| 0.00 | 7.98 | 25.7 |
| | 8.01 | 25.8 |
| | 8.19 | 26.4 |
| | 8.12 | 26.2 |
| | 8.18 | 26.4 |
| | 8.11 | 26.1 |
| 16.72 | 8.86 | 31.5 |
| 16.74 | 8.80 | 31.3 |
| 45.58 | 12.04 | 44.1 |
| 44.73 | 11.92 | 43.7 |
| 63.51 | 16.35 | 61.6 |
| 83.59 | 22.83 | 84.8 |
| 91.89 | 26.49 | 97.8 |
| 100.00 | 31.15 | 112.8 |

* It is not clear if this is a weight or mole per cent.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was passed into the original liquid (the aqueous solution in the acetic acid + water mixtures) as for a total pressure of 1 atm. The contents of the final solution were determined by chemical titrations, acid-base, and iodine-thiosulfate.

The "absorption coefficient, *L*" was determined by calculation from the weight data, 22400 being apparently taken as the molar volume in $cm^3$ at 1 atm and 273.15 K. Based on the real molar volume, these *L* values are 2% too large.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was obtained from Merck, quality sodium sulfite and concentrated sulfuric acid, by which it was dried.
2. Water may be taken as of satisfactory purity.
3. Acetic acid was of Merck standard, and gave no residue when ignited on a platinum capsule.

ESTIMATED ERROR:

REFERENCES:

1. Seidell, A.; Linke, W. F.
*Solubilities of Inorganic and Organic Compounds*,
1958, 1965.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Acetic acid; $C_2H_4O_2$; [64-19-7]
   Formic acid; $CH_2O_2$; [64-18-6]

ORIGINAL MEASUREMENTS:

Sano, H.; Nakamoto, Y.
*Nippon Kagaku Zasshi*
1968, *89*, 369-373.

VARIABLES:

PREPARED BY:

C. L. Young.

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

Vapor pressure of acetic acid = 0.010 atm
Vapor pressure of formic acid = 0.040 atm

| Absorption coefficient, $S^{a,b}$ | Bunsen coefficient,[b] $\alpha$ | Bunsen coefficient,[c] $\alpha$ | $\ell^{c,d}$ | Mole ratio | Mole fraction[e] |
|---|---|---|---|---|---|
| | | Acetic acid | | | |
| 106.0 | 97.4 | 96.2 | 95.2 | 0.251 | 0.201 |
| | | Formic acid | | | |
| 61.2 | 57.8 | 60.0 | 55.5 | 0.103 | 0.094 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Determined by static absorption method.

[c] Determined by flow method.

[d] $\alpha = \ell(1 - p_s^{\circ})$ where $p_s^{\circ}$ is the vapor pressure of solvent.

[e] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two techniques were used: (a) static absorption method and (b) flow method. Static method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The flow method consists of passing sulfur dioxide through a micro gas absorption tube and estimating sulfur dioxide by iodometric titration. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide, $SO_2$; [7446-09-5]<br>2. Acetic acid; $C_2H_4O_2$; [64-19-7] | Nitta, T.; Kido , O; Katayama, T.;<br>*J. Chem. Engng. Japan.* 1976, *9*, 317-8 |
| VARIABLES: | PREPARED BY: |
| Pressure | C.L. Young |

EXPERIMENTAL VALUES:

| T/K | $P$/bar | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ |
|---|---|---|
| 293.15 | 0.0800 | 0.0207 |
| | 0.2758 | 0.0796 |
| | 0.7079 | 0.1971 |
| | 0.9758 | 0.2651 |
| | 1.176 | 0.3173 |
| | 1.537 | 0.4065 |
| | 1.901 | 0.4981 |
| | 2.338 | 0.6171 |
| | 2.613 | 0.7013 |
| | 2.936 | 0.8238 |

AUXILIARY INFORMATION

METHOD:

Static method liquid phase composition estimated by iodometry. Few details given in source. Method similar to that used in ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Seitetsu Chemical Co. sample, purity better than 99.9 mole per cent.

2. Merck analytical grade sample.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.001$ (below 1.3 bar) $\pm 0.005$ (above 1.3 bar); $\delta x_{SO_2} = \pm 1.5\%$

REFERENCES:

Quitzich, K.; Ulbrecht, H.; Geiseler, G.

*Z. Physik Chem.* 1967, *234*, 33.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Esters of formic acid | Sano, H.<br>*Nippon Kagaku Zasshi*<br>1968, *89*, 362-368. |
| VARIABLES: | PREPARED BY:<br>C. L. Young |

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

| Bunsen coefficient, α | Mole ratio | Mole fraction[a] |
|---|---|---|
| Methyl formate; $C_2H_4O_2$; [107-31-3] | | |
| 331 | 0.920 | 0.479 |
| Ethyl formate; $C_3H_6O_2$; [109-94-4] | | |
| 217 | 0.781 | 0.439 |

[a] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static absorption method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. 1,2-Ethanediol (dihydroxyethane, ethylene glycol, glycol); $C_2H_6O_2$; [107-21-1] | Foote, H.W.; Fleisher, J.<br>*J. Am. Chem. Soc.* 1934, *56*, 870-873 |
| VARIABLES: | PREPARED BY:<br>W. Gerrard |

EXPERIMENTAL VALUES:

| T/K | $p_{SO_2}$/mmHg | Mole fraction $x_{SO_2}$ |
|---|---|---|
| 273.15 | 1055 | 0.707 |
| | 1028 | 0.673 |
| | 951 | 0.575 |
| | 857 | 0.499 |
| | 758 | 0.436 |
| | 571 | 0.340 |
| | 427 | 0.272 |
| | 291 | 0.206 |
| | 168 | 0.138 |
| | 99.1 | 0.093 |
| | 66.7 | 0.068 |

NOTE: A mole fraction of 0.707 is equivalent to a mole ratio of 2.413 moles of $SO_2$ per mole of 1,2-ethanediol.

760 mmHg = 1 atm = 101.325 kPa. Observed pressure was taken to be $p_{SO_2}$.

AUXILIARY INFORMATION

METHOD:/APPARATUS/PROCEDURE:

The apparatus and method had been previously described (1). A glass bulb of 29.3 $cm^3$ capacity was connected via a tap to an open manometer, a vacuum flask of 2 $dm^3$ capacity, and a source of sulfur dioxide. Component (2) was weighed in the bulb. Sulfur dioxide was condensed in it at 253 K. Equilibrium was attained at 273.15K and at the observed pressure $p_{Total}$, assumed to be equal to $p_{SO_2}$.

SOURCE AND PURITY OF MATERIALS:

(1) Sulfur dioxide was dried by sulfuric acid.

(2) The glycol was of Eastman C.P. grade, or purified by customary method.

ESTIMATED ERROR:

REFERENCES:

1. Foote, H.W.; Fleischer, J. *J. Am. Chem. Soc.* 1931, *53*, 1752.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Diols and glycerol

ORIGINAL MEASUREMENTS:

Sano, H.; Nakamoto, Y.
*Nippon Kagaku Zasshi*
1968, *89*, 369-373.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES: $T/°C = 30$ $T/K = 303$

| Absorption coefficient, $S^{a,b}$ | Bunsen coefficient,[b] $\alpha$ | Bunsen coefficient,[c,f] $\alpha$ | $\ell^{c,d}$ | Mole ratio | Mole fraction[e] |
|---|---|---|---|---|---|
| 1,2-Ethanediol (*ethylene glycol*); $C_2H_6O_2$; [107-21-1] | | | | | |
| 59.2 | 53.9 | 51.8 | 51.8 | 0.135 | 0.119 |
| 2,2'-Oxybisethanol (*diethylene glycol*); $C_4H_{10}O_3$; [111-46-6] | | | | | |
| 130 | 119 | 119 | 119 | 0.500 | 0.333 |
| 1,2-Propanediol (*propylene glycol*); $C_3H_8O_2$; [57-55-6] | | | | | |
| 68.0 | 61.9 | 61.7 | 61.7 | 0.204 | 0.169 |
| 1,2,3-Propanetriol (*glycerol*); $C_3H_8O_3$; [56-81-5] | | | | | |
| - | 57.5 | - | - | 0.188 | 0.158 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Determined by static absorption method.

[c] Determined by flow method.

[d] $\alpha = \ell(1 - p_s^\circ)$ where $p_s^\circ$ is the vapor pressure of solvent.

[e] Calculated by compiler.

[f] Assuming vapor pressure of solvent to be negligible.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two techniques were used: (a) static absorption method and (b) flow method. Static method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The flow method consists of passing sulfur dioxide through a micro gas absorption tube and estimating sulfur dioxide by iodometric titration. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$ [7446-09-5]
2. 1,2-Ethanediol (Ethylene glycol) $C_2H_6O_2$; [107-21-1]

ORIGINAL MEASUREMENTS:

Lenoir, J-Y.; Renault, P.; Renon, H.

*J. Chem. Eng. Data* 1971, *16*, 340-342.

VARIABLES:

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

760 mmHg = 1 atm = 101.325 kPa.

| T/K | Henry's constant $H_{SO_2}$/atm | *Mole fraction at 1 atm. |
|---|---|---|
| 298 | 3.41 | 0.293 |

* Calculated by compiler assuming a linear function of $P_{SO_2}$ vs $x_{SO_2}$, i.e. $x_{SO_2}$ (1 atm = $1/H_{SO_2}$.

The authors gave "Henry's constant" as

$$H_{SO_2} = \lim_{x_{SO_2} \to 0} \frac{f_{SO_2}(P,T)}{x_{SO_2}}$$

$x_{SO_2}$ is the mole fraction. $f_{SO_2}$ is the fugacity of $SO_2$ "in the equilibrium condition" of pressure and temperature. $H_{SO_2}$ is related to experimental chromatographic parameters based on the number of moles of solvent in in the column, and the absolute retention time of the solute. Helium was the carrier gas.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A conventional gas-liquid chromatographic unit was used. The chromatograph was an IGC 12 M Intersmat model, equipped with a thermal conductivity detector. The temperature control was stated to be within ± 0.1°C. The pressure drop in the column was measured by a mercury manometer. Helium was the carrier gas.

There is serious uncertainty in the estimation of accuracy.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was provided by l'Air Liquide, and had a stated purity of 99.9%. It was used as provided.
2. Provided by Touzart & Matignon and Serlabo, and stated to have a minimum purity of 99%. Distillation was carried out when necessary, and the refractive index was measured.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 1,2-Ethanediol, (ethylene glycol); $C_2H_6O_2$; [107-21-1]

ORIGINAL MEASUREMENTS:

Gerrard, W.

*J. Appl. Chem. Biotechnol.*

1972, *22*, 623-650.

VARIABLES:

Temperature

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | *P*/kPa | Mole ratio $SO_2$ / ROH | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| 273.15 | 101.5 | 0.83 | 0.448 |
| 283.15 | | 0.420 | 0.296 |
| 293.15 | | 0.310 | 0.237 |
| 298.15 | | 0.255 | 0.203 |

* Calculated by compiler.

*P* is the total pressure.

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Sulfur dioxide was bubbled into a weighed amount of component (2) in a bubbler tube as described in detail, diagram given, in the original paper. The amount of gas absorbed at equilibrium and at the observed temperature and pressure was weighed. By means of a manometer assembly, to which the bubbler tube was attached, the weight of gas absorbed at successively lower pressure was measured. Eventually the pressure was reduced to that of the component (2). The refractive index, and the infrared spectrum of the residue showed it to be essentially pure component (2).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was the best grade contained in a small cylinder. Its high purity was attested by the measurement of vapor pressure from 258 to 268 K.
2. The best obtainable specimen was carefully purified and rigorously attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 2-Propanone (acetone, dimethyl ketone); $C_3H_6O$; [67-64-1]

ORIGINAL MEASUREMENTS:

Schulze, H.

*J. Prakt. Chem.* 1881, *24*,168-183.

VARIABLES:

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

760 mmHg = 1 atm = 101.325 kPa.

| T/K | Weight of $SO_2$ /1g of Comp. (2). | *Mole ratio $SO_2$/Comp. (2) | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| 273.15 | 2.07 | 1.88 | 0.653 |

* Calculated by compiler.

Pressure of $SO_2$ stated to be 725 mmHg.

1 Volume of acetone absorbed 589 volumes of $SO_2$.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The gas was passed into a weighed amount of acetone in a long thin-walled test-tube carrying a rubber stopper and an inlet tube and an outlet tube. The test-tube was cooled by melting snow. The amount of gas absorbed was determined by weighing.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]

2. 2-Propanone (acetone); $C_3H_6O$;
[67-64-1]

ORIGINAL MEASUREMENTS:

Horiuti, J.
*Sci. Pap. Inst. Phys. Chem. Res. (Jpn.)*, 1931/32, *17*, 125-256.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

| T/K | $P^§$/bar | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ | T/K | $P^†$/bar | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ | Ostwald coefficient, L |
|---|---|---|---|---|---|---|
| 298.15 | 0.3053 | 0.000 | 283.15 | 0.9531 | 0.615 | 276.4 |
| | 0.4053 | 0.142 | 298.15 | 0.8440 | 0.448 | 216.4 |
| | 0.4142 | 0.160 | 313.15 | 0.6008 | 0.267 | 171.3 |
| | 0.5086 | 0.237 | | | | |
| | 0.6016 | 0.294 | | | | |
| | 0.6307 | 0.308 | | | | |
| | 0.7647 | 0.368 | | | | |
| | 0.7682 | 0.372 | | | | |
| | 0.9415 | 0.430 | | | | |
| | 0.9860 | 0.445 | | | | |
| | 1.012 | 0.470 | | | | |
| | 1.141 | 0.483 | | | | |
| | 1.232 | 0.506 | | | | |
| | 1.325 | 0.519 | | | | |

§ total pressure.

† partial pressure, total pressure = 1 atmosphere = $1.01325 \times 10^5$ Pa.

Ostwald coefficient (as $x \to 0$, T/K = 298.15) = 398.

Henry's law constant, $dp/dx$ (as $x \to 0$, T/K = 298.15) = 631 mmHg = 0.841 bar.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Apparatus consisted of a gas buret, a solvent reservoir and an absorption pipet. Dry gas introduced into degassed solvent. System mixed using a magnetic stirrer until saturation occurred. Care was taken to prevent solvent vapor from mixing with gas in the gas buret. Volume of gas determined from gas buret reading; volume of liquid determined from height of meniscus in absorption pipet.

SOURCE AND PURITY OF MATERIALS:

1. Sample obtained from Nippon Sulphuric Acid Manufacturing Co. Dried and fractionated several times.
2. Extra pure sample, recrystallized with sodium sulfite. Dried and fractionated. B. pt. 56.09 °C.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/bar = \pm 0.001$;
$\delta x_{SO_2} = \pm 0.001$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 2-Propanone, (Acetone); $C_3H_6O$; [67-64-1]

ORIGINAL MEASUREMENTS:

Bekarek, V.; Hala, E.

*Coll. Czech. Chem. Comm.* 1968 *33*, 2598-2607.

VARIABLES:

Temperature, pressure.

PREPARED BY:

C.L. Young.

EXPERIMENTAL VALUES:

| T/K | P/Torr | P/kPa | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ | in gas, $x_{SO_2}$ |
|---|---|---|---|---|
| 293.2 | 192.20 | 25.625 | 0.0374 | 0.0914 |
| | 200.20 | 26.691 | 0.0600 | 0.1450 |
| | 205.30 | 27.371 | 0.0741 | 0.1790 |
| | 227.60 | 30.344 | 0.1230 | 0.3000 |
| | 237.00 | 31.597 | 0.1390 | 0.3430 |
| | 253.90 | 33.851 | 0.1660 | 0.4100 |
| | 280.00 | 37.330 | 0.2020 | 0.4980 |
| | 397.30 | 52.969 | 0.3130 | 0.7200 |
| 303.2 | 294.70 | 39.290 | 0.0343 | 0.0814 |
| | 306.60 | 40.877 | 0.0562 | 0.1340 |
| | 322.40 | 42.983 | 0.0829 | 0.2030 |
| | 350.10 | 46.676 | 0.1217 | 0.3010 |
| | 397.30 | 52.969 | 0.1759 | 0.4310 |
| | 444.40 | 59.248 | 0.2150 | 0.5180 |
| | 558.70 | 74.487 | 0.2902 | 0.6780 |
| 313.2 | 440.40 | 58.715 | 0.0325 | 0.0776 |
| | 454.80 | 60.635 | 0.0513 | 0.1240 |
| | 470.00 | 62.662 | 0.0693 | 0.1670 |
| | 527.00 | 70.261 | 0.1240 | 0.3030 |
| | 548.80 | 73.167 | 0.1410 | 0.3510 |
| | 572.50 | 76.327 | 0.1600 | 0.3940 |
| | 592.70 | 79.020 | 0.2340 | 0.5570 |

N.B. Same data given in ref.(2)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A modified Gillespie still was used. Sulfur dioxide in liquid and gaseous phases estimated by iodometric titration. Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Dried with sulfuric acid and phosphorus pentoxide.
2. Analytical grade, fractionally distilled, $d_{20}^{4}$ = 0.7902.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/kPa = \pm 0.1\%$;
$\delta x_{SO_2}$, $\delta y_{SO_2}$ = ±0.5%.

(estimated by compiler).

REFERENCES:

1. Dvorak, K.; Boublik, T. *Coll. Czech. Chem. Comm.* 1963, *28*, 1252.
2. Bekarek, V.; Hala, E. *Coll. Czech. Chem. Comm.* 1968, *33*, 2608.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 2-Propanone (*acetone*); $C_3H_6O$; [67-64-1]
   2-Butanone (*methyl ethyl ketone*); $C_4H_8O$; [78-93-3]
   4-Methyl-2-pentanone (*methyl isobutyl ketone*); $C_6H_{12}O$; [108-10-1]

ORIGINAL MEASUREMENTS:

Sano, H.
*Nippon Kagaku Zasshi*
1968, *89*, 362-368.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

| Absorption coefficient, *S*[a] | Bunsen coefficient, α | Mole ratio | Mole fraction[b] |
|---|---|---|---|
| | 2-Propanone | | |
| 182.1 | 201.2 | 0.665 | 0.400 |
| | 2-Butanone | | |
| 161.9 | 163.2 | 0.656 | 0.396 |
| | 4-Methyl-2-pentanone | | |
| 109.3 | 100.5 | 0.563 | 0.360 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static absorption method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 2-Propanone, (Acetone); $C_3H_6O$; [67-64-1]

ORIGINAL MEASUREMENTS:

Lorimer, J.W.; Smith, B.C.; Smith, G.H.

*J.C.S. Faraday I*, 1975, *71*, 2232-50.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | $p$/mmHg | $p$/kPa | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ | Mole fraction of sulfur dioxide in vapor, $y_{SO_2}$ |
|---|---|---|---|---|
| 227.6 | 3.76 | 0.501 | 0.0000 | 0.000 |
| | 3.99 | 0.532 | 0.1088 | 0.187 |
| | 5.32 | 0.709 | 0.2123 | 0.518 |
| | 8.77 | 1.169 | 0.3132 | 0.792 |
| | 10.79 | 1.439 | 0.3899 | 0.880 |
| | 24.11 | 3.214 | 0.4926 | 0.969 |
| | 39.87 | 5.316 | 0.5889 | 0.990 |
| | 46.95 | 6.259 | 0.6241 | 0.994 |
| | 72.24 | 9.631 | 0.7419 | 0.998 |
| | 96.61 | 12.880 | 0.8623 | 1.000 |
| | 116.72 | 15.561 | 1.0000 | 1.000 |
| 237.4 | 7.53 | 1.004 | 0.0000 | 0.000 |
| | 8.66 | 1.155 | 0.1090 | 0.238 |
| | 11.93 | 1.591 | 0.2109 | 0.544 |
| | 18.42 | 2.456 | 0.3120 | 0.778 |
| | 26.00 | 3.466 | 0.3861 | 0.881 |
| | 45.93 | 6.123 | 0.4884 | 0.959 |
| | 73.19 | 9.758 | 0.5848 | 0.985 |
| | 84.40 | 11.252 | 0.6166 | 0.990 |
| | 128.49 | 17.131 | 0.7364 | 0.997 |
| | 172.24 | 22.963 | 0.8602 | 0.999 |
| | 208.81 | 27.839 | 1.0000 | 1.000 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static vapor-liquid equilibrium apparatus. Total pressure measured using mercury manometers and cathetometer. Temperature measured using a sulfur dioxide vapor pressure thermometer. Some details in source.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/kPa = \pm 0.01$

$\delta x_{SO_2}$, $\delta y_{SO_2}$ = ±1%.

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 2-Propanone, (Acetone); $C_3H_6O$; [67-64-1]

ORIGINAL MEASUREMENTS:

Lorimer, J.W.; Smith, B.C.; Smith, G.H.

*J.C.S. Faraday I*, 1975, *71*, 2232-50.

EXPERIMENTAL VALUES:

| T/K | $p$/mmHg | $p$/kPa | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ | Mole fraction of sulfur dioxide in vapor, $y_{SO_2}$ |
|---|---|---|---|---|
| 250.0 | 17.92 | 2.389 | 0.0000 | 0.000 |
| | 21.16 | 2.821 | 0.1076 | 0.257 |
| | 28.59 | 3.812 | 0.2092 | 0.543 |
| | 41.91 | 5.588 | 0.3094 | 0.761 |
| | 57.83 | 7.710 | 0.3792 | 0.864 |
| | 94.94 | 12.658 | 0.4797 | 0.946 |
| | 145.57 | 19.408 | 0.5750 | 0.979 |
| | 164.17 | 21.888 | 0.6016 | 0.984 |
| | 247.81 | 33.039 | 0.7248 | 0.995 |
| | 335.03 | 44.667 | 0.8554 | 0.999 |
| | 409.65 | 54.616 | 1.0000 | 1.000 |

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Propanoic acid (propionic acid); $C_3H_6O_2$; [79-09-4]

   Hexanoic acid (caproic acid); $C_6H_{12}O_2$; [142-62-1]

ORIGINAL MEASUREMENTS:

Sano, H.; Nakamoto, Y.
*Nippon Kagaku Zasshi*
1968, *89*, 369-373.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

$T/°C = 30$ $T/K = 303$

Vapor pressure of propanoic acid = 0.004 atm

| Absorption coefficient, $S^{a,b}$ | Bunsen coefficient,$^{b}$ $\alpha$ | Bunsen coefficient,$^{c,f}$ $\alpha$ | $\ell^{c,d}$ | Mole ratio | Mole fraction$^{e}$ |
|---|---|---|---|---|---|
| | | Propanoic acid | | | |
| 75.7 | 69.0 | - | - | 0.232 | 0.188 |
| | | Hexanoic acid | | | |
| 37.0 | 33.5 | 33.0 | 33.0 | 0.187 | 0.158 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Determined by static absorption method.

[c] Determined by flow method.

[d] $\alpha = \ell(1 - p_s^{\circ})$ where $p_s^{\circ}$ is the vapor pressure of solvent.

[e] Calculated by compiler.

[f] Assuming the vapor pressure of hexanoic acid is negligible.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two techniques were used: (a) static absorption method and (b) flow method. Static method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The flow method consists of passing sulfur dioxide through a micro gas absorption tube and estimating sulfur dioxide by iodometric titration. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]

2. Acetic acid, methyl ester (Methyl acetate); $C_3H_6O_2$; [79-20-9]

ORIGINAL MEASUREMENTS:

Horiuti, J.

*Sci. Pap. Inst. Phys. Chem.Res. (Jpn.)*, 1931/32, *17*, 125-256.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

| T/K | $P^{\S}$/bar | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ | T/K | $P^{\dagger}$/bar | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ | Ostwald coefficient, L |
|---|---|---|---|---|---|---|
| 298.15 | 0.2843 | 0.000 | 283.15 | 0.9568 | 0.602 | 254.9 |
| | 0.4237 | 0.137 | 298.15 | 0.8442 | 0.408 | 182.1 |
| | 0.4322 | 0.143 | 313.15 | 0.6000 | 0.227 | 133.8 |
| | 0.5887 | 0.243 | | | | |
| | 0.6084 | 0.254 | | | | |
| | 0.7659 | 0.322 | | | | |
| | 0.8027 | 0.336 | | | | |
| | 0.9471 | 0.387 | | | | |
| | 1.005 | 0.406 | | | | |
| | 1.123 | 0.438 | | | | |
| | 1.191 | 0.456 | | | | |
| | 1.295 | 0.478 | | | | |
| | 1.384 | 0.497 | | | | |

§ total pressure.

† partial pressure, total pressure = 1 atmosphere = $1.01325 \times 10^5$ Pa.

Ostwald coefficient (as $x \to 0$, T/K = 298.15) = 270.

Henry's law constant, $dp/dx$ (as $x \to 0$, T/K = 298.15) = 861 mmHg = 1.148 bar.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Apparatus consisted of a gas buret, a solvent reservoir and an absorption pipet. Dry gas introduced into degassed solvent. System mixed using a magnetic stirrer until saturation occurred. Care was taken to prevent solvent vapor from mixing with gas in the gas buret. Volume of gas determined from gas buret reading; volume of liquid determined from height of meniscus in absorption pipet.

SOURCE AND PURITY OF MATERIALS:

1. Sample obtained from Nippon Sulphufic Acid Manufacturing Co. Dried and fractionated several times.
2. Merck, extra pure sample, dried and distilled several times. B. pt. 57.12 °C.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.001$;

$\delta x_{SO_2} = \pm 0.001$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Acetic acid, methyl ester, (Methyl acetate); $C_3H_6O_2$; [79-20-9]

ORIGINAL MEASUREMENTS:

Bekarek, V.; Hala, E.

*Coll. Czech. Chem. Comm.* 1968, *33*, 2598-2607.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | $P$/Torr | $P$/kPa | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ | Mole fraction of sulfur dioxide in gas, $y_{SO_2}$ |
|---|---|---|---|---|
| 293.2 | 174.50 | 23.265 | 0.0110 | 0.0387 |
| | 200.90 | 26.784 | 0.0636 | 0.2110 |
| | 273.90 | 36.517 | 0.1660 | 0.4920 |
| | 360.60 | 48.076 | 0.2510 | 0.6650 |
| | 403.50 | 53.796 | 0.2840 | 0.7160 |
| | 410.00 | 54.662 | 0.2860 | 0.7200 |
| | 553.00 | 73.727 | 0.3720 | 0.8290 |
| 303.2 | 274.60 | 36.610 | 0.0169 | 0.0580 |
| | 329.60 | 43.943 | 0.0841 | 0.2660 |
| | 362.40 | 48.316 | 0.1150 | 0.3600 |
| | 381.00 | 50.796 | 0.1340 | 0.4010 |
| | 397.30 | 52.969 | 0.1480 | 0.4370 |
| | 476.00 | 63.461 | 0.2070 | 0.5700 |
| | 485.60 | 64.741 | 0.2120 | 0.5830 |
| | 646.20 | 86.153 | 0.3030 | 0.7260 |
| 313.2 | 413.20 | 55.089 | 0.0120 | 0.0401 |
| | 466.00 | 62.128 | 0.0587 | 0.1860 |
| | 483.60 | 64.475 | 0.0737 | 0.2330 |
| | 554.40 | 73.914 | 0.1240 | 0.3700 |
| | 556.00 | 74.127 | 0.1260 | 0.3710 |
| | 632.90 | 84.380 | 0.1710 | 0.4710 |

N.B. Same data given in ref.(2)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A modified Gillespie still was used. Sulfur dioxide in liquid and gaseous phases estimated by iodometric titration. Details in source and ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Dried with sulfuric acid and phosphorus pentoxide.
2. Added to 5 per cent acetic anhydride and fractionally distilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/kPa = \pm 0.1\%$

$\delta x_{SO_2}$, $\delta y_{SO_2} = \pm 0.5\%$. (estimated by compiler).

REFERENCES:

1. Dvorak, K.; Boublik, T.
*Coll. Czech. Chem. Comm.* 1963, *28*, 1252.

2. Bekarek, V.; Hala, E.
*Coll. Czech. Chem. Comm.* 1968, *33*, 2608.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 2-Propanone, $C_3H_6O$; [67-64-1]
3. Acetic acid, methyl ester, (Methyl acetate); $C_3H_6O_2$; [79-20-9]

ORIGINAL MEASUREMENTS:

Bekarek, V.; Hala, E.

*Coll. Czech. Chem. Comm.* 1968, *33*, 2598-2607.

VARIABLES:

Pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | p/Torr | p/kPa | Mole fractions in liquid | | in gas | |
|---|---|---|---|---|---|---|
| | | | $x_{SO_2}$ | $x_{C_3H_8O}$ | $y_{SO_2}$ | $y_{C_3H_8O}$ |
| 313.2 | 450.3 | 60.035 | 0.0426 | 0.829 | 0.107 | 0.769 |
| | 477.1 | 63.608 | 0.0609 | 0.383 | 0.169 | 0.352 |
| | 477.1 | 63.608 | 0.0736 | 0.847 | 0.183 | 0.738 |
| | 494.3 | 65.901 | 0.0801 | 0.411 | 0.214 | 0.353 |
| | 501.5 | 66.861 | 0.0864 | 0.407 | 0.231 | 0.342 |
| | 535.0 | 71.327 | 0.114 | 0.459 | 0.302 | 0.361 |
| | 506.7 | 67.554 | 0.107 | 0.834 | 0.262 | 0.683 |
| | 686.5 | 91.526 | 0.222 | 0.591 | 0.529 | 0.360 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A modified Gillespie still was used. Sulfur dioxide in liquid and gaseous phases estimated by iodometric titration. Details in source and ref. (1).

To determine the acetone concentration a bulb containing (0.5 - 1.0g) of mixture was broken in a solution containing iodine just sufficient to convert sulfur dioxide to sulfuric acid. Acetone was then determined by Messinger's method (ref.(2)).

SOURCE AND PURITY OF MATERIALS:

1. Dried with sulfuric acid and phosphorus pentoxide
2. Analytical grade, fractionally distilled, $d_{20}^{4}$ = 0.7902.
3. Added to 5 per cent acetic anhydride and fractionally distilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/kPa = \pm 0.1\%$. $\delta x_{SO_2}$, $\delta x_{C_3H_8O}$, $\delta y_{SO_2}$, $\delta y_{C_3H_8O}$ $= \pm 2\%$. (estimated by compiler).

REFERENCES:

1. Dvorak, K,; Boublik, T. *Coll. Czech. Chem. Comm.* 1963, *28*, 1252.
2. Goodwin, L.F.; *J. Am. Chem. Soc.*, 1920, *42*, 39.

**COMPONENTS:**

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Cellosolves

**ORIGINAL MEASUREMENTS:**

Sano, H.; Nakamoto, Y.

*Nippon Kagaku Zasshi*

1968, *89*, 369-373.

**VARIABLES:**

**PREPARED BY:**

C. L. Young

**EXPERIMENTAL VALUES:**

T/°C = 30 T/K = 303

Vapor pressure of 2-Methoxyethanol = 0.008 atm

Vapor pressure of 2-Butoxyethanol = 0.001 atm

| Absorption coefficient, $S^{a,b}$ | Bunsen coefficient,[b] α | Bunsen coefficient,[c] α | $\ell^{c,d}$ | Mole ratio | Mole fraction[e] |
|---|---|---|---|---|---|
| 2-Methoxyethanol (*methyl cellosolve*); $C_3H_8O_2$; [109-86-4] | | | | | |
| 201 | 184.2 | 185.9 | 185.1 | 0.652 | 0.395 |
| 2-Butoxyethanol (*butyl cellosolve*); $C_6H_{14}O_2$; [111-76-2] | | | | | |
| 113.5 | 103.2 | 103.7 | 103.6 | 0.605 | 0.377 |
| 2-Phenoxyethanol (*phenyl cellosolve*); $C_8H_{10}O_2$; [122-99-6] | | | | | |
| 96.1 | 87.5 | - | - | 0.491 | 0.329 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Determined by static absorption method.

[c] Determined by flow method.

[d] $\alpha = \ell(1 - p_s^\circ)$ where $p_s^\circ$ is the vapor pressure of solvent.

[e] Calculated by compiler.

**AUXILIARY INFORMATION**

**METHOD/APPARATUS/PROCEDURE:**

Two techniques were used: (a) static absorption method and (b) flow method. Static method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The flow method consists of passing sulfur dioxide through a micro gas absorption tube and estimating sulfur dioxide by iodometric titration. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

**SOURCE AND PURITY OF MATERIALS:**

1. Purity 99.0-99.8 mole per cent.

**ESTIMATED ERROR:**

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$ (estimated by compiler).

**REFERENCES:**

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Esters of acetic acid

ORIGINAL MEASUREMENTS:

Sano, H.

*Nippon Kagaku Zasshi*

1968, *89*, 362-368.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

Vapor pressure of ethyl acetate = 0.097 atm
Vapor pressure of butyl acetate = 0.023 atm
Vapor pressure of *iso*-amyl acetate = 0.007 atm

| Absorption coefficient, $S^{a,b}$ | Bunsen coefficient,[b] α | Bunsen coefficient,[c] α | $\ell^{c,d}$ | Mole ratio | Mole fraction[e] |
|---|---|---|---|---|---|
| Methyl acetate; $C_3H_6O_2$; [79-20-9] | | | | | |
| - | 142 | - | - | 0.509 | 0.337 |
| Ethyl acetate; $C_4H_8O_2$; [141-78-6] | | | | | |
| 118.9 | 119.7 | 110.5 | 100.5 | 0.531 | 0.347 |
| Butyl acetate; $C_6H_{12}O_2$; [123-86-4] | | | | | |
| 92.0 | 85.0 | 84.0 | 82.0 | 0.500 | 0.333 |
| 3-Methyl-1-butanol acetate (*iso-amyl acetate*); $C_7H_{14}O_2$; [123-92-2] | | | | | |
| 83.0 | 75.1 | 74.8 | 75.8 | 0.500 | 0.333 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Determined by static absorption method.

[c] Determined by flow method.

[d] $\alpha = \ell(1 - p_s^\circ)$ where $p_s^\circ$ is the vapor pressure of solvent.

[e] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two techniques were used: (a) static absorption method and (b) flow method. Static method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The flow method consists of passing sulfur dioxide through a micro gas absorption tube and estimating sulfur dioxide by iodometric titration. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 1,2,3-Propanetriol (glycerol); $C_3H_8O_3$; [56-81-5]

ORIGINAL MEASUREMENTS:

Gerrard, W.

*J. Appl. Chem. Biotechnol.* 1972, 22, 623-650.

VARIABLES:

Temperature

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

| T/K | *P*/kPa | Mole ratio $SO_2$/ ROH | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| 273.15 | 101.3 | 0.39 | 0.281 |
| 283.15 | | 0.20 | 0.167 |
| 293.15 | | 0.117 | 0.105 |

* Calculated by compiler

*P* is the total pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was bubbled into a weighed amount of component (2) in a bubbler tube as described in detail, diagram given, in the original paper. The amount of gas absorbed at equilibrium and at the observed temperature and pressure was weighed. By means of a manometer assembly, to which the bubbler tube was attached, the weight of gas absorbed at successively lower pressure was measured. Eventually the pressure was reduced to that of the component (2). The refractive index, and the infrared spectrum of the residue showed it to be essentially pure component (2).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was the best grade contained in a small cylinder. Its high purity was attested by the measurement of vapor pressure from 258 to 268 K.
2. The best obtainable specimen was carefully purified and rigorously attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Acetic acid, anhydride; $C_4H_6O_3$; [108-24-7]

ORIGINAL MEASUREMENTS:

Lloyd, S.J.

*J. Phys. Chem.* 1918, *22*, 300-302.

VARIABLES:

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

| T/K | Weight of $SO_2$ per $dm^3$ of solution/g. | *Speculative values<br>*Mole ratio, $SO_2$/ Comp.(2) | *Mole fraction (as for 1 atm) $x_{SO_2}$ |
|---|---|---|---|
| 268.15 | 196 | 0.342 | 0.255 |
| 273.15 | 148 | 0.247 | 0.198 |
| | | (0.220) | (0.181)** |
| 278.15 | 136 | 0.225 | 0.184 |
| 283.15 | 122 | 0.200 | 0.167 |
| 288.15 | 114 | 0.187 | 0.157 |
| 293.15 | 106 | 0.173 | 0.148 |
| 298.15 | 99 | 0.162 | 0.139 |
| 303.15 | 90 | 0.147 | 0.128 |

760 mmHg = 1 atm = 101.325 kPa

* Calculated by compiler by assuming that the volume of solution is the same as the volume of the component (2) before absorption of gas.

** Based on the original author's statement that the specific gravity of the "saturated acetic anhydride solution" is 1.22 at 273.15 K.

AUXILIARY INFORMATION

METHOD:/APPARATUS/PROCEDURE:

Gas was bubbled through component (2) in a long graduated tube of small diameter. After equilibrium had been attained at a total pressure of about 1 atm (barometric pressure, 756-760 mmHg), the volume of the solution (about 5 $cm^3$) was measured, and the weight of absorbed sulfur dioxide was determined by an iodometric titration.

SOURCE AND PURITY OF MATERIALS:

(1) Prepared from concentrated sulfuric acid and a saturated aqueous solution of sodium bisulfite. Dried by sulfuric acid and phosphorus pentoxide.

(2) Distilled, dried by calcium chloride, and redistilled before use.

ESTIMATED ERROR:

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Acetic acid anhydride; $C_4H_6O_3$; [108-24-7] | Sano, H.<br>*Nippon Kagaku Zasshi*<br>1968, *89*, 362-368. |
| VARIABLES: | PREPARED BY:<br>C. L. Young |

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

Vapor pressure of acetic anhydride = 0.006 atm

| Absorption coefficient, $S^{a,b}$ | Bunsen coefficient,[b] α | Bunsen coefficient,[c] α | $\ell^{c,d}$ | Mole ratio | Mole fraction[e] |
|---|---|---|---|---|---|
| 136.8 | 125.2 | 120.7 | 120.1 | 0.607 | 0.378 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Determined by static absorption method.

[c] Determined by flow method.

[d] $\alpha = \ell(1 - p_s^\circ)$ where $p_s^\circ$ is the vapor pressure of solvent.

[e] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two techniques were used: (a) static absorption method and (b) flow method. Static method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The flow method consists of passing sulfur dioxide through a micro gas absorption tube and estimating sulfur dioxide by iodometric titration. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5
2. Acetic acid, anhydride; $C_4H_6O_3$; [108-24-7]

ORIGINAL MEASUREMENTS:

Gerrard, W.

*J. Appl. Chem. Biotechnol.* 1972, *22*, 623-650.

VARIABLES:

Temperature, pressure

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | Total pressure /mmHg | Mole ratio $SO_2$/Component (2) | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| 273.15 | 760 | 3.08 | 0.753 |
| | 747 | 2.89 | 0.743 |
| | 649 | 2.33 | 0.700 |
| | 526 | 1.69 | 0.628 |
| | 448 | 1.35 | 0.574 |
| | 357 | 1.03 | 0.507 |
| | 253 | 0.703 | 0.413 |
| | 149 | 0.405 | 0.288 |
| | 70 | 0.183 | 0.155 |
| 283.15 | 747 | 1.57 | 0.611 |
| 293.15 | 747 | 0.95 | 0.487 |
| 298.15 | 747 | 0.76 | 0.432 |

NOTE: The plot of pressure vs solubility given in the original paper is based on the above data.

760 mmHg= 1 atm = 101.325 kPa.

* Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was bubbled into a weighed amount of component (2) in a bubbler tube as described in detail, diagram given, in the original paper. The amount of gas absorbed at equilibrium and at the observed temperature and pressure was weighed. By means of a manometer assembly, to which the bubbler tube was attached, the weight of gas absorbed at successively lower pressure was measured. Eventually the pressure was reduced to that of the component (2). The refractive index, and the infrared spectrum of the residue showed it to be essentially pure component (2).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was the best grade contained in a small cylinder. Its high purity was attested by the measurement of vapor pressure from 258 to 268 K.
2. The best obtainable specimen was carefully purified and rigorously attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Acetic acid anhydride; $C_4H_6O_3$; [108-24-7]

ORIGINAL MEASUREMENTS:

Nitta, T.; Kido, O.; Katayama, T.,

*J. Chem. Engng. Japan*, 1976, *9*, 317-8.

VARIABLES:

Pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | $P$/bar | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ |
|---|---|---|
| 293.15 | 0.0547 | 0.0411 |
| | 0.2004 | 0.1430 |
| | 0.7366 | 0.3940 |
| | 1.213 | 0.5378 |
| | 1.628 | 0.6388 |
| | 2.029 | 0.7288 |
| | 2.572 | 0.8350 |
| | 2.908 | 0.9061 |

AUXILIARY INFORMATION

METHOD:

Static method liquid phase composition estimated by iodometry. Few details given in source. Method similar to that used in ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Seitetsu Chemical Co. sample, purity better than 99.9 mole per cent.
2. Merck analytical grade sample.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P$/bar ±0.001 (below 1.3 bar), ±0.005 (above 1.3 bar); $\delta x_{SO_2} = \pm 1.5\%$

REFERENCES:

Quitzich, K.; Ulbrecht, H.; Geiseler, G.

*Z. Physik Chem.* 1967, *234*, 33.

COMPONENTS:

1. Sulfur dioxide, $SO_2$; [7446-09-5]
2. 4-Methyl-1,3-dioxolan-2-one, (Propylene carbonate); $C_4H_6O_3$; [108-32-7]

ORIGINAL MEASUREMENTS:

Lenoir, J-Y.; Renault, P.; Renon, H.

*J. Chem. Eng. Data* 1971, *16*, 340-342.

VARIABLES:

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

760 mmHg = 1 atm = 101.325 kPa.

| T/K | Henry's Constant $H_{SO_2}$/atm | *Mole fraction at 1 atm |
|---|---|---|
| 298 | 1.20 | 0.833 |
| 343 | 3.17 | 0.315 |

* Calculated by compiler assuming a linear function of $p_{SO_2}$ vs $x_{SO_2}$, i.e. $x_{SO_2}(1\ \text{atm}) = 1/H_{SO_2}$.

The authors gave "Henry's constant" as $H_{SO_2} = \lim\limits_{x_{SO_2}\to 0} \dfrac{f_{SO_2}(P,T)}{x_{SO_2}}$.

$x_{SO_2}$ is the mole fraction. $f_{SO_2}$ is the fugacity of $SO_2$ "in the equilibrium condition" of pressure and temperature. $H_{SO_2}$ is related to experimental chromatographic parameters based on the number of moles of solvent in the column, and the absolute retention time of the solute. Helium was the carrier gas.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A conventional gas-liquid chromatographic unit was used. The chromatograph was an IGC 12 M Intersmat model, equipped with a thermal conductivity detector. The temperature control was stated to be within ±0.1°C. The pressure drop in the column was measured by a mercury manometer. Helium was the carrier gas.

There is serious uncertainty in the estimation of accuracy.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was provided by l'Air Liquide, and had a stated purity of 99.9%. It was used as provided.
2. Provided by Touzart & Matignon and Serlabo, and stated to have a minimum purity of 99%. Distillation was carried out when necessary, and the refractive index was measured.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 4-Methyl-1,3-dioxolan-2-one, (Propylene carbonate); $C_4H_6O_3$; [108-32-7]

ORIGINAL MEASUREMENTS:

Benoit, R.L.; Milanova, E.

*Can. J. Chem.*, 1979, *57*, 1319-1323

VARIABLES:

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | Henry's law constant[+] $H$/atm |
|---|---|
| 298.15 | 1.51 |

[+] Defined in the original as

$$H = \frac{\text{partial pressure of sulfur dioxide}}{\text{mole fraction of sulfur dioxide}}$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Few details given. Pressure measured with quartz spiral gauge. Partial pressure calculated assuming Raoult's law. Concentration of sulfur dioxide determined by iodometric titration. Concentration of sulfur dioxide ranged from 0.2 to 1.0 mol $l^{-1}$

SOURCE AND PURITY OF MATERIALS:

1. Anhydrous sample from Canadian Liquid Air, purity 99.98 mole per cent.
2. Dried over 4A molecular sieve

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta H/\text{atm} = \pm 4\%$ (estimated by compiler)

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Cyclic ethers

ORIGINAL MEASUREMENTS:

Sano, H.
*Nippon Kagaku Zasshi*
1968, *89*, 362-368.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

$T/°C = 30$ $T/K = 303$

Vapor pressure of 1,4-Dioxane = 0.032 atm

| Absorption coefficient, $S$[a,b] | Bunsen coefficient,[b] $\alpha$ | Bunsen coefficient,[c] $\alpha$ | $\ell$[c,d] | Mole ratio | Mole fraction[e] |
|---|---|---|---|---|---|
| Tetrahydrofuran; $C_4H_8O_2$; [109-99-9] | | | | | |
| - | 256.5 | - | - | 0.550 | 0.355 |
| 1,4-Dioxane; $C_4H_8O_2$; [123-91-1] | | | | | |
| 264.6 | 248.6 | 257 | 238.2 | 0.95 | 0.487 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Determined by static absorption method.

[c] Determined by flow method.

[d] $\alpha = \ell(1 - p_s^{\circ})$ where $p_s^{\circ}$ is the vapor pressure of solvent.

[e] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two techniques were used: (a) static absorption method and (b) flow method. Static method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The flow method consists of passing sulfur dioxide through a micro gas absorption tube and estimating sulfur dioxide by iodometric titration. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Tetrahydrofuran; $C_4H_8O$; [109-99-9]

ORIGINAL MEASUREMENTS:

Benoit, R.L.; Milanova, E.

*Can. J. Chem.*, 1979, *57*, 1319-1323

VARIABLES:

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | Henry's law constant⁺ $H$/atm |
|---|---|
| 298.15 | 0.392 |

⁺ Defined in the original as

$$H = \frac{\text{partial pressure of sulfur dioxide}}{\text{mole fraction of sulfur dioxide}}$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Few details given. Pressure measured with quartz spiral gauge. Partial pressure calculated assuming Raoult's law. Concentration of sulfur dioxide determined by iodometric titration. Concentration of sulfur dioxide ranged from 0.1 to 0.9 mol $l^{-1}$

SOURCE AND PURITY OF MATERIALS:

1. Anhydrous sample from Canadian Liquid Air, purity 99.98 mole per cent.

2. Dried over 4A molecular sieve

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta H/\text{atm} = \pm 4\%$ (estimated by compiler)

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 1,4-Dioxane; $C_4H_8O_2$; [123-91-1]

ORIGINAL MEASUREMENTS:

Gerrard, W.

*J. Appl. Chem. Biotechnol.* 1972, *22*, 623-650.

VARIABLES:

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

| T/K | Pressure, total mmHg | Mole ratio $SO_2$/dioxane | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| 288.15 | 760 | 1.75 | 0.636 |

760 mmHg = 1 atm = 101.325 kPa.

* Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was bubbled into a weighed amount of component (2) in a bubbler tube as described in detail, diagram given, in the original paper. The amount of gas absorbed at equilibrium and at the observed temperature and pressure was weighed. By means of a manometer assembly, to which the bubbler tube was attached, the weight of gas absorbed at successively lower pressure was measured. Eventually the pressure was reduced to that of the component (2). The refractive index, and the infrared spectrum of the residue showed it to be essentially pure component (2).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was the best grade contained in a small cylinder. Its high purity was attested by the measurement of vapor pressure from 258 to 268 K.
2. The best obtainable specimen was carefully purified and rigorously attested.

ESTIMATED ERROR:

REFERENCES:

| | |
|---|---|
| COMPONENTS:<br>1. Sulfur dioxide, $SO_2$; [7446-09-5]<br>2. 1,4-Dioxane; $C_4H_8O_2$; [123-91-1] | ORIGINAL MEASUREMENTS:<br>Nitta, T.; Kido, O.; Katayama, T.;<br>*J. Chem. Engng. Japan.* 1976, *9*, 317-8. |
| VARIABLES:<br>Pressure | PREPARED BY:<br>C.L. Young |

EXPERIMENTAL VALUES:

| T/K | $P$/bar | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ |
|---|---|---|
| 293.15 | 0.0720 | 0.0920 |
| | 0.1108 | 0.1645 |
| | 0.1477 | 0.2162 |
| | 0.2329 | 0.2996 |
| | 0.3976 | 0.3988 |
| | 0.6514 | 0.4960 |
| | 1.139 | 0.6102 |
| | 1.624 | 0.6928 |
| | 2.220 | 0.7829 |
| | 2.824 | 0.8789 |

AUXILIARY INFORMATION

METHOD

Static method liquid phase composition estimated by iodometry. Few details given in source method similar to that used in ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Seitetsu Chemical Co. sample, purity better than 99.9 mole per cent.
2. Nakarai Chemicals Ltd. sample, spectral grade.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.001$ (up to 1.3 bar), $\pm 0.005$ (above 1.3 bar); $\delta x_{SO_2} = \pm 1.5\%$

REFERENCES:

Quitzich K.; Ulbrecht, H.; Geiseler, G.
*Z. Physik Chem.* 1967, *234*, 33.

| | |
|---|---|
| COMPONENTS:<br>1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Acetic acid, ethyl ester (ethyl acetate); $C_4H_8O_2$; [141-78-6] | ORIGINAL MEASUREMENTS:<br>Benoit, R.L.; Milanova, E.<br>*Can. J. Chem.*, 1979, *57*, 1319-1323 |
| VARIABLES: | PREPARED BY:<br>C.L. Young |

EXPERIMENTAL VALUES:

| T/K | Henry's law constant$^+$ $H$/atm |
|---|---|
| 298.15 | 1.09 |

$^+$ Defined in the original as

$$H = \frac{\text{partial pressure of sulfur dioxide}}{\text{mole fraction of sulfur dioxide}}$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Few details given. Pressure measured with quartz spiral gauge. Partial pressure calculated assuming Raoult's law. Concentration of sulfur dioxide determined by iodometric titration. Concentration of sulfur dioxide ranged from 0.1 to 0.5 mol $l^{-1}$

SOURCE AND PURITY OF MATERIALS:

1. Anhydrous sample from Canadian Liquid Air, purity 99.98 mole per cent.

2. Dried over 4A molecular sieve

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta H/\text{atm} = \pm 4\%$ (estimated by compiler)

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide, $SO_2$; [7446-09-5]<br>2. 1,1'-Oxybisethane, (Diethyl-ether); $C_4H_{10}O$; [60-29-7] | Yuferev, R.F.; Maluigin, P.V.<br>*Z. Chim. Prom.* 1930, *7*, 553-555 |
| **VARIABLES:** | **PREPARED BY:** |
| Temperature | W. Gerrard |

EXPERIMENTAL VALUES:

| T/K | Weight of $SO_2$ per $cm^3$ of solvent g | Volume of $SO_2$ per $cm^3$ of solvent $cm^3$ | *Mole ratio $SO_2$/diethyl ether. | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|---|
| 273.15 | 1.090 | 381.51 | 1.712 | 0.631 |
| 291.65 | 0.2828 | 98.98 | 0.457 | 0.314 |
| Ether saturated with water; | | | | |
| 273.15 | 0.8238 | 288.33 | | |
| 291.65 | 0.3252 | 113.82 | | |

* Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was passed into 5 $cm^3$ of ether until saturated. The whole solution was then transferred to a stoppered flask containing an aqueous solution of $I_2$ + KI. The sulfuric acid formed was determined gravimetrically. The total pressure was presumably 1 atm; but this was not stated.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was dried by sulfuric acid.
2. The ether was dried over "calcined potash," and then over sodium, distilled, and stored over sodium.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 1,1′-Oxybisethane, (Diethyl ether); $C_4H_{10}O$; [60-29-7]

ORIGINAL MEASUREMENTS:

Nitta, T.; Itami, J.; Katayama, T.,

*J. Chem. Engng. Japan*, 1973, *6*, 303-9.

VARIABLES:

Pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

| T/K | $p$/mmHg$^+$ | $p$/kPa$^+$ | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ |
|---|---|---|---|
| 293.15 | 635.9 | 84.78 | 0.2209 |
| | 761.3 | 101.5 | 0.3058 |
| | 887.0 | 118.3 | 0.3696 |
| | 1049 | 139.9 | 0.4542 |
| | 1269 | 169.2 | 0.5496 |
| | 1551 | 206.8 | 0.6490 |
| | 1804 | 240.5 | 0.7342 |
| | 2209 | 294.5 | 0.8960 |

$^+$ Total pressure

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell with magnetic stirrer. After equilibrium established, pressure measured with Bourdon gauge and approximately 2 $cm^3$ of liquid analysed by iodometric titration.

SOURCE AND PURITY OF MATERIALS:

1. Seitetsu Chemical Co. sample purity better than 99.9 mole per cent.
2. Merck Uvasol spectral grade.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta p/kPa = \pm 0.5$;

$\delta x_{SO_2} = \pm 1\%$ (estimated by compiler)

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 2-Furanmethanol (*furfuryl alcohol*); $C_5H_6O_2$; [98-00-0]

   Tetrahydro-2-furanmethanol (*tetrahydrofurfuryl alcohol*); $C_5H_{10}O_2$; [97-99-4]

ORIGINAL MEASUREMENTS:

Sano, H.; Nakamoto, Y.

*Nippon Kagaku Zasshi*

<u>1968</u>, *89*, 369-373.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

Vapor pressure of 2-Furanmethanol = 0.001 atm

Vapor pressure of Tetrahydro-2-furanmethanol = 0.001 atm

| Absorption coefficient, $S^{a,b}$ | Bunsen coefficient,$^b$ $\alpha$ | Bunsen coefficient,$^c$ $\alpha$ | $\ell^{c,d}$ | Mole ratio | Mole fraction$^e$ |
|---|---|---|---|---|---|
| | | 2-Furanmethanol | | | |
| 96 | 86 | | | 0.335 | 0.251 |
| | | Tetrahydro-2-furanmethanol | | | |
| 184 | 167 | 160.0 | 165.8 | 0.724 | 0.420 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Determined by static absorption method.

[c] Determined by flow method.

[d] $\alpha = \ell(1 - p_s^\circ)$ where $p_s^\circ$ is the vapor pressure of solvent.

[e] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two techniques were used: (a) static absorption method and (b) flow method. Static method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The flow method consists of passing sulfur dioxide through a micro gas absorption tube and estimating sulfur dioxide by iodometric titration. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Ethers

ORIGINAL MEASUREMENTS:

Sano, H.
*Nippon Kagaku Zasshi*
1968, *89*, 362-368.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

Vapor pressure of diisopropyl ether = 0.202 atm
Vapor pressure of 1,2-dimethoxyethane = 0.056 atm

| Absorption coefficient, $s^{a,b}$ | Bunsen coefficient,[b] $\alpha$ | Bunsen coefficient,[c] $\alpha$ | $\ell^{c,d}$ | Mole ratio | Mole fraction[e] |
|---|---|---|---|---|---|
| 1,1'-Oxybisethane (*diethyl ether*); $C_4H_{10}O$; [60-29-7] | | | | | |
| - | 148 | - | - | 0.687 | 0.407 |
| 2,2'-Oxybispropane (*isopropyl ether*); $C_6H_{14}O$; [108-20-3] | | | | | |
| 32.85 | 37.4 | 38.9 | 31.0 | 0.235 | 0.190 |
| Dimethoxymethane (*methylal*); $C_3H_8O_2$; [109-87-5] | | | | | |
| - | 304 | - | - | 1.22 | 0.550 |
| 1,2-Dimethoxyethane (*ethylene glycol dimethyl ether*); $C_4H_{10}O_2$; [110-71-4] | | | | | |
| 230.4 | 221.5 | 226.0 | 215.0 | 1.03 | 0.507 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Determined by static absorption method.

[c] Determined by flow method.

[d] $\alpha = \ell(1 - p_s^\circ)$ where $p_s^\circ$ is the vapor pressure of solvent.

[e] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two techniques were used: (a) static absorption method and (b) flow method. Static method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The flow method consists of passing sulfur dioxide through a micro gas absorption tube and estimating sulfur dioxide by iodometric titration. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7746-09-5]
2. Phenol; $C_6H_6O$; [108-95-2]

ORIGINAL MEASUREMENTS:

Lenoir, J-Y.; Renault, P.; Renon, H.

*J. Chem. Eng. Data.* 1971, *16*, 340-342

VARIABLES:

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

| T/K | Henry's constant $H_{SO_2}$/atm | Mole fraction at 1 atm * |
|---|---|---|
| 323 | 7.07 | 0.141 |

* Calculated by compiler assuming a linear function of $p_{SO_2}$ vs $x_{SO_2}$, i.e. $x_{SO_2}$ (1 atm) = $1/H_{SO_2}$.

The authors gave "Henry's constant" as

$$H_{SO_2} = \lim_{x_{SO_2} \to 0} \frac{f_{SO_2}(P,T)}{x_{SO_2}}$$

$x_{SO_2}$ is the mole fraction. $f_{SO_2}$ is the fugacity of $SO_2$ "in the equilibrium condition" of pressure and temperature. $H_{SO_2}$ is related to experimental chromatographic parameters based on the number of moles of solvent in the column, and the absolute retention time of the solute. Helium was the carrier gas.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A conventional gas-liquid chromatographic unit was used. The chromatograph was an IGC 12 M Intersmat model, equipped with a thermal conductivity detector. The temperature control was stated to be within ±0.1° C. The pressure drop in the column was measured by a mercury manometer. Helium was the carrier gas.

There is serious uncertainty in the estimation of accuracy.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was provided by l'Air Liquide, and had a stated purity of 99.9%. It was used as provided.
2. Provided by Touzart & Matignon and Serlabo, and stated to have a minimum purity of 99%. Distillation was carried out when necessary, and the refractive index was measured.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Phenol; $C_6H_6O$; [108-95-2]
   1,2-Benzenediol (*1,2-Cresol*); $C_6H_6O_2$; [120-80-9]
   2-Methoxyphenol (*Guaiacol*); $C_7H_8O_2$; [90-05-1]

ORIGINAL MEASUREMENTS:

Sano, H.; Nakamoto, Y.
*Nippon Kagaku Zasshi*
1968, *89*, 369-373.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES: T/°C = 30 T/K = 303

| Absorption coefficient, $S^{a,b}$ | Bunsen coefficient,$^{b}$ $\alpha$ | Bunsen coefficient,$^{c,f}$ $\alpha$ | $\ell^{c,d}$ | Mole ratio | Mole fraction$^{e}$ |
|---|---|---|---|---|---|
| | | Phenol | | | |
| 75.1 | 68.6 | 68.1 | 68.1 | 0.273 | 0.214 |
| | | 1,2-Benzenediol | | | |
| 75.0 | 68.3 | 68.0 | 68.0 | 0.315 | 0.240 |
| | | 2-Methoxyphenol | | | |
| 108 | 98.4 | - | - | 0.489 | 0.328 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Determined by static absorption method.

[c] Determined by flow method.

[d] $\alpha = \ell(1 - p_s^\circ)$ where $p_s^\circ$ is the vapor pressure of solvent.

[e] Calculated by compiler.

[f] Assuming the vapor pressure of phenol and 1,2-benzenediol to be negligible.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two techniques were used: (a) static absorption method and (b) flow method. Static method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The flow method consists of passing sulfur dioxide through a micro gas absorption tube and estimating sulfur dioxide by iodometric titration. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

δT/K = ±0.5; $\delta x_{SO_2}$ = ±5%

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Esters

ORIGINAL MEASUREMENTS:

Sano, H.
*Nippon Kagaku Zasshi*
1968, *89*, 362-368.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

| Absorption coefficient, $s^{a,b}$ | Bunsen coefficient,$^b$ $\alpha$ | Bunsen coefficient,$^{c,f}$ $\alpha$ | $\ell^{c,d}$ | Mole ratio | Mole fraction$^e$ |
|---|---|---|---|---|---|
| Dimethyl maleate (z)-2-Butenedioic acid, dimethyl ester; $C_6H_8O_4$; [624-48-6] | | | | | |
| 99.1 | 90.1 | - | - | 0.508 | 0.337 |
| Dimethyl phthalate 1,2-Benzenecarboxylic acid, dimethyl ester; $C_{10}H_{10}O_4$; [131-11-3] | | | | | |
| 96.5 | 87.9 | 88.0 | 88.0 | 0.643 | 0.391 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Determined by static absorption method.

[c] Determined by flow method.

[d] $\alpha = \ell(1 - p_s^\circ)$ where $p_s^\circ$ is the vapor pressure of solvent.

[e] Calculated by compiler.

[f] Assuming vapor pressure of dimethyl phthalate to be negligible.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two techniques were used; (a) static absorption method and (b) flow method. Static method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The flow method consists of passing sulfur dioxide through a micro gas absorption tube and estimating sulfur dioxide by iodometric titration. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Cyclohexanone; $C_6H_{10}O$; [108-94-1] or 3-Methylcyclohexanone ; $C_7H_{14}O$; [591-23-1]

ORIGINAL MEASUREMENTS:

Weissenberger, G.; Hadwiger, H.

Z. *angew. Chem.* 1927, *40*, 734-736.

VARIABLES:

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | Volume of Comp.(2)/cm$^3$ | Volume of $SO_2$ absorbed/cm$^3$ | *Mole ratio $SO_2$/Comp.(2) | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|---|
| | | | (pressure assumed to be barometric) | |
| | | cyclohexanone | | |
| 293.15 | 103.24 | 2353.87 | 0.10 | 0.0911 |
| | | 3-methylcyclohexanone | | |
| 293.15 | 124.6 | 2082.82 | 0.089 | 0.0817 |

* Calculated by compiler

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Used an absorption vessel of 200 cm$^3$ capacity, and a vessel with a two-way tap. Simply stated that the absorptiometer was like that used by Manchot, but the reference was not cited; probably ref. (1).

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

REFERENCES:

1. Manchot, W. Z. *anorg. Chem.* 1924, *141*, 38.

|  |  |
|---|---|
| COMPONENTS:<br>1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Cyclohexanone; $C_6H_{10}O$; [108-94-1]<br>1-Phenylethanone (*Acetophenone*); $C_8H_8O$; [98-86-2] | ORIGINAL MEASUREMENTS:<br>Sano, H.<br>*Nippon Kagaku Zasshi*<br>1968, *89*, 362-368. |
| VARIABLES: | PREPARED BY:<br>C. L. Young |

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

Vapor pressure of cyclohexanone = 0.005 atm

Vapor pressure of acetophenone = 0.001 atm

| Absorption coefficient, $S$[a] | Bunsen coefficient, $\alpha$ | Mole ratio | Mole fraction[b] |
|---|---|---|---|
|  | Cyclohexanone |  |  |
| 133.4 | 122.1 | 0.567 | 0.362 |
|  | 1-Phenylethanone |  |  |
| 96.4 | 87.9 | 0.460 | 0.315 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static absorption method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$ [7446-09-5]
2. Cyclohexanone; $C_6H_{10}O$; [108-94-1] or 2-Methylcyclohexanone ; $C_7H_{12}O$; [583-60-8]

ORIGINAL MEASUREMENTS:

Gerrard, W.; "*Solubility of Gases and Liquids*,: Plenum Press, New York, 1976, p. 239.

VARIABLES:

Temperature

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

| T/K | Weight of component(2) g | Weight of $SO_2$ absorbed, g | Mole ratio $SO_2$ /Comp.(2) | Mole fraction $x_{SO_2}$ |
|---|---|---|---|---|
| | | Cyclohexanone | | |
| | | | (Total pressure = 1 atm) | |
| 283.15 | 2.0601 | 2.1639 | 1.611 | 0.617 |
| 293.15 | 2.0601 | 1.4730 | 1.100 | 0.521 |
| | | Methyl cyclohexanone | | |
| | | | (Total pressure = 1 atm) | |
| 283.15 | 2.5852 | 1.9010 | 1.290 | 0.563 |
| 293.15 | 2.5852 | 1.3808 | 0.937 | 0.484 |

760 mmHg = 1 atm = 101.325 kPa.

AUXILIARY INFORMATION

METHOD:

Sulfur dioxide was bubbled into a weighed amount of component (2) in a bubbler tube. The amount of gas absorbed was determined by reweighing the tube. The total pressure was barometric, very nearly 1 atm. See ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was the best grade contained in a small cylinder. Its high degree of purity was attested by the measurement of vapor pressure from 258-268 K.
2. The best commercial specimen was purified and attested.

ESTIMATED ERROR:

REFERENCES:

1. Gerrard, W. *J. Appl. Chem. Biotechnol.* 1972, *22*, 623.

|  |  |
|---|---|
| COMPONENTS:<br>1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. 1,2-Ethanediol diacetate (*Ethylene glycol diacetate*); $C_6H_{10}O_2$; [111-55-7]<br>2-Ethoxyethanol acetate (*Ethylene glycol monoethyl monoacetate*); $C_6H_{12}O_3$; [111-15-9] | ORIGINAL MEASUREMENTS:<br>Sano, H.<br>*Nippon Kagaku Zasshi*<br>1968, *89*, 362-368. |
| VARIABLES: | PREPARED BY:<br>C. L. Young |

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

Vapor pressure of ethylene glycol diacetate = 0.001 atm
Vapor pressure of ethylene glycol monoethyl monoacetate = 0.002 atm

| Absorption coefficient, $S^a$ | Bunsen coefficient, α | Mole ratio | Mole fraction$^b$ |
|---|---|---|---|
| | Ethylene glycol diacetate | | |
| 150.4 | 137.0 | 0.808 | 0.447 |
| | Ethylene glycol monoethyl monoacetate | | |
| 141.7 | 129.4 | 0.786 | 0.440 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static absorption method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 3-Oxobutanoic acid, ethyl ester (*Ethyl acetoacetate*); $C_6H_{10}O_3$; [141-97-9]

ORIGINAL MEASUREMENTS:

Sano, H.
*Nippon Kagaku Zasshi*
1968, *89*, 362-368.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

| Absorption coefficient, $S^a$ | Bunsen coefficient, $\alpha$ | Mole ratio | Mole fraction$^b$ |
|---|---|---|---|
| 133.3 | 120.7 | 0.687 | 0.407 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static absorption method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Hexanoic acid; $C_6H_{12}O_2$; [142-62-1]

ORIGINAL MEASUREMENTS:

Gerrard, W.

*J. Appl. Chem. Biotechnol.* 1972, *22*, 623-650

VARIABLES:

Temperature, pressure

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | Pressure, total /mmHg | Mole ratio $SO_2$/Comp. (2) | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| 273.15 | 755 | 0.86 | 0.462 |
| | ** 712 | 0.824 | 0.452 |
| | 660 | 0.690 | 0.408 |
| | 566 | 0.521 | 0.343 |
| | 206 | 0.143 | 0.125 |
| | 124 | 0.076 | 0.0706 |
| | 45 | 0.028 | 0.0272 |
| 283.15 | 755 | 0.440 | 0.306 |
| | ***756 | 0.442 | 0.307 |
| | 700 | 0.417 | 0.294 |
| | 620 | 0.353 | 0.261 |
| | 510 | 0.277 | 0.217 |
| | 370 | 0.182 | 0.154 |
| | 244 | 0.113 | 0.102 |
| | 158 | 0.070 | 0.065 |
| | 42 | 0.017 | 0.017 |
| 293.15 | 755 | 0.276 | 0.216 |
| 298.15 | 755 | 0.25 | 0.200 |

760 mmHg = 1 atm = 101.325 kPa.

* Calculated by compiler

** Plot of pressure vs solubility given in Ref. (1) is based on these data.

*** Plot of pressure vs solubility given in original paper is based on these data.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was bubbled into a weighed amount of component (2) in a bubbler tube as described in detail, diagram given, in the original paper. The amount of gas absorbed at equilibrium and at the observed temperature and pressure was weighed. By means of a manometer assembly, to which the bubbler tube was attached, the weight of gas absorbed at successively lower pressure was measured. Eventually the pressure was reduced to that of the component (2). The refractive index, and the infrared spectrum of the residue showed it to be essentially pure component (2).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was the best grade contained in a small cylinder. Its high purity was attested by the measurement of vapor pressure from 258 to 268K.
2. The best obtainable specimen was carefully purified and rigorously attested.

ESTIMATED ERROR:

REFERENCES:

1. Gerrard, W. *Solubility of Gases and Liquids*, Plenum Press, New York, 1976.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide, $SO_2$; [7446-09-5]<br>2. Benzenemethanol (Benzyl alcohol); $C_7H_8O$; [100-51-6] | Lenoir, J-Y.; Renault, P.; Renon, H.<br>*J. Chem. Eng. Data* 1971, *16*, 340-342. |
| VARIABLES: | PREPARED BY:<br>W. Gerrard |

EXPERIMENTAL VALUES: 760 mmHg = 1 atm = 101.325 kPa.

| T/K | Henry's Constant $H_{SO_2}$/atm | *Mole fraction at 1 atm |
|---|---|---|
| 298 | 2.08 | 0.481 |

* Calculated by compiler assuming a linear function of $p_{SO_2}$ vs $x_{SO_2}$, i.e. $x_{SO_2}(1\text{ atm}) = 1/H_{SO_2}$.

The authors gave "Henry's constant" as $H_{SO_2} = \lim_{x_{SO_2} \to 0} \frac{f_{SO_2}(P,T)}{x_{SO_2}}$

$H_{SO_2}$ is the mole fraction. $f_{SO_2}$ is the fugacity of $SO_2$ "in the equilibrium condition"of pressure and temperature. $H_{SO_2}$ is related to experimental chromatographic parameters based on the number of moles of solvent in the column, and the absolute retention time of the solute. Helium was the carrier gas.

AUXILIARY INFORMATION

| METHOD/APPARATUS/PROCEDURE: | SOURCE AND PURITY OF MATERIALS: |
|---|---|
| A conventional gas-liquid chromatographic unit was used. The chromatograph was an IGC 12 M Intersmat model, equipped with a thermal conductivity detector. The temperature control was stated to be within ±0.1°C. The pressure drop in the column was measured by a mercury manometer. Helium was the carrier gas. There is serious uncertainty in the estimation of accuracy.. | 1. Sulfur dioxide was provided by l'Air Liquide, and had a stated purity of 99.9%. It was used as provided.<br>2. Provided by Touzart & Matignon and Serlabo, and stated to have a minimum purity of 99%. Distillation was carried out when necessary and the refractive index was measured. |
| | ESTIMATED ERROR: |
| | REFERENCES: |

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Benzoic acid, methyl ester (*methyl benzoate*); $C_8H_8O_2$; [93-58-3]

ORIGINAL MEASUREMENTS:

Sano, H.
*Nippon Kagaku Zasshi*
1968, *89*, 362-368.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

$T/°C = 30$ $T/K = 303$

Vapor pressure of methyl benzoate = 0.001 atm

| Absorption coefficient, $S$[a] | Bunsen coefficient, $\alpha$ | Mole ratio | Mole fraction[b] |
|---|---|---|---|
| 72.1 | 65.5 | 0.365 | 0.267 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static absorption method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. 2-Hydroxybenzoic acid, methyl ester (*methyl salicylate*); $C_8H_8O_3$; [119-36-8] | Sano, H.; Nakamoto, Y.<br>*Nippon Kagaku Zasshi*<br>1968, *89*, 369-373. |
| VARIABLES: | PREPARED BY:<br>C. L. Young |

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

| Absorption coefficient, $S$[a] | Bunsen coefficient, α | Mole ratio | Mole fraction[b] |
|---|---|---|---|
| 84.3 | 76.7 | 0.441 | 0.306 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static absorption method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 2-Hydroxybenzoic acid, methyl ester; (methyl salicylate) $C_8H_8O_3$; [119-36-8]

ORIGINAL MEASUREMENTS:

Gerrard, W. *J. Appl. Chem. Biotechnol.* 1972, *22*, 623-650.

VARIABLES:

Temperature, pressure

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | Pressure, total /mmHg | Mole ratio $SO_2$/Component (2) | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| 273.15 | 761 | 2.21 | 0.688 |
| | ** 616 | 1.43 | 0.588 |
| | 477 | 0.949 | 0.487 |
| | 289 | 0.477 | 0.323 |
| | 146 | 0.222 | 0.182 |
| 283.15 | 761 | 1.03 | 0.507 |

760 mmHg = 1 atm = 101.325 kPa.

* Calculated by compiler

** The plot of pressure and solubility given in the original paper, and that in Ref. (1) are based on these data.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was bubbled into a weighed amount of component (2) in a bubbler tube as described in detail, diagram given, in the original paper. The amount of gas absorbed at equilibrium and at the observed temperature and pressure was weighed. By means of a manometer assembly, to which the bubbler tube was attached, the weight of gas absorbed at successively lower pressure was measured. Eventually the pressure was reduced to that of the component (2). The refractive index, and the infrared spectrum of the residue showed it to be essentially pure component (2).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was the best grade contained in a small cylinder. Its high purity was attested by the measurement of vapor pressure from 258 to 268 K.
2. The best obtainable specimen was carefully purified and rigorously attested.

ESTIMATED ERROR:

REFERENCES:

1. Gerrard, W. *Solubility of Gases and Liquids*, Plenum Press, New York, 1976.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Aromatic ethers

ORIGINAL MEASUREMENTS:

Sano, H.
*Nippon Kagaku Zasshi*
1968, *89*, 362-368.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

Vapor pressure of methoxybenzene = 0.004 atm

| Absorption coefficient, $S^{a,b}$ | Bunsen coefficient,$^b$ $\alpha$ | Bunsen coefficient,$^{c,f}$ $\alpha$ | $\ell^{c,d}$ | Mole ratio | Mole fraction$^e$ |
|---|---|---|---|---|---|
| 1,1'-(Methoxymethylene)bisbenzene (*benzyl ether*); $C_{14}H_{14}O$; [1016-09-7] | | | | | |
| 68.8 | 62.5 | 63.3 | 63.3 | 0.549 | 0.354 |
| Methoxybenzene (*anisole*); $C_7H_8O$; [100-66-3] | | | | | |
| 94.9 | 86.8 | 87.8 | 87.5 | 0.424 | 0.298 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Determined by static absorption method.

[c] Determined by flow method.

[d] $\alpha = \ell(1 - p_s^\circ)$ where $p_s^\circ$ is the vapor pressure of solvent.

[e] Calculated by compiler.

[f] Assuming vapor pressure of benzyl ether is negligible.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two techniques were used: (a) static absorption method and (b) flow method. Static method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The flow method consists of passing sulfur dioxide through a micro gas absorption tube and estimating sulfur dioxide by iodometric titration. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Ethoxybenzene , (phenetole); $C_8H_{10}O$; [103-73-1]

ORIGINAL MEASUREMENTS:

Gerrard, W.

*J. Appl. Chem. Biotechnol.* 1972, *22*, 623-650.

VARIABLES:

Temperature, pressure

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | Pressure, total /mmHg | Mole ratio $SO_2$/Comp. (2) | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| 273.15 | 760 | 2.10 | 0.677 |
| | ** 715 | 1.81 | 0.644 |
| | 665 | 1.57 | 0.611 |
| | 600 | 1.27 | 0.559 |
| | 480 | 0.874 | 0.466 |
| | 390 | 0.664 | 0.399 |
| | 252 | 0.375 | 0.273 |
| | 148 | 0.213 | 0.176 |
| 283.15 | 760 | 0.93 | 0.482 |

760 mmHg = 1 atm = 101.325 kPa.

* Calculated by compiler

** Data on which the graph in the original paper is based.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was bubbled into a weighed amount of component (2) in a bubbler tube as described in detail, diagram given, in the original paper. The amount of gas absorbed at equilibrium and at the observed temperature and pressure was weighed. By means of a manometer assembly, to which the bubbler tube was attached, the weight of gas absorbed at successively lower pressure was measured. Eventually the pressure was reduced to that of the component (2). The refractive index, and the infrared spectrum of the residue showed it to be essentially pure component (2).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was the best grade contained in a small cylinder. Its high purity was attested by the measurement of vapor pressure from 258 to 268 K.
2. The best obtainable specimen was carefully purified and rigorously attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 2-Octanone; $C_8H_{16}O$; [111-13-7]

ORIGINAL MEASUREMENTS:

Albright, L.F.; Shannon, P.T.;
Yu, S.-N.; Chueh, P.L.
*Chem. Engng. Prog. Symp. Ser.* 1963. *59*, (44), 66-74.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young.

EXPERIMENTAL VALUES:

| T/K | $P$/bar | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ |
|---|---|---|
| 298.14 | 1.14 | 0.402 |
| | 2.03 | 0.609 |
| | 3.45 | 0.854 |
| 310.93 | 1.63 | 0.400 |
| | 2.98 | 0.604 |
| | 5.01 | 0.854 |
| 338.71 | 3.41 | 0.389 |
| | 6.04 | 0.587 |
| | 6.10 | 0.594 |
| | 10.67 | 0.845 |
| 366.48 | 6.19 | 0.376 |
| | 10.70 | 0.567 |
| | 19.44 | 0.833 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell fitted with Bourdon pressure gauge. Temperature measured with mercury in glass thermometer. The equipment used in this investigation was stated to be similar to that used in previous studies, (1), (2).

SOURCE AND PURITY OF MATERIALS:

1. and 2. Commercial grade samples, no other details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/\text{bar} = \pm 0.3$; $\delta x_{SO_2} = \pm 1\%$.

REFERENCES:

1. Albright, L. F.; Shannon, P. T.; Terrier, F.; Chueh, P. L. *Am. Inst. Chem. Engrs. J.* 1962, *8*, 668.
2. Albright, L. F.; Buclez, P. C.; Pluche, C. R.; Doody, T.C. *ASHRAE Trans.* 1960, *66*, 423.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. 1,1′-Oxybisbutane, (dibutyl ether); $C_8H_{18}O$; [142-96-1] | Hill, A.E.; Fitzgerald, T.B.<br>*J. Am. Chem. Soc.* 1935, *57*, 250-254. |
| VARIABLES: | PREPARED BY: |
|  | W. Gerrard |

EXPERIMENTAL VALUES:

| T/K | Weight of $SO_2$ absorbed by 5 $cm^3$ of ether, g | Total pressure, P, mmHg | "Const.of Henry" $K$ (Note) | *Mole Ratio $SO_2$/ ether | Mole fraction $x_{SO_2}$ |
|---|---|---|---|---|---|
| 293.15 | 0.0 | 11.0 |  |  |  |
|  | 0.0764 | 87.5 | 1.00 | 0.040 | 0.0389 |
|  | 0.1541 | 170.5 | 1.04 | 0.082 | 0.0755 |
|  | 0.2291 | 250.1 | 1.05 | 0.121 | 0.108 |
|  | 0.3128 | 332.4 | 1.03 | 0.166 | 0.142 |
|  | 0.3960 | 413.5 | 1.02 | 0.210 | 0.173 |
|  | 0.4762 | 483.5 | 0.99 | 0.252 | 0.201 |

760 mmHg = 1 atm = 101.325 kPa

* Calculated by compiler.

NOTE: $p_{SO_2}$ is taken to be $p_{total}$ - 11.0 mmHg throughout. This cannot be strictly correct.

NOTE: "Constant of Henry's Law", $K = p_{SO_2}/W$

W = Milligrams $SO_2$ absorbed by 5 $cm^3$ of the ether.

AUXILIARY INFORMATION

METHOD:/APPARATUS/PROCEDURE:

The apparatus had been previously described (1).

A weighed amount of liquid was treated with a measured volume of sulfur dioxide at a constant temperature and at a measured total pressure. A gas buret and a mercury manometer were used.

SOURCE AND PURITY OF MATERIALS:

(1) Not stated.

(2) Purified by distillation.

ESTIMATED ERROR:

REFERENCES:

1. Hill, A.E.
*J. Am. Chem. Soc.* 1931, *53*, 2598.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 1,4-Dimethoxybenzene (*hydroquinone dimethyl ether*); $C_8H_{10}O_2$; [150-78-7]
   1,3-Dimethoxybenzene (*resorcinol dimethyl ether*); $C_8H_{10}O_2$; [151-10-0]
   1,1'-Oxybis(2-methoxyethane) (*diglyme*); $C_6H_{14}O_3$; [111-96-6]

ORIGINAL MEASUREMENTS:

Sano, H.
*Nippon Kagaku Zasshi*
<u>1968</u>, *89*, 362-368.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

Vapor pressure of 1,1'-Oxybis(2-methoxyethane) = 0.002 atm

| Absorption coefficient, $S^a$ | Bunsen coefficient, α | Mole ratio | Mole fraction[b] |
|---|---|---|---|
| | 1,4-Dimethoxybenzene | | |
| 116.2 | 105.5 | 0.625 | 0.385 |
| | 1,3-Dimethoxybenzene | | |
| 102.6 | 96.3 | 1.02 | 0.505 |
| | 1,1'-Oxybis(2-methoxyethane) | | |
| 177.6 | 96.3 | 0.345 | 0.257 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static absorption method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Acetic acid, phenylmethyl ester, (benzyl acetate); $C_9H_{10}O_2$; [140-11-4] or Benzoic acid, phenylmethyl ester, (benzyl benzoate); $C_{14}H_{12}O_2$; [120-51-4]

ORIGINAL MEASUREMENTS:

Gerrard, W.; *"Solubility of Gases and Liquids,"* Plenum Press, New York, 1976, p. 239.

VARIABLES:

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | Weight of Component(2) g | Weight of $SO_2$ absorbed, g | Mole ratio $SO_2$ / Comp(2) | Mole fraction, $x_{SO_2}$ (Total Pressure = 1 atm) |
|---|---|---|---|---|
| | | Acetic acid, phenylmethyl ester | | |
| 293.15 | 6.1630 | 2.4370 | 0.928 | 0.481 |
| | | Benzoic acid,phenylmethyl ester | | |
| 293.15 | 7.2841 | 1.5875 | 0.723 | 0.420 |

760 mmHg = 1 atm = 101.325 kPa

AUXILIARY INFORMATION

METHOD:

Sulfur dioxide was bubbled into a weighed amount of component (2) in a bubbler tube. The amount of gas absorbed was determined by re-weighing the tube. The total pressure was barometric, very nearly 1 atm. See ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was the best grade contained in a small cylinder. Its high degree of purity was attested by the measurement of vapor pressure from 258-268 K.

2. The best commercial specimen was purified and attested.

ESTIMATED ERROR:

REFERENCES:

1. Gerrard, W. *J. Appl. Chem. Biotechnol.* 1972, *22*, 623.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 1,7,7-Trimethylbicyclo [2.2.1] heptan-2-one, (Camphor); $C_{10}H_{16}O$; [464-49-3]

ORIGINAL MEASUREMENTS:

Bineau, A.

*Ann. Chim. Phys.* 1848, (3), *24*, 326-337.

Information repeated in :

*J. Prakt. Chem.* 1849, *46*, 296-301.

VARIABLES:

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES: 760 mmHg = 1 atm = 101.325 kPa.

| T/K | Pressure, total /mmHg. | Weight of $SO_2$/ 100 g camphor | *Mole fraction $x_{SO_2}$ | * $x_{SO_2}$ (700 mmHg) | * $x_{SO_2}$ (760mmHg) |
|---|---|---|---|---|---|
| 297 | 524 | 25.5 | 0.377 | | |
| | 650 | 30.8 | 0.423 | | |
| | 745 | 35.4 | 0.457 | (0.440) | (0.46) |
| 294 | 670 | 34.7 | 0.452 | | |
| 293 | 730 | 39.7 | 0.485 | (0.472) | |
| 288.6 | 355 | 28.0 | 0.399 | | |
| | 744 | 47.6 | 0.531 | (0.513) | (0.536) |
| 287 | 611 | 40.4 | 0.490 | | |
| | 738 | 48.6 | 0.536 | (0.526) | (0.543) |
| 285.6 | 529 | 37.3 | 0.470 | | |
| | 703 | 49.1 | 0.538 | | |
| | 727 | 50.5 | 0.545 | (0.537) | (0.555) |
| 283 | 320 | 31.7 | 0.429 | | |
| | 560 | 42.6 | 0.503 | | |
| | 720 | 55.8 | 0.570 | (0.562) | (0.582) |
| 281 | 304 | 33.0 | 0.439 | | |
| | 503 | 42.0 | 0.499 | | |
| | 682 | 57.4 | 0.577 | (0.582) | (0.605) |
| 277 | 490 | 46.0 | 0.522 | | |
| | 720 | 73.6 | 0.636 | (0.626) | (0.656) |
| 275 | 469 | 48.4 | 0.535 | | |
| | 650 | 72.0 | 0.631 | - | (0.690) |

* Calculated by compiler. The column $x_{SO_2}$ (700 mmHg) is based on the weight value of Bineau estimated for 700 mmHg. The corresponding column for $x_{SO_2}$ (760 mmHg) shows a value read from the compiler's graph.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

No information

SOURCE AND PURITY OF MATERIALS:

No information.

ESTIMATED ERROR:

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. 1,7,7-Trimethylbicyclo [2.2.1] heptan-2-one, (Camphor); $C_{10}H_{16}O$; [464-49-3] | Schulze, H.<br>*J. Prakt. Chem.* 1881, *24*, 168-183. |
| VARIABLES: | PREPARED BY:<br>W. Gerrard. |

EXPERIMENTAL VALUES:

760 mmHg = 1 atm = 101.325 kPa.

| T/K | Weight of $SO_2$ / 1 g of Comp. (2) | *Mole ratio $SO_2$/Comp. (2) | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| 273.15 | 0.880 | 2.090 | 0.676 |

* Calculated by compiler.

Pressure of $SO_2$ stated to be 725 mmHg. 1 Volume of camphor absorbed 308 volumes of $SO_2$.

NOTE: Schulze quoted three values by Bineau; but one reference was wrong, and the other did not appear to apply. Bineau's data have been compiled. Markham and Kobe (1) cited only the Bineau group; but attributed it to Schulze. Bineau's name was not mentioned.

AUXILIARY INFORMATION

| METHOD/APPARATUS/PROCEDURE: | SOURCE AND PURITY OF MATERIALS: |
|---|---|
| The gas was passed into a weighed amount of liquid camphor in a thin-walled test-tube fitted with a rubber stopper carrying an inlet tube and an out-let tube. The test-tube was cooled in melting snow. The amount of gas absorbed was determined by weighing. | No details given. |
| | ESTIMATED ERROR: |
| | REFERENCES:<br>1. Markham, A.E.; Kobe, K.A. *Chem. Rev.* 1941, *28*, 519. |

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. 1,7,7-Trimethylbicyclo[2.2.1]-heptan-2-one (*camphor*); $C_{10}H_{16}O$; [76-22-2] or [464-49-3] | Sano, H.<br>*Nippon Kagaku Zasshi*<br>1968, *89*, 362-368. |
| VARIABLES: | PREPARED BY:<br>C. L. Young |

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

| Bunsen coefficient, α | Mole ratio | Mole fraction[a] |
|---|---|---|
| 99.0 | 0.670 | 0.401 |

[a] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static absorption method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 1,7,7-Trimethylbicyclo [2.2.1] heptan-2-one, (Camphor); $C_{10}H_{16}O$ (in solution); [469-49-3]

ORIGINAL MEASUREMENTS:

Weissenberger, G.; Hadwiger, H.

*Z. angew. Chem.* 1927, *40*, 734-736.

VARIABLES:

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

T/K = 293.15

| "Percent solution of camphor" | Solvent | Vol. of 1 mole of mixture /$cm^3$ | Vol. $SO_2$ absorbed /$cm^3$ $mol^{-1}$ (soln) |
|---|---|---|---|
| 10 | *Tetrahydro-naphthalene<br>$C_{10}H_{12}$;<br>[119-64-2] | 141.1 | 1001.81 |
| 10 | Cyclohexanone<br>$C_6H_{10}O$;<br>[108-94-1] | 111.67 | 1697.38 |
| 20 | Cyclohexanone | 120.09 | 1765 |
| 10 | 1,3-Methylcyclo-hexanol<br>$C_8H_{16}O$; | 130.9 | 2264.57 |
| 20 | 1,3-Methylcyclo-hexanol | 137.18 | 1508.98 |

* Tetrahydronaphthalene itself was stated to absorb no measurable volume of gas.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Used an absorption vessel of 200 $cm^3$ capacity, and a vessel with a two-way tap. Simply stated that the absorptiometer was like that used by Manchot, but the reference was not cited; probably ref. (1).

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

REFERENCES:

1. Manchot, W.
*Z. anorg. Chem.* 1924, *141*, 38.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 2,5,8,11,14-Pentaoxapentadecane, (Tetraethylene glycol dimethyl ether); $C_{10}H_{22}O_5$; [143-24-8]

ORIGINAL MEASUREMENTS:

Albright, L.F.; Shannon, P.T., Yu, S.-N.; Chueh, P.L.

*Chem. Engng. Prog. Symp. Ser.* 1963, *59*, (44), 66-74.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | $P$/bar | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ | T/K | $P$/bar | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ |
|---|---|---|---|---|---|
| 298.15 | 0.042 | 0.157 | 310.93 | 5.03 | 0.925 |
| | 0.086 | 0.253 | 338.71 | 0.245 | 0.157 |
| | 0.159 | 0.361 | | 0.448 | 0.252 |
| | 0.283 | 0.484 | | 0.830 | 0.358 |
| | 0.834 | 0.671 | | 1.52 | 0.484 |
| | 2.36 | 0.841 | | 3.65 | 0.672 |
| | 2.45 | 0.844 | | 3.76 | 0.676 |
| | 3.31 | 0.926 | | 7.91 | 0.833 |
| 310.93 | 0.085 | 0.157 | | 10.9 | 0.921 |
| | 0.155 | 0.253 | 366.48 | 0.597 | 0.157 |
| | 0.283 | 0.359 | | 1.091 | 0.251 |
| | 0.508 | 0.483 | | 1.98 | 0.355 |
| | 1.52 | 0.683 | | 2.35 | 0.476 |
| | 1.55 | 0.687 | | 7.36 | 0.658 |
| | 3.59 | 0.838 | | 14.55 | 0.830 |
| | 3.69 | 0.841 | | 20.31 | 0.915 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell fitted with Bourdon pressure gauge. Temperature measured with mercury in glass thermometer. The equipment used in this investigation was stated to be similar to that used in previous studies, (1), (2).

SOURCE AND PURITY OF MATERIALS:

1. and 2. Commercial grade samples, no other details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/\text{bar} = \pm 0.3$; $\delta x_{SO_2} = \pm 1\%$.

REFERENCES:

1. Albright, L. F.; Shannon, P. T.; Terrier, F.; Chueh, P. L. *Am. Inst. Chem. Engrs. J.* 1962, *8*, 668.
2. Albright, L. F.; Buclez, P. C.; Pluche, C. R.; Doody, T. C. *ASHRAE Trans.* 1960, *66*, 423.

COMPONENTS:

1. Sulfur dioxide, $SO_2$; [7446-09-5]
2. Dodecanoic acid, ethyl ester (Ethyl laurate); $C_{14}H_{28}O_2$; [106-33-2]

ORIGINAL MEASUREMENTS:

Albright, L.F.; Shannon, P.T.;

Yu, S.-N.;Chueh, P.L.

*Chem. Engng. Prog. Symp. Ser.* 1963, *59*, (44) 66-74.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young.

EXPERIMENTAL VALUES:

| T/K | P/bar | Mole fraction of sulfur dioxide in liquid $x_{SO_2}$ |
|---|---|---|
| 298.15 | 1.45 | 0.453 |
| | 2.48 | 0.638 |
| | 3.45 | 0.839 |
| | 3.51 | 0.846 |
| 310.93 | 2.14 | 0.448 |
| | 3.69 | 0.626 |
| | 5.07 | 0.839 |
| | 5.21 | 0.844 |
| 338.71 | 4.30 | 0.432 |
| | 7.10 | 0.615 |
| | 10.78 | 0.828 |
| | 10.87 | 0.841 |
| 366.48 | 7.31 | 0.412 |
| | 11.85 | 0.591 |
| | 19.55 | 0.824 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell fitted with Bourdon pressure gauge. Temperature measured with mercury in glass thermometer. The equipment used in this investigation was stated to be similar to that used in previous studies, (1), (2).

SOURCE AND PURITY OF MATERIALS:

1 and 2. Commercial grade samples, no other details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/bar = \pm 0.3$; $\delta x_{SO_2} = \pm 1\%$.

REFERENCES:

1. Albright, L. F.; Shannon, P. T.; Terrier, F.; Chueh, P. L. *Am. Inst. Chem. Engrs. J.* 1962, *8*, 668.
2. Albright, L.F.; Buclez, P. C.; Pluche, C. R.; Doody, T. C. *ASHRAE Trans.* 1960, *66*, 423.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Polyethylene glycol (α-*hydro-ω-hydroxy-poly(oxy-1,2-ethanediyl)*); $(C_2H_4O)_nH_2O$; [25322-68-3] | Sano, H.<br>*Nippon Kagaku Zasshi*<br>1968, *89*, 362-368. |
| VARIABLES: | PREPARED BY:<br>C. L. Young |

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

| Bunsen coefficient, α | Mole ratio | Mole fraction[a] |
|---|---|---|
| 140.8 | 0.295 | 0.228 |

[a] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static absorption method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

2. Molecular weight 400.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

| COMPONENTS: | EVALUATOR: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Compounds containing nitrogen | Colin L. Young,<br>School of Chemistry,<br>University of Melbourne,<br>Parkville, Victoria 3052,<br>Australia.<br>December 1982 |

CRITICAL EVALUATION:

*N,N*-Dimethylformamide; $C_2H_7NO$; [68-12-2]

Measurements on this system have been reported by five groups of workers. The data of Gerrard (1) and Albright, Shannon, Yu and Church (2) are consistent with each other and broadly consistent with the isolated value from DuPont (3). Values of mole fraction of sulfur dioxide for smooth values of temperatures estimated from the data of refs. (1) and (2) are as follows:

| T/K | 273 | 283 | 293 | 298 | 303 | |
|---|---|---|---|---|---|---|
| $x_{SO_2}$ (total pressure = 1 atm) | 0.787 | 0.706 | 0.636 | 0.600 | 0.564 | |
| T/K | 313 | 323 | 333 | 343 | 353 | 363 |
| $x_{SO_2}$ (total pressure = 1 atm) | 0.494 | 0.425 | 0.363 | 0.307 | 0.259 | 0.218 |

The data of Pfeifer (4) deviate considerably from these values at low temperatures but agree at 333 K. The isolated data of Sano (5) agrees with that of Pfeifer at 303 K.

The isolated value of Benoit and Milanova (6) was determined at a low partial pressure and is not considered further as extrapolation on the basis of Henry's law to 1 atmosphere total pressure would not be valid.

Pyridine; $C_5H_5N$; [110-86-1]

This system has been investigated by three groups of workers. The isolated value of Benoit and Milanova (6) was determined at a low partial pressure and is not considered further as extrapolation on the basis of Henry's law to 1 atmosphere pressure would not be valid. Gerrard's (1) data extrapolated to a partial pressure of 1 atmosphere and 303 K is broadly consistent with the value found by Sano and Nakamoto (7).

Nitrobenzene; $C_6H_5NO_2$; [98-95-3]

This system has been investigated by six groups of workers (1,2,5, 6,8,9). The data of Lenoir *et al.* (8) was determined using gas chromatography and corresponds to a very low partial pressure of sulfur dioxide. It is considerably larger than the data of Lloyd (9), Albright *et al.* (2), and Gerrard (1) and is classified as doubtful. Similarly the data of Benoit and Milanova correspond to a low partial pressure of sulfur dioxide.

There is moderate agreement between the data of Gerrard (1), Albright *et al.* (2), and Lloyd (9). Because of the different ranges of pressure and temperature involved and the fact that considerable approximation was incurred in calculating mole fraction solubility from Lloyd's data (9), precise comparison is not possible and the data are classified as tentative. The value of Sano (5) is considerably larger than the value of Lloyd at the same temperature.

*N,N*-Dimethylbenzenamine; $C_8H_{11}N$; [121-69-7]

Hill and Fitzgerald (10) gave data for this compound as mole ratio $SO_2$/Dimethylaniline for several pressures up to above 75 kPa at 298.15 K. Balej and Regner (11) used mixtures of nitrogen and sulfur dioxide to achieve different partial pressures of sulfur dioxide below about 35 kPa for temperatures 288 K, 293 K, 298 K and 313 K. There is qualitative agreement between the two sets of results where they overlap and both are classified as tentative. The isolated value of Sano and Nakamoto (7) is broadly consistent with the two sets of data but no precise comparison is possible.

(cont.)

| COMPONENTS: | EVALUATOR: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Compounds containing nitrogen | Colin L. Young,<br>School of Chemistry,<br>University of Meloburne,<br>Parkville, Victoria 3052,<br>Australia.<br>December 1982 |

CRITICAL EVALUATION:

References

1. Gerrard, W. *J. Appl. Chem. Biotechnol.* 1972, *22*, 623.
2. Albright, L. F.; Shannon, P. T.; Yu, S.-N.; Cheuh, P. L. *Chem. Engng. Prog. Symp. Ser.* 1963, *59*, 66.
3. DuPont de Nemours and Co. *Chem. Eng. New* 1955, *33*, 2366.
4. Pfeifer, G. *Magy. Kem. Folyoirat.* 1963, *69*, No. 3, 138.
5. Sano, H. *Nippon Kagaku Zasshi* 1968, *89*, 362.
6. Benoit, R. L.; Milanova, E. *Can. J. Chem.* 1979, *57*, 1319.
7. Sano, H.; Nakamoto, Y. *Nippon Kagaku Zasshi* 1968, *89*, 369.
8. Lenoir, J.-Y.; Renault, P.; Renon, H.*J. Chem. Engng. Data* 1971, *16*, 340.
9. Lloyd, S. J. *J. Phys. Chem.* 1918, *22*, 300.
10. Hill, A. E.; Fitzgerald, T. B. *J. Am. Chem. Soc.* 1935, *57*, 250.
11. Balej, J.; Regner, A. *Chem. Listy* 1956, *50*, 1374.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Formamide; $CH_3NO$; [75-12-7]

ORIGINAL MEASUREMENTS:

Sano, H.; Nakamoto, Y.

*Nippon Kagaku Zasshi*

1968, *89*, 369-373.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

Vapor pressure of formamide = 0.001 atm

| Absorption coefficient, $S^{a,b}$ | Bunsen coefficient,$^b$ $\alpha$ | Bunsen coefficient,$^c$ $\alpha$ | $\ell^{c,d}$ | Mole ratio | Mole fraction$^e$ |
|---|---|---|---|---|---|
| 175.2 | 160.0 | 159.2 | 158.0 | 0.286 | 0.222 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Determined by static absorption method.

[c] Determined by flow method.

[d] $\alpha = \ell(1 - p_s^\circ)$ where $p_s^\circ$ is the vapor pressure of solvent.

[e] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two techniques were used: (a) static absorption method and (b) flow method. Static method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The flow method consists of passing sulfur dioxide through a micro gas absorption tube and estimating sulfur dioxide by iodometric titration. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

**COMPONENTS:**

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Nitromethane; $CH_3NO_2$; [75-52-5]

   Nitrobenzene; $C_6H_5NO_2$; [98-95-3]

**ORIGINAL MEASUREMENTS:**

Sano, H.

*Nippon Kagaku Zasshi*

1968, *89*, 362-368.

**VARIABLES:**

**PREPARED BY:**

C. L. Young

**EXPERIMENTAL VALUES:**

T/°C = 30 T/K = 303

Vapor pressure of nitromethane = 0.042 atm

| Absorption coefficient, $s^{a,b}$ | Bunsen coefficient,[b] α | Bunsen coefficient,[c,f] α | $\ell^{c,d}$ | Mole ratio | Mole fraction[e] |
|---|---|---|---|---|---|
| | Nitromethane; | $CH_3NO_2$, | [75-52-5] | | |
| 150.5 | 142.0 | 149.3 | 143.5 | 0.531 | 0.347 |
| | Nitrobenzene; | $C_6H_5NO_2$; | [98-95-3] | | |
| 70.4 | 64.1 | 65.0 | 65.0 | 0.500 | 0.333 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Determined by static absorption method.

[c] Determined by flow method.

[d] $\alpha = \ell(1 - p_s^\circ)$ where $p_s^\circ$ is the vapor pressure of solvent.

[e] Calculated by compiler.

[f] Assuming the vapor pressure of nitrobenzene is negligible.

## AUXILIARY INFORMATION

**METHOD/APPARATUS/PROCEDURE:**

Two techniques were used: (a) static absorption method and (b) flow method. Static method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The flow method consists of passing sulfur dioxide through a micro gas absorption tube and estimating sulfur dioxide by iodometric titration. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

**SOURCE AND PURITY OF MATERIALS:**

1. Purity 99.0-99.8 mole per cent.

**ESTIMATED ERROR:**

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

**REFERENCES:**

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Nitromethane; $CH_3NO_2$; [75-52-5]

ORIGINAL MEASUREMENTS:

Benoit, R.L.; Milanova, E.

*Can. J. Chem.*, 1979, *59*, 1319-1323

VARIABLES:

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | Henry's law constant$^+$ $H$/atm |
|---|---|
| 298.15 | 2.33 |

$^+$ Defined in the original as

$$H = \frac{\text{partial pressure of sulfur dioxide}}{\text{mole fraction of sulfur dioxide}}$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Few details given. Pressure measured with quartz spiral gauge. Partial pressure calculated assuming Raoult's law. Concentration of sulfur dioxide determined by iodometric titration. Concentration of sulfur dioxide ranged from 0.1 to 0.8 mol $l^{-1}$

SOURCE AND PURITY OF MATERIALS:

1. Anhydrous sample from Canadian Liquid Air, purity 99.98 mole per cent.

2. Dried over 4A molecular sieve

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta H/\text{atm} = \pm 4\%$ (estimated by compiler)

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Nitriles

ORIGINAL MEASUREMENTS:

Sano, H.
*Nippon Kagaku Zasshi*
1968, *89*, 362-368.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

Vapor pressure of benzonitrile = 0.001 atm

| Absorption coefficient, $S^{a,b}$ | Bunsen coefficient,$^b$ $\alpha$ | Bunsen coefficient,$^{c,f}$ $\alpha$ | $\ell^{c,d}$ | Mole ratio | Mole fraction$^e$ |
|---|---|---|---|---|---|
| | | Acetonitrile; $C_2H_3N$; [75-05-8] | | | |
| - | - | 175.7 | - | 0.920 | 0.479 |
| | | Benzonitrile; $C_7H_5N$; [100-47-0] | | | |
| 82.9 | 75.3 | 75.8 | 75.7 | 0.509 | 0.337 |
| | | Benzyl cyanide (Benzeneacetonitrile); $C_8H_7N$; [140-29-4] | | | |
| 98.3 | 89.3 | 90.2 | 90.2 | 0.781 | 0.439 |

## AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two techniques were used: (a) static absorption method and (b) flow method. Static method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The flow method consists of passing sulfur dioxide through a micro gas absorption tube and estimating sulfur dioxide by iodometric titration. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Nitriles | Sano, H.<br>*Nippon Kagaku Zasshi*<br>1968, *89*, 362-368. |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Determined by static absorption method.

[c] Determined by flow method.

[d] $\alpha = \ell(1 - p_s^\circ)$ where $p_s^\circ$ is the vapor pressure of solvent.

[e] Calculated by compiler.

[f] Assuming the vapor pressure of benzyl cyanide is negligible.

| | |
|---|---|
| COMPONENTS:<br>1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Acetonitrile; $C_2H_3N$; [75-05-8] | ORIGINAL MEASUREMENTS:<br>Benoit, R.L.; Milanova, E.<br>*Can. J. Chem.*, 1979, *57*, 1319-1323 |
| VARIABLES: | PREPARED BY:<br>C.L. Young |

EXPERIMENTAL VALUES:

| T/K | Henry's law constant$^+$ $H$/atm |
|---|---|
| 298.15 | 1.91 |

$^+$ Defined in the original as

$$H = \frac{\text{partial pressure of sulfur dioxide}}{\text{mole fraction of sulfur dioxide}}$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Few details given. Pressure measured with quartz spiral gauge. Partial pressure calculated assuming Raoult's law. Concentration of sulfur dioxide determined by iodometric titration. Concentration of sulfur dioxide ranged from 0.2 to 1.4 mol $l^{-1}$

SOURCE AND PURITY OF MATERIALS:

1. Anhydrous sample from Canadian Liquid Air, purity 99.98 mole per cent.

2. Dried over 4A molecular sieve

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta H/\text{atm} = \pm 4\%$
(estimated by compiler)

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. *N,N*-Dimethylformamide; $C_3H_7NO$; [68-12-2] | DuPont de Nemours and Co.<br>*Chem. Eng. New.* 1955, *33*, 2366. |
| VARIABLES: | PREPARED BY:<br>W. Gerrard |

EXPERIMENTAL VALUES:

1 atm = 101.325 kPa

| T/K | Volume of $SO_2$ (adjusted to 273.15 K and 1 atm) absorbed by 1 volume of *N,N*-dimethylformamide at 298.15 K and $p_{SO_2}$ = 1 atm. | *Mole ratio $SO_2$/DMF | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| 298.15 | 405 | 1.432 | 0.589 |

$d_4^{25}$ taken to be 0.9445 g $cm^{-3}$

* Calculated by compiler.

Molar volume $SO_2$ at 273.15 K and 1 atm taken to be 21885 $cm^3$, based on the published density.

AUXILIARY INFORMATION

| METHOD/APPARATUS/PROCEDURE: | SOURCE AND PURITY OF MATERIALS: |
|---|---|
| No stated. | Not stated. |
| | ESTIMATED ERROR: |
| | REFERENCES: |

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]

2. *N*,*N*-Dimethylformamide; $C_3H_7NO$; [68-12-2]

ORIGINAL MEASUREMENTS:

Pfeifer, Gyula,

*Magy. Kem. Folyoirat.* 1963, *69*, No. 3. 138-141.

VARIABLES:

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES: 1 atm = 760 mmHg = 101.325 kPa.

| T/K | ml $SO_2$/g DMF | $p_{SO_2}$/mmHg | *M.R. | *M.F.$x_{SO_2}$ |
|---|---|---|---|---|
| 293.15 | 159 | 135 | 0.531 | 0.347 |
| | 177 | 155 | 0.591 | 0.372 |
| | 195 | 179 | 0.651 | 0.394 |
| | 231 | 225 | 0.772 | 0.435 |
| | 258 | 270 | 0.862 | 0.463 |
| | 284 | 314 | 0.949 | 0.487 |
| | 307 | 357 | 1.025 | 0.506 |
| | 332 | 401 | 1.109 | 0.526 |
| | 350 | 431 | 1.169 | 0.539 |
| | 382 | 512 | 1.276 | 0.561 |
| | 402 | 582 | 1.343 | 0.573 |
| | 414 | 660 | 1.383 | 0.580 |
| | 424 | 758 | 1.416 | 0.586 |
| | 428 | 842 | 1.430 | 0.588 |
| | (424) | (760) | (1.416) | (0.586) |
| 303.15 | 125 | 177 | 0.4175 | 0.295 |
| | 141 | 207 | 0.471 | 0.320 |
| | 160 | 235 | 0.534 | 0.348 |
| | 180 | 270 | 0.601 | 0.376 |
| | 216 | 334 | 0.721 | 0.419 |
| | 240 | 384 | 0.802 | 0.445 |
| | 262 | 425 | 0.875 | 0.467 |
| | 281 | 475 | 0.939 | 0.484 |
| | 308 | 641 | 1.029 | 0.507 |
| | 313 | 745 | 1.045 | 0.511 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A known volume of gas was added to the evacuated absorption vessel containing a known amount of component (2). After equilibrium, pressure and decrease in volume of gas were measured. The vapor pressure was measured by Smith-Menzies isoteniscopic method.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was probably of acceptable purity.

2. Dried and distilled; $d^{20}$ = 0.950 g $ml^{-1}$

ESTIMATED ERROR:

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5] | Pfeifer, Gyula, |
| 2. *N*,*N*-Dimethylformamide;<br>$C_3H_7NO$; [68-12-2] | *Magy. Kem. Folyoirat*, 1963, *69*,<br>No. 3, 138-141. |

EXPERIMENTAL VALUES: 1 atm = 760 mmHg = 101.325 kPa

| T/K | ml $SO_2$/g DMF | $p_{SO_2}$/mmHg | *M.R. | *M.F. $x_{SO_2}$ |
|---|---|---|---|---|
| 303.15 | 314 | 845 | 1.049 | 0.512 |
| | (313) | (760) | (1.045) | (0.511) |
| 313.15 | 124 | 210 | 0.414 | 0.293 |
| | 134 | 230 | 0.448 | 0.309 |
| | 164 | 292 | 0.548 | 0.354 |
| | 188 | 363 | 0.628 | 0.386 |
| | 214 | 423 | 0.715 | 0.417 |
| | 230 | 489 | 0.768 | 0.435 |
| | 237 | 511 | 0.792 | 0.442 |
| | 248 | 594 | 0.828 | 0.453 |
| | 254 | 715 | 0.848 | 0.459 |
| | 258 | 793 | 0.862 | 0.463 |
| | (257) | (760) | (0.858) | (0.462) |
| 323.15 | 86 | 225 | 0.287 | 0.223 |
| | 106 | 278 | 0.354 | 0.261 |
| | 117 | 315 | 0.391 | 0.281 |
| | 154 | 432 | 0.514 | 0.340 |
| | 157 | 454 | 0.524 | 0.344 |
| | 174 | 521 | 0.581 | 0.368 |
| | 192 | 610 | 0.641 | 0.391 |
| | 203 | 722 | 0.678 | 0.404 |
| | 208 | 795 | 0.695 | 0.410 |
| | (205) | (760) | (0.685) | (0.406) |
| 333.15 | 79 | 286 | 0.264 | 0.209 |
| | 94 | 343 | 0.314 | 0.239 |
| | 99 | 363 | 0.331 | 0.249 |
| | 116 | 444 | 0.387 | 0.279 |
| | 136 | 533 | 0.454 | 0.312 |
| | 149 | 612 | 0.498 | 0.332 |
| | 158 | 677 | 0.528 | 0.345 |
| | 164 | 719 | 0.548 | 0.354 |
| | (167) | (760) | (0.558) | (0.358) |

Vapor pressure, $p_{DMF}$, stated to be as follows:

| T/K: | 283.15 | 288.15 | 293.15 | 298.15 | 303.15 | 308.15 | 313.15 | 318.15 | 323.15 | 333.15 |
|---|---|---|---|---|---|---|---|---|---|---|
| mmHg: | 1.32 | 1.90 | 2.65 | 3.66 | 5.00 | 6.70 | 8.90 | 11.80 | 15.70 | 26.90 |

*M.R. Mole ratio $SO_2$/DMF, calculated by compiler.

*M.F. Mole fraction, $x_{SO_2}$, calculated by compiler.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. *N*,*N*-Dimethylformamide; $C_3H_7NO$; [68-12-2]

ORIGINAL MEASUREMENTS:

Albright, L.F.; Shannon, P.T.; Yu, S.-N.; Chueh, P.L.

*Chem. Engng. Prog. Symp. Ser.* 1963, *59*, (44), 66-74.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | $P$/bar | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ |
|---|---|---|
| 298.15 | 0.096 | 0.180 |
| | 0.317 | 0.407 |
| | 1.331 | 0.626 |
| | 2.661 | 0.799 |
| | 3.089 | 0.851 |
| 310.93 | 0.129 | 0.180 |
| | 0.517 | 0.407 |
| | 1.999 | 0.625 |
| | 4.033 | 0.798 |
| | 4.654 | 0.850 |
| | 4.585 | 0.851 |
| 338.71 | 0.328 | 0.180 |
| | 1.489 | 0.406 |
| | 4.420 | 0.620 |
| | 8.494 | 0.793 |
| | 9.956 | 0.847 |
| 366.48 | 0.845 | 0.180 |
| | 3.296 | 0.401 |
| | 8.722 | 0.609 |
| | 15.975 | 0.787 |
| | 18.733 | 0.841 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell fitted with Bourdon pressure gauge. Temperature measured with mercury in glass thermometer. The equipment used in this investigation was stated to be similar to that used in previous studies, (1), (2).

SOURCE AND PURITY OF MATERIALS:

1. and 2. Commercial grade samples, no other details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/\text{bar} = \pm 0.3$; $\delta x_{SO_2} = \pm 1\%$.

REFERENCES:

1. Albright, L. F.; Shannon, P. T.; Terrier, F.; Chueh, P. L. *Am. Inst. Chem. Engrs. J.* 1962, *8*, 668.
2. Albright, L. F.; Buclez, P. C.; Pluche, C. R.; Doody, T. C. *ASHRAE Trans.* 1960, *66*, 423.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. *N*,*N*-Dimethylformamide; $C_3H_7NO$; [68-12-2]

ORIGINAL MEASUREMENTS:

Gerrard, W.

*J. Appl. Chem. Biotechnol.* 1972, 22, 623-650.

VARIABLES:

Temperature, pressure

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | Total pressure /mmHg | Mole ratio $SO_2$/amide | Mole fraction * $x_{SO_2}$ | T/K | Total pressure /mmHg | Mole ratio $SO_2$/amide | Mole fraction * $x_{SO_2}$ |
|---|---|---|---|---|---|---|---|
| 273.15 | 760 | 3.70 | 0.787 | 293.15 | 200 | 0.758 | 0.431 |
| | 709 | 3.47 | 0.776 | | 127 | 0.590 | 0.371 |
| | 611 | 2.89 | 0.742 | 283.15 | 760 | 2.40 | 0.706 |
| | 527 | 2.48 | 0.712 | | 733 | 2.30 | 0.697 |
| | 330 | 1.69 | 0.627 | | 670 | 2.12 | 0.679 |
| | 167 | 1.13 | 0.531 | | 614 | 1.97 | 0.663 |
| | 100 | 0.844 | 0.458 | | 530 | 1.78 | 0.640 |
| | 32 | 0.504 | 0.335 | | 479 | 1.60 | 0.615 |
| | 22 | 0.417 | 0.294 | | 368 | 1.36 | 0.576 |
| | 7 | 0.230 | 0.187 | | 275 | 1.13 | 0.531 |
| | | | | | 132 | 0.728 | 0.421 |
| 293.15 | 760 | 1.75 | 0.636 | | 87 | 0.549 | 0.354 |
| | 695 | 1.66 | 0.624 | | 65 | 0.367 | 0.268 |
| | 581 | 1.55 | 0.608 | | 35 | 0.300 | 0.231 |
| | 491 | 1.37 | 0.578 | | 26 | 0.275 | 0.216 |
| | 404 | 1.21 | 0.548 | | | | |
| | 300 | 0.990 | 0.497 | 298.15 | 760 | 1.50 | 0.600 |

1 atm = 760 mmHg = 101.325 kPa.

* Calculated by compiler

NOTE The pressure/solubility values are the basis of the plots given in the original.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was bubbled into a weighed amount of component (2) in a bubbler tube as described in detail, diagram given, in the original paper. The amount of gas absorbed at equilibrium and at the observed temperature and pressure was weighed. By means of a manometer assembly, to which the bubbler tube was attached, the weight of gas absorbed at successively lower pressure was measured. Eventually the pressure was reduced to that of the component (2). The refractive index, and the infrared spectrum of the residue showed it to be essentially pure component (2).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was the best grade contained in a small cylinder. Its high purity was attested by the measurement of vapor pressure from 258 to 268 K.
2. The best obtainable specimen was carefully purified and rigorously attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Dimethylformamide; $C_3H_7NO$; [68-12-2]

ORIGINAL MEASUREMENTS:

Sano, H.
*Nippon Kagaku Zasshi*
1968, *89*, 362-368.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

| Bunsen coefficient, α | Mole ratio | Mole fraction[a] |
|---|---|---|
| 303 | 1.05 | 0.512 |

[a] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static absorption method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. *N,N*-Dimethylformamide; $C_3H_7NO$; [68-12-2]

ORIGINAL MEASUREMENTS:

Benoit, R.L.; Milanova, E.

*Can. J. Chem.*, 1979, *57*, 1319-23

VARIABLES:

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | Henry's law constant$^+$ $H$/atm |
|---|---|
| 298.15 | 0.172 |

$^+$ Defined in the original as

$$H = \frac{\text{partial pressure of sulfur dioxide}}{\text{mole fraction of sulfur dioxide}}$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Few details given. Pressure measured with quartz spiral gauge. Partial pressure calculated assuming Raoult's law. Concentration of sulfur dioxide determined by iodometric titration. Concentration of sulfur dioxide ranged from 0.4 to 1.7 mol $l^{-1}$

SOURCE AND PURITY OF MATERIALS:

1. Anhydrous sample from Canadian Liquid Air, purity 99.98 mole per cent.
2. Dried over 4A molecular sieve

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta H/\text{atm} = \pm 4\%$
(estimated by compiler)

REFERENCES:

COMPONENTS:

1. Sulfur dioxide, $SO_2$; [7446-09-5]
2. *N*,*N*-Dimethylacetamide; $C_4H_9NO$; [127-19-5]

ORIGINAL MEASUREMENTS:

Albright, L.F.; Shannon, P.T.; Yu, S.-N. Chueh, P.L.

*Chem.Engng. Prog. Symp.Ser.* 1963, *59*, (44), 66-74.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | *P*/bar | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ |
|---|---|---|
| 298.15 | 0.021 | 0.105 |
| | 0.061 | 0.166 |
| | 0.127 | 0.297 |
| | 0.248 | 0.391 |
| | 1.207 | 0.625 |
| | 2.413 | 0.771 |
| 310.93 | 0.041 | 0.105 |
| | 0.094 | 0.166 |
| | 0.228 | 0.297 |
| | 0.417 | 0.391 |
| | 1.875 | 0.624 |
| | 3.65 | 0.769 |
| 338.71 | 0.137 | 0.105 |
| | 0.254 | 0.166 |
| | 0.614 | 0.294 |
| | 1.155 | 0.389 |
| | 4.247 | 0.619 |
| | 7.708 | 0.763 |
| 366.48 | 0.399 | 0.105 |
| | 0.665 | 0.166 |
| | 1.517 | 0.291 |
| | 1.551 | 0.293 |
| | 2.613 | 0.383 |
| | 8.239 | 0.611 |
| | 14.445 | 0.756 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell fitted with Bourdon pressure gauge. Temperature measured with mercury in glass thermometer. The equipment used in this investigation was stated to be similar to that used in previous studies, (1), (2).

SOURCE AND PURITY OF MATERIALS:

1. and 2. Commercial grade samples, no other details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/\text{bar} = \pm 0.3$;

$\delta x_{SO_2} = \pm 1\%$.

REFERENCES:

1. Albright, L. F.; Shannon, P. T.; Terrier, F.; Chueh, P. L. *Am. Inst. Chem. Engrs. J.* 1962, *8*, 668.
2. Albright, L. F.; Buclez, P. C.; Pluche, C. R.; Doody, T. C. *ASHRAE Trans.* 1960, *66*, 423.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Amines

ORIGINAL MEASUREMENTS:

Sano, H.; Nakamoto, Y.

*Nippon Kagaku Zasshi*

1968, *89*, 369-373.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES: T/°C = 30 T/K = 303

| Absorption coefficient, *S*[a] | Bunsen coefficient, α | Mole ratio | Mole fraction[b] |
|---|---|---|---|
| 1-Butanamine (*butylamine*); $C_4H_{11}N$; [109-73-9] | | | |
| - | 350 | 1.6 | 0.615 |
| *N,N*-Dibutylbutanamine (*tributylamine*); $C_{12}H_{27}N$; [102-82-9] | | | |
| 206.1 | 187.5 | 2.02 | 0.669 |
| 2-Aminoethanol (*monoethanolamine*); $C_2H_7NO$; [141-43-5] | | | |
| - | 380 | 1.1 | 0.52 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static absorption method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

| | |
|---|---|
| COMPONENTS:<br>1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Pyridine; $C_5H_5N$; [110-86-1]<br>Methylpyridine (*Picoline*); $C_6H_7N$; [1333-41-1]<br>Quinoline; $C_9H_7N$; [91-22-5] | ORIGINAL MEASUREMENTS:<br>Sano, H.; Nakamoto, Y.<br>*Nippon Kagaku Zasshi*<br>1968, *89*, 369-373. |
| VARIABLES: | PREPARED BY:<br>C. L. Young |

EXPERIMENTAL VALUES: T/°C = 30 T/K = 303

| Bunsen coefficient, α | Mole ratio | Mole fraction[a] |
|---|---|---|
| | Pyridine | |
| 424 | 1.54 | 0.606 |
| | Methylpyridine | |
| 335.5 | 1.47 | 0.595 |
| | Quinoline | |
| 229.5 | 1.21 | 0.549 |

[a] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static absorption method consisted or equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Pyridine; $C_5H_5N$; [110-86-1]

ORIGINAL MEASUREMENTS:

Gerrard, W.

*J. Appl. Chem. Biotechnol.* 1972, *22*, 623-650.

VARIABLES:

Temperature, pressure

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | Total pressure /mmHg | Mole ratio $SO_2$/ $C_5H_5N$ | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| 273.15 | **760 | 3.40 | 0.773 |
| | 735 | 3.35 | 0.770 |
| | 658 | 3.02 | 0.751 |
| | 580 | 2.62 | 0.724 |
| | 520 | 2.37 | 0.703 |
| | 312 | 1.70 | 0.630 |
| | 261 | 1.56 | 0.609 |
| | 102 | 1.13 | 0.531 |
| 283.15 | 757 | 2.26 | 0.693 |
| 293.15 | 757 | 1.70 | 0.630 |
| 298.15 | 757 | 1.56 | 0.609 |

** The plot of pressure vs solubility in the original paper is based on these data.

760 mmHg = 1 atm = 101.325 kPa.

* Calculated by compiler

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was bubbled into a weighed amount of component (2) in a bubbler tube as described in detail, diagram given, in the original paper. The amount of gas absorbed at equilibrium and at the observed temperature and pressure was weighed. By means of a manometer assembly, to which the bubbler tube was attached, the weight of gas absorbed at successively lower pressure was measured. Eventually the pressure was reduced to that of the component (2). The refractive index, and the infrared spectrum of the residue showed it to be essentially pure component (2).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was the best grade contained in a small cylinder. Its high purity was attested by the measurement of vapor pressure from 258 to 268 K.
2. The best obtainable specimen was carefully purified and rigorously attested.

ESTIMATED ERROR:

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Pyridine; $C_5H_5N$; [110-86-1] | Benoit, R.L.; Milanova, E.<br>*Can. J. Chem.*, 1979, *57*, 1319-23 |
| VARIABLES: | PREPARED BY:<br>C.L. Young |

EXPERIMENTAL VALUES:

| T/K | Henry's law constant[+] *H*/atm |
|---|---|
| 298.15 | 0.088 |

[+] Defined in the original as

$$H = \frac{\text{partial pressure of sulfur dioxide}}{\text{mole fraction of sulfur dioxide}}$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Few details given. Pressure measured with quartz spiral gauge. Partial pressure calculated assuming Raoult's law. Concentration of sulfur dioxide determined by iodometric titration. Concentration of sulfur dioxide range from 0.5 to 1.2 mol $l^{-1}$

SOURCE AND PURITY OF MATERIALS:

1. Anhydrous sample from Canadian Liquid Air, purity 99.98 mole per cent.

2. Dried over 4A molecular sieve

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta H/\text{atm} = \pm 4\%$ (estimated by compiler)

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 1-Methyl-2-pyrrolidinone (*N-Methylpyrrolidone*); $C_5H_9NO$; [872-50-4]

ORIGINAL MEASUREMENTS:

Sano, H.
*Nippon Kagaku Zasshi*
1968, *89*, 362-368.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

| Absorption coefficient, $S^a$ | Bunsen coefficient, $\alpha$ | Mole ratio | Mole fraction$^b$ |
|---|---|---|---|
| 340.3 | 309.6 | 1.52 | 0.603 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static absorption method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Nitrobenzene; $C_6H_5NO_2$; [98-95-3]

ORIGINAL MEASUREMENTS:

Lloyd, S.J.

*J. Phys. Chem.* 1918, *22*, 300-302

VARIABLES:

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | Weight of $SO_2$ per $dm^3$ of solution /g. | *Speculative values<br>*Mole ratio, $SO_2$/Comp. (2) | *Mole fraction (as for 1 atm) $x_{SO_2}$ |
|---|---|---|---|
| 288.15 | 311.4 | 0.668 | 0.400 |
| 293.15 | 267.4 | 0.549 | 0.355 |
| 298.15 | 227.9 | 0.451 | 0.311 |
| 303.15 | 190.0 | 0.364 | 0.267 |
| 313.15 | 132.0 | 0.241 | 0.194 |
| 323.15 | 98.7 | 0.177 | 0.150 |
| 333.15 | 78.6 | 0.139 | 0.122 |

760 mmHg = 1 atm = 101.325 kPa

* Calculated by compiler by assuming that the volume of solution is the same as the volume of the component (2) before absorption of gas.

AUXILIARY INFORMATION

METHOD:/APPARATUS/PROCEDURE:

Gas was bubbled through component (2) in a long graduated tube of small diameter. After equilibrium had been attained at a total pressure of about 1 atm (barometric pressure, 756-760 mmHg), the volume of the solution (about $5 cm^3$) was measured, and the weight of absorbed sulfur dioxide was determined by an iodometric titration.

SOURCE AND PURITY OF MATERIALS:

(1) Prepared from concentrated sulfuric acid and a saturated aqueous solution of sodium bisulfite. Dried by sulfuric acid and phosphorus pentoxide.

(2) Distilled, dried by calcium chloride, and redistilled before use.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Nitrobenzene; $C_6H_5NO_2$; [98-95-3]

ORIGINAL MEASUREMENTS:

Albright, L.F.; Shannon, P.T.; Yu, S.-N.; Chueh, P.L.

*Chem. Engng. Prog. Symp. Ser.* 1963, *59*, (44), 66-74.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | $P$/bar | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ |
|---|---|---|
| 298.15 | 1.32 | 0.371 |
| | 2.16 | 0.569 |
| | 3.30 | 0.842 |
| | 3.39 | 0.843 |
| 310.93 | 1.97 | 0.367 |
| | 3.25 | 0.565 |
| | 5.05 | 0.841 |
| 338.71 | 4.03 | 0.355 |
| | 6.65 | 0.549 |
| | 10.65 | 0.837 |
| 366.48 | 7.12 | 0.340 |
| | 11.68 | 0.515 |
| | 19.87 | 0.828 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell fitted with Bourdon pressure gauge. Temperature measured with mercury in glass thermometer. The equipment used in this investigation was stated to be similar to that used in previous studies, (1), (2).

SOURCE AND PURITY OF MATERIALS:

1. and 2. Commercial grade samples, no other details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta P/\text{bar} = \pm 0.3$; $\delta x_{SO_2} = \pm 1\%$.

REFERENCES:

1. Albright, L. F.; Shannon, P. T.; Terrier, F.; Chueh, P. L. *Am. Inst. Chem. Engrs. J.* 1962, *8*, 668.
2. Albright, L. F.; Buclez, P. C.; Pluche, C. R.; Doody, T. C. *ASHRAE Trans.* 1960, *66*, 423.

COMPONENTS:

1. Sulfur dioxide, $SO_2$; [7446-09-5]
2. Nitrobenzene; $C_6H_5NO_2$; [98-95-3]

ORIGINAL MEASUREMENTS:

Lenoir, J-Y.; Renault, P.; Renon, H.

*J. Chem. Eng. Data.* 1971, *16*, 340-342

VARIABLES:

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | Henry's constant $H_{SO_2}$/atm | Mole fraction* at 1 atm |
|---|---|---|
| 298 | 1.64 | 0.610 |

* Calculated by compiler assuming a linear function of $p_{SO_2}$ vs $x_{SO_2}$, i.e. $x_{SO_2}$ (1 atm) = $1/H_{SO_2}$.

The authors gave "Henry's constant" as $$H_{SO_2} = \lim_{x_{SO_2}\to 0} \frac{f_{SO_2}(P,T)}{x_{SO_2}}$$

$x_{SO_2}$ is the mole fraction. $f_{SO_2}$ is the fugacity of $SO_2$ "in the equilibrium condition" of pressure and temperature. $H_{SO_2}$ is related to experimental chromatographic parameters based on the number of moles of solvent in the column, and the absolute retention time of the solute. Helium was the carrier gas.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A conventional gas-liquid chromatographic unit was used. The chromatograph was an IGC 12 M Intersmat model, equipped with a thermal conductivity detector. The temperature control was stated to be within ±0.1° C. The pressure drop in the column was measured by a mercury manometer. Helium was the carrier gas.

There is serious uncertainty in the estimation of accuracy.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was provided by l'Air Liquide, and had a stated purity of 99.9%. It was used as provided.
2. Provided by Touzart & Matignon and Serlabo, and stated to have a minimum purity of 99%. Distillation was carried out when necessary, and the refractive index was measured.

ESTIMATED ERROR:

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Nitrobenzene; $C_6H_5NO_2$; [98-95-3] | Gerrard, W.<br>*J. Appl. Chem. Biotechnol.* 1972, *22*, 623-650. |
| **VARIABLES:** | **PREPARED BY:** |
| Temperature, pressure | W. Gerrard |

EXPERIMENTAL VALUES:

| T/K | Pressure, total /mmHg | Mole ratio $SO_2$/Comp. (2) | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| 273.15 | 772 | 2.0 | 0.667 |
| 283.15 | 772 | 0.878 | 0.468 |
| 280.15 | 760 | 1.105 | 0.525 |
| | ** 733 | 1.040 | 0.510 |
| | 670 | 0.901 | 0.474 |
| | 593 | 0.745 | 0.427 |
| | 427 | 0.487 | 0.328 |
| | 285 | 0.291 | 0.225 |
| | 186 | 0.177 | 0.150 |
| | 51 | 0.042 | 0.040 |
| 293.15 | 772 | 0.545 | 0.353 |
| 298.15 | 772 | 0.45 | 0.310 |

** The plot of pressure vs solubility given in the original paper is based on these data.

760 mmHg = 1 atm = 101.325 kPa.

* Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was bubbled into a weighed amount of component (2) in a bubbler tube as described in detail, diagram given, in the original paper. The amount of gas absorbed at equilibrium and at the observed temperature and pressure was weighed. By means of a manometer assembly, to which the bubbler tube was attached, the weight of gas absorbed at successively lower pressure was measured. Eventually the pressure was reduced to that of the component (2). The refractive index, and the infrared spectrum of the residue showed it to be essentially pure component (2).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was the best grade contained in a small cylinder. Its high purity was attested by the measurement of vapor pressure from 258 to 268 K.
2. The best obtainable specimen was carefully purified and rigorously attested.

ESTIMATED ERROR:

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Nitrobenzene; $C_6H_5NO_2$; [98-95-3] | Benoit, R.L.; Milanova, E.<br>*Can. J. Chem.*, 1979, *57*, 1319-1323 |
| VARIABLES: | PREPARED BY:<br>C.L. Young |

EXPERIMENTAL VALUES:

| T/K | Henry's law constant⁺ $H$/atm |
|---|---|
| 298.15 | 3.18 |

⁺ Defined in the original as

$$H = \frac{\text{partial pressure of sulfur dioxide}}{\text{mole fraction of sulfur dioxide}}$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Few details given. Pressure measured with quartz spiral gauge. Partial pressure calculated assuming Raoult's law. Concentration of sulfur dioxide determined by iodometric titration. Concentration of sulfur dioxide ranged from 0.1 to 0.5 mol $l^{-1}$

SOURCE AND PURITY OF MATERIALS:

1. Anhydrous sample from Canadian Liquid Air, purity 99.98 mole per cent.

2. Dried over 4A molecular sieve

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta H/\text{atm} = \pm 4\%$
(estimated by compiler)

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Benzenamine (*aniline*); $C_6H_7N$; [62-53-3]
   *ar*-Methylbenzenamine (*toluidine* (*mixed*)); $C_7H_9N$; [26915-12-8]
   *ar*,*ar*-Dimethylbenzenamine (*xylidine* (*mixed*)); $C_8H_{11}N$; [1300-73-8]

ORIGINAL MEASUREMENTS:

Sano, H.; Nakamoto, Y.
*Nippon Kagaku Zasshi*
1968, *89*, 369-373.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

| Bunsen coefficient, α | Mole ratio | Mole fraction[a] |
|---|---|---|
| Benzeneamine | | |
| 274 | 1.14 | 0.534 |
| *ar*-Methylbenzenamine (mixture of isomers) | | |
| 241 | - | - |
| *ar*,*ar*-Dimethylbenzenamine (mixture of isomers) | | |
| 234 | - | - |

[a] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static absorption method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Benzonitrile; $C_7H_5N$; [100-47-0]

ORIGINAL MEASUREMENTS:

Gerrard, W.

*J. Appl. Chem. Biotechnol.* 1972, *22*, 623-650.

VARIABLES:

Temperature, pressure

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | Pressure, total /mmHg | Mole ratio $SO_2$/Comp.(2) | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| 273.15 | 754 | 2.19 | 0.687 |
| | ** 736 | 2.07 | 0.674 |
| | 712 | 1.93 | 0.659 |
| | 660 | 1.64 | 0.621 |
| | 577 | 1.30 | 0.565 |
| | 469 | 0.951 | 0.487 |
| | 343 | 0.633 | 0.388 |
| | 176 | 0.288 | 0.224 |
| | 71 | 0.0972 | 0.0886 |
| 283.15 | 754 | 1.01 | 0.502 |
| 293.15 | 754 | 0.629 | 0.386 |
| 298.15 | 754 | 0.50 | 0.333 |

760 = 1 atm = 101.325 kPa.

* Calculated by compiler

** Data on which the graph in the original paper is based.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was bubbled into a weighed amount of component (2) in a bubbler tube as described in detail, diagram given, in the original paper. The amount of gas absorbed at equilibirium and at the observed temperature and pressure was weighed. By means of a manometer assembly, to which the bubbler tube was attached, the weight of gas absorbed at successively lower pressure was measured. Eventually the pressure was reduced to that of the component (2). The refractive index, and the infrared spectrum of the residue showed it to be essentially pure component (2).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was the best grade contained in a small cylinder. Its high purity was attested by the measurement of vapor pressure from 258 to 268 K.
2. The best obtainable specimen was carefully purified and rigorously attested.

ESTIMATED ERROR:

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. 1-Methyl-2-nitrobenzene, (2-nitrotoluene); $C_7H_7NO_2$; [88-72-2] | Lloyd, S.J.<br>*J. Phys. Chem.* 1918, *22*, 300-302 |
| VARIABLES: | PREPARED BY:<br>W. Gerrard |

EXPERIMENTAL VALUES:

| T/K | Weight of $SO_2$ per $dm^3$ of solution /g. | *Speculative values<br>*Mole ratio, $SO_2$/ Comp.(2) | *Mole fraction (as for 1 atm) $x_{SO_2}$ |
|---|---|---|---|
| 288.15 | 290.8 | 0.711 | 0.415 |
| 293.15 | 236.0 | 0.545 | 0.353 |
| 298.15 | 192.2 | 0.426 | 0.299 |
| 303.15 | 160.7 | 0.347 | 0.258 |
| 313.15 | 118.5 | 0.248 | 0.199 |
| 323.15 | 87.0 | 0.178 | 0.151 |
| 333.15 | 68.8 | 0.140 | 0.123 |

760 mmHg = 1 atm = 101.325 kPa

* Calculated by compiler by assuming that the volume of solution is the same as the volume of the component (2) before absorption of gas.

AUXILIARY INFORMATION

METHOD:/APPARATUS/PROCEDURE:

Gas was bubbled through component (2) in a long graduated tube of small diameter. After equilibrium had been attained at a total pressure of about 1 atm (barometric pressure, 756-760 mmHg), the volume of the solution (about 5 $cm^3$) was measured, and the weight of absorbed sulfur dioxide was determined by an iodometric titration.

SOURCE AND PURITY OF MATERIALS:

(1) Prepared from concentrated sulfuric acid and a saturated aqueous solution of sodium bisulfite. Dried by sulfuric acid and phosphorus pentoxide.

(2) Distilled, dried by calcium chloride, and redistilled before use.

ESTIMATED ERROR:

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. *N*-Methylbenzenamine, (methylaniline); $C_7H_9N$; [100-61-8] | Hill, A.E.; Fitzgerald, T.B.<br>*J. Am. Chem. Soc.* 1935, *57*,250-254. |
| VARIABLES: | PREPARED BY:<br>W. Gerrard |

EXPERIMENTAL VALUES:

| T/K | Pressure, total, mmHg | Mole ratio $SO_2$/ component (2) | *Mole fraction, $x_{SO_2}$ |
|---|---|---|---|
| 298.15 | 2.0 | 0.00 | |
| | 19.5 | 0.124 | 0.110 |
| | 42.0 | 0.258 | 0.205 |
| | 72.5 | 0.396 | 0.284 |
| | 114.4 | 0.525 | 0.344 |
| | 166.1 | 0.652 | 0.395 |
| | 237.0 | 0.772 | 0.436 |
| | 329.0 | 0.896 | 0.473 |
| | 436.0 | 1.010 | 0.502 |
| | 552.5 | 1.115 | 0.527 |
| | (760.0) | | (0.560) Extrapolated by compiler. |

760 mmHg = 1 atm = 101.325 kPa

* Calculated by compiler.

AUXILIARY INFORMATION

METHOD:/APPARATUS/PROCEDURE:

The apparatus had been previously described (1).

A weighed amount of liquid was treated with a measured volume of sulfur dioxide at a constant temperature and at a measured total pressure. A gas buret and a mercury manometer were used.

SOURCE AND PURITY OF MATERIALS:

(1) Not specified.

(2) Purified by distillation.

ESTIMATED ERROR:

REFERENCES:

1. Hill, A.E. *J. Am. Chem. Soc.* 1931, *53*,2598.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. *N,N*-Dimethylbenzenamine, (*N,N*-dimethylaniline); $C_8H_{11}N$; [121-69-7] | Hill, A.E.; Fitzgerald, T.B.<br>*J. Am. Chem. Soc.* 1935, *57*, 250-254. |
| VARIABLES: | PREPARED BY:<br>W. Gerrard |

EXPERIMENTAL VALUES:

| T/K | Pressure, total mmHg | Mole ratio $SO_2$/ component (2) | *Mole fraction, $x_{SO_2}$ |
|---|---|---|---|
| 298.15 | 2.0 | 0.00 | |
| | 14.6 | 0.185 | 0.156 |
| | 30.0 | 0.362 | 0.266 |
| | 56.5 | 0.564 | 0.361 |
| | 106.0 | 0.770 | 0.435 |
| | 189.1 | 0.950 | 0.487 |
| | 290.2 | 1.090 | 0.522 |
| | 449.5 | 1.271 | 0.560 |
| | 575.0 | 1.400 | 0.583 |
| | (760.0) | | (0.610) Extrapolated by compiler. |

760 mmHg = 1 atm = 101.325 kPa

* Calculated by compiler.

AUXILIARY INFORMATION

| METHOD:/APPARATUS/PROCEDURE: | SOURCE AND PURITY OF MATERIALS: |
|---|---|
| The apparatus had been previously described (1).<br>A weighed amount of liquid was treated with a measured volume of sulfur dioxide at a constant temperature and at a measured total pressure. A gas buret and a mercury manometer were used. | (1) Not specified.<br>(2) Purified by distillation. |
| | ESTIMATED ERROR: |
| | REFERENCES:<br>1. Hill, A.E.<br>*J. Am. Chem. Soc.* 1931, *53*, 2598. |

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. *N*,*N*-Dimethylbenzenamine, (*N*,*N*-dimethylaniline); $C_8H_{11}N$; [121-69-7]

ORIGINAL MEASUREMENTS:

Balej, J.; Regner, A.
*Chem. Listy*, 1956, *50*, 1374-1380

*Collection Czech. Chem. Communs.* 1956, *21*, 1545-1552.

VARIABLES:

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES: 760 mmHg = 101.325 kPa.

| T/K | $p_{SO_2}$ /mmHg | Mole ratio SO /comp.(2) | $^*x_{SO_2}$ | T/K | $p_{SO_2}$ /mmHg | Mole ratio SO /Comp.(2) | $^*x_{SO_2}$ |
|---|---|---|---|---|---|---|---|
| 288.15 | 5.27 | 0.2238 | 0.1829 | 298.15 | 13.10 | 0.225 | 0.184 |
| | 12.30 | 0.3913 | 0.2812 | | 13.78 | 0.230 | 0.187 |
| | 14.19 | 0.4171 | 0.2943 | | 25.72 | 0.363 | 0.266 |
| | 21.51 | 0.5320 | 0.3473 | | 48.0 | 0.520 | 0.342 |
| | 30.30 | 0.6225 | 0.3837 | | 49.7 | 0.524 | 0.344 |
| | 48.70 | 0.7610 | 0.4321 | | 56.0 | 0.562 | 0.360 |
| | 63.4 | 0.8550 | 0.4609 | | 89.2 | 0.707 | 0.414 |
| | 78.6 | 0.8980 | 0.4731 | | 119.5 | 0.792 | 0.442 |
| | 83.6 | 0.9150 | 0.4778 | | 162.0 | 0.896 | 0.473 |
| | 95.0 | 0.9575 | 0.4891 | | 232.5 | 1.028 | 0.507 |
| | 121.0 | 1.029 | 0.507 | | | | |
| | 169.5 | 1.150 | 0.535 | 313.15 | 8.98 | 0.0703 | 0.0657 |
| | 220.5 | 1.243 | 0.554 | | 13.30 | 0.0910 | 0.0834 |
| 293.15 | 12.25 | 0.3031 | 0.2326 | | 25.80 | 0.1595 | 0.1376 |
| | 13.25 | 0.3122 | 0.2379 | | 36.30 | 0.2219 | 0.1816 |
| | 21.23 | 0.4240 | 0.2978 | | 39.10 | 0.2346 | 0.1900 |
| | 28.08 | 0.5075 | 0.3366 | | 43.00 | 0.2460 | 0.1974 |
| | 39.90 | 0.5838 | 0.3686 | | 58.5 | 0.3302 | 0.2482 |
| | 42.20 | 0.5975 | 0.3740 | | 93.5 | 0.4320 | 0.3017 |
| | 89.0 | 0.829 | 0.453 | | 103.95 | 0.4606 | 0.3153 |
| | 137.3 | 0.954 | 0.488 | | 154.9 | 0.5850 | 0.3691 |
| | 150.0 | 0.983 | 0.496 | | 158.0 | 0.5972 | 0.3739 |
| | 235.5 | 1.145 | 0.534 | | 246.0 | 0.7212 | 0.4190 |

$x_{SO_2}$ = mole fraction of $SO_2$. * Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Diagram given. See Hill and Fitzgerald (1). Separate streams of purified nitrogen and sulfur dioxide were mixed in a vessel containing glass wool covered with phosphorus pentoxide. The gaseous mixture was then passed into the absorption vessel and then to a sampling tap to enable the $SO_2$ content of the gas phase to be determined by an iodometric titration. The $SO_2$ content of the solution was likewise determined. The method was described as a dynamic one.

SOURCE AND PURITY OF MATERIALS:

1. Probably of satisfactory purity.
2. B.p. 192-193.5°C, probably at atmospheric pressure.

ESTIMATED ERROR:

REFERENCES:

1. Hill, A.E.; Fitzgerald, T.B. *J. Am. Chem. Soc.* 1935, *57*, 250.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. *N,N*-Dimethylbenzenamine (*N,N-dimethylaniline*); $C_8H_{11}N$; [121-69-7]
   Benzenemethanamine (*Benzylamine*); $C_7H_9N$; [100-46-9]

ORIGINAL MEASUREMENTS:

Sano, H.; Nakamoto, Y.
*Nippon Kagaku Zasshi*
1968, *89*, 369-373.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

| Absorption coefficient, $S^a$ | Bunsen coefficient, $\alpha$ | Mole ratio | Mole fraction$^b$ |
|---|---|---|---|
| | *N,N*-Dimethylbenzenamine | | |
| 280 | 254 | 1.44 | 0.591 |
| | Benzylamine | | |
| - | 288 | 1.40 | 0.583 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static absorption method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]

2. *N*-Ethylbenzenamine, (ethylaniline); $C_8H_{11}N$; [103-69-5]

ORIGINAL MEASUREMENTS:

Hill, A.E.; Fitzgerald, T.B.

*J. Am. Chem. Soc.* 1935, *57*, 250-254.

VARIABLES:

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | Pressure, total, mmHg | Mole ratio $SO_2$ / component (2) | *Mole fraction, $x_{SO_2}$ |
|---|---|---|---|
| 298.15 | 1.5 | 0.00 | |
| | 46.5 | 0.182 | 0.154 |
| | 101.0 | 0.361 | 0.265 |
| | 172.5 | 0.536 | 0.349 |
| | 264.5 | 0.706 | 0.414 |
| | 378.0 | 0.870 | 0.465 |
| | 510.0 | 1.027 | 0.507 |
| | 655.0 | 1.183 | 0.542 |
| | (760.0) | | (0.560) Extrapolated by compiler. |

760 mmHg = 1 atm = 101.325 kPa.

*Calculated by compiler.

AUXILIARY INFORMATION

METHOD:/APPARATUS/PROCEDURE:

The apparatus had been previously described (1).

A weighed amount of liquid was treated with a measured volume of sulfur dioxide at a constant temperature and at a measured total pressure. A gas buret and a mercury manometer were used.

SOURCE AND PURITY OF MATERIALS:

(1) Not specified.

(2) Purified by distillation.

ESTIMATED ERROR:

REFERENCES:

1. Hill, A.E.
*J. Am. Chem. Soc.* 1931, *53*, 2598.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. *N*,*N*-Diethylbenzenamine, [diethylaniline); $C_{10}H_{15}N$; [91-66-7]

ORIGINAL MEASUREMENTS:

Foote, H.W.; Fleischer, J.

*J. Am. Chem. Soc.* 1934, *56*, 870-873.

VARIABLES:

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | $p_{SO_2}$ mmHg | Mole fraction $x_{SO_2}$ |
|---|---|---|
| 273 | 1008 | 0.891 |
| | 946 | 0.862 |
| | 845 | 0.817 |
| | 784 | 0.793 |
| | 733 | 0.774 |
| | 673 | 0.751 |
| | 584 | 0.716 |
| | 472 | 0.671 |
| | 359 | 0.618 |
| | 276 | 0.570 |
| | 225 | 0.532 |
| | 149 | 0.459 |
| | 81 | 0.347 |
| | 44 | 0.252 |
| | 13 | 0.092 |

NOTE : A mole fraction of 0.891 is equivalent to a mole ratio of 8.17 moles of $SO_2$ to 1 of N, N-diethyl aniline.

760 mmHg = 1 atm = 101.325 kPa. Observed pressure was taken to be $p_{SO_2}$.

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

The apparatus and method had been previously described (1).

A glass bulb of 29.3 $cm^3$ capacity was connected via a tap to an open manometer, a vacuum flask of 2 $dm^3$ capacity, and a source of sulfur dioxide. Component (2) was weighed in the bulb. Sulfur dioxide was condensed in the bulb and 253 K. Equilibrium at 273.15 K and at the observed pressure, total, but assumed to be equal to $p_{SO_2}$, was attained.

SOURCE AND PURITY OF MATERIALS:

(1) Sulfur dioxide: Dried by sulfuric acid.

(2) "The compounds used were either of Eastman C.P. grade or were purified by customary methods."

ESTIMATED ERROR:

REFERENCES:

1. Foote, H.W.; Fleischer, J. *J. Am. Chem. Soc.* 1931, *53*, 1752

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. *N,N*-Diethylbenzenamine, (diethylaniline); $C_{10}H_{15}N$; [91-66-7] | Hill, A.E.; Fitzgerald, T.B.<br>*J. Am. Chem. Soc.* 1935, *57*, 250-254. |
| VARIABLES: | PREPARED BY:<br>W. Gerrard |

EXPERIMENTAL VALUES:

| T/K | Pressure, total, mmHg | Mole ratio $SO_2$/ component (2) | *Mole fraction, $x_{SO_2}$ |
|---|---|---|---|
| 298.15 | 1.5 | 0.000 | |
| | 120.8 | 0.204 | 0.169 |
| | 249.0 | 0.410 | 0.291 |
| | 393.1 | 0.617 | 0.382 |
| | 529.5 | 0.803 | 0.445 |
| | 679.5 | 1.010 | 0.502 |
| | (760.0) | | (0.530) Extrapolated by compiler. |

760 mmHg = 1 atm = 101.325 kPa

* Calculated by compiler.

AUXILIARY INFORMATION

METHOD:/APPARATUS/PROCEDURE:

The apparatus had been previously described (1).

A weighed amount of liquid was treated with a measured volume of sulfur dioxide at a constant temperature and at a measured total pressure. A gas buret and a mercury manometer were used.

SOURCE AND PURITY OF MATERIALS:

(1) Not specified.

(2) Purified by distillation.

ESTIMATED ERROR:

REFERENCES:

1. Hill, A.E.

*J. Am. Chem. Soc.* 1931, *53*, 2598

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Miscellaneous solvents

ORIGINAL MEASUREMENTS:

Bogeatzes, A. S.; Tassios, D. P.

*Ind. Eng. Chem. Process Des. Develop.* 1973, *12*, 274-278.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

| Solvent | Activity coefficient at infinite dilution, $\gamma$ | T/K |
|---|---|---|
| *N*,*N*-Dimethylaniline (*N*,*N*-Dimethylbenzenamine); $C_8H_{11}N$; [121-69-7] | 0.027 | 314.2 |
| *N*,*N*-Dimethylformamide; $C_3H_7NO$; [68-12-2] | 0.081 | 313.7 |
| *N*,*N*-Dimethylacetamide; $C_4H_9NO$; [127-19-5] | 0.036 | 314.7 |
| | 0.070 | 339.2 |
| | 0.077 | 366.2 |
| Nitrobenzene; $C_6H_5NO_2$; [98-95-3] | 0.910 | 298.7 |
| Trimethylpyridine; $C_8H_{11}N$; [29611-84-5] | 0.123 | 312.2 |
| Xylidine (ar,ar-dimethylbenzenamine); $C_8H_{11}N$; [1300-73-8] | 0.140 | 313.2 |
| Benzonitrile; $C_7H_5N$; [100-47-0] | 0.532 | 312.2 |
| 3-Methylsulfolane (tetrahydro-3-methylthiophene-1,1-dioxide); $C_5H_{10}O_2S$; [872-93-5] | 0.609 | 313.2 |
| 3-Methoxysulfolane (tetrahydro-3-methoxythiophene-1,1-dioxide); $C_5H_{10}O_3S$; [20627-66-1] | 1.090 | 312.2 |
| *N*-Methylmethanamine (Dimethylamine); $C_2H_7N$; [124-40-3] | 1.590 | 315.2 |
| *N*,*N*'-Bis(2-aminoethyl)-1,2-Ethanediamine (Triethylenetetramine); $C_6H_{18}N_4$; [112-24-3] | 1.580 | 314.2 |
| Equimolar mixture of xylidine and *N*,*N*-dimethylaniline | 0.040 | 313.2 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Gas chromatographic method. Activity coefficients determined from retention volumes of sulfur dioxide on solvents as stationary phases. It is probable that the activity coefficients are in error because of absorption at the carrier gas-solvent interface.

SOURCE AND PURITY OF MATERIALS:

No details given except purity better than 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.2$; $\delta\gamma/\gamma = \pm 0.05$.

REFERENCES:

| COMPONENTS: | EVALUATOR: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Organic compounds containing halogens | Colin L. Young,<br>School of Chemistry,<br>University of Melbourne,<br>Parkville, Victoria 3052,<br>Australia.<br>December 1982 |

CRITICAL EVALUATION:

Trichloromethane; $CHCl_3$; [67-66-3]

Although this system has been investigated by three groups (1,2,3) the ranges of temperature and pressure of the measurements do not overlap. The measurements are broadly consistent but no precise comparison is possible.

Tetrachloromethane; $CCl_4$; [56-23-5]

This system has been investigated by three groups. The data of Sobolev *et al.* (4) is classified as doubtful, the mole fraction solubilities being considerably smaller than those of Horiuti (5) and Sano (2). The datum of Sano (2) is several per cent higher than the value obtained by interpolation of Horiuti values.

Chlorobenzene; $C_6H_5Cl$; [108-90-7]

The data of Horiuti (5) and Gerrard (6) for this system are in reasonable agreement. The isolated value of Sano (2) appears to be a few percent low when compared with the values of Gerrard at low temperatures.

References

1. Lindner, J. *Monatsh.* 1912, *33*, 613.
2. Sano, H. *Nippon Kagaku Zasshi* 1968, *89*, 362.
3. Lorimer, J. W.; Smith, B. C.; Smith, G. H. *J.C.S. Faraday I* 1975, *71*, 2232.
4. Sobolev, I. A.; Kukarin, V. A.; Dzhagatspanyan, R. V.; Kosorotov, V. I.; Zogarets, P. A.; Popov, A. I. *Khim. Prom.* 1970, *46*, 668.
5. Horiuti, J. *Sci. Pap. Inst. Phys. Chem. Res. (Jpn.)* 1931/32, *17*, 125.
6. Gerrard, W. *J. Appl. Chem. Biotechnol.* 1972, *22*, 623.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Trichloromethane, (chloroform); $CHCl_3$; [67-66-3]

ORIGINAL MEASUREMENTS:

Lindner, J.

*Monatsh.* 1912, *33*, 613-672.

VARIABLES:

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

760 mmHg = 1 atm = 101.325 kPa.

| T/K | Weight of $SO_2$ g | Weight of solution g (sp.gr.) | Pressure, $SO_2$/mmHg | *Mole ratio $SO_2$/ Comp.(2). | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|---|---|
| 273.15 | 0.0738 | 160.7 (1.526) | (2.7?) | 0.000857 | - |
| | 0.1879 | 160.3 (1.526) | 5.6 | 0.00218 | - |
| | 0.9068 | 198.1 (1.525) | 22.0 | 0.00858 | - |
| | 3.4395 | 169.1 (1.523) | 90.2 | 0.0387 | 0.0373 |
| | 7.222 | 133.0 (1.514) | 219.6 | 0.107 | 0.0967 |
| | ‡Rational extrapolation | | (760 ) | (1.174) | (0.540) |
| 298.15 | 0.0727 | 160.7 (1.480) | 5.7 | 0.000844 | - |
| | 0.1853 | 160.3 (1.480) | 12.9 | 0.00216 | 0.00215 |
| | 0.9008 | 198.1 (1.479) | 48.0 | 0.00852 | 0.00845 |
| | 3.3943 | 169.1 (1.472?) | 200.2 | 0.0382 | 0.0368 |
| | 7.0866 | 133.0 (1.472) | 488.8 | 0.105 | 0.0950 |
| | ‡Rational extrapolation | | (760 ) | (0.202) | (0.168) |

‡By compiler's plot of $x_{SO_2}$ vs $P_{SO_2}$ on the reference line diagram of Gerrard (1)

*Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Somewhat complex arrangement of six glass vessels containing the liquid. A small sealed tube containing a weighed amount of sulfur dioxide was fitted onto each tube assembly by a flexible joint. The previously scratched tip of the tube was broken to release sulfur dioxide, and the absorption of this was encouraged by a twirling motion of the apparatus. The pressure was measured manometrically. To obtain the amount absorbed, an allowance was made for the amount in the gas phase. The description of the procedure for deciding the partial pressure of the sulfur dioxide is somewhat involved, and cannot be briefly reported. One of the bulbs contained pure chloroform so that its vapor pressure at the operational temperature could be indicated.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide may be taken as pure.
2. May be taken as pure, density compared with the literature value.

ESTIMATED ERROR:

REFERENCES:

Gerrard, W. "*Solubility of Gases and Liquids*," Plenum Press, New York, 1976.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Trichloromethane (*chloroform*); $CHCl_3$; [67-66-3]

   Tetrachloromethane (*carbon tetrachloride*); $CCl_4$; [56-23-5]

ORIGINAL MEASUREMENTS:

Sano, H.

*Nippon Kagaku Zasshi*

1968, *89*, 362-368.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

Vapor pressure of trichloromethane, $p^{\circ}_{CHCl_3}$ = 0.272 atm

Vapor pressure of tetrachloromethane, $p^{\circ}_{CCl_4}$ = 0.200 atm

| Absorption coefficient, $S^{a,b}$ | Bunsen coefficient,$^b$ $\alpha$ | Bunsen coefficient,$^c$ $\alpha$ | $\ell^{c,d}$ | Mole ratio | Mole fraction$^e$ |
|---|---|---|---|---|---|
| | | Trichloromethane | | | |
| 30.1 | 37.6 | - | - | 0.134 | 0.118 |
| | | Tetrachloromethane | | | |
| 12.3 | 14.0 | 12.2 | 9.8 | 0.061 | 0.0575 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Determined by static absorption method.

[c] Determined by flow method.

[d] $\alpha = \ell(1 - p^{\circ}_s)$ where $p^{\circ}_s$ is the vapor pressure of solvent.

[e] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two techniques were used: (a) static absorption method and (b) flow method. Static method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The flow method consists of passing sulfur dioxide through a micro gas absorption tube and estimating sulfur dioxide by iodometric titration. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Trichloromethane, (chloroform); $CHCl_3$; [67-66-3]

ORIGINAL MEASUREMENTS:

Lorimer, J.W.; Smith, B.C.; Smith, G.H.

*J.C.S. Faraday I*, 1975, *71*, 2232-50.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | $p$/mmHg | $p$/kPa | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ | Mole fraction of sulfur dioxide in vapor, $y_{SO_2}$ |
|---|---|---|---|---|
| 227.6 | 3.44 | 0.459 | 0.0000 | 0.000 |
| | 30.58 | 4.077 | 0.0920 | 0.897 |
| | 52.83 | 7.043 | 0.2091 | 0.946 |
| | 67.28 | 8.970 | 0.3154 | 0.961 |
| | 73.73 | 9.830 | 0.3812 | 0.966 |
| | 82.05 | 10.939 | 0.4878 | 0.972 |
| | 89.25 | 11.899 | 0.5928 | 0.977 |
| | 91.65 | 12.219 | 0.6335 | 0.979 |
| | 98.81 | 13.174 | 0.7674 | 0.984 |
| | 106.48 | 14.196 | 0.8885 | 0.990 |
| | 116.49 | 15.531 | 1.0000 | 1.000 |
| 237.4 | 7.20 | 0.960 | 0.0000 | 0.000 |
| | 51.50 | 6.866 | 0.0824 | 0.871 |
| | 89.35 | 11.912 | 0.1922 | 0.932 |
| | 116.32 | 15.508 | 0.3018 | 0.952 |
| | 126.75 | 16.899 | 0.3590 | 0.958 |
| | 142.74 | 19.030 | 0.4701 | 0.966 |
| | 157.11 | 20.946 | 0.5803 | 0.972 |
| | 162.44 | 21.657 | 0.6120 | 0.974 |
| | 176.86 | 23.579 | 0.7577 | 0.981 |
| | 191.17 | 25.487 | 0.8861 | 0.989 |
| | 208.74 | 27.830 | 1.0000 | 1.000 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static vapor-liquid equilibrium apparatus. Total pressure measured using mercury manometers and cathetometer. Temperature measured using a sulfur dioxide vapor pressure thermometer. Some details in source.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/kPa = \pm 0.01$;
$\delta x_{SO_2}$, $\delta y_{SO_2} = \pm 1\%$.

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Trichloromethane, (chloroform); $CHCl_3$; [67-66-3]

ORIGINAL MEASUREMENTS:

Lorimer, J.W.; Smith, B.C.; Smith, G.H.

*J.C.S. Faraday I*, 1975, *71*, 2232-50.

EXPERIMENTAL VALUES:

| T/K | $p$/mmHg | $p$/kPa | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ | Mole fraction of sulfur dioxide in vapor, $y_{SO_2}$ |
|---|---|---|---|---|
| 249.8 | 16.31 | 2.174 | 0.0000 | 0.000 |
| | 88.56 | 11.807 | 0.0650 | 0.827 |
| | 156.27 | 20.834 | 0.1656 | 0.909 |
| | 211.30 | 28.171 | 0.3019 | 0.940 |
| | 226.36 | 30.179 | 0.3093 | 0.944 |
| | 266.04 | 35.469 | 0.4274 | 0.957 |
| | 296.86 | 39.578 | 0.5493 | 0.966 |
| | 303.07 | 40.406 | 0.5708 | 0.968 |
| | 338.45 | 45.123 | 0.7395 | 0.977 |
| | 372.26 | 49.631 | 0.8816 | 0.987 |
| | 405.40 | 54.049 | 1.0000 | 1.000 |

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]

2. Tetrachloromethane, (Carbon tetrachloride); $CCl_4$; [56-23-5]

ORIGINAL MEASUREMENTS:

Horiuti, J.

*Sci. Pap. Inst. Phys. Chem. Res. (Jpn.)*, 1931/32, *17*, 125-256.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

| T/K | $P^{\S}$/bar | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ | T/K | $P^{\dagger}$/bar | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ | Ostwald coefficient, L |
|---|---|---|---|---|---|---|
| 298.15 | 0.1497 | 0.0000 | 283.15 | 0.9338 | 0.1111 | 30.96 |
| | 0.3537 | 0.0126 | 298.15 | 0.8585 | 0.0604 | 18.45 |
| | 0.4765 | 0.0208 | 313.15 | 0.7285 | 0.0342 | 12.52 |
| | 0.6776 | 0.0348 | | | | |
| | 0.7090 | 0.0371 | | | | |
| | 0.8610 | 0.0490 | | | | |
| | 0.9611 | 0.0567 | | | | |
| | 1.085 | 0.0673 | | | | |
| | 1.172 | 0.0748 | | | | |
| | 1.260 | 0.0827 | | | | |
| | 1.321 | 0.0880 | | | | |

§ total pressure.

† partial pressure, total pressure = 1 atmosphere = $1.01325 \times 10^5$ Pa.

Ostwald coefficient (as $x \rightarrow 0$, T/K = 298.15) = 15.1.

Henry's law constant, $dp/dx$ (as $x \rightarrow 0$, T/K = 298.15) = 12700 mmHg = 16.93 bar

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Apparatus consisted of a gas buret, a solvent reservoir and an absorption pipet. Dry gas introduced into degassed solvent. System mixed using a magnetic stirrer until saturation occurred. Care was taken to prevent solvent vapor from mixing with gas in the gas buret. Volume of gas determined from gas buret reading; volume of liquid determined from height of meniscus in absorption pipet.

SOURCE AND PURITY OF MATERIALS:

1. Sample obtained from Nippon Sulphuric Acid Manufacturing Co. Dried and fractionated several times.
2. Kahlbaum sample, dried and distilled. B. pt. 76.74 °C.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.001$;

$\delta x_{SO_2} = \pm 0.001$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Tetrachloromethane, (Carbon tetrachloride); $CCl_4$; [56-23-5]

ORIGINAL MEASUREMENTS:

Sobolev, I.A.; Kukarin, V.A.; Dzhagatspanyan, R.V.; Kosorotov, V.I.; Zogorets, P.A.; Popov, A.I.

*Khim. Prom.* 1970, *46*, 668-70.

VARIABLES:

Temperature

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | Solubility*, $S$ /mol $l^{-1}$ | Mole fraction of+ sulfur dioxide in liquid, $x_{SO_2}$ |
|---|---|---|
| 283.15 | 0.67 | 0.061 |
| 288.15 | 0.536 | 0.049 |
| 293.15 | 0.435 | 0.040 |
| 298.15 | 0.365 | 0.034 |
| 303.15 | 0.296 | 0.028 |

\+ calculated by compiler

* at atmospheric pressure

$\ln S = 1528/(T/K) - 8.47$ (where $S$ is in units of mol $l^{-1}$ $atm^{-1}$).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Bubbler method. Samples of saturated liquid taken and added to sodium hydroxide solution and then excess alkali back titrated.

SOURCE AND PURITY OF MATERIALS:

1. Purity at least 95 mole per cent.
2. Chemically pure. Dried.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta$(Solubility) = ±2%; $\delta x_{SO_2} = \pm 0.001$; (estimated by compiler).

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. 2,2,2-Trichloroethanol; $C_2H_3Cl_3O$; [115-20-8] | Gerrard, W.<br>*J. Appl. Chem. Biotechnol.* 1972, *22*, 623-650. |
| VARIABLES: | PREPARED BY: |
| Temperature | W. Gerrard. |

EXPERIMENTAL VALUES:

| T/K | P/kPa | Mole ratio $SO_2$ /ROH | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| 273.15 | 99.1 | 0.70 | 0.412 |
| 283.15 | | 0.377 | 0.274 |
| 293.15 | | 0.240 | 0.194 |
| 298.15 | | 0.200 | 0.167 |

* Calculated by compiler.

*P* is the total pressure.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was bubbled into a weighed amount of component (2) in a bubbler tube as described in detail, diagram given, in the original paper. The amount of gas absorbed at equilibrium and at the observed temperature and pressure was weighed. By means of a manometer assembly, to which the bubbler tube was attached, the weight of gas absorbed at successively lower pressure was measured. Eventually the pressure was reduced to that of the component (2). The refractive index, and the infrared spectrum of the residue showed it to be essentially pure component (2).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was the best grade contained in a small cylinder. Its high purity was attested by the measurement of vapor pressure from 258 to 268 K.
2. The best obtainable specimen was carefully purified and rigorously attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 1,2-Dichloroethane; $C_2H_4Cl_2$; [107-06-2]
   1,2-Dichloropropane; $C_3H_6Cl_2$; [78-87-5]
   Trichloroethene (*trichloroethylene*); $C_2HCl_3$; [79-01-6]

ORIGINAL MEASUREMENTS:

Sano, H.
*Nippon Kagaku Zasshi*
1968, *89*, 362-368.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES: T/°C = 30 T/K = 303

Vapor pressure of 1,2-dichloroethane, $p_s^\circ$ = 0.110 atm
Vapor pressure of 1,2-dichloropropane, $p_s^\circ$ = 0.065 atm
Vapor pressure of trichloroethene, $p_s^\circ$ = 0.120 atm

| Absorption coefficient, $S^{a,b}$ | Bunsen coefficient,$^b$ $\alpha$ | Bunsen coefficient,$^c$ $\alpha$ | $\ell^{c,d}$ | Mole ratio | Mole fraction$^e$ |
|---|---|---|---|---|---|
| | | 1,2-Dichloroethane | | | |
| 67.0 | 68.4 | 72.9 | 62.0 | 0.296 | 0.228 |
| | | 1,2-Dichloropropane | | | |
| 47.6 | 46.0 | 47.0 | 43.5 | 0.200 | 0.167 |
| | | Trichloroethene | | | |
| 22.0 | 22.5 | 22.9 | 20.1 | 0.091 | 0.0834 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.
[b] Determined by static absorption method.
[c] Determined by flow method.
[d] $\alpha = \ell(1 - p_s^\circ)$ where $p_s^\circ$ is the vapor pressure of solvent.
[e] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two techniques were used: (a) static absorption method and (b) flow method. Static method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The flow method consists of passing sulfur dioxide through a micro gas absorption tube and estimating sulfur dioxide by iodometric titration. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$
(estimated by compiler).

REFERENCES:

| | |
|---|---|
| COMPONENTS:<br>1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. 1,2-Dichloroethane; $C_2H_4Cl_2$; [107-06-2] | ORIGINAL MEASUREMENTS:<br>Benoit, R.L.; Milanova, E.<br>*Can. J. Chem.*, 1979, *59*, 1319-1323 |
| VARIABLES: | PREPARED BY:<br>C.L. Young |

EXPERIMENTAL VALUES:

| T/K | Henry's law constant$^+$ $H$/atm |
|---|---|
| 298.15 | 4.23 |

$^+$ Defined in the original as

$$H = \frac{\text{partial pressure of sulfur dioxide}}{\text{mole fraction of sulfur dioxide}}$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Few details given. Pressure measured with quartz spiral gauge. Partial pressure calculated assuming Raoult's law. Concentration of sulfur dioxide determined by iodometric titration. Concentration of sulfur dioxide ranged from 0.05 to 0.2 mol $l^{-1}$

SOURCE AND PURITY OF MATERIALS:

1. Anhydrous sample from Canadian Liquid Air, purity 99.98 mole per cent.

2. Dried over 4A molecular sieve

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta H/\text{atm} = \pm 4\%$
(estimated by compiler)

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Chlorobenzene; $C_6H_5Cl$; [108-90-7] | Horiūti, J.<br>*Sci. Pap. Inst. Phys. Chem. Res. (Jpn.)*, 1931/32, *17*, 125-256. |
| VARIABLES:<br>Temperature, pressure | PREPARED BY:<br>C. L. Young |

EXPERIMENTAL VALUES:

| T/K | $P^{\S}$/bar | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ | T/K | $P^{\dagger}$/bar | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ | Ostwald coefficient, L |
|---|---|---|---|---|---|---|
| 298.15 | 0.0155 | 0.000 | 273.15 | 1.011 | 0.5310 | 169.3 |
| | 0.3662 | 0.0602 | 283.15 | 1.008 | 0.3415 | 97.4 |
| | 0.4058 | 0.0660 | 293.15 | 1.003 | 0.2181 | 59.14 |
| | 0.6745 | 0.1163 | 303.15 | 0.9950 | 0.1532 | 41.17 |
| | 0.7626 | 0.1328 | 313.15 | 0.9816 | 0.1102 | 29.92 |
| | 0.9318 | 0.1666 | 323.15 | 0.9612 | 0.0821 | 22.88 |
| | 1.0369 | 0.1876 | 333.15 | 0.9306 | 0.0614 | 17.83 |
| | 1.193 | 0.2202 | 343.15 | 0.8882 | 0.0466 | 14.33 |
| | 1.229 | 0.2271 | 353.15 | 0.8265 | 0.0365 | 12.23 |
| | 1.373 | 0.2590 | | | | |
| | 1.397 | 0.2635 | | | | |

§ total pressure.

† partial pressure, total pressure = 1 atmosphere = $1.01325 \times 10^5$ Pa.

Ostwald coefficient (as $x \to 0$, T/K = 298.15) = 40.4.

Henry's law constant, $dp/dx$ (as $x \to 0$, T/K = 298.15) = 4502 mmHg = 6.002 bar.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Apparatus consisted of a bas buret, a solvent reservoir and an absorption pipet. Dry gas introduced into degassed solvent. System mixed using a magnetic stirrer until saturation occurred. Care was taken to prevent solvent vapor from mixing with gas in the gas buret. Volume of gas determined from gas buret reading; volume of liquid determined from height of meniscus in absorption pipet.

SOURCE AND PURITY OF MATERIALS:

1. Sample obtained from Nippon Sulphuric Acid Manufacturing Co. Dried and fractionated several times.
2. Sample from Kahlbaum, dried and distilled. Boiling point at atmospheric pressure, 131.96 °C.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/\text{bar} = \pm 0.001$;

$\delta x_{SO_2} = \pm 0.001$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Chlorobenzene; $C_6H_5Cl$; [108-90-7]

   1,2-Dichlorobenzene; $C_6H_4Cl_2$; [95-50-1]

ORIGINAL MEASUREMENTS:

Sano, H.
*Nippon Kagaku Zasshi*
1968, *89*, 362-368.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

Vapor pressure of chlorobenzene, $p_s^\circ$ = 0.020 atm

| Absorption coefficient, $s^{a,b}$ | Bunsen coefficient,[b] $\alpha$ | Bunsen coefficient,[c,f] $\alpha$ | $\ell^{c,d}$ | Mole ratio | Mole fraction[e] |
|---|---|---|---|---|---|
| | | Chlorobenzene | | | |
| 40.1 | 37.2 | 38.0 | 37.1 | 0.170 | 0.145 |
| | | 1,2-Dichlorobenzene | | | |
| 25.7 | 23.6 | 24.1 | 24.1 | 0.117 | 0.105 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Determined by static absorption method.

[c] Determined by flow method.

[d] $\alpha = \ell(1 - p_s^\circ)$ where $p_s^\circ$ is the vapor pressure of solvent.

[e] Calculated by compiler.

[f] Assuming vapor pressure of 1,2-dichlorobenzene to be negligible.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two techniques were used: (a) static absorption method and (b) flow method. Static method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The flow method consists of passing sulfur dioxide through a micro gas absorption tube and estimating sulfur dioxide by iodometric titration. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Chlorobenzene; $C_6H_5Cl$; [108-90-7]

ORIGINAL MEASUREMENTS:

Gerrard, W.

*J. Appl. Chem. Biotechnol.* 1972, *22*, 623-650.

VARIABLES:

Temperature, pressure

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

| T/K | Pressure, total /mmHg | Mole ratio $SO_2$/Comp.(2) | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| 273 .15 | 760 | 1.20 | 0.545 |
| | ** 715 | 1.06 | 0.516 |
| | 694 | 0.962 | 0.490 |
| | 636 | 0.783 | 0.439 |
| | 530 | 0.546 | 0.353 |
| 283.15 | 760 | 0.510 | 0.338 |
| 293.15 | 760 | 0.28 | 0.219 |
| 298.15 | 760 | 0.23 | 0.187 |

760 mmHg = 1 atm = 101.325 kPa.

* Calculated by compiler

** The plot of pressure vs solubility given in the original paper is based on these data.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was bubbled into a weighed amount of component (2) in a bubbler tube as described in detail, diagram given, in the original paper. The amount of gas absorbed at equilibrium and at the observed temperature and pressure was weighed. By means of a manometer assembly, to which the bubbler tube was attached, the weight of gas absorbed at successively lower pressure was measured. Eventually the pressure was reduced to that of the component (2). The refractive index, and the infrared spectrum of the residue showed it to be essentially pure component (2).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was the best grade contained in a small cylinder. Its high purity was attested by the measurement of vapor pressure from 258 to 268 K.
2. The best obtainable specimen was carefully purified and rigorously attested.

ESTIMATED ERROR:

REFERENCES:

| | |
|---|---|
| COMPONENTS:<br>1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Bromobenzene; $C_6H_5Br$; [108-86-1] | ORIGINAL MEASUREMENTS:<br>Gerrard, W.<br>*J. Appl. Chem. Biotechnol.* 1972, *22*, 623-650 |
| VARIABLES:<br>Temperature | PREPARED BY:<br>W. Gerrard |

EXPERIMENTAL VALUES:

| T/K | Pressure,total /mmHg | Mole ratio $SO_2$/Comp.(2) | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| 273.15 | 760 | 0.91 | 0.476 |
| 283.15 | 760 | 0.41 | 0.291 |
| 293.15 | 760 | 0.245 | 0.197 |
| 298.15 | 760 | 0.21 | 0.174 |

760 = mmHg = 1 atm = 101.325 kPa

* Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was bubbled into a weighed amount of component (2) in a bubbler tube as described in detail, diagram given, in the original paper. The amount of gas absorbed at equilibrium and at the observed temperature and pressure was weighed. By means of a manometer assembly, to which the bubbler tube was attached, the weight of gas absorbed at successively lower pressure was measured. Eventually the pressure was reduced to that of the component (2). The refractive index, and the infrared spectrum of the residue showed it to be essentially pure component (2).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was the best grade contained in a small cylinder. Its high purity was attested by the measurement of vapor pressure from 258 to 268 K.
2. The best obtainable specimen was carefully purified and rigorously attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Iodobenzene; $C_6H_5I$; [591-50-4]

ORIGINAL MEASUREMENTS:

Gerrard, W.

*J. Appl. Chem. Biotechnol.* 1972, *22*, 623-650

VARIABLES:

Temperature,

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

| T/K | Pressure, total /mmHg | Mole ratio $SO_2$/Comp.(2) | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| 273.15 | 760 | 0.81 | 0.448 |
| 283.15 | 760 | 0.335 | 0.251 |
| 293.15 | 760 | 0.21 | 0.174 |
| 298.15 | 760 | 0.18 | 0.153 |

760 mmHg = 1 atm = 101.325 kPa.

* calculated by compiler

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was bubbled into a weighed amount of component (2) in a bubbler tube as described in detail, diagram given, in the original paper. The amount of gas absorbed at equilibrium and at the observed temperature and pressure was weighed. By means of a manometer assembly, to which the bubbler tube was attached, the weight of gas absorbed at successively lower pressure was measured. Eventually the pressure was reduced to that of the component (2). The refractive index, and the infrared spectrum of the residue showed it to be essentially pure component (2).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was the best grade contained in a small cylinder. Its high purity was attested by the measurement of vapor pressure from 258 to 268 K.
2. The best obtainable specimen was carefully purified and rigorously attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 2-Chlorophenol; $C_6H_5ClO$; [95-57-8]

ORIGINAL MEASUREMENTS:

Sano, H.; Nakamoto, Y.
*Nippon Kagaku Zasshi*
1968, *89*, 369-373.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

| Absorption coefficient, $S^a$ | Bunsen coefficient, $\alpha$ | Mole ratio | Mole fraction$^b$ |
|---|---|---|---|
| 76.2 | 69.4 | 0.323 | 0.244 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static absorption method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 1-Chloro-octane; (octyl chloride); $C_8H_{17}Cl$; [111-85-3]

ORIGINAL MEASUREMENTS:

Gerrard, W. *J. Appl. Chem. Biotechnol.* 1972, *22*, 623-650.

VARIABLES:

Temperature

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | Pressure, total /mmHg | Mole ratio $SO_2$/Comp. (2) | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| 273.15 | 748 | 0.75 | 0.429 |
| 283.15 | 748 | 0.40 | 0.286 |
| 293.15 | 748 | 0.25 | 0.200 |
| 298.15 | 748 | 0.21 | 0.174 |

760 mmHg = 1 atm = 101.325 kPa.

* Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was bubbled into a weighed amount of component (2) in a bubbler tube as described in detail, diagram given, in the original paper. The amount of gas absorbed at equilibrium and at the observed temperature and pressure was weighed. By means of a manometer assembly, to which the bubbler tube was attached, the weight of gas absorbed at successively lower pressure was measured. Eventually the pressure was reduced to that of the component (2). The refractive index, and the infrared spectrum of the residue showed it to be essentially pure component (2).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was the best grade contained in a small cylinder. Its high purity was attested by the measurement of vapor pressure from 258 to 268 K.
2. The best obtainable specimen was carefully purified and rigorously attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. 1-Bromooctane, (octyl bromide); $C_8H_{17}Br$; [111-83-1]

ORIGINAL MEASUREMENTS:

Gerrard. W.

*J. Appl. Chem. Biotechnol.* 1972, *22*, 623-650.

VARIABLES:

Temperature

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | Pressure, total /mmHg | Mole ratio $SO_2$/ Comp. (2) | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| 273.15 | 757 | 0.66 | 0.398 |
| 283.15 | 757 | 0.365 | 0.267 |
| 293.15 | 757 | 0.235 | 0.190 |
| 298.15 | 757 | 0.195 | 0.163 |

760 mmHg = 1 atm = 101.325 kPa.

* Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Sulfur dioxide was bubbled into a weighed amount of component (2) in a bubbler tube as described in detail, diagram given, in the original paper. The amount of gas absorbed at equilibrium and at the observed temperature and pressure was weighed. By means of a manometer assembly, to which the bubbler tube was attached, the weight of gas absorbed at successively lower pressure was measured. Eventually the pressure was reduced to that of the component (2). The refractive index, and the infrared spectrum of the residue showed it to be essentially pure component (2).

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was the best grade contained in a small cylinder. Its high purity was attested by the measurement of vapor pressure from 258 to 268 K.
2. The best obtainable specimen was carefully purified and rigorously attested.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Heptadecane; $C_{17}H_{36}$; [629-78-7]
3. Tetrachloromethane, (Carbon tetrachloride); $CCl_4$; [56-23-5]

ORIGINAL MEASUREMENTS:

Sobolev, I. A.; Kurkarin, V. A.; Dzhogatspanyan, R. V.; Kosorotov, V. I.; Zogorets, P. A.; Popov, A. I. *Khim. Prom.* 1970, *46*, 668-70.

VARIABLES:

Temperature, concentration

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

| T/K | Percentage of heptadecane by volume | Solubility*, $S$ /mol $\ell^{-1}$ |
|---|---|---|
| 283.15 | 25 | 0.530 |
| 288.15 | | 0.440 |
| 293.15 | | 0.350 |
| 298.15 | | 0.299 |
| 303.15 | | 0.248 |
| 283.15 | 50 | 0.421 |
| 288.15 | | 0.350 |
| 293.15 | | 0.292 |
| 298.15 | | 0.248 |
| 303.15 | | 0.211 |
| 283.15 | 75 | 0.313 |
| 288.15 | | 0.266 |
| 293.15 | | 0.226 |
| 298.15 | | 0.196 |
| 303.15 | | 0.172 |

* at atmospheric pressure

Authors claim solubility is given by

$$\ln S = -\left((967x - 1582)/(T/K) + 8.47 - 2.71x\right)$$

where x is the mole fraction of heptadecane and S is in units of mol $l^{-1}$ $atm^{-1}$.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Bubbler method. Samples of saturated liquid taken and added to excess sodium hydroxide solution and back titrated.

SOURCE AND PURITY OF MATERIALS:

1. Purity at least 95 mole per cent.

2 and 3. Chemically pure, dried.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta$(Solubility) = ±2% (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Soft paraffin (see note).
3. Tetrachloromethane, (carbon tetrachloride); $CCl_4$; [56-23-5]

ORIGINAL MEASUREMENTS:

Sobolev, I.A.; Kukarin, V.A.; Dzhagatspanyan, R.V.; Kosorotov, V.I.; Zogorets, P.A; Popov, A.I.

*Khim. Prom.* 1970, *46*, 668-70.

VARIABLES:

Temperature, composition

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | Percentage of soft paraffin (by volume) | Solubility*, $S$ /mol $l^{-1}$ |
|---|---|---|
| 283.15 | 25 | 0.533 |
| 288.15 | | 0.419 |
| 293.15 | | 0.344 |
| 298.15 | | 0.294 |
| 303.15 | | 0.246 |
| 283.15 | 50 | 0.412 |
| 288.15 | | 0.343 |
| 293.15 | | 0.283 |
| 298.15 | | 0.238 |
| 303.15 | | 0.208 |
| 283.15 | 75 | 0.317 |
| 288.15 | | 0.265 |
| 293.15 | | 0.221 |
| 298.15 | | 0.195 |
| 303.15 | | 0.167 |
| 288.15 | 90 | 0.227 |
| 293.15 | | 0.204 |
| 298.15 | | 0.180 |
| 303.15 | | 0.157 |

* at atmospheric pressure.

Author claim solubility is given by $\ln S = -((838x - 1582)/(T/K) + 8.27 - 2.49x)$ where $x$ is the mole fraction of hydrocarbon (appears to be based on assuming a molecular weight of about 250) and $S$ is in units of mol $l^{-1}$ atm$^{-1}$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Bubbler method. Sample of saturated liquid taken and added to excess sodium hydroxide solution and back titrated.

NOTE: Mixture of $C_{12}$-$C_{22}$hydrocarbons (86.7% normal paraffins, 11.3% branched paraffins, 0.4% aromatic and 1.6% naphthenic hydrocarbons).

SOURCE AND PURITY OF MATERIALS:

1. Purity at least 95 mole per cent.
2. See note.
3. Chemically pure. Dried.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta$(Solubility) = ±2%; $\delta x_{SO_2} = \pm 0.001$; (estimated by compiler.

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Sulfinylbismethane; $C_2H_6OS$; [67-68-5]

EVALUATOR:

Colin L. Young,
School of Chemistry,
University of Melbourne,
Parkville, Victoria 3052,
Australia.

December 1982

CRITICAL EVALUATION:

The isolated value of Sano (1) is in fair agreement with the data of Smedslund (2). Both the value of Lenoir *et al.* (3) and Benoit and Milanova (4) were determined at low partial pressures of sulfur dioxide and extrapolation to 1 atmosphere partial pressure assuming Henry's law, is not valid. However, the two values, one obtained using chemical analysis and the other using gas chromatographic retention datum, are in fair agreement, which suggests the values are essentially correct but refer to very low partial pressures of sulfur dioxide.

References

1. Sano, H. *Nippon Kagaku Zasshi* 1968, *89*, 362.
2. Smedslund, T. H. *Finska Kemisteamfundets Medd.* 1950, *59*, 40.
3. Lenoir, J.-Y.; Renault, P.; Renon, H. *J. Chem. Engng. Data* 1971, *16*, 340.
4. Benoit, R. L.; Milanova, E. *Can. J. Chem.* 1979, *57*, 1319.

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Sulfinylbismethane (Dimethylsulfoxide); $C_2H_6OS$; [67-68-5]

ORIGINAL MEASUREMENTS:

Smedslund, T.H.
*Finska Kemistsamfundets Medd.* 1950, *59*, 40-43.

VARIABLES:

Temperature

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | $SO_2$, Weight % | *Mole ratio $SO_2/(CH_3)_2SO$ | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| 291 | 60.13 | 1.839 | 0.648 |
| 293 | 59.12 | 1.763 | 0.638 |
| 373 | 17.9 | 0.266 | 0.210 |
| 434 | 3.2 | 0.0403 | 0.039 |

| T/K | $SO_2$, Weight % | Partial Pressure $SO_2$, mmHg | * Mole ratio $SO_2/(CH_3)_2SO$ | Mole fraction * $x_{SO_2}$ |
|---|---|---|---|---|
| "293" | 4.9 | 5.2 | 0.0628 | 0.0590 |
| Probably | 14.6 | 21 | 0.208 | 0.172 |
|  | 27.6 | 71 | 0.465 | 0.317 |

See also general statement (data not given) in U.S. Patent No. 2,539,871, 1951.

* Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The first set of data are for "the saturation of dimethylsulfoxide at a pressure of 1 atm." Details are not available for the second set.

SOURCE AND PURITY OF MATERIALS:

1. Information not available.
2. Dimethylsulfoxide was prepared by the catalytic oxidation of dimethyl sulfide in the vapor state.

   The purified product had b.p. 63°C/6 mmHg. (1).

ESTIMATED ERROR:

REFERENCES:

1. Smedslund, T.H. *U.S. Patent*, 2,581,050, 1952.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Sulfinylbismethane (*dimethylsulfoxide*); $C_2H_6OS$; [67-68-5]<br>Sulfuric acid, dimethyl ester (*dimethyl sulfate*); $C_2H_6O_4S$; [77-78-1]<br>Tetramethylene sulfone (*tetrahydro thiophene, 1,1-dioxide*); $C_4H_8O_2S$; [126-33-0] | Sano, H.<br>*Nippon Kagaku Zasshi*<br>1968, *89*, 362-368. |
| VARIABLES: | PREPARED BY: |
| | C. L. Young |

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

Vapor pressure of dimethyl sulfate = 0.001 atm

| Absorption coefficient, $S^a$ | Bunsen coefficient, $\alpha$ | Mole ratio | Mole fraction$^b$ |
|---|---|---|---|
| | Sulfinylbismethane | | |
| - | 447 | 1.42 | 0.587 |
| | Dimethyl sulfate | | |
| 124.2 | 113.3 | 0.482 | 0.325 |
| | Tetrahydrothiophene 1,1-dioxide | | |
| 186.4 | 169.6 | 0.929 | 0.482 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Calculated by compiler.

## AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static absorption method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$

(estimated by compiler).

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide, $SO_2$; [7446-09-5]<br>2. Sulfinylbismethane, (dimethylsulfoxide); $C_2H_6OS$; [67-68-5] | Lenoir, J-Y.; Renault, P.; Renon, H.<br>*J. Chem. Eng. Data* 1971, *16*, 340-342. |
| VARIABLES: | PREPARED BY:<br>W. Gerrard |

EXPERIMENTAL VALUES: 760 mmHg = 1 atm = 101.325 kPa.

| T/K | Henry's constant $H_{SO_2}$/atm | *Mole fraction at 1 atm, |
|---|---|---|
| 298 | 0.117 | 8.55 (An impossible condition) |

* Calculated by compiler assuming a linear function of $p_{SO_2}$ vs $x_{SO_2}$, i.e. $x_{SO_2}$ (1 atm) = $1/H_{SO_2}$.

The authors gave "Henry's constant" as

$$H_{SO_2} = \lim_{x_{SO_2} \to 0} \frac{f_{SO_2}(P,T)}{x_{SO_2}}$$

$x_{SO_2}$ is the mole fraction. $f_{SO_2}$ is the fugacity of $SO_2$ "in the equilibrium condition" of pressure and temperature. $H_{SO_2}$ is related to experimental chromatographic parameters based on the number of moles of solvent in the column, and the absolute retention time of the solute. Helium was the carrier gas.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A conventional gas-liquid chromatographic unit was used. The chromatograph was an IGC 12 M Intersmat model, equipped with a thermal conductivity detector. The temperature control was stated to be within ±0.1 °C. The pressure drop in the column was measured by a mercury manometer. Helium was the carrier gas.

There is serious uncertainty in the estimation of accuracy.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was provided by l'Air Liquide, and had a stated purity of 99.9%. It was used as provided.
2. Provided by Touzart & Matignon and Serlabo, and stated to have a minimum purity of 99%. Distillation was carried out when necessary and the refractive index was measured.

ESTIMATED ERROR:

REFERENCES:

| | |
|---|---|
| COMPONENTS:<br>1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Sulfinylbismethane (Dimethylsulfoxide); $C_2H_6OS$; [67-68-5] | ORIGINAL MEASUREMENTS:<br>Benoit, R.L.; Milanova, E.<br>*Can. J. Chem.*, 1979, *57*, 1319-1323 |
| VARIABLES: | PREPARED BY:<br>C.L. Young |

EXPERIMENTAL VALUES:

| T/K | Henry's law constant + $H$/atm |
|---|---|
| 298.15 | 0.109 |

+ Defined in the original as

$$H = \frac{\text{partial pressure of sulfur dioxide}}{\text{mole fraction of sulfur dioxide}}$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Few details given. Pressure measured with quartz spiral gauge. Partial pressure calculated assuming Raoult's law. Concentration of sulfur dioxide determined by iodometric titration. Concentration of sulfur dioxide ranged from 0.3 to 1.5 mol $l^{-1}$

SOURCE AND PURITY OF MATERIALS:

1. Anhydrous sample from Canadian Liquid Air, purity 99.98 mole per cent.

2. Dried over 4A molecular sieve.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta H/\text{atm} = \pm 4\%$ (estimated by compiler)

REFERENCES:

| | |
|---|---|
| COMPONENTS:<br>1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Tetrahydrothiophene, 1,1-dioxide, (sulfolane); $C_4H_8O_2S$; [126-33-0] | ORIGINAL MEASUREMENTS:<br>Benoit, R.L.; Milanova, E.<br>*Can. J. Chem.*, 1979, *57*, 1319-1323 |
| VARIABLES: | PREPARED BY:<br>C.L. Young |

EXPERIMENTAL VALUES:

| T/K | Henry's law constant$^+$ $H$/atm |
|---|---|
| 303.15 | 1.01 |

$^+$ Defined in the original as

$$H = \frac{\text{partial pressure of sulfur dioxide}}{\text{mole fraction of sulfur dioxide}}$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Few details given. Pressure measured with quartz spiral gauge. Partial pressure calculated assuming Raoult's law. Concentration of sulfur dioxide determined by iodometric titration. Concentration of sulfur dioxide ranged from 0.1 to 1.0 mol $l^{-1}$

SOURCE AND PURITY OF MATERIALS:

1. Anhydrous sample from Canadian Liquid Air, purity 99.98 mole per cent.

2. Dried over 4A molecular sieve

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta H/\text{atm} = \pm 4\%$ (estimated by compiler)

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Esters of phosphoric acid

ORIGINAL MEASUREMENTS:

Sano, H.
*Nippon Kagaku Zasshi*
1968, *89*, 362-368.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES: T/°C = 30 T/K = 303

| Absorption coefficient, $S^{a,b}$ | Bunsen coefficient,$^b$ $\alpha$ | Bunsen coefficient,$^{c,f}$ $\alpha$ | $\ell^{c,d}$ | Mole ratio | Mole fraction$^e$ |
|---|---|---|---|---|---|
| Phosphoric acid, tributyl ester (*Tributyl phosphate*); $C_{12}H_{27}PO_4$; [126-73-8] | | | | | |
| 84.9 | 77.3 | 75.5 | 75.5 | 0.942 | 0.485 |
| Phosphoric acid, tris(methylphenyl) ester (*Tritolyl phosphate*); $C_{21}H_{21}PO_4$; [1330-78-5] | | | | | |
| 61.2 | 55.7 | 56.0 | 56.0 | 0.790 | 0.441 |

[a] Volume of sulfur dioxide absorbed by unit volume of solvent at experimental temperature and a total pressure of 1 atmosphere.

[b] Determined by static absorption method.

[c] Determined by flow method.

[d] $\alpha = \ell(1 - p_s^\circ)$ where $p_s^\circ$ is the vapor pressure of solvent.

[e] Calculated by compiler.

[f] Assuming vapor pressure of solvent to be negligible.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two techniques were used: (a) static absorption method and (b) flow method. Static method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The flow method consists of passing sulfur dioxide through a micro gas absorption tube and estimating sulfur dioxide by iodometric titration. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$
(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7746-09-5]
2. Esters of phosphoric acid.

ORIGINAL MEASUREMENTS:

Lenoir, J-Y,; Renault, P.; Renon, H.

*J. Chem. Eng. Data.* 1971, *16*, 340-342

VARIABLES:

PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

| T/K | Henry's constant $H_{SO_2}$/atm | Mole fraction at 1 atm * |
|---|---|---|
| Phosphoric acid, triethyl ester; $C_6H_{15}O_4P$; [78-40-0] | | |
| 325 | 1.41 | 0.709 |
| Phosphoric acid, tripropyl ester; $C_9H_{21}O_4P$; [513-08-6] | | |
| 323 | 0.621 | (1.61) |
| 343 | 1.45 | 0.690 |
| Phosphoric acid, tris (2-methyl propyl) ester; $C_{12}H_{27}O_4P$; [126-71-6] | | |
| 325 | 0.695 | (1.44) |

* Calculated by compiler assuming a linear function $p_{SO_2}$ vs $x_{SO_2}$, i.e. $x_{SO_2}$ (1 atm) = $1/H_{SO_2}$.

The authors gave "Henry's constant" as $H_{SO_2} = \lim_{x_{SO_2}\to 0} \dfrac{f_{SO_2}(P,T)}{x_{SO_2}}$.

$x_{SO_2}$ is the mole fraction. $f_{SO_2}$ is the fugacity of $SO_2$ "in the equilibrium condition" of pressure and temperature. $H_{SO_2}$ is related to experimental chromatographic parameters based on the number of moles of solvent in the column, and the absolute retention time of the solute. Helium was the carrier gas.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A conventional gas-liquid chromatographic unit was used. The chromatograph was an IGC 12 M Intersmat model, equipped with a thermal conductivity detector. The temperature control was stated to be within ±0.1° C. The pressure drop in the column was measured by a mercury manometer. Helium was the carrier gas.

There is serious uncertainty in the estimation of accuracy.

SOURCE AND PURITY OF MATERIALS:

1. Sulfur dioxide was provided by l'Air Liquide, and had a stated purity of 99.9%. It was used as provided.
2. Provided by Touzart & Matignon and Serlabo, and stated to have a minimum purity of 99%. Distillation was carried out when necessary, and the refractive index was measured.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Sulfur dioxide; $SO_2$; [7446-09-5]
2. Tributylphosphate, (Phosphoric acid, tributyl ester); $C_{12}H_{27}O_4P$; [126-73-8]

ORIGINAL MEASUREMENTS:

Cooper, D.F.; Smith, J.W.

*J. Chem. Eng. Data*, 1974, *19*, 133-6

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

| T/K | $p_{SO_2}$/mmHg $^+$ | $p_{SO_2}$/kPa $^+$ | Wt ratio $SO_2/C_{12}H_{27}O_4P$ | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ $^*$ |
|---|---|---|---|---|
| 279.2 | 6.9 | 0.92 | 0.0239 | 0.0904 |
| | 8.7 | 1.16 | 0.0291 | 0.1079 |
| | 12.4 | 1.65 | 0.0389 | 0.1392 |
| | 19.3 | 2.57 | 0.0584 | 0.1954 |
| | 30.4 | 4.05 | 0.0807 | 0.2512 |
| | 43.7 | 5.83 | 0.1045 | 0.3029 |
| | 64.0 | 8.53 | 0.1315 | 0.3535 |
| | 72.8 | 9.71 | 0.1426 | 0.3722 |
| | 105 | 14.0 | 0.1731 | 0.4185 |
| | 162 | 21.6 | 0.2156 | 0.4727 |
| | 219 | 29.2 | 0.2538 | 0.5134 |
| | 299 | 39.9 | 0.3116 | 0.5644 |
| | 394 | 52.5 | 0.3771 | 0.6106 |
| | 492 | 65.6 | 0.4256 | 0.6389 |
| 290.2 | 33.8 | 4.51 | 0.0608 | 0.2018 |
| | 44.9 | 5.99 | 0.0730 | 0.2328 |
| | 57.8 | 7.71 | 0.0871 | 0.2658 |
| | 73.9 | 9.85 | 0.1016 | 0.2970 |
| | 94.6 | 12.6 | 0.1192 | 0.3314 |
| | 130 | 17.3 | 0.1458 | 0.3774 |
| | 179 | 23.9 | 0.1764 | 0.4231 |
| | 267 | 35.6 | 0.2203 | 0.4780 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Glass equilibrium cell. After equilibrium established samples of liquid removed and analysed by GC. Partial pressure of sulfur dioxide obtained by mixing with air to a total pressure of atmospheric pressure (757 ± 3 mmHg)

SOURCE AND PURITY OF MATERIALS:

1. Matheson sample, purity 99.9 mole per cent.
2. BDH sample containing 0.099 weight per cent water.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta p/kPa = \pm 2\%$

$\delta x_{SO_2} = \pm 2\%$ (estimated by compiler)

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Tributylphosphate (Phosphoric acid, tributyl ester); $C_{12}H_{27}O_4P$; [126-73-8] | Cooper, D. F.; Smith, J. W.<br>*J. Chem. Eng. Data*<br>1974, *19*, 133-6. |

| T/K | $p_{SO_2}$/mmHg$^+$ | $p_{SO_2}$/kPa$^+$ | Wt ratio $SO_2/C_{12}H_{27}O_4P$ | Mole fraction of sulfur dioxide in liquid, $x_{SO_2}$ $^*$ |
|---|---|---|---|---|
| 290.2 | 362 | 48.3 | 0.2663 | 0.5254 |
| | 534 | 71.2 | 0.3279 | 0.5768 |
| | 661 | 88.1 | 0.3809 | 0.6129 |
| 307.0 | 7.4 | 0.99 | 0.0073 | 0.0295 |
| | 11.0 | 1.47 | 0.0106 | 0.0422 |
| | 17.6 | 2.35 | 0.0167 | 0.0649 |
| | 31.6 | 4.21 | 0.0288 | 0.1069 |
| | 38.8 | 5.17 | 0.0345 | 0.1254 |
| | 44.4 | 5.92 | 0.0388 | 0.1389 |
| | 55.1 | 7.35 | 0.0467 | 0.1626 |
| | 70.8 | 9.44 | 0.0575 | 0.1929 |
| | 105 | 14.0 | 0.0785 | 0.2461 |
| | 177 | 23.6 | 0.1131 | 0.3198 |
| | 269 | 35.9 | 0.1478 | 0.3806 |
| | 326 | 43.5 | 0.1655 | 0.4076 |
| | 458 | 61.1 | 0.2009 | 0.4551 |
| | 486 | 64.8 | 0.2078 | 0.4635 |
| | 570 | 76.0 | 0.2279 | 0.4865 |
| 327.3 | 13.6 | 1.81 | 0.0062 | 0.0251 |
| | 23.7 | 3.16 | 0.0106 | 0.0422 |
| | 37.2 | 4.96 | 0.0155 | 0.0605 |
| | 54.4 | 7.25 | 0.0222 | 0.0845 |
| | 69.6 | 9.28 | 0.0285 | 0.1059 |
| | 115 | 15.3 | 0.0427 | 0.1508 |
| | 115 | 15.3 | 0.0429 | 0.1514 |
| | 139 | 18.5 | 0.0486 | 0.1681 |
| | 176 | 23.5 | 0.0611 | 0.2026 |
| | 226 | 30.1 | 0.0733 | 0.2336 |
| | 320 | 42.7 | 0.0995 | 0.2926 |
| | 405 | 54.0 | 0.1160 | 0.3254 |
| | 429 | 57.2 | 0.1192 | 0.3314 |
| | 449 | 59.9 | 0.1220 | 0.3365 |
| | 480 | 64.0 | 0.1320 | 0.3543 |
| | 511 | 68.1 | 0.1367 | 0.3624 |
| | 590 | 78.7 | 0.1458 | 0.3774 |
| | 677 | 90.3 | 0.1610 | 0.4010 |
| 342.7 | 21.7 | 2.89 | 0.0056 | 0.0228 |
| | 58.7 | 7.83 | 0.0137 | 0.0539 |
| | 142 | 18.9 | 0.0315 | 0.1158 |
| | 200 | 26.7 | 0.0449 | 0.1573 |
| | 262 | 34.9 | 0.0548 | 0.1856 |
| | 331 | 44.1 | 0.0630 | 0.2076 |
| | 365 | 48.7 | 0.0710 | 0.2279 |
| | 430 | 57.3 | 0.0850 | 0.2611 |
| | 587 | 78.3 | 0.1028 | 0.2994 |
| | 663 | 88.4 | 0.1148 | 0.3231 |

$^+$ $p_{SO_2}$ = partial pressure of $SO_2$

* Calculated by compiler

| | |
|---|---|
| COMPONENTS:<br>1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Carbon disulfide; $CS_2$; [75-15-0] | ORIGINAL MEASUREMENTS:<br>Sano, H.<br>*Nippon Kagaku Zasshi*<br>1968, *89*, 362-368. |
| VARIABLES: | PREPARED BY:<br>C. L. Young |

EXPERIMENTAL VALUES:

T/°C = 30 T/K = 303

| Bunsen coefficient, α | Mole ratio | Mole fraction[a] |
|---|---|---|
| 10.1 | 0.027 | 0.0263 |

[a] Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static absorption method consisted of equilibrating solvent and sulfur dioxide in a 50 ml flask and measuring the absorption volumetrically. The vapor pressure of the solvents were measured roughly and were assumed to be equal to the partial pressure of the solvent by the authors when calculating the Bunsen coefficient.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.0-99.8 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.5$; $\delta x_{SO_2} = \pm 5\%$ (estimated by compiler).

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Sulfuryl chloride; $O_2Cl_2S$; [7791-25-5] | Schulze, H.<br>*J. Prakt. Chem.* 1881, *24*, 168-183 |
| VARIABLES: | PREPARED BY:<br>W. Gerrard. |

EXPERIMENTAL VALUES: 760 mmHg = 1 atm = 101.325 kPa.

| T/K | Weight of $SO_2$ /1 g of comp.(2) | *Mole ratio $SO_2$/Comp.(2) | *Mole fraction $x_{SO_2}$ |
|---|---|---|---|
| 273.15 | 0.323 | 0.681 | 0.405 |

*Calculated by compiler.

Pressure of $SO_2$ stated to be 725 mmHg.

1 Volume of sulfuryl chloride absorbed 187 volumes of $SO_2$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The gas was passed into a weighed amount of sulfuryl chloride in a thin-walled test-tube fitted with a rubber stopper carrying an inlet, and an outlet tube. The test tube was cooled in melting snow. The amount of gas absorbed was determined by weighing.

SOURCE AND PURITY OF MATERIALS:

1. Probably of satisfactory purity.
2. Probably of satisfactory purity. The paper gave details on the preparation of sulfuryl chloride.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

(1) Sulfur dioxide; $SO_2$; [7446-09-5]

(2) Lithium tetrachloro aluminate(1-); $AlCl_4.Li$; [14024-11-4]

(3) Thionyl chloride; $SOCl_2$; [7719-09-7]

ORIGINAL MEASUREMENTS:

Domeniconi, M.; Klinedinst, K.; Marincic, N.; Schlaikjer, C.; Staniewicz, R.; Swette, L.

ONR Contract # N00014-76-C-0524
Interim Report Jan. 1976 - Oct. 1977.

VARIABLES:

T/K: 273 - 333
P: Atmospheric

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

Fifteen measurements of the solubility of sulfur dioxide, $SO_2$, in a 1.8 mole $LiAlCl_4$ $dm^{-3}$ solution in thionyl chloride were made between 273 and 333 K. The mole fraction solubility values are shown on a graph (Figure 10 of the report). The data are not tabulated, but they were fitted to the following equation by the authors.

$$\ln x_{SO_2} = [(2.417 \pm 0.184) \times 10^3]/T - (9.863 \pm 0.613)$$

The equation can be used to calculate the mole fraction solubility of sulfur dioxide at a partial pressure of 1 atm between temperatures of 273 and 333 K in 1.8 molar $LiAlCl_4$ in $SOCl_2$.

The authors imply that they also measured the solubility of sulfur dioxide in pure thionyl chloride. However, they give neither data nor an equation. They do show what may be a smoothed curve for the sulfur dioxide solubility in thionyl chloride,(Figure 10 of report).

Figure 10 of the report compares the ln mole fraction solubility *vs.* 1/T and Figure 11 compares the molar solubility *vs.* temperature in pure thionyl chloride and in the 1.8 M $LiAlCl_4$ solution. In both solubility units the solubility appears to be equal at a temperature near 288 K. At lower temperatures sulfur dioxide is more soluble in pure thionyl chloride than in the 1.8 M $LiAlCl_4$ solution, above 288K the sulfur dioxide is more soluble in the solution than in the pure solvent.

In the original report the equation intercept is given erroneously as 0.863 instead of 9.863.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The sulfur dioxide was determined gravimetrically. A special Erlenmeyer flask fitted with a side arm bubbler was dried and weighed. The solvent was added and the flask weighed again The flask was placed in either an oil or a water bath. A glass wool-packed water-jacketed condenser was attached to the flask. The sulfur dioxide was bubbled in until saturation. The flask was weighed. Dry argon was bubb bubbled through the solution as it was heated to reflux,thus driving off the previously dissolved $SO_2$. The flask was again weighed.

The authors do not explain their reason for weighing the $SO_2$ gain on saturation, and the weight loss on degassing. It is not clear whether this is a check on the measurement, or the degassing procedure for the next determination at another temperature.

SOURCE AND PURITY OF MATERIALS:

(1) Sulfur dioxide.

(2) Lithium tetrachloroaluminate(1-).

(3) Thionyl chloride. Source not given. Distilled twice before use.

ESTIMATED ERROR:

$\delta X_1/X_1 = 0.20$
(Compiler)

REFERENCES:

COMPONENTS:

(1) Sulfur dioxide; $SO_2$;[7446-09-5]

(2) Lithium tetrachloro aluminate(1-); $AlCl_4.Li$; [14024-11-4]

(3) Thionyl chloride; $SOCl_2$; [7719-09-7]

ORIGINAL MEASUREMENTS:

Driscoll, J. R.; Brummer, S. B.; Gudrais, P.; Holleck, G. L.; Toland, D. E.; Turchan, M. J.

Report ECOM-74-0030-F
March 1978

VARIABLES:

T/K: 273 , 298
P: atmosphere

PREPARED BY:

H. L. Clever

EXPERIMENTAL VALUES:

| T/K | Mol Fraction $x_1$ | Molarity mol $SO_2$ $dm^{-3}$ solution[a] |
|---|---|---|
| Thionyl chloride; $SOCl_2$; 7719-09-7 | | |
| 273 | 0.465 | 8.0 |
| 298 | 0.160 | 2.3 |
| Lithium tetrachloro aluminate(1-) + thionyl chloride; 1.5 mol $LiAlCl_4$ $dm^{-3}$ solution | | |
| 273 | >0.498 | 8.4 |
| | 0.512 | 8.7 |
| 298 | 0.192 | 2.7 |
| | 0.187 | 2.6 |

[a] The mole fraction values were calculated directly from the weights of the components in the saturated solutions. The molarities were calculated assuming a solution density of 1.60 g $cm^{-3}$. The solution densities were calculated from $\rho(\text{solution}) = \rho(SO_2) \cdot x(SO_2) + \rho(\text{solvent}) \cdot x(\text{solvent})$. All of the calculated densities were within ±0.03 of 1.60 g $cm^{-3}$. The 1.60 value was chosen to calculate all of the molarity values.

The present values confirm the authors earlier values by gas chromatography. They are much greater than values reported by Spandau and Brunneck (1). The present results are in substantial agreement of those of Domeniccui *et al.* (2).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The solubility was determined gravimetrically. The sufur dioxide gas cylinder was connected to three gas bubblers joined in series. The first bubbler contained glass wool, the second bubbler contained a weighed portion of the solvent, and the third bubbler contained concentrated $H_2SO_4$. The third bubbler both isolated the system from the atmosphere, and acted as a flow monitor. The flow of $SO_2$ was set to minimize thionyl chloride loss by allowing little or no exit bubbling. Bubbling was continued until there was no more weight gain.

The sample bubbler was maintained at 25 °C in air or at 0 °C in a ice bath.

SOURCE AND PURITY OF MATERIALS:

(1) Sulfur dioxide. Matheson Co., Inc. Anhydrous, minimum purity 99.98 per cent.

(2) Lithium tetrachloro aluminate(1-). Source and purity not given.

(3) Thionyl chloride. Eastman Co. Number 246, used as received.

ESTIMATED ERROR:

$\delta x_1/x_1 = 0.03 - 0.05$
(Compiler)

REFERENCES:

1. Spandau, H.; Brunneck, E. *Z.Anorg.Allgem.Chem.* 1952, *270*, 201.

2. Domeniccui, M.; Kliaedinst, K.; Marincic, N.; Schlaikjer, C.; Staniewicz, R.; Swette, L. Interim Report, Jan.1976-Oct. 1977, ONR Contract # N00014-76-C-0524.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Sulfur dioxide; $SO_2$; [7446-09-5]<br>2. Rubber. | Venable, C.S.; Fuwa, T.<br>*Ind. Eng. Chem.* 1922, *14*, 139-142. |
| VARIABLES: | PREPARED BY:<br>W. Gerrard |

EXPERIMENTAL VALUES:

The data were expressed as quantity of gas measured as $S =$ $cm^3$ gas (273.15K, 1 atm) absorbed by 100 $cm^3$ of rubber.

At 293-295 K, $S = 1950$. The pressure appears to be the prevailing barometric one.

The compiler assumes that the isoprene unit, $C_5H_8$, may be taken to calculate an equivalent mole ratio (and hence mole fraction) as follows:

Equivalent mole ratio $SO_2/C_5H_8 = (19.50/21868) \times (68/0.75) = 0.0808$; $x_{SO_2} = 0.075$.

The gram mole volume of sulfur dioxide is taken to be 21868 $cm^3$ at 273.15 K and 1 atm.); 0.75 is the assumed density of the rubber.

The $x_{SO_2}$ value of 0.075 obtained in this way fits the value for the pure hydrocarbons, $C_5$ onwards, obtained by Makranczy *et al.* (1).

AUXILIARY INFORMATION

| METHOD/APPARATUS/PROCEDURE: | SOURCE AND PURITY OF MATERIALS: |
|---|---|
| The rubber was held under high vacuum for 48 hours. A weighed amount of the degassed rubber, as thin strips, was left in contact with the gas until equilibrium had been attained, as indicated by the constancy of pressure in the bulb. The gas was removed by a pump and measured over mercury. Temperature control was by a large bath of water. | 1. Dried over phosphorus pentoxide. From a cylinder. |
| | ESTIMATED ERROR: |
| | REFERENCES:<br>1. Makranczy, J.; Magyery-Balog, K.; Rusz, L.; Patyi, L.<br>*Hung. J. Ind. Chem.* 1976, *4*, 269. |

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. Water; $H_2O$; [7732-18-5]

EVALUATOR:

Rubin Battino,
Department of Chemistry,
Wright State University,
Dayton, Ohio 45435, U.S.A.

July 1981

CRITICAL EVALUATION:

The solubility of chlorine in pure water is complicated by two factors: (a) it reacts chemically with the water hydrolyzing to form $Cl^-$ and HClO; and (b) at relatively low pressures (near atmospheric) it forms a hydrate ($Cl_2.8H_2O$) which separates out. The hydrolysis has been studied in great detail by Yakovkin (1) whose work was analyzed by Arkadiev (2). Unfortunately, neither of these papers was available to the Evaluator at the time of writing this critical evaluation. However, a summary of both of these papers was provided by Adams and Edmonds (3). Formation of the hydrate was specifically studied by Bakhuis Roozeboom (4) and Stackelberg and Müller (5).

There were a number of papers reporting on the solubility of chlorine in water. We take these solubilities to be bulk solubilities, i.e., we assume that all of the chlorine containing species present are present as $Cl_2(aq)$. The work reported by Bunsen (6) and cited in other places was apparently carried out by Schönfeld (7) using a chemical method for determining the amount of dissolved chlorine. Roscoe (8) repeated Schönfeld's work at one temperature while studying gaseous mixtures of chlorine and hydrogen in aqueous solutions. Bakhuis Roozeboom (4) determined the solubility of chlorine in water at three temperatures (and extrapolated to two lower temperatures). Mellor (9) measured the solubility of chlorine in water at one temperature by chemical means while studying hydrogen and chlorine reactions. Winkler's results (10) are reported in the International Critical Tables for a wide range of temperature (283-383 K). Finally, Whitney and Vivian (11) reported on solubilities they determined while studying the hydrolysis constants of chlorine in water.

The solubility results fall into two main groups with that of Bakhuis Roozeboom falling roughly in the middle. Roscoe, Mellor, and Bunsen/Schönfeld's values are in quite good agreement with each other. Winkler, Whitney and Vivian, and Yakovkin's results (the latter as analyzed by Arkadiev and by Adams and Edmonds) are in good agreement with each other, but higher than the other group. The recommended values below were calculated from Table 1 in Adams and Edmonds' paper (3). They should be reliable to about ±2 per cent. The mole fractions are calculated for 101.325 kPa partial pressure of the gas.

| T/K | $10^3x_1$ | T/K | $10^3x_1$ |
|---|---|---|---|
| 283.15 | 2.48 | 343.15 | 0.849 |
| 293.15 | 1.88 | 353.15 | 0.784 |
| 303.15 | 1.50 | 363.15 | 0.737 |
| 313.15 | 1.23 | 373.15 | 0.697 |
| 323.15 | 1.06 | 383.15 | 0.668 |
| 333.15 | 0.939 | | |

(cont.)

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. Water; $H_2O$; [7732-18-5]

EVALUATOR:

Rubin Battino,
Department of Chemistry,
Wright State University,
Dayton, Ohio 45435, U.S.A.

July 1981

CRITICAL EVALUATION:

References:

1. Yakovkin, A. *J. Russ. Phys.-Chem.* 1900, *32*, 673.
2. Arkadiev, V. *J. Russ. Phys.-Chem.* 1918, *50*, 205.
3. Adams, F. W.; Edmonds, R. G. *Ind. Eng. Chem.* 1937, *29*, 447-50.
4. Bakhuis Roozeboom, H. W. *Recl. Trav. Chim. Pays-Bas* 1884, *3*, 59-72.
5. Stackelberg, von M.; Müller, H. R. *Z. Elektrochem.* 1954, *58*, 25-39.
6. Bunsen, R. *Phil. Mag.* 1855, *9*, 181-201.
7. Schönfeld, M. *Ann.* 1855, *93*, 26.
8. Roscoe, H. E. *J. Chem. Soc.* 1856, *8*, 14-26.
9. Mellor, W. *J. Chem. Soc.* 1901, *79*, 216-38.
10. Winkler, L. W. *Mathematikai es Termeszettudomanyi Ertesitö Budapest* 1907, *25*, 86.
11. Whitney, R. P.; Vivian, J. E. *Ind. Eng. Chem.* 1941, *33*, 741-4; *Tech. Assoc. Papers* 1941, *24*, 435-6; *Paper Trade J.* 1941, *113*, 31-2. (Note that the last two papers are essentially identical.)

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Water; $H_2O$; [7732-18-5] | Bunsen, R.<br>*Phil. Mag.*<br>1855, *9*, 181-201. |
| VARIABLES:<br>T/K = 283-313 | PREPARED BY:<br>R. Battino |

EXPERIMENTAL VALUES:

| t/°C | $T^a$/K | $10^3x_1$ $^{a,b}$ | $L^{a,c}$ | $\alpha^d$/cm$^3$ (STP) cm$^{-3}$ atm$^{-1}$ |
|---|---|---|---|---|
| 10 | 283 | 2.074 | 2.680 | 2.5852 |
| 11 | 284 | 2.039 | 2.644 | 2.5413 |
| 12 | 285 | 2.005 | 2.607 | 2.4977 |
| 13 | 286 | 1.970 | 2.571 | 2.5453 |
| 14 | 287 | 1.936 | 2.535 | 2.4111 |
| 15 | 288 | 1.901 | 2.498 | 2.3681 |
| 16 | 289 | 1.867 | 2.462 | 2.3253 |
| 17 | 290 | 1.834 | 2.425 | 2.2828 |
| 18 | 291 | 1.800 | 2.388 | 2.2405 |
| 19 | 292 | 1.767 | 2.351 | 2.1984 |
| 20 | 293 | 1.733 | 2.314 | 2.1565 |
| 21 | 294 | 1.700 | 2.277 | 2.1148 |
| 22 | 295 | 1.667 | 2.240 | 2.0734 |
| 23 | 296 | 1.635 | 2.203 | 2.0322 |
| 24 | 297 | 1.602 | 2.166 | 1.9912 |
| 25 | 298 | 1.570 | 2.129 | 1.9504 |
| 26 | 299 | 1.538 | 2.092 | 1.9099 |
| 27 | 300 | 1.506 | 2.054 | 1.8695 |
| 28 | 301 | 1.474 | 2.017 | 1.8295 |
| 29 | 302 | 1.442 | 1.979 | 1.7895 |
| 30 | 303 | 1.411 | 1.942 | 1.7499 |
| 31 | 304 | 1.379 | 1.905 | 1.7104 |
| 32 | 305 | 1.348 | 1.867 | 1.6712 |
| 33 | 306 | 1.317 | 1.829 | 1.6322 |

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

These data are values reported in several places as having been determined by a chemical method by M. Schönfeld (1) of Dusseldorf.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.02$ (compiler's estimate).

REFERENCES:

1. Schönfeld, M.
   *Annalen*
   1855, *93*, 26.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Water; $H_2O$; [7732-18-5] | Bunsen, R.<br>*Phil. Mag.*<br>1855, *9*, 181-201. |

EXPERIMENTAL VALUES:

| t/°C | $T^a$/K | $10^3 x_1$ [a,b] | $L^{a,c}$ | $\alpha^d$/cm³ (STP) cm⁻³ atm⁻¹ |
|---|---|---|---|---|
| 34 | 307 | 1.286 | 1.792 | 1.5934 |
| 35 | 308 | 1.256 | 1.754 | 1.5550 |
| 36 | 309 | 1.225 | 1.716 | 1.5166 |
| 37 | 310 | 1.195 | 1.679 | 1.4785 |
| 38 | 311 | 1.165 | 1.641 | 1.4406 |
| 39 | 312 | 1.135 | 1.603 | 1.4029 |
| 40 | 313 | 1.105 | 1.566 | 1.3655 |

[a] Calculated by compiler.

[b] Mole fraction solubility at 101.325 kPa partial pressure of gas.

[c] Ostwald coefficient.

[d] Bunsen coefficient.

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. Water; $H_2O$; [7732-18-5]

ORIGINAL MEASUREMENTS:

Roscoe, H. E.
*J. Chem. Soc.*
1856, *8*, 14-26.

VARIABLES:

T/K = 287

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

| $t/°C$ | $T^a/K$ | $10^3\ x_1{}^{a,b}$ | $L^{a,c}$ | $\alpha^d/cm^3\ (STP)\ cm^{-3}\ atm^{-1}$ |
|---|---|---|---|---|
| 14.0 | 287.2 | 1.920 | 2.514 | 2.3911 |

[a] Calculated by compiler.

[b] Mole fraction solubility at 101.325 kPa partial pressure of gas.

[c] Ostwald coefficient.

[d] Bunsen coefficient.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The amount of chlorine dissolved appears to have been determined chemically using Schönfeld's method.

SOURCE AND PURITY OF MATERIALS:

1. From electrolysis of HCl solutions.

ESTIMATED ERROR:

$\delta\alpha/\alpha = \pm 0.02$ (compiler's estimate).

REFERENCES:

1. Schönfeld, M.
*Annalen*
1855, *93*, 26.

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. Water; $H_2O$; [7732-18-5]

ORIGINAL MEASUREMENTS:

Bakhuis Roozeboom, H. W.,

*Recl. Trav. Chim. Pays-Bas*

1884, *3*, 59-72.

VARIABLES:

T/K = 273-285

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

| $t/°C$ | $T^a/K$ | $10^3\ x_1{}^{a,b}$ | $L^{a,c}$ | $\alpha^{a,d}$ | $\beta^e$ |
|---|---|---|---|---|---|
| 0 | 273 | 3.72 | 4.64 | 4.64 | $4.61^f$ |
| 3 | 276 | 3.17 | 4.00 | 3.96 | $3.93^f$ |
| 6 | 279 | 2.77 | 3.53 | 3.45 | 3.42 |
| 9 | 282 | 2.46 | 3.17 | 3.07 | 3.03 |
| 12 | 285 | 2.26 | 2.93 | 2.81 | 2.77 |

[a] Calculated by compiler.

[b] Mole fraction solubility at 101.325 kPa partial pressure of gas.

[c] Ostwald coefficient.

[d] Bunsen coefficient. Units of $cm^3$(STP) $cm^{-3}$ $atm^{-1}$.

[e] Solubility coefficient similar to Bunsen coefficient but at 1 atm total pressure. $\alpha = \beta \times 760/(760 - p_{H_2O})$.

[f] Points interpolated by author. The original values are presented as 1.07% $Cl_2$ (6 °C), 0.95% $Cl_2$ (9 °C), and 0.87% $Cl_2$ (12 °C) at a total pressure of 1 atm.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The author was investigating the hydrate formed between chlorine and water and incidentally determined the solubility of chlorine in water at 6, 9 and 12 °C at a total pressure of 1 atm. The β values given above are those appearing in the *International Critical Tables* (1).

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:

1. *International Critical Tables*, Vol. III, p.256.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Water; $H_2O$; [7732-18-5] | Mellor, W.<br>*J. Chem. Soc.*<br>1901, *79*, 216-38. |
| VARIABLES: | PREPARED BY: |
| T/K = 294.2 | R. Battino |

EXPERIMENTAL VALUES:

| t/°C | $T^a$/K | $10^3\ x_1{}^{a,b}$ | $L^{a,c}$ | $\alpha^d/cm^3$ (STP) $cm^{-3}$ $atm^{-1}$ |
|---|---|---|---|---|
| 21.0 | 294.2 | 1.701 | 2.278 | 2.1157 |

[a] Calculated by compiler.

[b] Mole fraction solubility at 101.325 kPa partial pressure of gas.

[c] Ostwald coefficient.

[d] Bunsen coefficient.

AUXILIARY INFORMATION

| METHOD/APPARATUS/PROCEDURE: | SOURCE AND PURITY OF MATERIALS: |
|---|---|
| Chlorine bubbled through solution. Amount determined by reaction with potassium iodide and titration of iodine with sodium thiosulfate soln. | 1. Prepared by reaction of hydrochloric acid with chromic acid. |
| | ESTIMATED ERROR:<br>δT/K = ±0.2; δα/α = ±0.02 (compiler's estimate). |
| | REFERENCES: |

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. Water; $H_2O$; [7732-18-5]

ORIGINAL MEASUREMENTS:

Winkler, L. W.

*Mathematikai es Termeszettudomanyi Ertesitö, Budapest*

1907, *25*, 86. (*International Critical Tables*, Vol. III, p.256)

VARIABLES:

T/K = 283-373

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

| t/°C | $T^a$/K | $10^3\ x_1{}^{a,b}$ | $L^{a,c}$ | $\alpha^{a,d}$ | $\beta^e$ |
|---|---|---|---|---|---|
| 10 | 283 | 2.556 | 3.304 | 3.187 | 3.148 |
| 11 | 284 | 2.476 | 3.211 | 3.087 | 3.047 |
| 12 | 285 | 2.399 | 3.112 | 2.991 | 2.950 |
| 13 | 286 | 2.326 | 3.037 | 2.899 | 2.856 |
| 14 | 287 | 2.256 | 2.955 | 2.811 | 2.767 |
| 15 | 288 | 2.188 | 2.876 | 2.726 | 2.680 |
| 16 | 289 | 2.123 | 2.799 | 2.644 | 2.597 |
| 17 | 290 | 2.061 | 2.726 | 2.566 | 2.517 |
| 18 | 291 | 2.009 | 2.655 | 2.491 | 2.440 |
| 19 | 292 | 1.944 | 2.588 | 2.420 | 2.368 |
| 20 | 293 | 1.891 | 2.525 | 2.353 | 2.299 |
| 21 | 294 | 1.844 | 2.470 | 2.294 | 2.238 |
| 22 | 295 | 1.800 | 2.418 | 2.238 | 2.180 |
| 23 | 296 | 1.757 | 2.368 | 2.184 | 2.123 |
| 24 | 297 | 1.716 | 2.320 | 2.133 | 2.070 |
| 25 | 298 | 1.677 | 2.275 | 2.084 | 2.019 |
| 26 | 299 | 1.641 | 2.232 | 2.038 | 1.970 |
| 27 | 300 | 1.605 | 2.190 | 1.993 | 1.923 |
| 28 | 301 | 1.573 | 2.153 | 1.953 | 1.880 |
| 29 | 302 | 1.543 | 2.118 | 1.915 | 1.839 |
| 30 | 303 | 1.514 | 2.084 | 1.878 | 1.799 |
| 35 | 308 | 1.374 | 1.920 | 1.702 | 1.608 |

(cont.)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

As the original article was not available, the above values were obtained from the compilation in the *International Critical Tables*.

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Water; $H_2O$; [7732-18-5] | Winkler, L. W.<br>*Mathematikai es Termeszettudomanyi Ertesitö, Budapest* 1907, *25*, 86. (*International Critical Tables*, Vol. III, p.256) |

| t/°C | $T^a$/L | $10^3\ x_1{}^{a,b}$ | $L^{a,c}$ | $\alpha^{a,d}$ | $\beta^e$ |
|---|---|---|---|---|---|
| 40 | 313 | 1.265 | 1.793 | 1.564 | 1.450 |
| 45 | 318 | 1.182 | 1.698 | 1.458 | 1.320 |
| 50 | 323 | 1.125 | 1.639 | 1.385 | 1.216 |
| 60 | 333 | 1.042 | 1.556 | 1.276 | 1.025 |
| 70 | 343 | 1.022 | 1.564 | 1.245 | 0.862 |
| 80 | 353 | 1.059[f] | 1.657[f] | 1.282[f] | 0.683[f] |
| 90 | 363 | 1.052[f] | 1.682[f] | 1.265[f] | 0.39[f] |

[a] Calculated by compiler.

[b] Mole fraction solubility at 101.325 kPa partial pressure of gas.

[c] Ostwald coefficient.

[d] Bunsen coefficient in units of $cm^3$(STP) $cm^{-3}$ $atm^{-1}$.

[e] Solubility coefficient similar to the Bunsen coefficient but at 1 atm total pressure. $\alpha = \beta \times 760/(760 - P_{H_2O})$.

[f] Doubtful points due to very high vapor pressure of water at these temperatures.

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. Water; $H_2O$; [7732-18-5]

ORIGINAL MEASUREMENTS:

Whitney, R.P.; Vivian, J.E.

*Ind. Eng. Chem.* 1941, *33*, 741-4

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

| T/K | Partial Pressure $p_{Cl_2}$/atm | Partial Pressure $p_{Cl_2}$/kPa | Solubility $^+$ g/$10^2$g $H_2O$ | Mole fraction of chlorine, $x_{Cl_2}$ |
|---|---|---|---|---|
| 283.2 | 0.0601 | 6.09 | 0.124 | 0.000315 |
| | 0.0660 | 6.69 | 0.131 | 0.000333 |
| | 0.155 | 15.7 | 0.228 | 0.000579 |
| | 0.157 | 15.9 | 0.237 | 0.000602 |
| | 0.292 | 29.6 | 0.368 | 0.000934 |
| | 0.293 | 29.7 | 0.366 | 0.000929 |
| | 0.498 | 50.5 | 0.541 | 0.001373 |
| | 0.498 | 50.5 | 0.555 | 0.001408 |
| 288.2 | 0.0581 | 5.89 | 0.111 | 0.000282 |
| | 0.0611 | 6.19 | 0.115 | 0.000292 |
| | 0.140 | 14.2 | 0.195 | 0.000495 |
| | 0.145 | 14.7 | 0.201 | 0.000510 |
| | 0.291 | 29.5 | 0.330 | 0.000838 |
| | 0.297 | 30.1 | 0.330 | 0.000838 |
| | 0.488 | 49.4 | 0.477 | 0.00121 |
| | 0.490 | 49.6 | 0.480 | 0.00128 |
| | 0.951 | 96.4 | 0.825 | 0.00209 |
| | 0.951 | 96.4 | 0.825 | 0.00209 |
| 293.2 | 0.0665 | 6.74 | 0.112 | 0.000284 |
| | 0.1195 | 12.11 | 0.160 | 0.000406 |
| | 0.260 | 26.3 | 0.262 | 0.000665 |
| | 0.260 | 26.3 | 0.265 | 0.000673 |
| | 0.487 | 49.3 | 0.415 | 0.00105 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Single pass flow apparatus. Chlorine and nitrogen at a total pressure of atmospheric pressure was bubbled through water in an "equilibrium" cell. After one hour samples of saturated liquid analysed by adding to excess potassium iodide and titrating the liberated iodine with sodium thiosulfate. Partial pressure of chlorine varied by adjusting proportion in nitrogen chlorine mixture. Also see references (1) and (2) (which are identical) for additional calculations on this system.

SOURCE AND PURITY OF MATERIALS:

1. Purity 98.5 mole per cent.
2. Distilled.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta x_{Cl_2}/x_{Cl_2} = \pm 0.02$

(estimated by compiler)

REFERENCES:

1. Whitney, R. P.; Vivian, J. E. *Tech. Assoc. Papers* 1941, *24*, 435-6.
2. Whitney, R. P.; Vivian, J. E. *Paper Trade J.* 1941, *113*, 31-2.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Water; $H_2O$; [7732-18-5] | Whitney, R.P.; Vivian, J.E.<br>*Ind. Eng. Chem.* 1941, *33*, 741-4. |

EXPERIMENTAL VALUES:

| T/K | Partial pressure $p_{Cl_2}$/atm | $p_{Cl_2}$/kPa | Solubility$^+$, g/$10^5$g $H_2O$ | Mole fraction of chlorine, $x_{Cl_2}$ |
|---|---|---|---|---|
| 293.2 | 0.490 | 49.6 | 0.422 | 0.00107 |
|  | 0.965 | 97.8 | 0.725 | 0.00184 |
| 298.2 | 0.0621 | 6.29 | 0.104 | 0.000264 |
|  | 0.0655 | 6.64 | 0.106 | 0.000269 |
|  | 0.104 | 10.5 | 0.139 | 0.000353 |
|  | 0.109 | 11.0 | 0.143 | 0.000363 |
|  | 0.174 | 17.6 | 0.189 | 0.000480 |
|  | 0.270 | 27.4 | 0.246 | 0.000625 |
|  | 0.551 | 55.8 | 0.391 | 0.000992 |
|  | 0.589 | 59.7 | 0.418 | 0.00106 |
|  | 0.961 | 97.4 | 0.628 | 0.00159 |

| T/K | $10^4\ x_1$ [a] |
|---|---|
| 283.2 | 26.25 |
| 288.2 | 22.11 |
| 293.2 | 19.20 |
| 298.2 | 16.19 |

[a] Extrapolated values at 101.325 kPa partial pressure of gas calculated by compiler from a least squares smoothing of the data at each temperature.

| COMPONENTS: | EVALUATOR: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Water; $H_2O$; [7732-18-5]<br>3. Hydrochloric acid; HCl; [7647-01-0] | Colin L. Young,<br>School of Chemistry,<br>University of Melbourne,<br>Parkville, Victoria 3052,<br>Australia.<br>March 1982 |

EVALUATION:

Much of the solubility data for chlorine in aqueous hydrochloric acid solutions has been determined in order to study the various chemical equilibria established in solution. Jakowkin (Yakovkin) (1) found that the solubility of chlorine in water was decreased by small additions of hydrogen chloride, but is increased by larger additions. Other early investigations were those of Roscoe (2), Berthelot (3) and Goodwin (4). None of these workers data are considered accurate enough for inclusion in the compiled tables. The early data of Mellor (5) are compiled but are classified as doubtful. The data of Hine and Inuta (6) are classified as tentative but are considered inferior to the data of Sherrill and Izard (7), (8) but because of the different temperatures employed, the two sets of data are not directly comparable.

References

1. Jakowkin, A. A.
   *Z. physik. Chem.*, 1899, *29*, 613.

2. Roscoe, H. E.
   *J. Chem. Soc.*, 1956, *8*, 14.

3. Berthelot, M.
   *Ann. Chim. Phys.*, 1881, *22*, 462 and *Compt. rend.*, 1880, *91*, 194.

4. Goodwin, W. L.
   *Trans. Roy. Soc. Edin.*, 1882, *30*, 597 or *Ber.*, 1882, *15*, 3039.

5. Mellor, W.
   *J. Chem. Soc.*, 1901, *79*, 216.

6. Hine, F.; Inuta, S.
   *Bull. Chem. Soc. Japan*, 1968, *41*, 71.

7. Sherrill, M. S.; Izard, E. F.
   *J. Am. Chem. Soc.*, 1928, *50*, 1665.

8. Sherrill, M. S.; Izard, E. F.
   *J. Am. Chem. Soc.*, 1931, *53*, 1667.

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. Water; $H_2O$; [7732-18-5]
3. Hydrochloric acid; HCl; [7647-01-0]

ORIGINAL MEASUREMENTS:

Mellor, W.

*J. Chem. Soc.*

1901, *79*, 216.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

| t/°C | T/K | Conc. of HCl /g dm$^{-3}$ | *p*/mmHg | *p*/kPa | Conc. of $Cl_2$ † /g dm$^{-3}$ | Bunsen Coefficient α | Ostwald Coefficient |
|---|---|---|---|---|---|---|---|
| 21.0 | 294.2 | 313.401 | 761 | 101.5 | 12.03 | 3.5492 | 3.8224 |
| 21.0 | 294.2 | 282.060 | 761 | 101.5 | 11.87 | 3.3278 | 3.5859 |
| 21.0 | 294.2 | 250.720 | 759 | 101.2 | 10.68 | 3.1272 | 3.3677 |
| 21.0 | 294.2 | 219.380 | 759 | 101.2 | 9.93 | 2.9243 | 3.1312 |
| 20.2 | 293.4 | 188.040 | 761 | 101.5 | 9.23 | 2.7020 | 2.9117 |
| 20.2 | 293.4 | 156.700 | 761 | 101.5 | 8.58 | 2.5095 | 2.7043 |
| 20.5 | 293.7 | 125.360 | 761 | 101.5 | 7.76 | 2.2711 | 2.4473 |
| 20.5 | 293.7 | 94.020 | 760 | 101.3 | 7.19 | 2.1044 | 2.2677 |
| 20.0 | 293.2 | 62.680 | 760 | 101.3 | 6.38 | 1.8682 | 2.0131 |
| 21.0 | 294.2 | 31.340 | 762 | 101.6 | 5.81 | 1.6736 | 1.8033 |
| 21.0 | 294.2 | 15.670 | 759 | 101.2 | 5.10 | 1.4933 | 1.6092 |
| 21.0 | 294.2 | 12.540 | 759 | 101.2 | 4.85 | 1.4200 | 1.5292 |
| 21.0 | 294.2 | 9.402 | 760 | 101.3 | 4.76 | 1.3942 | 1.5013 |
| 20.0 | 293.2 | 6.248 | 760 | 101.3 | 4.94 | 1.4483 | 1.5607 |
| 21.0 | 294.2 | 3.134 | 760 | 101.3 | 5.30 | 1.5496 | 1.6698 |
| 21.0 | 294.2 | 0.00 | 760 | 101.3 | 7.23 | 2.1157 | 2.2799 |

† volume measured after saturation with chlorine.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine bubbled through solution. Amount determined by reaction with potassium iodide and titration of iodine with sodium thiosulfate solution.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

δT/K = ±0.2; δα/α = ±0.02 (compiler's estimate).

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. Water; $H_2O$; [7732-18-5]
3. Hydrochloric acid; HCl; [7647-01-0]

ORIGINAL MEASUREMENTS:

Sherrill, M. S.; Izard, E. F.
*J. Am. Chem. Soc.*
1928, *50*, 1665-1675 and
*J. Am. Chem. Soc.*
1931, *53*, 1667-1674.

VARIABLES:

Concentration of acid

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

| T/K | Concentration of acid /mol $kg^{-1}$ ($H_2O$) | Concentration of chlorine /mol $kg^{-1}$ ($H_2O$) | Mole fraction of chlorine,§ $x_{Cl_2}$ |
|---|---|---|---|
| 298.15 | 0.000 | 0.0923 | 0.001660 |
| | 0.010 | 0.08264 | 0.001486 |
| | 0.100 | 0.06394 | 0.001146 |
| | 0.200 | 0.0619 | 0.00111 |
| | 0.496 | 0.0630 | 0.00112 |
| | 1.019 | 0.0665 | 0.00118 |
| | 1.991 | 0.0737 | 0.00128 |
| | 2.990 | 0.0824 | 0.00141 |
| | 3.989 | 0.0914 | 0.00153 |
| | * 4.903 | 0.0978 | 0.00162 |
| | 5.180 | 0.1004 | 0.00165 |
| | * 7.016 | 0.1150 | 0.00184 |
| | * 8.163 | 0.1219 | 0.00191 |
| | * 8.854 | 0.1281 | 0.00199 |
| | * 9.805 | 0.1326 | 0.00203 |

§ at a partial pressure of chlorine of 101.3 kPa.

* taken from earlier reference at a partial pressure of chlorine of 101.3 kPa.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine bubbled through solution. Absorption train painted black to prevent decomposition of chlorine by light. Before the liquid sample was analysed the saturated solution was allowed to equilibrate for at least 3 hours without chlorine being bubbled through. Amount of chlorine determined by reaction with potassium iodide and titrating liberated iodine with sodium thiosulfate.

SOURCE AND PURITY OF MATERIALS:

1. Chlorine prepared by action of hydrochloric acid on chromic acid.

ESTIMATED ERROR:

$\delta T/K = \pm 0.01$; $\delta x_{Cl_2} = \pm 2\%$
(estimated by compiler).

REFERENCES:

| | |
|---|---|
| COMPONENTS:<br>1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Water; $H_2O$; [7732-18-5]<br>3. Hydrochloric acid; HCl; [7647-01-0] | ORIGINAL MEASUREMENTS:<br>Hine, F.; Inuta, S.<br>*Bull. Chem. Soc. Japan*<br>1968, *41*, 71-75. |
| VARIABLES:<br>Temperature, pressure, concentration of component 3 | PREPARED BY:<br>C. L. Young |

EXPERIMENTAL VALUES:

These workers presented data in graphical form for the solubility of chlorine at partial pressures up to $10^5$ Pa in hydrochloric acid of concentrations in the range 2 to 10 moles per litre at temperatures between 30 to 90 °C. They proposed the following smoothing equation for the solubility of chlorine

$$S = (\alpha C + \beta)p \qquad \ldots (1)$$

where $p$ is the pressure in units of atmosphere. C is the concentration of hydrogen chloride in molality or g $dm^{-3}$. $\alpha$ and $\beta$ were functions of temperature and when C was expressed in g $dm^{-3}$

$$\log \alpha = -1.21 \times 10^{-2}\ t - 1.603$$

$$\text{and} \quad \beta = 2.14 \times 10^{2}\ t^{-1.21}$$

$$\text{where} \quad t = \text{Temperature in °C.}$$

The constants for equation (1) are given below.

(cont.)

AUXILIARY INFORMATION

| | |
|---|---|
| METHOD/APPARATUS/PROCEDURE:<br>Flow system similar to that used by Whitney and Vivian (1). Chlorine and nitrogen mixture of known composition and pressure bubbled through acid of known composition. After one hour, samples of saturated liquid analysed by adding to excess potassium iodide and titrating the liberated iodine with sodium thiosulfate. Partial pressure of chlorine varied by adjusting proportion in nitrogen chlorine mixture. | SOURCE AND PURITY OF MATERIALS:<br>No details given. |
| | ESTIMATED ERROR: |
| | REFERENCES:<br>1. Whitney, R. P.; Vivian, J. E. *Ind. Eng. Chem.* 1941, *33*, 741. |

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Water; $H_2O$; [7732-18-5]<br>3. Hydrochloric acid; HCl; [7647-01-0] | Hine, F.; Inuta, S.<br>*Bull. Chem. Soc. Japan*<br>1968, *41*, 71-75. |

EXPERIMENTAL VALUES:

| t/°C | (K/T) × $10^3$ | α<br>α(†) × $10^3$ | α(*) × $10^2$ | β<br>β(§) × $10^2$ | β(#) |
|---|---|---|---|---|---|
| 30 | 3.300 | 6.57 | 1.08 | 4.85 | 3.42 |
| 40 | 3.195 | 5.11 | 0.844 | 3.49 | 2.46 |
| 50 | 3.096 | 3.65 | 0.592 | 2.72 | 1.92 |
| 70 | 2.915 | 2.20 | 0.350 | 1.76 | 1.22 |
| 90 | 2.755 | 1.38 | 0.204 | 1.32 | 0.916 |

† α/(mole $Cl_2$ per 1000 gm solvent)/(mole HCl per 1000 gm solvent)(atm))

* α/(g $Cl_2$ per $dm^3$ solvent)/(g HCl per $dm^3$ solvent)(atm))

§ β/(mole $Cl_2$ per 1000 gm solvent/atm)

# β/(g $Cl_2$ per $dm^3$ solvent/atm)

| COMPONENTS: | EVALUATOR: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Electrolyte solutions | Colin L. Young,<br>School of Chemistry,<br>University of Melbourne,<br>Parkville, Victoria 3052,<br>Australia.<br>June 1981. |

CRITICAL EVALUATION:

## Note on the data of Karapysh and coworkers

Karapysh and coworkers have made fairly extensive studies of the solubility of chlorine in aqueous solutions but the data are, in general, presented in a graphical form or the work was presented in journals which are not readily available. In many cases the information was presented in an ambiguous manner and the meaning of the tables and graphs was not clear.

The solubility of chlorine in perchloric acid has been investigated by Semchenko *et al.* (1), Loseva *et al.* (2), Levchenko and Karapysh (3) and Semchenko and Karapysh (4). In reference (1) a graph of solubility (g $dm^{-3}$) versus chlorine pressure was given.

In a later paper Smirnov *et al.* (5) presented the solubility of chlorine in hydrochloric acid. The data were presented only in graphical form.

Smirnov and Aliev (6) presented results for the solubility of chlorine in aqueous solutions of lithium chloride, sodium chloride and of potassium chloride. The results were presented in graphical form. A table was given in the paper but the values do not agree, even approximately, with the data presented in the graphs.

Aliev *et al.* (7) studied the solubility of chlorine in water and in aqueous sodium chloride solution. Blaznina *et al.* (8) studied the solubility of chlorine in aqueous barium chloride at concentrations in the range 0.1 to 3.0 mol $dm^{-3}$ and temperatures in the range 10 to 50 °C. Karapysh and Semchenko (9) studied the solubility of chlorine in aqueous solutions of lithium chloride, strontium chloride and barium chloride. Karapysh and Semchenko (10) also studied the solubility of chlorine in aqueous solutions of lithium and sodium perchlorates. The papers (7) to (10) could not be obtained by us despite considerable effort.

## References

1. Semchenko, D. P.; Smirnov, V. A.; Aliev, Z. M.; Karapysh, V. V. *Zh. Fiz. Khim.* 1974, *48*, 1002; *Russ. J. Phys. Chem.* 1974, *48*, 580-581.
2. Loseva, G. K.; Semchenko, D. P.; Il'in, K. G. *Tr. Novocherk. Politekh. Inst.* 1969, *197*, 37.
3. Levchenko, V. M.; Karapysh, V. V. *Gidrokhim. Mater.* 1969, *51*, 153.
4. Semchenko, D. P.; Karapysh, V. V. *Tr. Novocherk. Politekh. Inst.* 1956, *48*, 19.
5. Smirnov, V. A.; Aliev, Z. M.; Karapysh, V. V.; Gurchin, I. I. *Zh. Fiz. Khim.* 1974, *48*, 1241; *Russ. J. Phys. Chem.* 1974, *48*, 720.
6. Smirnov, V. A.; Aliev, Z. M. *Zh. Fiz. Khim.* 1976, *50*, 1132; *Russ. J. Phys. Chem.* 1976, *50*, 684.
7. Aliev, Z. M.; Karapysh, V. V.; Smirnov, V. A. *Tr. Novocherk. Politekh. Inst.* 1972, *266*, 155.
8. Blaznina, V. A.; Fedorina, V. F.; Shul'gina, G. A.; Karapysh, V. V. *Nauch. Raboty Stud. Khim.-Tekhnol.Fak., Novocherkasshii Politekh. Inst. im. S. Ordzhonikidze* 1959, *7*, 17.
9. Karapysh, V. V.; Semchenko, D. P. *Tr. Novocherk. Politekh. Inst.* 1960, *98*, 173.
10. Karapysh, V. V.; Semchenko, D. P. *Tr. Novocherk. Politekh. Inst.* 1959, *65*, 111.

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. Water; $H_2O$; [7732-18-5]
3. Sulfuric acid; $H_2SO_4$; [7664-93-9]

ORIGINAL MEASUREMENTS:

Sherrill, M. S.; Izard, E. F.

*J. Am. Chem. Soc.*

1931, *53*, 1667-1674.

VARIABLES:

Concentration of acid

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

| T/K | Conc. of salt /mol $kg^{-1}$ ($H_2O$) | Conc. of chlorine /mol $kg^{-1}$ ($H_2O$) | Mole fraction of chlorine $x_{Cl_2}$ |
|---|---|---|---|
| 298.15 | 0.0000 | 0.0923 | 0.001660 |
| | 0.4995 | 0.06272 | 0.001119 |
| | 1.0240 | 0.05617 | 0.000993 |
| | 1.9686 | 0.04973 | 0.000865 |
| | 3.0090 | 0.04550 | 0.000777 |
| | 3.9934 | 0.04278 | 0.000718 |
| | 4.9901 | 0.04066 | 0.000672 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine bubbled through solution. Absorption train painted black to prevent decomposition of chlorine by light. Before the liquid sample was analysed the saturated solution was allowed to equilibrate for at least 3 hours without chlorine being bubbled through. Amount of chlorine determined by reaction with potassium iodide and titrating liberated iodine with sodium thiosulfate.

SOURCE AND PURITY OF MATERIALS:

1. Chlorine prepared by action of hydrochloric acid on chromic acid.

ESTIMATED ERROR:

$\delta T/K = \pm 0.01$; $\delta x_{Cl_2} = \pm 2\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. Water; $H_2O$; [7732-18-5]
3. Barium chloride; $BaCl_2$; [10361-37-2]

ORIGINAL MEASUREMENTS:

Sherrill, M. S.; Izard, E. F.

*J. Am. Chem. Soc.*

1931, *53*, 1667-1674.

VARIABLES:

Concentration of salt

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

| T/K | Conc. of salt /mol $kg^{-1}$ ($H_2O$) | Conc. of chlorine /mol $kg^{-1}$ ($H_2O$) | Mole fraction of chlorine $x_{Cl_2}$ |
|---|---|---|---|
| 298.15 | 0.000 | 0.0923 | 0.001660 |
| | 0.330 | 0.06216 | 0.001112 |
| | 0.667 | 0.05494 | 0.000977 |
| | 1.000 | 0.04924 | 0.000871 |
| | 1.333 | 0.04468 | 0.000785 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine bubbled through solution. Absorption train painted black to prevent decomposition of chlorine by light. Before the liquid sample was analysed the saturated solution was allowed to equilibrate for at least 3 hours without chlorine being bubbled through. Amount of chlorine determined by reaction with potassium iodide and titrating liberated iodine with sodium thiosulfate.

SOURCE AND PURITY OF MATERIALS:

1. Chlorine prepared by action of hydrochloric acid on chromic acid.

ESTIMATED ERROR:

$\delta T/K = \pm 0.01$; $\delta x_{Cl_2} = \pm 2\%$

(estimated by compiler).

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Water; $H_2O$; [7732-18-5]<br>3. Sodium chloride; NaCl; [7647-14-5] | Sherrill, M. S.; Izard, E. F.<br>*J. Am. Chem. Soc.*<br>1931, *53*, 1667-1674. |
| VARIABLES: | PREPARED BY: |
| Concentration of salt | C. L. Young |

EXPERIMENTAL VALUES:

| T/K | Conc. of salt /mol $kg^{-1}$ ($H_2O$) | Conc. of chlorine /mol $kg^{-1}$ ($H_2O$) | Mole fraction of chlorine $x_{Cl_2}$ |
|---|---|---|---|
| 298.15 | 0.000 | 0.0923 | 0.001660 |
| | 0.501 | 0.06575 | 0.001183 |
| | 0.998 | 0.05795 | 0.001025 |
| | 2.991 | 0.04161 | 0.000711 |
| | 3.989 | 0.03601 | 0.000605 |
| | 4.989 | 0.03087 | 0.000510 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine bubbled through solution. Absorption train painted black to prevent decomposition of chlorine by light. Before the liquid sample was analysed the saturated solution was allowed to equilibrate for at least 3 hours without chlorine being bubbled through. Amount of chlorine determined by reaction with potassium iodide and titrating liberated iodine with sodium thiosulfate.

SOURCE AND PURITY OF MATERIALS:

1. Chlorine prepared by action of hydrochloric acid on chromic acid.

ESTIMATED ERROR:

$\delta T/K = \pm 0.01$; $\delta x_{Cl_2} = \pm 2\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. Water; $H_2O$; [7732-18-5]
3. Potassium chloride; KCl; [7447-40-7]

ORIGINAL MEASUREMENTS:

Sherrill, M. S.; Izard, E. F.

*J. Am. Chem. Soc.*

1931, *53*, 1667-1674.

VARIABLES:

Concentration of salt

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

| T/K | Conc. of salt /mol $kg^{-1}$ ($H_2O$) | Conc. of chlorine /mol $kg^{-1}$ ($H_2O$) | Mole fraction of chlorine $x_{Cl_2}$ |
|---|---|---|---|
| 298.15 | 0.000 | 0.0923 | 0.001660 |
| | 0.500 | 0.06610 | 0.001179 |
| | 1.000 | 0.06109 | 0.001080 |
| | 2.013 | 0.05388 | 0.000936 |
| | 3.014 | 0.04865 | 0.000831 |
| | 3.913 | 0.04724 | 0.000794 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine bubbled through solution. Absorption train painted black to prevent decomposition of chlorine by light. Before the liquid sample was analysed the saturated solution was allowed to equilibrate for at least 3 hours without chlorine being bubbled through. Amount of chlorine determined by reaction with potassium iodide and titrating liberated iodine with sodium thiosulfate.

SOURCE AND PURITY OF MATERIALS:

1. Chlorine prepared by action of hydrochloric acid on chromic acid.

ESTIMATED ERROR:

$\delta T/K = \pm 0.01$; $\delta x_{Cl_2} = \pm 2\%$

(estimated by compiler).

REFERENCES:

| COMPONENTS: | EVALUATOR: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Organic liquids | P. G. T. Fogg,<br>Department of Chemistry,<br>Polytechnic of North London,<br>Holloway,<br>London, U.K.<br>September 1980 |

CRITICAL EVALUATION:

It is not possible, in general, to judge between the merits of different apparatus from the information which has been given by authors. In the descriptions of technique it has not always been clearly stated or implied whether or not allowance has been made for the partial pressure of the solvent in the calculation of the partial pressure of chlorine. In the case of solvents which have low volatility at the temperature of measurement such correction is of little importance. However, at a temperature of about 50 K below the normal boiling point of a typical solvent the partial vapor pressure of the solvent is about 0.08 atm and appropriate correction becomes increasingly important for measurements at higher temperatures. Uncertainty as to whether appropriate correction has been made by authors leads to corresponding uncertainty in the significance of the results which have been reported.

Where solubilities have been reported for a range of temperatures and the partial pressure of chlorine equal to 1 atm or a sum of partial pressures of chlorine and solvent equal to 1 atm, the evaluator has carried out a least squares analysis to fit values of $RT\ln x_{Cl_2}$ to equations of the form:

$$-RT\ln x_{Cl_2} = a + bT$$

where $x_{Cl_2}$ is the mole fraction solubility of chlorine at a temperature T. In several cases solubilities were measured at an unstated barometric pressure. Any differences between a standard atmosphere and barometric pressure have been neglected for the purpose of general comparison of results.

If $\Delta\bar{G}°$, $\Delta\bar{H}°$ and $\Delta\bar{S}°$ are defined as the change in Gibbs free energy, enthalpy and entropy for the hypothetical process:

$$Cl_2\ (1\ \text{atm}) \rightarrow Cl_2\ (\text{solution}, x_{Cl_2} = 1)$$

it follows that:

$$\Delta\bar{G}° \approx -RT\ln x_{Cl_2}$$

$$\Delta\bar{H}° \approx a$$

$$\Delta\bar{S}° \approx -b$$

provided that the solubility is measured at a partial pressure of chlorine equal to 1 atm (1). Values of $a$ and $b$ are given in table I.

In the cases where it appears to the evaluator that no allowance has been made by the authors for the vapor pressure of a volatile solvent, "corrected" solubility values have been determined. These "corrected" solubilities have been calculated using published vapor pressure data (2). It has been assumed that dissolution of chlorine lowers the partial vapor pressure of the solvent in accordance with the relationship:

$$p_{\text{solvent}} = p°_{\text{solvent}}(1 - x_{Cl_2})$$

and that $x_{Cl_2}$ ($p_{Cl_2}$ = 1 atm) may be calculated from $x_{Cl_2}$ ($p_{Cl_2} + p_{\text{Solvent}}$ = 1 atm) by assuming that $x_{Cl_2}$ is directly proportional to $p_{Cl_2}$ over a small pressure range. This procedure, used by Hildebrand, is subject to limitations (3), (4). The "corrected" solubilities have been subjected to least squares analysis and fitted to equations of the form:

$$-RT\ln x_{Cl_2(\text{corrected})} = a' + b'T.$$

| COMPONENTS: | EVALUATOR: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Organic liquids | P. G. T. Fogg,<br>Department of Chemistry,<br>Polytechnic of North London,<br>Holloway,<br>London, U.K.<br>September 1980 |

CRITICAL EVALUATION:

Values of $a'$ and of $b'$ are also given in table I. In view of the uncertainties involved they are not necessarily better constants than values of $a$ and $b$.

Solubility measurements made at a single temperature have been collected together in table II and values of $x_{Cl_2 (corrected)}$ are given where appropriate.

The average value of $a$ is -18935 J $mol^{-1}$. The average is -17284 J $mol^{-1}$ if the "corrected" values, $a'$, are taken into account. The enthalpy of vaporization of liquid chlorine, calculated from the variation of vapor pressure with temperature (2), is 19912 J $mol^{-1}$ at 298.16 K. The average value of $b$ is 80.10 J $K^{-1}$ $mol^{-1}$ or 74.43 J $K^{-1}$ $mol^{-1}$ if "corrected" values of $b'$ are taken into account. These values can be compared with the value of $\Delta S°$ for the process:

$$Cl_2(\text{liquid}) \rightarrow Cl_2(\text{vapor; 1 atm}) \text{ at } 298.16 \text{ K.}$$

The value of this entropy change, calculated by the evaluator from the variation of vapor pressure of chlorine with temperature (2), is 83.68 J $K^{-1}$ $mol^{-1}$. It follows that, on average, for the solvents under consideration there is no great difference between the values of $\Delta\bar{G}°$, $\Delta\bar{H}°$, and $\Delta\bar{S}°$ for the hypothetical process:

$$Cl_2(\text{gas, 1 atm}) \rightarrow Cl_2(\text{solution, } x_{Cl_2} = 1)$$

and the corresponding values for the process:

$$Cl_2(\text{gas, 1 atm}) \rightarrow Cl_2(\text{liquid}).$$

Experimental measurements of solubilities of chlorine which have led to values of $a$ or $a'$ and $b$ or $b'$ which differ appreciably from mean values are not necessarily unreliable but ought to be used with caution. Measurements which have given large standard deviations from the smoothing equations should also be treated with similar caution.

Experimental values of $x_{Cl_2}$(1 atm) as a function of T for various systems are shown in figs. 1 and 2. On these graphs are also plotted reference lines corresponding to the equation:

$$x_{Cl_2} = p_{Cl_2}/p°_{Cl_2}$$

where $p°_{Cl_2}$ is the vapor pressure of liquid chlorine at temperature T. As explained by Gerrard (4), comparison of experimental results with reference lines can give an estimation of the reliability of the measurements.

Experimental curves showing the variation of the mole fraction solubility of a gas as a function of temperature at constant pressure are often similar in shape to the corresponding reference lines. Solvents of similar structure usually show similar behavior relative to the reference line for a particular gas.

The general considerations outlined above lead to the following detailed observations on the results which have been reported:

Trichloromethanesulfenyl chloride

Values of $a$ and $b$ are large compared with average values. There is nothing unusual in the graph of $x_{Cl_2}$ against T and the measurements (5) are classified as tentative.

| COMPONENTS: | EVALUATOR: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Organic liquids | P. G. T. Fogg,<br>Department of Chemistry,<br>Polytechnic of North London,<br>Holloway,<br>London, U.K.<br>September 1980 |

CRITICAL EVALUATION:

Carbon disulfide

Values of $a$ and $b$ are large compared with the average. "Corrected" values, $a'$ and $b'$ are a little closer in line with the average. "Uncorrected" values of $x_{Cl_2}$ become increasingly lower than corresponding points on the reference line with increasing temperature. In contrast, "corrected" values become increasingly higher than the reference line with increasing temperature. The data of Raskina *et al.* (5) are classified as tentative.

Tetrachloromethane

The solubilities of chlorine in this liquid are evaluated on page 395.

Mixtures of tetrachloromethane, trichloromethanesulfenyl chloride and carbon disulfide

The solubilities of chlorine in six mixtures of the three solvents were measured by Raskina *et al.* (5). In the case of two of the mixtures there is a discrepancy between solubilities given by the authors as mole fractions and those given as weight fractions. It is not clear which figures are erroneous.

Each mole fraction solubility, $x_{Cl_2}$, reported by the authors is close to the sum of the solubilities, $x'_{Cl_2}$, in the separate portions of the pure solvents which were used to make up the mixture. (Coef. corr. 0.8731; $x_{Cl_2}/x'_{Cl_2} = 1.01 \pm 0.03$.) The agreement between weight fraction solubilities, $w_{Cl_2}$, given by the authors and the sum weight fraction solubilities, $w'_{Cl_2}$, in separate portions of the pure liquid is not as good. (Coef. corr. 0.3772; $w_{Cl_2}/w'_{Cl_2} = 0.97 \pm 0.07$.)

Tetrachloroethene

The standard deviation of "uncorrected" values of $RT\ln x_{Cl_2}$ is about 8%. Corrected values have a standard deviation of about 3%. Uncorrected values of $a$ and $b$ are above average whereas corrected values are about average. A plot of uncorrected values of $x_{Cl_2}$ crosses the reference line, i.e., exhibits both positive and negative deviations from Raoult's law. Corrected values of $x_{Cl_2}$ fall on a curve which approaches but does not cross the reference line as the temperature is increased. The "corrected" values are to be preferred (6).

1,1,2,2-Tetrachloroethane

Standard deviations of both "uncorrected" and "corrected" values of $RT\ln x_{Cl_2}$ are about 6%. Corrected and uncorrected values of $a$ and $b$ are clearly considerably smaller than in any other similar system. The measurements (7) must therefore be considered doubtful.

Acetic acid

Values of $a$ and $b$ based on measurements by Kumar and Gehlawat (8) are appreciably greater than mean values. A plot of "uncorrected" values of $x_{Cl_2}$(1 atm) against T is close to a straight line which would indicate a very unusual temperature dependence of solubility. "Corrected" values of solubility do not show such an unusual temperature dependence and are deemed more reliable. Jones (9) measured solubilities at 289.2 K and low pressures of chlorine. Extrapolation of these results to 1 atm gives a value close to that obtained by extrapolating the results of Kumar and Gehlawat (8) to 289.2 K by use of the "corrected" smoothing equation.

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. Organic liquids

EVALUATOR:

P. G. T. Fogg,
Department of Chemistry,
Polytechnic of North London,
Holloway,
London, U.K.

September 1980

CRITICAL EVALUATION:

However, in view of uncertainty of the "correction" to Kumar and Gehlawat (8) values and the extrapolation from low pressure needed to compare Jones (9) values, both sets of data are classified as doubtful.

1,1,2,3,4,4-Hexachloro-1,3-butadiene

The measurements of Kogan *et al.* (10) indicate that $x_{Cl_2}$ is proportional to $p_{Cl_2}$ in the range 408 mmHg to 974 mmHg at 303 K with $p_{Cl_2}/x_{Cl_2}$ equal to 4827 ± 17 mmHg. Values of $x_{Cl_2}$(1 atm) for temperatures in the range 253 K to 365 K are close to corresponding values for tetrachloromethane and are classified as tentative.

Chlorobenzene

Values of *a* and *b* based on the measurements by Cervinka (11) at three temperatures are well below average and differ appreciably from values based upon measurements by Krentsel *et al.* (12) and by Zetkin *et al.* (13). However, with the exception of a measurement at 298 K by Cervinka (11) which appears to be erroneous and which distorts the pattern of his results, solubilities reported by the different authors fall into a consistent pattern. "Corrected" smoothing equation constants, *a*' and *b*', from Zetkin's results agree more closely than "uncorrected" values with the corresponding constants based upon the work of Krentsel *et al.* (12). However, because of the low volatility of the solvent at the temperature of measurement, such correction for the vapor pressure of the solvent is of little significance. The following equation, based upon "corrected" measurements by Zetkin *et al.* (13) and measurements by Krentsel *et al.* (12), is recommended:

$$\Delta G°/\text{J mol}^{-1} = (-RT\ln x_{Cl_2})/\text{J mol}^{-1} = -19804 + 81.654T/K$$

$$\text{Std. dev. } \Delta G°/\text{J mol}^{-1} = 154; \quad \text{Coef. corr.} = 0.9951.$$

Benzene

There is appreciable disagreement between results over a range of temperatures which have been published by different authors. Corresponding values of *a* and *b* are inconsistent. However "corrected" solubilities based upon measurements by Zetkin *et al.* (13) are close to the values based upon the results of Cervinka (11). To estimate solubilities at 1 atm from the results given by Krivonos (14), it is assumed that Bunsen coefficients are independent of the pressure at which they are measured. This procedure may introduce considerable error and explain why these solubilities are appreciably greater than those based upon the work of Cervinka (11) and Zetkin *et al.* (13). Nevertheless, the measurement at 1 atm and 293 K by Pozin and Opykhtina (15) is close to the value based upon Krivonos' (14) work. The following equation is based upon a combination of "corrected" measurements by Zetkin *et al.* (13) and measurements by Cervinka (14):

$$\Delta G°/\text{J mol}^{-1} = (-RT\ln x_{Cl_2})/\text{J mol}^{-1} = -15043 + 66.633T/K$$

$$\text{Std. dev. } \Delta G°/\text{J mol}^{-1} = 192; \quad \text{Coef. corr.} = 0.9872.$$

Values of $x_{Cl_2}$ measured by Pozin and Opykhtina (15) at 293 K for the range 49 mmHg to 763 mmHg give a standard deviation of 9.6% when expressed as a linear function of $p_{Cl_2}$.

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. Organic liquids

EVALUATOR:

P. G. T. Fogg,
Department of Chemistry,
Polytechnic of North London,
Holloway,
London, U.K.

September 1980

CRITICAL EVALUATION:

## Mixtures of trifluoromethylbenzene and its ring substituted chlorinated derivatives

Solubilities of chlorine in pure trifluoromethylbenzene and in mixtures with chlorinated derivatives were measured by Ushakov *et al.* (16). Solubilities increased with the proportion of chlorinated derivatives present. In each case plots of $x_{Cl_2}$ against T fall on a smooth curve which tends to approach the reference line with increase in temperature. Data for the smoothing equation:

$$-RT\ln x_{Cl_2} = a + bT$$

are as follows:

| Composition before passage of chlorine (wt-%) | | | $a$ | $b$ | Coef. corr. | (Std. dev.) /J mol$^{-1}$ of $RT\ln x_{Cl_2}$ |
|---|---|---|---|---|---|---|
| $C_7H_5F_3$ | $C_7H_4ClF_3$ | $C_7H_3Cl_2F_3$ | /J mol$^{-1}$ | /JK$^{-1}$mol$^{-1}$ | | |
| 100 | - | - | -22918 | 94.563 | 0.9972 | 184 |
| 84.84 | 15.16 | - | -20233 | 84.933 | 0.9982 | 105 |
| 58.29 | 39.47 | 2.24 | -20851 | 86.514 | 0.9994 | 65 |
| 22.82 | 60.86 | 16.32 | -16565 | 71.346 | 0.9989 | 70 |

The proportions of the different isomers having the same empirical formulae were not determined.

## Cyclohexane

Solubilities at three temperatures, 283 K, 293 K and 313 K, over a range of pressures were measured by Tsiklis and Svetlova (17). In each case a plot of $x_{Cl_2}$ *vs.* $p_{Cl_2}$ (T const.) is a curve which, when extrapolated, cuts the reference line for constant temperature at values of $x_{Cl_2}$ ranging from about 0.1 to about 0.16. This behavior is unusual and the data ought to be used with caution. The data are classified as doubtful.

## Methylbenzene

Values of $a$ and $b$ are high compared with the average. "Corrected" values, $a'$ and $b'$, while still above the average values appear to be reasonable. A plot of "uncorrected" values of $x_{Cl_2}$ against T cuts the reference line. "Corrected" values fall on a curve which approaches but does not cut the reference line. These values seem to be more acceptable than the "uncorrected" values (18).

## Heptane

Solubilities measured by Semb (19) are consistent with those measured by Zetkin *et al.* (20) over a shorter temperature range and with the measurement by Taylor and Hildebrand (3) at the single temperature of 273 K. Values above about 333 K should be used with caution because of uncertainties associated with the effect of the vapor pressure of the solvent and the difficulties of making satisfactory corrections as the

| COMPONENTS: | EVALUATOR: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Organic liquids | P. G. T. Fogg,<br>Department of Chemistry,<br>Polytechnic of North London,<br>Holloway,<br>London, U.K.<br>September 1980 |

CRITICAL EVALUATION:

temperature approaches the b.p. of the solvent. The values of $a$ and $b$ based on Zetkin *et al.* results lie close to values for other hydrocarbons also based upon Zetkin *et al.* results. "Correction" of results leads to some inconsistencies between values of $a'$ and $b'$ for different hydrocarbons. It may therefore be preferable to use"uncorrected"values of solubilities of heptane and other hydrocarbons studied by Zetkin *et al.* (20).

Dichlorodioxochromium

A plot of $x_{Cl_2}$(1 atm) against T based upon measurements by Roozeboom (21) approaches the reference line with increase in temperature and values are acceptable. Values of $x_{Cl_2}$ at 273.2 K for the pressure range 753 to 1302 mmHg differ from values given by the equation:

$$x_{Cl_2} = p_{Cl_2}/p^\circ_{Cl_2}$$

by about 4% and can be fitted to a curve which cuts the reference line for a constant temperature of 273.2 K at $x_{Cl_2} = 0$ and $x_{Cl_2} = 1$. This is a good indication that the measurements are acceptable (4) and add support to the validity of the way in which the original measurements were interpreted when the data were compiled.

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COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. Organic liquids

EVALUATOR:

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September 1980

CRITICAL EVALUATION:

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*Table I. Quantitative evaluation of measurements of the solubility of chlorine in liquids at 1 atm.*

| Solvent | b.p. /K | Authors | Temp. range /K | Allowance for v.p. of solvent | Smoothing equation | | | | Corrected smoothing equation | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Constants | | Coef. corr. | (Std.dev.) /J mol$^{-1}$ of RTln$x_{Cl_2}$ | Constants | | Coef. corr. | (Std.dev.) /J mol$^{-1}$ of RTln$x_{Cl_2}$ |
| | | | | | a /J mol$^{-1}$ | b /JT$^{-1}$ mol$^{-1}$ | | | a /J mol$^{-1}$ | b /JT$^{-1}$ mol$^{-1}$ | | |
| $CHCl_3$; Trichloromethane | 335 | VK | 257-298 | Yes | -19788 | 84.219 | 0.9973 | 108 | | | | |
| $CH_2Cl_2$; Dichloromethane | 313. | VK | 254-298 | Yes | -17147 | 76.348 | 0.9996 | 42 | | | | |
| $CCl_4$; Tetrachloromethane | 349 | † | 253-353 | Yes | -18728 | 78.052 | 0.9995 | 83 | | | | |
| $CCl_4S$; Trichloromethane-sulfinyl chloride | 422 | RZZKK | 275-308 | No | -23717 | 98.600 | 0.9906 | 159 | | | | |
| $CS_2$; Carbon disulfide | 319 | RZZKK | 275-298 | No | -24996 | 102.504 | 0.9995 | 30 | -14570 | 63.636 | 0.9971 | 43 |
| $C_2Cl_4$; Tetrachloroethene | 394 | CH | 273-363 | No | -22825 | 92.530 | 0.9920 | 387 | -18750 | 78.377 | 0.9983 | 151 |
| $C_2H_2Cl_4$; 1,1,2,2-Tetrachloroethane | 419 | KN | 298-383 | No | -12509 | 62.349 | 0.9721 | 502 | -8674 | 50.056 | 0.9612 | 479 |
| $C_2H_4Br_2$; 1,2-Dibromoethane | 405 | TH | 293;313 | Yes | -18257 | 75.999 | - | - | | | | |
| $C_2H_4O_2$; Acetic acid | 391 | KG | 303-333 | No | -26872 | 111.932 | 0.9926 | 176 | -24136 | 102.76 | 0.9935 | 151 |
| $C_4Cl_6$; 1,1,2,3,4,4-Hexachloro-1,3-butadiene | 488 | KKL | 253-365 | No | -17228 | 72.090 | 0.9997 | 66 | -17082 | 71.570 | 0.9997 | 72 |
| $C_6H_3Cl_3$; 1,2,4-Trichlorobenzene | 487 | ZKSD | 288-333 | No | -22450 | 89.500 | 0.9995 | 48 | | | | |
| $C_6H_3Cl_2NO_2$; 1,2-Dichloro-4-nitrobenzene | | ZKZD | 333-433 | No | -17771 | 78.307 | 0.9999 | 30 | | | | |

(cont.)

Table I (cont.)

| Solvent | b.p. /K | Authors | Temp. range /K | Allowance for v.p. of solvent | Smoothing equation | | | | Corrected smoothing equation | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Constants | | | | Constants | | | |
| | | | | | a /J mol$^{-1}$ | b /J T$^{-1}$ mol$^{-1}$ | Coef. corr. | (Std.dev.) /J mol$^{-1}$ of RTln$x_{Cl_2}$ | a /J mol$^{-1}$ | b /J T$^{-1}$ mol$^{-1}$ | Coef. corr. | (Std.dev.) /J mol$^{-1}$ of RTln$x_{Cl_2}$ |
| $C_6H_3Cl_2NO_2$; 1,4-Dichloro-2-nitrobenzene | 540 | ZKZD | 333-433 | No | -18585 | 78.712 | 0.9999 | 31 | | | | |
| $C_6H_4ClNO_2$; 1-Chloro-2-nitrobenzene | 519 | ZKZD | 313-433 | No | -17700 | 78.794 | 0.9999 | 41 | | | | |
| $C_6H_4ClNO_2$; 1-Chloro-3-nitrobenzene | 508 | ZKZD | 333-433 | No | -19424 | 84.055 | 0.9999 | 36 | | | | |
| $C_6H_4ClNO_2$; 1-Chloro-4-nitrobenzene | 515 | ZKZD | 373-433 | No | -22866 | 91.459 | 1.0000 | 12 | | | | |
| $C_6H_4Cl_2$; 1,2-Dichlorobenzene | 454 | ZKSD | 288-333 | No | -20174 | 81.553 | 0.9967 | 117 | -19930 | 80.718 | 0.9966 | 117 |
| $C_6H_5Cl$; Chlorobenzene | 405 | C | 298-338 | Yes | -13327 | 62.404 | 0.9943 | 134 | | | | |
| $C_6H_5Cl$; Chlorobenzene | 405 | KLS | 313-343 | Yes | -17357 | 74.542 | 0.9999 | 10 | | | | |
| $C_6H_5Cl$; Chlorobenzene | 405 | ZKSD | 283-333 | No | -20090 | 82.631 | 0.9971 | 199 | -18919 | 78.541 | 0.9960 | 131 |
| $C_6H_5NO_2$; Nitrobenzene | 484 | ZKZD | 313-433 | No | -19405 | 82.342 | 0.9996 | 102 | -16838 | 74.745 | 0.9978 | 213 |
| $C_6H_6$; Benzene | 353 | C | 298-341 | Yes | -13448 | 62.072 | 0.9970 | 82 | | | | |
| $C_6H_6$; Benzene | 353 | K | 283-323 | Yes | -11182 | 50.557 | 0.9963 | 69 | | | | |
| $C_6H_6$; Benzene | 353 | ZKSD | 283-333 | No | -23857 | 97.081 | 0.9991 | 78 | -14836 | 65.573 | 0.9916 | 160 |
| $C_7H_5Cl_3$; Trichloromethyl benzene | 494 | EKRG | 303-423 | No | -19730 | 81.311 | 0.9955 | 287 | | | | |
| $C_7H_5F_3$; Trifluoromethyl benzene | 375 | UKSM | 279-353 | No | -22918 | 94.563 | 0.9972 | 184 | -16158 | 71.402 | 0.9966 | 155 |

(cont.)

*Table I (cont.)*

| Solvent | b.p. /K | Authors | Temp. range /K | Allowance for v.p. of solvent | Smoothing equation |  |  |  | Corrected smoothing equation |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Constants a /J mol$^{-1}$ | Constants b /JT$^{-1}$ mol$^{-1}$ | Coef. corr. | (Std.dev.) /J mol$^{-1}$ of RTln$x_{Cl_2}$ | Constants a /J mol$^{-1}$ | Constants b /JT$^{-1}$ mol$^{-1}$ | Coef. corr. | (Std.dev.) /J mol$^{-1}$ of RTln$x_{Cl_2}$ |
| $C_7H_6Cl_2$; Dichloromethyl benzene | 478 | EKRG | 303-403 | No | -18877 | 78.531 | 0.9957 | 235 |  |  |  |  |
| $C_7H_7Cl$; Chloromethyl benzene | 452 | EKRG | 303-383 | No | -18003 | 75.960 | 0.9958 | 191 |  |  |  |  |
| $C_7H_8$; Methyl benzene | 384 | EKRG | 303-353 | No | -26746 | 104.440 | 0.9967 | 158 | -19709 | 81.343 | 0.9932 | 179 |
| $C_7H_{16}$; Heptane | 372 | S | 254-358 | No | -18261 | 77.873 | 0.9947 | 278 | -12108 | 55.750 | 0.9883 | 298 |
| $C_7H_{16}$; Heptane |  | ZKZMD | 283-323 | No | -15768 | 69.270 | 0.9998 | 19 | -12660 | 58.281 | 0.9990 | 40 |
| $C_7F_{16}$; Hexadeca-fluoro heptane | 356 | GH | 273-298 | Yes | -13666 | 65.106 | 0.9964 | 24 |  |  |  |  |
| $C_8H_{18}$; Octane | 399 | ZKZMD | 283-323 | No | -15972 | 69.416 | 0.9994 | 38 | -14882 | 65.579 | 0.9988 | 51 |
| $C_8H_{18}$; 2,2,4-Trimethyl pentane | 372 | ZKZMD | 283-323 | No | -15022 | 66.962 | 0.9996 | 28 | -11914 | 55.928 | 0.9976 | 61 |
| $C_{10}H_{24}$; Decane | 447 | ZKZMD | 283-323 | No | -16770 | 71.116 | 0.9994 | 39 | -16613 | 70.582 | 0.9993 | 43 |
| $C_{14}H_{30}$; Tetradecane | 527 | ZKZMD | 283-323 | No | -16899 | 69.183 | 0.9994 | 37 | -16899 | 69.183 | 0.9994 | 37 |
| $Cl_2CrO_2$; Dichloro-dioxo chromium * | 390 | R | 247-273 | No | -19362 | 82.241 | 0.9954 | 65 |  |  |  |  |
| $Cl_4Ti$; Titanium chloride * | 410 | KM | 293;303 | No | -21816 | 89.226 | - | - |  |  |  |  |

† See evaluation of $CCl_4$ by W. Gerrard. b.p. - boiling point at 1 atm pressure. v.p. - vapor pressure.

* Solubilities at 1 atm estimated from values at other pressures.

| COMPONENTS: | EVALUATOR: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Organic liquids | P. G. T. Fogg,<br>Department of Chemistry,<br>Polytechnic of North London,<br>Holloway, London, U.K.<br>September 1980. |

TABLE II

Quantitative evaluation of measurements of the solubility of chlorine in liquids.

| Solvent | b.p. /K | Authors | Temp. /K | Allowance for v.p. of solvent | $x_{Cl_2}$ (1 atm) | $x_{Cl_2}$ (corrected) (1 atm) |
|---|---|---|---|---|---|---|
| $C_3H_7NO$; *N*,*N*-dimethylformamide | 422 | DuP | 273 | - | 0.569 | |
| $C_6H_6$; Benzene | 353 | PO | 293 | No | 0.2081* | 0.2254 |
| $C_7H_{16}$; Heptane | 372 | TH | 273 | Yes | | |
| $Cl_2O_2S$; Sulfuryl chloride | 343 | Sch | 273 | No | 0.206 | |
| $Cl_4Si$; Tetrachlorosilane | 331 | TH | 273 | Yes | 0.288 | |
| 1,2-Benzenedicarboxylic acid esters: | | PMBK | 323 | - | | |
| $C_{10}H_{10}O_4$ dimethyl ester | 557 | | | | 0.116* | |
| $C_{12}H_{14}O_4$ diethyl ester | 571 | | | | 0.124* | |
| $C_{16}H_{22}O_4$ dibutyl ester | 613 | | | | 0.144* | |
| $C_{24}H_{38}O_4$ dioctyl ester | | | | | 0.175* | |
| $C_{26}H_{42}O_4$ dinonyl ester | | | | | 0.180* | |
| $C_{30}H_{50}O_4$ diundecyl ester | | | | | 0.192* | |

* estimated from measurements made at other pressures.
b.p. boiling point at 1 atm pressure.

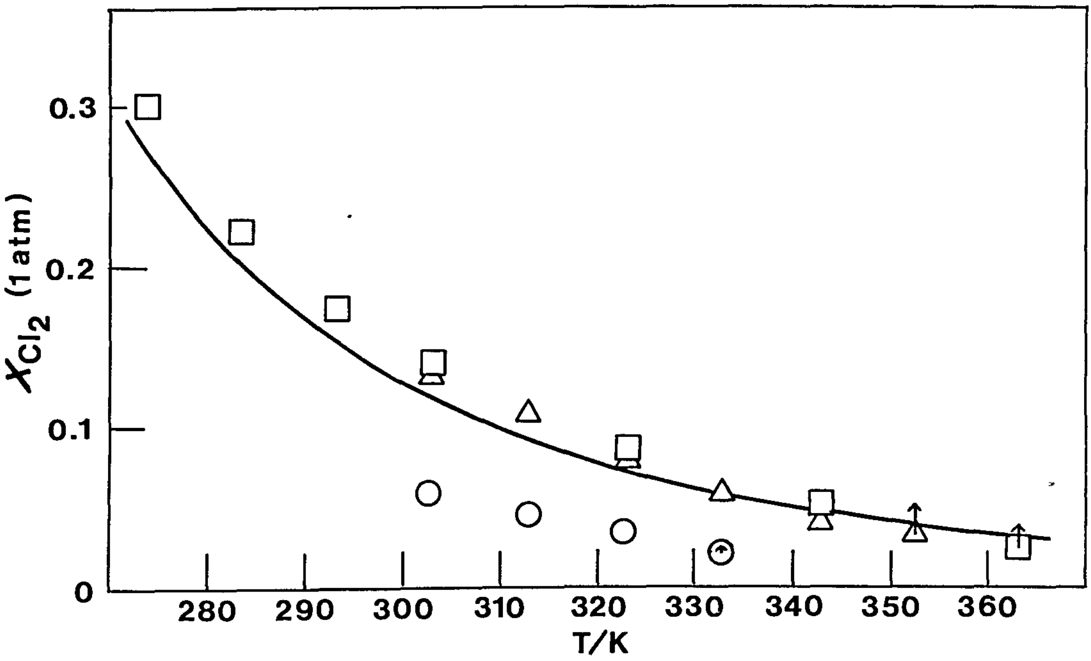

Figure 2. Experimental values of $x_{Cl_2}$ (1 atm) compared with the reference line.

☐ tetrachloroethene

○ acetic acid

△ methylbenzene.

The effects of "correction" of one experimental value for each compound are indicated by vertical arrows.

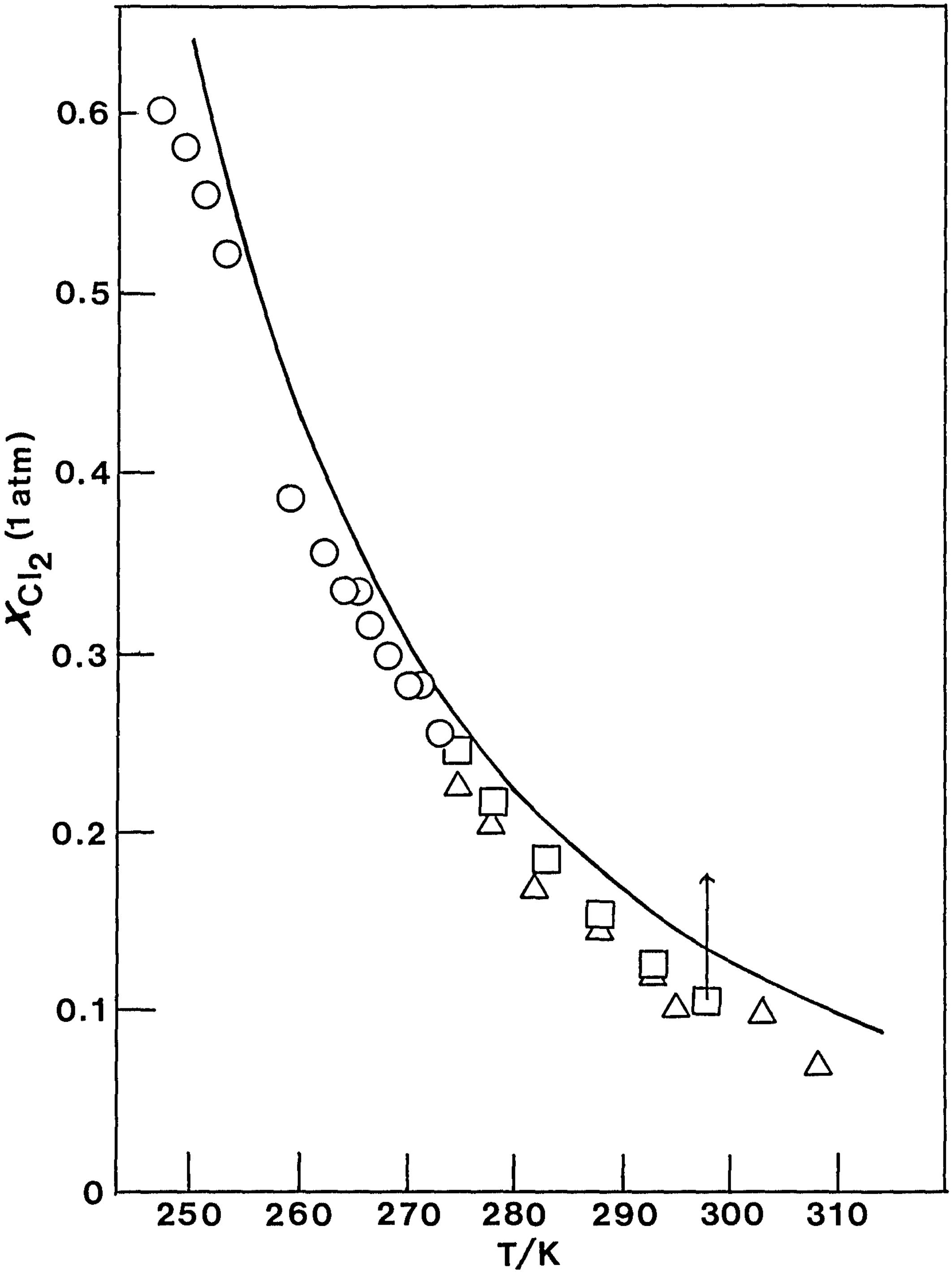

Figure 3. Experimental values of $x_{Cl_2}$ (1 atm) compared with the reference line.

□ trichloromethanesulfenyl chloride

○ carbon disulfide

△ dichlorodioxochromium.

The effect of "correction" of one experimental value for carbon disulfide is indicated by a vertical arrow.

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. Heptane; $C_7H_{16}$; [142-82-5]

ORIGINAL MEASUREMENTS:

Taylor, N. W.; Hildebrand, J. H.
*J. Amer. Chem. Soc.* 1923, *45*, 682-694.

VARIABLES:

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

| T/K | g $Cl_2$/g of solution | $p_{Cl_2}$/mmHg | Mole fractions<br>$x_{Cl_2}$ | <br>$x_{Cl_2}$ (1 atm) |
|---|---|---|---|---|
| 273.16 | 0.2036 | 750 | 0.265 | 0.270 |

760 mmHg = 1 atm

1 atm = 1.013 × $10^5$ Pascal

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Saturator tube (1). Chlorine was bubbled through liquid. Samples of saturated liquid were run into a weighed flask containing aqueous KI, and iodine was titrated with standard solution of thiosulfate. Temperature control was manual to 0.1 K.
Saturation was at barometric pressure, $p_{total}$. The value of $p_{C_7H_{16}}$ was estimated by Raoult's law from vapor pressure data for $C_7H_{16}$ in ref. (2). Hence:

$$p_{Cl_2} = p_{total} - p_{C_7H_{16}}$$

SOURCE AND PURITY OF MATERIALS:

1. $Cl_2$: from an electrolytic supply; contained less than 0.1% of free acid.

2. $C_7H_{16}$: not specified.

ESTIMATED ERROR:

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1. Bichowsky, F. R.; Storch, H. *J. Amer. Chem. Soc.* 1915, *37*, 2695.
2. Landolt-Börnstein Tabellen.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Heptane; $C_7H_{16}$; [142-82-5] | Semb, J.<br>*J. Am. Pharm. Assoc.* 1935, *24*, 547-553. |
| VARIABLES: | PREPARED BY: |
| Temperature | P. G. T. Fogg |

EXPERIMENTAL VALUES:

| T/K | g $Cl_2$/100 $cm^3$ solution | Mole fraction,* $x_{Cl_2}$ |
|---|---|---|
| 254.2 | 32.9 | 0.394 |
| 262.2 | 25.9 | 0.340 |
| 273.2 | 17.9 | 0.265 |
| 284.2 | 12.0 | 0.197 |
| 293.2 | 10.1 | 0.173 |
| 303.2 | 7.7 | 0.139 |
| 313.2 | 5.4 | 0.103 |
| 313.7 | 5.6 | 0.106 |
| 333.2 | 3.17 | 0.0646 |
| 334.2 | 2.95 | 0.0604 |
| 349.2 | 2.25 | 0.0478 |
| 350.2 | 1.79 | 0.0384 |
| 358.2 | 1.65 | 0.0359 |

The pressure of chlorine plus heptane was equal to barometric pressure (unspecified).

* Calculated by compiler using published densities of heptane (1) and assuming that dissolution of chlorine causes no change of volume of the liquid phase.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine was passed into about 5 $cm^3$ of heptane in a 25 $cm^3$ graduated cylinder until the solution was saturated. The volume of solution was recorded and the dissolved chlorine determined iodometrically. Light was excluded as far as possible but the formation of HCl was detected in all cases.

SOURCE AND PURITY OF MATERIALS:

1. $Cl_2$: from a cylinder purified and dried.
2. $C_7H_{16}$: isolated from a commercial oil and purified by chemical treatment and fractional distillation; b.p. 96.8-97.4 °C (743 mmHg).

ESTIMATED ERROR:

REFERENCES:

1. J. Timmermans, "*Physico-Chemical Constants of Pure Organic Compounds*", Vol. 2, Elsevier, London. 1965.

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. Heptane; $C_7H_{16}$; [142-82-5]

ORIGINAL MEASUREMENTS:

Zetkin, V. I.; Kosorotov, V. I.; Zakharov, E. V.; Martynov, Yu. M.; Dzhagatspanyan, R. V.
*Zh. Fiz. Khim.* 1970, *44*, 830-831.

(Complete article deposited at VINITI. No. 1480-70, dep. from 24 Feb. 1970.)

VARIABLES:

Temperature, pressure

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

| T/K | Mole fraction, $x_{Cl_2}$ (1 atm) |
|---|---|
| 283 | 0.195 |
| 293 | 0.157 |
| 303 | 0.125 |
| 313 | 0.104 |
| 323 | 0.085 |

760 mmHg = 1 atm

1 atm = $1.013 \times 10^5$ Pascal

The authors gave the following equation:

$$\log_{10}(x_{Cl_2}/p_{Cl_2}) = (930/(T/K)) - 3.97$$

where $p_{Cl_2}$ is the pressure of $Cl_2$ in atm.

This equation cannot be tested because only measurements made at a pressure of chlorine equal to one atmosphere were reported.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is described in ref. (1). Chlorine at a pressure of 1 atm ± 10 mmHg was absorbed by heptane in a thermostatted vessel of capacity 100 $cm^3$. Chlorination of the heptane was prevented by addition of phenol. Samples were withdrawn periodically for iodometric analysis until consistent results were obtained.

It was stated that the system obeys Henry's law as shown by the variation of the absorption when the partial pressure of chlorine was varied by dilution with air. However only measurements made at a partial pressure of one atmosphere were reported.

SOURCE AND PURITY OF MATERIALS:

1. $Cl_2$: to USSR standard GOST 6718-53. Dried by passing through $H_2SO_4$.
2. $C_7H_{16}$: "Chemically pure" grade dried with molecular sieve.

ESTIMATED ERROR:

REFERENCES:

1. Zetkin, V. I.; Kolesnikov, I. M.; Zakharov, E. V.; Dzhagatspanyan, R.V. *Khim. Promst. (Moscow)* 1966, *42* (8), 624.

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. Octane; $C_8H_{18}$; [111-65-9]

ORIGINAL MEASUREMENTS:

Zetkin, V. I.; Kosorotov, V. I.; Zakharov, E. V.; Martynov, Yu. M.; Dzhagatspanyan, R. V.
*Zh. Fiz. Khim.* 1970, *44*, 830-831.
(Complete article depostеd at VINITI. No. 1480-70, dep. from 24 Feb. 1970.)

VARIABLES:

Temperature, pressure

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

| T/K | Mole fraction, $x_{Cl_2}$ (1 atm) |
|---|---|
| 283 | 0.210 |
| 293 | 0.168 |
| 303 | 0.134 |
| 313 | 0.107 |
| 323 | 0.092 |

760 mmHg = 1 atm

1 atm = $1.013 \times 10^5$ Pascal

The authors gave the following equation:

$$\log_{10}(x_{Cl_2}/p_{Cl_2}) = (950/(T/K)) - 4.02$$

where $p_{Cl_2}$ is the pressure of $Cl_2$ in atm.

This equation cannot be tested because only measurements made at a pressure of chlorine equal to one atmosphere were reported.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is described in ref. (1). Chlorine at a pressure of 1 atm ± 10 mmHg was absorbed by octane in a thermostatted vessel of capacity 100 $cm^3$. Chlorination of the octane was prevented by addition of phenol. Samples were withdrawn periodically for iodometric analysis until consistent results were obtained.

It was stated that the system obeys Henry's law as shown by the variation of the absorption when the partial pressure of chlorine was varied by dilution with air. However only measurements made at a partial pressure of one atmosphere were reported.

It is not clear whether allowances were made for the contribution of the vapor pressure of octane to the total pressure.

SOURCE AND PURITY OF MATERIALS:

1. $Cl_2$: to USSR standard GOST 6718-53. Dried by passing through $H_2SO_4$.

2. $C_8H_{18}$: "Chemically pure" grade dried with molecular sieve.

ESTIMATED ERROR:

REFERENCES:

1. Zetkin, V. I.; Kolesnikov, I. M.; Zakharov, E. V.; Dzhagatspanyan, R.V.
*Khim. Promst. (Moscow)* 1966, *42* (8), 624.

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. 2,2,4-Trimethylpentane;
$C_8H_{18}$; [540-84-1]

ORIGINAL MEASUREMENTS:

Zetkin, V. I.; Kosorotov, V. I.; Zakharov, E. V.; Martynov, Yu. M.; Dzhagatspanyan, R. V.
*Zh. Fiz. Khim.* 1970, *44*, 830-831.
(Complete article deposited at VINITI No. 1480-70, dep. from 24 Feb. 1970.)

VARIABLES:

Temperature, pressure

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

| T/K | Mole fraction, $x_{Cl_2}$ (1 atm) |
|---|---|
| 283 | 0.187 |
| 293 | 0.154 |
| 303 | 0.123 |
| 313 | 0.101 |
| 323 | 0.086 |

760 mmHg = 1 atm

1 atm = $1.013 \times 10^5$ Pascal

The authors gave the following equation:

$$\log_{10}(x_{Cl_2}/p_{Cl_2}) = (870/(T/K)) - 3.77$$

where $p_{Cl_2}$ is the pressure of $Cl_2$ in atm.

This equation cannot be tested because only measurements made at a pressure of chlorine equal to one atmosphere were reported.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is described in ref. (1). Chlorine at a pressure of 1 atm ± 10 mmHg was absorbed by iso-octane in a thermostatted vessel of capacity 100 $cm^3$. Chlorination of the iso-octane was prevented by addition of 0.5 wt-% of phenol. Samples were withdrawn periodically for iodometric analysis until consistent results were obtained.

It was stated that the system obeys Henry's law as shown by the variation of the absorption when the partial pressure of chlorine was varied by dilution with air. However only measurements made at a partial pressure of 1 atm were reported.

It is not clear whether allowances were made for the contribution of the vapor pressure of iso-octane to the total pressure

SOURCE AND PURITY OF MATERIALS:

1. $Cl_2$: to USSR standard GOST 6718-53. Dried by passing through $H_2SO_4$.
2. $C_8H_{18}$: "Chemically pure" grade dried with molecular sieve.

ESTIMATED ERROR:

REFERENCES:

1. Zetkin, V. I.; Kolesnikov, I. M.; Zakharov, E. V.; Dzhagatspanyan, P. B.
*Khim. Promst. (Moscow)* 1966, *42* (8), 624.

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. Decane; $C_{10}H_{22}$; [124-18-5]

ORIGINAL MEASUREMENTS:

Zetkin, V. I.; Kosorotov, V. I.; Zakharov, E. V.; Martynov, Yu. M.; Dzhagatspanyan, R. V.
*Zh. Fiz. Khim.* 1970, *44*, 830-831.

(Complete article deposited at VINITI. No. 1480-70, dep. from 24 Feb. 1970.)

VARIABLES:

Temperature, pressure

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

| T/K | $p_{Cl_2}$/mmHg | Mole fraction $x_{Cl_2}$ |
|---|---|---|
| 283 | 150 | 0.058 |
| | 275 | 0.105 |
| | 400 | 0.150 |
| | 550 | 0.190 |
| | 760 | 0.237 |
| 293 | 150 | 0.050 |
| | 275 | 0.083 |
| | 400 | 0.101 |
| | 550 | 0.147 |
| | 760 | 0.192 |
| 303 | 150 | 0.034 |
| | 275 | 0.058 |
| | 400 | 0.088 |
| 303 | 550 | 0.115 |
| | 760 | 0.151 |
| 313 | 150 | 0.031 |
| | 275 | 0.053 |
| | 400 | 0.067 |
| | 550 | 0.092 |
| | 760 | 0.119 |
| 323 | 150 | 0.021 |
| | 275 | 0.035 |
| | 400 | 0.052 |
| | 550 | 0.074 |
| | 760 | 0.100 |

The authors have given the following equation:

$$\log_{10}(x_{Cl_2}/p_{Cl_2}) = (1010/(T/K)) - 4.16$$

where $p_{Cl_2}$ is the pressure of $Cl_2$ in atm.

The compiler has calculated that experimental values of $x_{Cl_2}$ for this equation with a standard deviation of 0.008.

760 mmHg = 1 atm 1 atm = $1.013 \times 10^5$ Pascal

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is described in ref. (1). Chlorine was absorbed by decane in a thermostatted vessel of capacity 100 $cm^3$. Chlorination of the decane was prevented by addition of 0.5 wt-% of phenol. Samples were withdrawn periodically for iodometric analysis until consistent results were obtained. The partial pressure of chlorine was varied by dilution with air. Pressures were controlled to ± 10 mmHg.

It is not clear whether allowances were made for the contribution of the vapor pressure of decane to the total pressure.

SOURCE AND PURITY OF MATERIALS:

1. $Cl_2$: to USSR standard GOST 6718-53. Dried by passing through $H_2SO_4$.

2. $C_{10}H_{22}$: "Chemically pure" grade dried with molecular sieve.

ESTIMATED ERROR:

REFERENCES:

1. Zetkin, V. I.; Kolesnikov, I. M.; Zakharov, E. V.; Dzhagatspanyan, P. B.
*Khim. Promst. (Moscow)* 1966, *42* (8), 624.

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. Tetradecane; $C_{14}H_{30}$; [629-59-4]

ORIGINAL MEASUREMENTS:

Zetkin, V. I.; Kosorotov, V. I.; Zakharov, E. V.; Martynov, Yu. M.; Dzhagatspanyan, R. V.
*Zh. Fiz. Khim.* 1970, *44*, 830-831.

(Complete article deposited at VINITI. No. 1480-70, dep. from 24 Feb. 1970.)

VARIABLES:

Temperature, pressure

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

| T/K | Mole fraction, $x_{Cl_2}$ (1 atm) |
|---|---|
| 283 | 0.316 |
| 293 | 0.254 |
| 303 | 0.202 |
| 313 | 0.158 |
| 323 | 0.132 |

760 mmHg = 1 atm

1 atm = $1.013 \times 10^5$ Pascal

The authors gave the following equation:

$$\log_{10}(x_{Cl_2}/p_{Cl_2}) = (1090/(T/K)) - 4.32$$

where $p_{Cl_2}$ is the pressure of $Cl_2$ in atm.

This equation cannot be tested because only measurements made at a pressure of chlorine equal to one atmosphere were reported.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus is described in ref. (1). Chlorine at a pressure of 1 atm ± 10 mmHg was absorbed by tetradecane in a thermostatted vessel of capacity 100 $cm^3$. Chlorination of the tetradecane was prevented by addition of 0.5 wt-% of phenol. Samples were withdrawn periodically for iodometric analysis until consistent results were obtained.

It was stated that the system obeys Henry's law as shown by the variation of the absorption when the partial pressure of chlorine was varied by dilution with air. However only measurements made at a partial pressure of one atmosphere were reported.

It is not clear whether allowances were made for the contribution of the vapor pressure of tetradecane to the total pressure.

SOURCE AND PURITY OF MATERIALS:

1. $Cl_2$: to USSR standard GOST 6718-53.

2. $C_{14}H_{30}$: "Chemically pure" grade dried with molecular sieve.

ESTIMATED ERROR:

REFERENCES:

1. Zetkin, V. I.; Kolesnikov, I. M.; Zakharov, E. V.; Dzhagatspanyan, P. B.
*Khim. Promst. (Moscow)* 1966, *42* (8), 624.

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. Cyclohexane; $C_6H_{12}$; [110-82-7]

ORIGINAL MEASUREMENTS:

Tsiklis, D. S.; Svetlova, G. M.;
*Zh. Fiz. Khim.* 1958, *32*, 1476.

VARIABLES:

Temperature, pressure

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

| T/K<br>$p_{Cl_2}$/mmHg | 283.2<br>Mole fraction<br>$x_{Cl_2}$ | 293.2<br>Mole fraction<br>$x_{Cl_2}$ | 313.2<br>Mole fraction<br>$x_{Cl_2}$ |
|---|---|---|---|
| 100 | 0.0129 | 0.0092 | 0.0061 |
| 200 | 0.0287 | 0.0200 | 0.0134 |
| 300 | 0.0465 | 0.0321 | 0.0213 |
| 400 | 0.0692 | 0.0472 | 0.0300 |
| 500 | 0.110 | 0.0699 | 0.0400 |
| 600 | | 0.111 | 0.0515 |
| 700 | | | 0.0665 |
| 800 | | | 0.0867 |

760 mmHg = 1 atm
1 atm = 1.013 × $10^5$ Pascal

The authors gave the following equation:

$$\log_{10}\left\{\frac{p_{Cl_2}/\text{mmHg}}{x_{Cl_2}}\right\} = \log_{10}K - \beta(1 - x^2_{C_6H_{12}})$$

where K has the values 8240, 12180 and 17400 at 283.2 K, 293.2 K and 313.2 K, respectively and $\beta$ has the values 1.250, 1.706 and 1.700 at 283.2 K, 293.2 K and 313.2 K, respectively.
The compiler has calculated that values of $p_{Cl_2}$/mmHg fit the equation with a standard deviation of 8.
The authors have given the head of solution of chlorine calculated from the variation of solubility with temperature as -4500 cal $mol^{-1}$ (± 10-15%).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A known weight of chlorine was dissolved in a known weight of cyclohexane and the resulting total pressure was measured by a manometer. The pressure of chlorine was equal to the total pressure minus the vapor pressure of the cyclohexane. Temperatures were controlled to ± 0.1 °C.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. Benzene; $C_6H_6$; [71-43-2]

ORIGINAL MEASUREMENTS:

Pozin, M. E.; Opykhtina, M. A.
*Zh. Prik. Khim. (Leningrad)* 1947, *20*, 523-531.

VARIABLES:

Pressure

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

| $p_{Cl_2}$/mmHg | Mole fraction, $x_{Cl_2}$ |
|---|---|
| 48.8 | 0.0152 |
| 53.6 | 0.0115 |
| 123.4 | 0.0367 |
| 263.5 | 0.0687 |
| 282.5 | 0.0684 |
| 311.5 | 0.0775 |
| 416 | 0.1091 |
| 460 | 0.1287 |
| 494 | 0.1378 |
| 663 | 0.1708 |
| 693 | 0.1809 |
| 730 | 0.1978 |
| 763 | 0.2089 |

Temperature = 293.2 K

760 mmHg = 1 atm

1 atm = 1.013 × $10^5$ Pascal

The authors gave the Henry's law constant as:

$$H = 3.8 \times 10^3 \text{ mmHg}/x_{Cl_2}$$

The compiler has calculated that the mean value of $(p_{Cl_2}/\text{mmHg})/x_{Cl_2}$ is 3788 with a standard deviation of 362.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The volume of chlorine absorbed by a measured quantity of benzene was determined by use of apparatus described in ref. (1). The absorbing liquid was stirred and maintained at a temperature constant to within 2 °C.

SOURCE AND PURITY OF MATERIALS:

2. $C_6H_6$: b.p. 80.5 °C (barometric pressure unspecified); density (20 °C) 0.8796 g $cm^{-3}$.

ESTIMATED ERROR:

REFERENCES:

1. Pozin, M. E.
*Zh. Prik. Khim. (Leningrad)* 1947, *20*, 345.

| | |
|---|---|
| COMPONENTS:<br>1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Benzene; $C_6H_6$; [71-43-2] | ORIGINAL MEASUREMENTS:<br>Krivonos, F. F.<br>*J. Appl. Chem. USSR* 1958, *31*, 487-491. |
| VARIABLES:<br>Temperature | PREPARED BY:<br>P. G. T. Fogg |

EXPERIMENTAL VALUES:

| T/K | Bunsen coefficient | Mole fraction, $x_{Cl_2}^*$ (1 atm) (calculated by compiler) |
|---|---|---|
| 283.2 | 95 | 0.274 |
| 293.2 | 69 | 0.217 |
| 303.2 | 57 | 0.189 |
| 313.2 | 49 | 0.168 |
| 323.2 | 42 | 0.149 |

[*] Values of $x_{Cl_2}$ (1 atm) have been calculated by the compiler on the assumption that the Bunsen coefficient is independent of pressure. This is equivalent to assuming the validity of Henry's law (mole ratio form).

1 atm = $1.013 \times 10^5$ Pascal

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A mixture of chlorine and air was admitted into a round bottomed flask of known volume. The quantities of the two were calculated from the total weight, total volume and total pressure of the mixture (measured by a manometer). A measured volume of benzene was introduced and the total pressure measured after equilibrium had been reached. The partial pressure of chlorine, $p_{Cl_2}$, was calculated from:

$$p_{total} = p_{C_6H_6} + p_{air} + p_{Cl_2}$$

It was assumed that $p_{C_6H_6}$ was equal to the vapor pressure of pure benzene. Temperatures were controlled by a thermostat bath and light was excluded as far as possible. The authors claimed that reproducible results indicated that no irreversible reaction between benzene and chlorine took place.

SOURCE AND PURITY OF MATERIALS:

Not specified

ESTIMATED ERROR:

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Benzene, $C_6H_6$; [71-43-2] | Cervinka, M.<br>*Chem. Prum.* 1960, *10*, 249-251. |
| VARIABLES:<br>Pressure, temperature | PREPARED BY:<br>P. G. T. Fogg |

EXPERIMENTAL VALUES:

| T/K | $H$/mmHg | Mole fraction, $x_{Cl_2}$ ( 1 atm) (calculated by compiler) |
|---|---|---|
| 298.3 | $5.74 \times 10^3$ | 0.132 |
| 308.2 | $7.33 \times 10^3$ | 0.104 |
| 314.2 | $7.60 \times 10^3$ | 0.100 |
| 329.2 | $9.45 \times 10^3$ | 0.0804 |
| 341.2 | $11.8 \times 10^3$ | 0.0644 |

The Henry's law constant, $H$, was taken to be the slope of a plot of pressure of $Cl_2$ in the gas phase against mole fraction of $Cl_2$ in the liquid phase. The author has given the following equation:

$$\log_{10}H = 6.1227 - 701.9/(T/K)$$

The compiler has calculated that the experimental values of $H$ quoted above fit this equation with a standard deviation of $0.27 \times 10^3$.

The heat of solution of chlorine, calculated by the author from the variation of $H$ with temperature, is $-3.20$ kcal $mol^{-1}$.

760 mmHg = 1 atm
1 atm = $1.013 \times 10^5$ Pascal

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The absorption of chlorine at partial pressures up to 1 atm was determined by passing mixtures of chlorine and air into benzene in an absorption vessel. The apparatus is described in ref. (1). Temperatures were controlled to ± 0.5 K. The chlorine content of the gas phase and the liquid phase were determined by iodometry.

SOURCE AND PURITY OF MATERIALS:

1. $Cl_2$ & air: dried with concentrated $H_2SO_4$.

2. $C_6H_6$: distilled before use.

ESTIMATED ERROR:

REFERENCES:

1. Balej, J.; Regner, A. *Chem. Listy* 1956, *50*, 1374.

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. Benzene; $C_6H_6$; [71-43-2]

ORIGINAL MEASUREMENTS:

Zetkin, V.I.; Kosorotov, V.I.; Stul, B.Ya.; Dzhagatspanyan, R.V.;

*Khim. Prom.* 1971, *47*, 102-103.

VARIABLES:

Temperature

PREPARED BY:

P.G.T. Fogg

EXPERIMENTAL VALUES:

| T/K | $x_{Cl_2}$ |
|---|---|
| 283.2 | 0.209 |
| 293.2 | 0.154 |
| 303.2 | 0.107 |
| 313.2 | 0.083 |
| 323.2 | 0.063 |
| 333.2 | 0.045 |

The pressure of $Cl_2$ plus $C_6H_6$ was apparently equal to barometric pressure.

The following equation was given :

$$\log_{10} x_{Cl_2} = 1250/(T/K) - 5.08.$$

The heat of solution of $Cl_2$ calculated from the variation of solubility with temperature was given as - 5700 cal $mol^{-1}$.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method and apparatus were described in ref. (1). Chlorine was bubbled through a measured quantity of benzene in a thermostatted vessel of capacity 100 $cm^3$. Chlorination of the benzene was prevented by addition of 0.5 wt % of phenol. Samples were withdrawn periodically for iodometric analysis until consistent results were obtained.

SOURCE AND PURITY OF MATERIALS:

$Cl_2$ : to USSR standard GOST 6718-53. Dried by passing through $H_2SO_4$.

$C_6H_6$ : 99% pure. Dried with $CaCl_2$.

ESTIMATED ERROR:

REFERENCES:

1. Zetkin, V.I. et al.
*Zh. Fiz. Khim.* 1970, *44*, 830.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Benzene; $C_6H_6$; [71-43-2] | Lohse, M.; Deckwer, W.-D.<br>*J. Chem. Eng. Data*<br>1981, *26*, 159-161. |
| VARIABLES:<br>Temperature | PREPARED BY:<br>C. L. Young |

EXPERIMENTAL VALUES:

| T/K | Solubility,§ $S$/mol $dm^{-3}$ (soln.) |
|---|---|
| 288.15 | 3.590 |
| 298.15 | 2.521 |
| 308.15 | 1.780 |
| 318.15 | 1.110 |
| 328.15 | 0.841 |
| 338.15 | 0.503 |

§ at a partial pressure of $Cl_2$ of 101.3 kPa.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solvent saturated with chlorine in dark (∿1% phenol added to prevent photochemical chlorination). Samples withdrawn added to known amount of additional solvent and then 250 $cm^3$ of potassium iodide solution. Released iodine titrated with thiosulfate.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta S = \pm 3\%$

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. Methylbenzene; $C_7H_8$; [108-88-3]

ORIGINAL MEASUREMENTS:

Egunov, A. V.; Konobeev, B. I.; Ryabov, E. A.; Gubanova, T. I.

*Zh. Prik. Khim. (Leningrad)* 1973, *46*, 1855-1856.

VARIABLES:

Temperature

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

| T/K | Mole fraction, $x_{Cl_2}$ |
|---|---|
| 303.2 | 0.132 |
| 313.2 | 0.106 |
| 323.2 | 0.080 |
| 333.2 | 0.054 |
| 343.2 | 0.039 |
| 353.2 | 0.032 |

The partial pressure of chlorine plus partial pressure of toluene was apparently equal to barometric pressure (unspecified).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine was bubbled through a weighed portion of the solvent (15-20 g) until a differential manometer registered no pressure drop when the chlorine supply was discontinued. The chlorine content of the solution was determined from the increase in weight and also argentometrically. Loss of solvent in the gas stream was shown to be negligible in comparison with other errors which the authors estimate to be ± 5%. Light was excluded and 1-2 wt-% of phenol was added to inhibit chlorination of toluene. The chlorination products which were formed were estimated by gas chromatography and appropriate corrections made during calculation of solubility.

SOURCE AND PURITY OF MATERIALS:

1. $Cl_2$: from a cylinder; dried over $H_2SO_4$.

2. $C_7H_8$: "chemically pure" grade.

ESTIMATED ERROR:

REFERENCES:

| | |
|---|---|
| COMPONENTS:<br>1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Methylbenzene (toluene); $C_7H_8$; [108-88-3] | ORIGINAL MEASUREMENTS:<br>Lohse, M.; Deckwer, W.-D.<br>*J. Chem. Eng. Data*<br>1981, *26*, 159-161. |
| VARIABLES:<br>Temperature | PREPARED BY:<br>C. L. Young |

EXPERIMENTAL VALUES:

| T/K | Solubility,[§] $S$/mol $dm^{-3}$ (soln.) |
|---|---|
| 288.15 | 2.570 |
| 298.15 | 1.905 |
| 308.15 | 1.479 |
| 318.15 | 1.122 |
| 328.15 | 0.771 |
| 338.15 | 0.611 |
| 348.15 | 0.464 |

[§] at a partial pressure of $Cl_2$ of 101.3 kPa.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solvent saturated with chlorine in dark (∿1% phenol added to prevent photochemical chlorination). Samples withdrawn added to known amount of additional solvent and then 250 $cm^3$ of potassium iodide solution. Released iodine titrated with thiosulfate.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta S = \pm 3\%$ (estimated by compiler).

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. 1,2-Dimethylbenzene; $C_8H_{10}$; [95-47-6] | Lohse, M.; Deckwer, W.-D.<br>*J. Chem. Eng. Data*<br>1981, *26*, 159-161. |
| VARIABLES: | PREPARED BY: |
| Temperature | C. L. Young |

EXPERIMENTAL VALUES:

| T/K | Solubility§, $S$/mol $dm^{-3}$ (soln.) |
|---|---|
| 308.15 | 1.124 |
| 328.15 | 0.765 |

§at a partial pressure of 101.3 kPa.

AUXILIARY INFORMATION

| METHOD/APPARATUS/PROCEDURE: | SOURCE AND PURITY OF MATERIALS: |
|---|---|
| Solvent saturated with chlorine in dark (∿1% phenol added to prevent photochemical chlorination). Samples withdrawn added to known amount of additional solvent and then 250 $cm^3$ of potassium iodide solution. Released iodine titrated with thiosulfate. | No details given.<br>ESTIMATED ERROR:<br>δT/K = ±0.1; δ$S$ = ±3%<br>(estimated by compiler).<br>REFERENCES: |

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. 1,3-Dimethylbenzene; $C_8H_{10}$; [108-38-3]

ORIGINAL MEASUREMENTS:

Lohse, M.; Deckwer, W.-D.
*J. Chem. Eng. Data*
1981, *26*, 159-161.

VARIABLES:

Temperature

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

| T/K | Solubility[§], $S$/mol dm$^{-3}$ (soln.) |
|---|---|
| 298.15 | 1.373 |
| 318.15 | 0.915 |
| 338.15 | 0.627 |

[§] at a partial pressure of 101.3 kPa.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solvent saturated with chlorine in dark (∿1% phenol added to prevent photochemical chlorination). Samples withdrawn added to known amount of additional solvent and then 250 cm$^3$ of potassium iodide solution. Released iodine titrated with thiosulfate.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta S = \pm 3\%$
(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. 1,4-Dimethylbenzene (*p*-xylene);
   $C_8H_{10}$; [106-42-3]

ORIGINAL MEASUREMENTS:

Lohse, M.; Deckwer, W.-D.
*J. Chem. Eng. Data*
1981, *26*, 159-161.

VARIABLES:

Temperature

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

| T/K | Solubility[§], $S$/mol dm$^{-3}$ (soln.) |
|---|---|
| 288.15 | 1.693 |
| 298.15 | 1.397 |
| 308.15 | 1.127 |
| 318.15 | 0.921 |
| 328.15 | 0.767 |
| 338.15 | 0.623 |
| 348.15 | 0.484 |

[§] at a partial pressure of Cl of 101.3 kPa.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solvent saturated with chlorine in dark ( ∿ 1% phenol added to prevent photochemical chlorination). Samples withdrawn added to known amount of additional solvent and then 250 cm$^3$ of potassium iodide solution. Released iodine titrated with thiosulfate.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta S = \pm 3\%$
(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. Ethylbenzene; $C_8H_{10}$; [100-41-4]

ORIGINAL MEASUREMENTS:

Lohse, M.; Deckwer, W.-D.
*J. Chem. Eng. Data*
1981, *26*, 159-161.

VARIABLES:

Temperature

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

| T/K | Solubility,[§] $S$/mol dm$^{-3}$ (soln.) |
|---|---|
| 288.15 | 2.193 |
| 298.15 | 1.657 |
| 308.15 | 1.228 |
| 318.15 | 0.980 |
| 328.15 | 0.779 |
| 338.15 | 0.660 |
| 348.15 | 0.528 |

[§] at a partial pressure of $Cl_2$ of 101.3 kPa.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solvent saturated with chlorine in dark (∿1% phenol added to prevent photochemical chlorination). Samples withdrawn added to known amounts of additional solvent and then 250 cm$^3$ of potassium iodide solution. Released iodine titrated with thiosulfate.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta S = \pm 3\%$
(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. Acetic acid; $C_2H_4O_2$; [64-19-7]

ORIGINAL MEASUREMENTS:

Jones, W. J.

*J. Chem. Soc.* 1911, *99*, 392-404.

VARIABLES:

Concentration

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

| T/K | $S$ | $p_{Cl_2}$/Pa* | Mole fraction,* $x_{Cl_2}$ |
|---|---|---|---|
| 289.2 | 36.6 | 948 | 0.00086 |
| 289.2 | 36.9 | 1038 | 0.00095 |
| 289.2 | 36.9 | 1739 | 0.00160 |
| 289.2 | 36.4 | 2395 | 0.00218 |

$$S = \frac{\text{concentration of } Cl_2 \text{ in mol dm}^{-3} \text{ of the solution}}{\text{concentration of } Cl_2 \text{ in mol dm}^{-3} \text{ of the gas phase}}$$

* Calculated by the compiler from the volumes of titrant given in the original paper. It has been assumed that the volume of the solution is equal to the volume of the original liquid at these low concentrations.

Extrapolation to $p_{Cl_2}$ = 1 atm is not valid.

AUXILIARY INFORMATION

METHOD APPARATUS/PROCEDURE:

The apparatus consisted of a bubbler and wash bottles. The concentration of the original solution was determined by iodometry. Chlorine, carried away from the solution in a stream of air, was also determined by iodometry. The results were given as a partition coefficient, $S$. $S$ was deemed to be constant and independent of pressure $p_{Cl_2}$.

SOURCE AND PURITY OF MATERIALS:

1. $Cl_2$: not specified.

2. $C_2H_4O_2$: some prepared in the laboratory; some obtained from Kahlbaum. Both samples said to be "specially purified".

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. Acetic acid; $C_2H_4O_2$; [64-19-7]

ORIGINAL MEASUREMENTS:

Kumar, S.; Gehlawat, J.K.;
*J. Chem. Technol. Biotechnol.* 1979 *29*, 353-360.

VARIABLES:

Temperature

PREPARED BY:

P.G.T. Fogg.

EXPERIMENTAL VALUES:

| T/K | $mol_{Cl_2} dm^{-3}$ * | Mole fraction** $x_{Cl_2}$ |
|---|---|---|
| 303 | 1.06 | 0.058 |
| 313 | 0.81 | 0.045 |
| 323 | 0.59 | 0.034 |
| 333 | 0.38 | 0.022 |

Total pressure = 101 kPa.

* It is not clear whether values refer to $mol_{Cl_2} dm^{-3}$ (solution) or to $mol_{Cl_2} dm^{-3}$ (solvent).

** Calculated by the compiler using published values of densities of acetic acid (ref. 1) and assuming that dissolution of chlorine causes no change in the volume of the liquid phase.

The authors stated that the solubility data were unlikely to be in error by more than 15%. No basis for this statement was given.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The authors stated that the solutions were saturated with chlorine at a specified temperature and the dissolved chlorine was determined by standard iodometric titration. No further details were given.

SOURCE AND PURITY OF MATERIALS:

$Cl_2$ : analytical grade.

$C_2H_4O_2$ : analytical grade.

ESTIMATED ERROR:

REFERENCES:

1. J. Timmermans, "Physico-Chemical Constants of Pure Organic Compounds", Vol. 2, Elsevier, London. 1965.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Acetic acid, anhydride; $C_4H_6O_3$; [108-24-7] | Jones, W. J.<br>*J. Chem. Soc.* 1911, *99*, 392-404. |
| VARIABLES: | PREPARED BY: |
| Concentration | P. G. T. Fogg |

EXPERIMENTAL VALUES:

| T/K | conc. $Cl_2$ in soln. /mol $dm^{-3}$ | $S$ | $p_{Cl_2}$/Pa* | Mole fraction, $x_{Cl_2}$ * |
|---|---|---|---|---|
| 288.2 | 0.01574 | 39.6 | 953 | 0.00148 |
| 288.2 | 0.01015 | 40.1 | 606 | 0.00095 |
| 288.2 | 0.00403 | 38.8 | 249 | 0.00038 |

$$S = \frac{\text{concn. } Cl_2 \text{ in mol dm}^{-3} \text{ solution}}{\text{concn. } Cl_2 \text{ in mol dm}^{-3} \text{ gas phase}}$$

* Calculated by the compiler on the assumption that the volume of the solution is equal to that of the original liquid at these low concentrations.

Extrapolation to $p_{Cl_2}$ = 1 atm is not valid.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The apparatus consisted of a bubbler and wash bottles. The concentration of the original solution was determined by iodometry. Chlorine, carried away from the solution in a stream of air, was also determined by iodometry. The results were given as a partition coefficient, $S$. $S$ was deemed to be constant and independent of pressure $p_{Cl_2}$.

SOURCE AND PURITY OF MATERIALS:

1. $Cl_2$: not specified.
2. $C_4H_6O_3$: supplied by Kahlbaum.

ESTIMATED ERROR:

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. 1,2-Benzenedicarboxylic acid esters. | Prokop'eva, M. F.; Mar'yanovskaya, K. Sh.; Bukina, V. K.; Korol', A. N. *Zh. Fiz. Khim.* 1971, *45*, 722.<br>(Complete article deposited at VINITI. No.2400-70, dep. from 17 Dec. 1970). |
| VARIABLES: | PREPARED BY: |
| None | P. G. T. Fogg |

EXPERIMENTAL VALUES:

Temperature = 323.2 K

| Stationary phase | Specific retention volume | Mole fraction,* $x_{Cl_2}$ (1 atm) |
|---|---|---|
| Dimethyl ester, $C_{10}H_{10}O_4$ [131-11-3] | 14.92 | 0.116 |
| Diethyl ester, $C_{12}H_{14}O_4$ [84-66-2] | 14.10 | 0.124 |
| Dibutyl ester, $C_{16}H_{22}O_4$ [84-74-2] | 13.34 | 0.144 |
| Dioctyl ester, $C_{24}H_{38}O_4$ [117-84-0] | 12.00 | 0.175 |
| Dinonyl ester, $C_{26}H_{42}O_4$ [84-76-4] | 11.59 | 0.180 |
| Diundecyl ester, $C_{30}H_{50}O_4$ [3648-20-2] | 11.01 | 0.192 |

* Values of $x_{Cl_2}$ (1 atm) have been calculated by the compiler on the assumption that specific retention volumes given above are in units of $cm^3\ g^{-1}$ and that these values can be equated with the volume of gas, corrected to 273.2 K, absorbed by 1 g of solvent (see ref. 1). It has also been assumed that this volume is independent of pressure. This last assumption may have introduced appreciable error and the values of $x_{Cl_2}$ (1 atm) given above can only be thought of as approximate values.

AUXILIARY INFORMATION

| METHOD/APPARATUS/PROCEDURE: | SOURCE AND PURITY OF MATERIALS: |
|---|---|
| Retention volumes for chlorine were determined for the various stationary phases using conventional gas chromatographic techniques. | No information. |
| | ESTIMATED ERROR: |
| | REFERENCES:<br>1. Ambrose, D.; Keulemans, A. I. M.; Purnell, J. H. *Anal. Chem.* 1958, *30*, 1582. |

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. *N,N*-Dimethyl formamide; $C_3H_7NO$; [68-12-2]

ORIGINAL MEASUREMENTS:

DuPont de Nemours and Co. (Inc.); *Chem. Eng. News* 1955, *33*, 2366.

VARIABLES:

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

| T/K | $p_{Cl_2}$ | Vol of $Cl_2$ absorbed per vol. of DMF | Mole fraction*, $x_{Cl_2}$ (1 atm) |
|---|---|---|---|
| 273.2 | 1 atm | 385 | 0.569 |

1 atm = 1.013 × $10^5$ Pascal

* Calculated by compiler on the assumption that the volume of gas absorbed is independent of pressure and that the density of DMF at 273.2 K is given by a linear extrapolation of published values at 293.2 K (1) and 298.2 K (2).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Not stated.

SOURCE AND PURITY OF MATERIALS:

Not stated.

ESTIMATED ERROR:

REFERENCES:

1. *"Handbook of Chemistry & Physics"* (57th edition), C.R.C. Press, Cleveland, Ohio. 1976.
2. *"Lange's Handbook of Chemistry"* (12th edition), McGraw-Hill, New York. 1979.

| | |
|---|---|
| COMPONENTS:<br>1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Nitrobenzene; $C_6H_5NO_2$; [98-95-3] | ORIGINAL MEASUREMENTS:<br>Zetkin, V.I.; Kolesnikov, I.M.; Zakharov, E.V.; Dzhagatspanyan, R.V.<br>*Khim. Prom.* 1966, *42*, 624-626 |
| VARIABLES:<br>Temperature | PREPARED BY:<br>P.G.T. Fogg |

EXPERIMENTAL VALUES:

| T/K | $mol_{Cl_2}/mol_{C_6H_5NO_2}$ | $g_{Cl_2}/100g_{C_6H_5NO_2}$ | Mole fraction* $x_{Cl_2}$ |
|---|---|---|---|
| 313 | 0.0891 | 5.138 | 0.0818 |
| 333 | 0.0610 | 3.518 | 0.0575 |
| 353 | 0.0408 | 2.353 | 0.0392 |
| 373 | 0.0264 | 1.522 | 0.0257 |
| 393 | 0.0190 | 1.096 | 0.0187 |
| 413 | 0.0143 | 0.825 | 0.0141 |
| 433 | 0.0111 | 0.646 | 0.0110 |

The total pressure was apparently equal to barometric pressure (unspecified).

The heat of solution of $Cl_2$ calculated from the variation of solubility with temperature was given by the authors as - 4680 cal $mol^{-1}$.

* Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine was bubbled through nitrobenzene in a thermostatted vessel of capacity 100 $cm^3$. Samples were withdrawn periodically for iodometric analysis until consistent results were obtained.

SOURCE AND PURITY OF MATERIALS:

$Cl_2$ : to USSR standards GOST 6718-53. Dried with $H_2SO$ and with $CaCl_2$.

$C_6H_5NO_2$ : Dried with $CaCl_2$. Distilled through a 20-plate column before use.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. Carbon disulfide; $CS_2$; [75-15-0]

ORIGINAL MEASUREMENTS:

Raskina, A.D.; Zetkin, V.I.; Zakharov, E.V.; Kolesnikov, I.M. Kosorotov, V.I.;

*Zh. Prik. Khim. (Leningrad)*, 1972, *45*, 1333-1334.

VARIABLES:

Temperature

PREPARED BY:

P.G.T. Fogg

EXPERIMENTAL VALUES:

| T/K | $g_{Cl_2}$/100 g of solution | Mole fraction $x_{Cl_2}$ |
|---|---|---|
| 275 | 23.0 | 0.246 |
| 278 | 20.4 | 0.218 |
| 283 | 17.2 | 0.184 |
| 288 | 14.4 | 0.154 |
| 293 | 11.7 | 0.125 |
| 298 | 9.9 | 0.106 |

The total pressure was apparently equal to barometric pressure (unspecified).

The authors have given the following equation:

$$\log_{10}(100x_{Cl_2}) = (1250/(T/K)) - 3.18$$

The compiler has calculated that values of $x_{Cl_2}$ quoted above fit this equation with a standard deviation of 0.011. The compiler has also calculated that the equation:

$\log_{10}(100x_{Cl_2}) = (1304/(T/K)) - 3.55$ fits the data better (standard deviation 0.002).

The authors have given the heat of solution of chlorine, calculated from the variation of solubility with temperature, as - 5.7 kcal $mol^{-1}$.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine or chlorine/nitrogen mixtures were bubbled through carbon disulfide until the concentration of chlorine in the liquid phase, as determined by iodometry, was constant. The apparatus was protected from light. The total pressure of gas was apparently equal to barometric pressure although this is not explicitly stated. Variations of solubility when chlorine was diluted with nitrogen is said to indicate that Henry's law is obeyed although these experimental measurements are not reported. No allowances seem to have been made for the partial pressure of the carbon disulfide.

SOURCE AND PURITY OF MATERIALS:

$Cl_2$ : to USSR standard GOST 6718-53; additionally dried over $H_2SO_4$.

$N_2$ : to GOST 9293-59; dried over $H_2SO_4$.

$CS_2$ : to GOST 1541-42; distilled and dried over ignited $CaCl_2$.

ESTIMATED ERROR:

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Dichloromethane; $CH_2Cl_2$; [75-09-2] | Vdovichenko, V. T.; Kondratenko, V. I.<br>*Khim. Promst.* 1967, *43*, 290-291. |
| VARIABLES:<br>Temperature | PREPARED BY:<br>P. G. T. Fogg |

EXPERIMENTAL VALUES:

| T/K | Mole fraction, $x_{Cl_2}$ (1 atm) |
|---|---|
| 254.2 | 0.338 |
| 273.2 | 0.198 |
| 283.2 | 0.152 |
| 298.2 | 0.102 |

1 atm = 1.013 × $10^5$ Pascal

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method described by Taylor and Hildebrand was used (1).

SOURCE AND PURITY OF MATERIALS:

1. $Cl_2$: to USSR standard GOST 6718-53.
2. $CH_2Cl_2$: b.p. 40.0-40.3 °C (barometric pressure unspecified); density (20 °C) 1.3260 g $cm^{-3}$; $n_D$ (20 °C) 1.4245.

ESTIMATED ERROR:

REFERENCES:

1. Taylor, N. W.; Hildebrand, J. H. *J. Amer. Chem. Soc.* 1923, *45*, 682.

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. Trichloromethane; $CHCl_3$; [67-66-3]

ORIGINAL MEASUREMENTS:

Vdovichenko, V. T.; Kondratenko, V. I.

*Khim. Promst.* 1967, *43*, 290-291.

VARIABLES:

Temperature

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

| T/K | Mole fraction, $x_{Cl_2}$ (1 atm) |
|---|---|
| 257.2 | 0.399 |
| 273.2 | 0.259 |
| 283.2 | 0.178 |
| 298.2 | 0.114 |

1 atm = $1.013 \times 10^5$ Pascal

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method described by Taylor and Hildebrand was used (1).

SOURCE AND PURITY OF MATERIALS:

1. $Cl_2$: to USSR standard GOST 6718-53.

2. $CHCl_3$: b.p. 61.1-61.2 °C; density (293.2 K) 1.4892 g $cm^{-3}$; $n_D$ (293.2 K) 1.4464.

ESTIMATED ERROR:

REFERENCES:

1. Taylor, N. W.; Hildebrand, J. H. *J. Amer. Chem. Soc.* 1923, *45*, 682.

| COMPONENTS: | EVALUATOR: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Tetrachloromethane; $CCl_4$; [56-23-5] | W. Gerrard, Department of Chemistry,<br>The Polytechnic of North London,<br>Holloway,<br>London, N7 8DB<br>UNITED KINGDOM |

CRITICAL EVALUATION:

Only five sets of values need be considered in arriving at an average plot of $x_{Cl_2}$ vs. T/K from which the recommended values are taken. The original data are given as referring to a partial pressure of 1 atm. i.e. $p_{Cl_2} = 1$ atm. The uncertainty in these values for $p_{Cl_2} = 1$ atm, lies in two assumptions. Firstly, the total pressure $p_T = p_{Cl_2} + p_{CCl_4}$ was measured, and $p_{CCl_4}$ was estimated by assuming Raoult's law, although this is not explicitly stated in every paper. Secondly, the derived $p_{Cl_2}$ value is taken to adjust the corresponding $x_{Cl_2}$ value to that at 1 atm, on the assumption that Henry's law, mole fraction form, holds; but this assumption is frequently not valid, although it may be used with caution.

Data used in the construction of the average curve are shown in Fig. 1, and are taken from the following contributors: Taylor and Hildebrand (1) (T-H), Smith (2) (S), Kogan, Kol'tsov, and Litvinov (3) (K-K-L), Vdovichenko and Kondratenko (4) (V-K), Raskina, Zetkin, Zakharov, Kolesnikov, and Kosorotov (5) (not shown on diagram because the numbers are identical with the K-K-L values, although three T/K values are slightly different). The derived plot is shown in Fig. 2.

Data by Curda and Holas (6) are for a total pressure, $p_T$, about 1 atm, see line C-H in Fig. 1. and are excluded from the mean line. Data by Blair and Yost (7) should not be used for extrapolation beyond the highest $p_{Cl_2} = 73.4$ mm Hg. Data by Jones (8) should not be used for extrapolation beyond $p_{Cl_2} = 13$ mm Hg. Jakowkin's isolated value (9) is for similar low $p_{Cl_2}$. Perkin's (10) and Egunov et al. (11) data are for total pressure about 1 atm. and serve to support the average line. Value by Schwab and Hantke (12) is out-of-line.

REFERENCES:

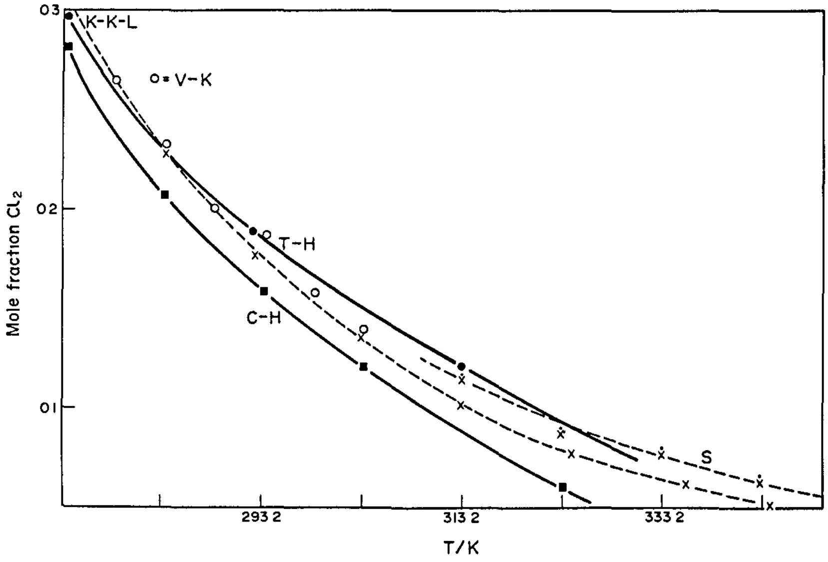
1. Taylor, N.W.; Hildebrand, J.H. *J.Amer.Chem.Soc.* 1923, *45*, 682.
2. Smith, T.L. *J.Phys. Chem.* 1955, *59*, 188.
3. Kogan, L.M.; Kol'tsov, N.S.; Litvinov, N.D. *Zh.Fiz.Khim.* 1963, *37*, 1914.
4. Vdovichenko, V.T.; Kondratenko, V.I. *Khim.Prom.* 1967, *43*, 290.
5. Raskina, A.D.; Zetkin, V.I.; Zakharov, E.V.; Kolesnikov, I.M.; Kosorotov, V.I. *Zh.Prikl.Khim.* 1972, *45*, 1333.
6. Curda, M; Holas, J. *Chem. Prumysl.* 1964, *14*, 547.
7. Blair, M.C. Jr.; Yost, D.M. *J. Amer. Chem. Soc.* 1933, *55*, 4489.
8. Jones, W.J. *J. Chem. Soc.* 1911, *99*, 392.
9. Jakowkin, A.A. *Z. Phys. Chem.* 1899, *29*, 613.
10. Perkin, W.H. *J. Chem. Soc.* 1894, *65*, 20.
11. Egunov, A.V.; Konobeev, B.I.; Ryabov, E.A.; Gubanova, T.I. *Zh. Prikl. Khim.* 1973, *46*, 1855.
12. Schwab, G.M.; Hantke, G. *Z. Phys. Chem.* 1924, *114*, 251.

| COMPONENTS: | EVALUATOR: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Tetrachloromethane; $CCl_4$; [56-23-5] | W. Gerrard, Department of Chemistry,<br>The Polytechnic of North London,<br>Holloway,<br>London, N7 8DB.<br>UNITED KINGDOM: |

CRITICAL EVALUATION:

RECOMMENDED NUMERICAL VALUES

| T/K | $x_{Cl_2}$ (1 atm) |
|---|---|
| 253.16 | 0.600 |
| 263.16 | 0.434 |
| 273.16 | 0.305 |
| 283.16 | 0.262 |
| 293.16 | 0.181 |
| 303.16 | 0.142 |
| 313.16 | 0.112 |
| 323.16 | 0.088 |
| 333.16 | 0.072 |
| 343.16 | 0.058 |
| 353.16 | 0.050 |



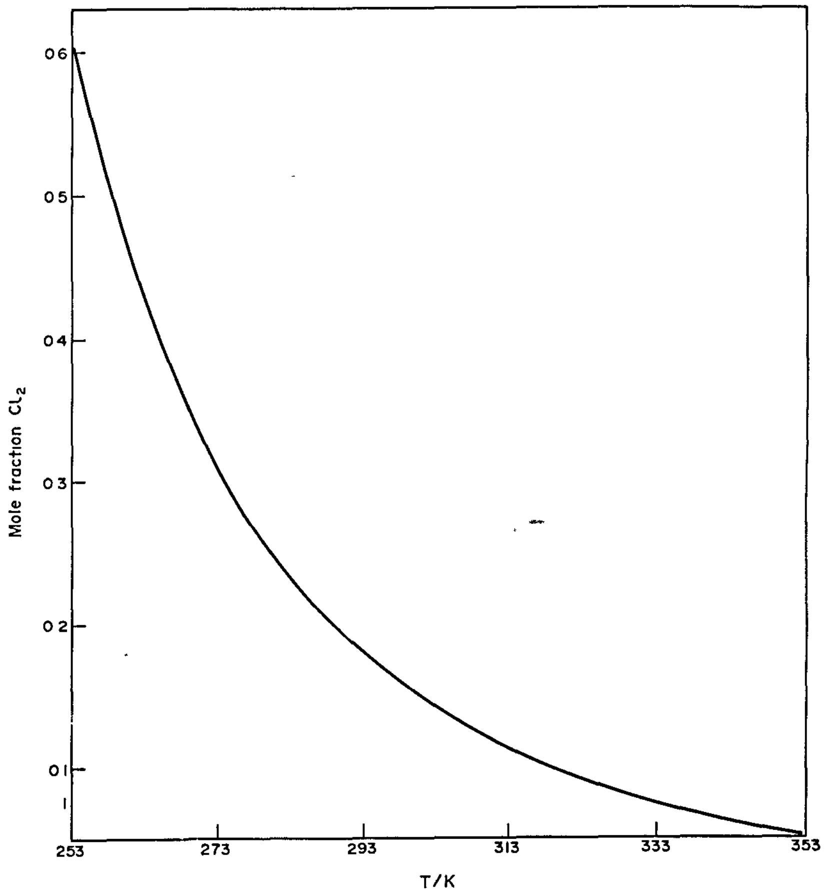
COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. Tetrachloromethane; $CCl_4$; [56-23-5]

EVALUATOR:

W. Gerrard, Department of Chemisty,
The Polytechnic of North London,
Holloway,
London, N7 8DB
UNITED KINGDOM

CRITICAL EVALUATION:



| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Tetrachloromethane; $CCl_4$; [56-23-5] | Perkin, W. H.<br>*J. Chem. Soc.*<br>1894, *65*, 20-28. |
| VARIABLES: | PREPARED BY:<br>W. Gerrard |

EXPERIMENTAL VALUES:

| T/K | wt-% | B* | $x_{Cl_2}$ |
|---|---|---|---|
| 286.16 | 10.29 | 4.02 | 0.199 |
| | 9.88 | 4.204 | 0.192 |

1 atm = 1.013 × $10^5$ Pascal

* see note below.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

No details except as below.
The amount of chlorine taken up by the solvent was determined by introducing a weighed quantity of the solution into a bottle containing potassium iodide, and titrating with sodium thiosulfate. The pressure was not mentioned; it was presumably barometric.

NOTE:

The pressure was presumably total (approximately 1 atm). The solubility was expressed as a mole ratio: $1\text{-}Cl_2 + B\text{-}CCl_4$, B being the number of moles of $CCl_4$ for each mole of $Cl_2$. The wt-% was also given.

SOURCE AND PURITY OF MATERIALS:

Not specified.

ESTIMATED ERROR:

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Tetrachloromethane; $CCl_4$; [56-23-5] | Jakowkin, A.A.<br>*Z. Phys. Chem.* 1899, *29*, 613. |
| VARIABLES: | PREPARED BY:<br>W. Gerrard |

EXPERIMENTAL VALUES:

| T/K | Absorption coefficient, | $x_{Cl_2}$ (approximate, assuming $p_{Cl_2}$ is about 1 atm and the coefficient is independent of pressure). |
|---|---|---|
| 273.16 | 83.3<br>(83.3 = 1/0.012) | 0.267 |

760 mmHg = 1 atm = $1.013 \times 10^5$ Pa

Solubility expressed as absorption coefficient:

$$\frac{\text{concn. in gas}}{\text{concn. in liquid}} = 0.012 \text{ (average)}$$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two bulbs, one connected to an ordinary pipette carrying a tap. Absorption was at a pressure of about 15 mm Hg. Amount absorbed was determined by a titration (potassium iodide-thiosulfate).

SOURCE AND PURITY OF MATERIALS:

$Cl_2$ : Self-prepared. Purity not specified.

$CCl_4$ : Not specified.

ESTIMATED ERROR:

REFERENCES:

SDC - N

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. Tetrachloromethane; $CCl_4$; [56-23-5]

ORIGINAL MEASUREMENTS:

Jones, W. J.
*J. Chem. Soc.*
1911, *99*, 392-404.

VARIABLES:

Pressure

PREPARED BY:

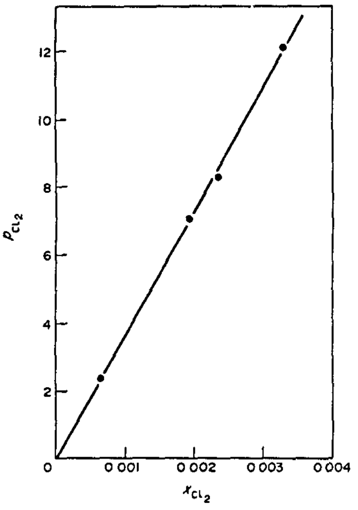
W. Gerrard

EXPERIMENTAL VALUES:

| T/K | $S$ | $p_{Cl_2}$/mmHg | $x_{Cl_2}$ |
|---|---|---|---|
| 288.16 | 50.7 | 2.34 | 0.000634 |
| | 51.4 | 7.03 | 0.00193 |
| | 53.7 | 8.29 | 0.00237 |
| | 51.0 | 12.14 | 0.00331 |

(Extrapolation to $p_{Cl_2}$ = 1 atm is not valid.)

760 mmHg = 1 atm = $1.013 \times 10^5$ Pascal



AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Bubbler and wash bottles. Concentration of the original solution determined iodometrically. Chlorine, carried away from the solution in a stream of air, was determined by iodometric titration. The results were given as a partition coefficient,

$$S = \frac{\text{concn. } Cl_2 \text{ in moles/dm}^3 \text{ solution}}{\text{concn. } Cl_2 \text{ in moles/dm}^3 \text{ gas phase}}.$$

$S$ was deemed to be constant and independent of pressure, $p_{Cl_2}$.

NOTES: Compiler has given the approximate $p_{Cl_2}$ and $x_{Cl_2}$ values on the assumption that the volume of solution is equal to that of the original liquid for these low concentrations.

SOURCE AND PURITY OF MATERIALS:

1. $Cl_2$ : not specified.
2. $CCl_4$ : redistilled.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. Tetrachloromethane; $CCl_4$; [56-23-5]

ORIGINAL MEASUREMENTS:

Taylor, N. W.; Hildebrand, J. H.
*J. Amer. Chem. Soc.*
1923, *45*, 682-694.

VARIABLES:

Temperature

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | g $Cl_2$/g of solution | $p_{gas}$ /mmHg | $x_{gas}$ | $x_{gas}$ (1 atm) |
|---|---|---|---|---|
| 273.16 | 0.156 | 729 | 0.286 | 0.298 |
| 292.16 | 0.0848 | 680 | 0.163 | 0.187 |
| 313.16 | 0.0433 | 557 | 0.0892 | 0.1215 |

760 mmHg = 1 atm = $1.013 \times 10^5$ Pascal

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Saturator tube (1). Chlorine was bubbled through liquid. Samples of saturated liquid were run into a weighed flask containing aqueous KI, and iodine was titrated with standard solution of thiosulfate. Temperature control was manual to 0.1 K. Saturation at barometric pressure, $p_{total}$, partial pressure, $p_{gas}$, estimated by Raoult's law to give $p_{CCl_4}$. Hence $p_{gas} = p_{total} - p_{CCl_4}$. $x_{gas}$ (1 atm) estimated by Henry's law, mole fraction form.

SOURCE AND PURITY OF MATERIALS:

1. Chlorine was from an electrolytic supply; it contained less than 0.1% of free acid.
2. Purity of $CCl_4$ not specified. Vapor pressure data from ref. 2.

ESTIMATED ERROR:

REFERENCES:

1. Bichowsky, F. R.; Storch, H. *J. Amer. Chem. Soc.* 1915, *37*, 2695.
2. Young, S. *J. Chem. Soc.* 1891, *59*, 911.

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. Tetrachloromethane; $CCl_4$; [56-23-5]

ORIGINAL MEASUREMENTS:

Schwab, G.M.; Hantke, G.
*Z. Phys. Chem.* 1924, *114*, 251.

VARIABLES:

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | $s$ | $1/s$ | Approx. $x_{Cl_2}$ (1 atm) |
|---|---|---|---|
| 292.16 | 0.031 | 32.26 | 0.116 |

760 mmHg = 1 atm = $1.013 \times 10^5$ Pa

Solubility was expressed as an absorption coefficient

$$s = \frac{\text{concn. of } Cl_2 \text{ in gas}}{\text{concn. of } Cl_2 \text{ in liquid}}$$

Actual pressure was about 700 mm Hg.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Liquid held in small bulb of 1 $cm^3$ capacity connected to manometer assembly. Diagram given in original paper.

Absorption coefficient determined by measurement of the decrease of pressure with time in an apparatus of known volume connected with a small bulb containing a small amount of $CCl_4$.

SOURCE AND PURITY OF MATERIALS:

$Cl_2$ : Gas from liquid passed through calcium chloride.

$CCl_4$ : Not specified.

ESTIMATED ERROR:

±10% (Compiler)

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Tetrachloromethane; $CCl_4$; [56-23-5] | Blair, M.C. Jr.; Yost, D.M.<br>*J. Amer. Chem. Soc.* 1933, *55*, 4489-96. |
| VARIABLES: Pressure | PREPARED BY: W. Gerrard. |

EXPERIMENTAL VALUES:

| $p_{Cl_2}$ /mmHg | $x_{Cl_2}$ at $p_{Cl_2}$ | Henry's Constant* $H_{Cl_2}$ |
|---|---|---|
| 18.6 | 0.00394 | 4730 |
| 22.8 | 0.00448 | 5080 |
| 28.0 (a) | 0.00609 | 4600 |
| 30.4 | 0.00615 | 4940 |
| 32.2 | 0.00690 | 4670 |
| 39.8 | 0.00781 | 5100 |
| 64.6 | 0.01245 | 5180 |
| 69.0 | 0.01363 | 5070 |
| 73.4 | 0.01391 | 5280 |

(a) Given as 2.80 in the original. The lowest value of $H_{Cl_2}$ gives $x_{Cl_2}$ = 0.165; the highest value gives $x_{Cl_2}$ = 0.144, for $p_{Cl_2}$ = 1 atm.

760 mmHg = 1 atm.
1 atm = $1.013 \times 10^5$ Pascal.

* $H_{Cl_2}$ defined as $H_{Cl_2} = p_{Cl_2}/x_{Cl_2}$

AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

The vapor pressures, $p_{Cl_2}$, were determined by the iodometric determination of chlorine carried away in a stream of nitrogen (see ref. 1), at 298.16 K. The pressures were not greater than 74 mmHg.

SOURCE AND PURITY OF MATERIALS:

All reagents were stated to be of the highest purity obtainable.

ESTIMATED ERROR:

REFERENCES:

1. Bichowsky, F.R.; Storch, H. *J. Amer. Chem. Soc.* 1915, *37*, 2696.

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. Tetrachloromethane; $CCl_4$; [56-23-5]

ORIGINAL MEASUREMENTS:

Smith, T. L.
*J. Phys. Chem.*
1955, *59*, 188-189.

VARIABLES:

Temperature

PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | Total pressure $p_T$/atm | Moles $Cl_2$/ (kg solution)/atm $Cl_2$ | $x_{Cl_2}$[a]/atm $Cl_2$ |
|---|---|---|---|
| 313.16 | 2.02 | 0.797 | |
| | 2.36 | 0.789 | 0.115 |
| 323.16 | 2.02 | 0.590 | |
| | 2.36 | 0.602 | 0.0875 |
| 333.16 | 2.02 | 0.522 | |
| | 2.36 | 0.522 | 0.0771 |
| 343.16 | 2.36 | 0.417 | |
| | 2.36 | 0.433 | 0.0632 |
| 353.16 | 2.36 | 0.340 | |
| | 2.70 | 0.329 | 0.0502 |
| 363.16 | 2.70 | 0.269 | 0.0444 |

1 atm = $1.013 \times 10^5$ Pascal

[a] at 1 atm partial pressure of chlorine

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two bulbs separated by stopcock. Bulbs are detachable for weighing. Bourdon gauge. Chlorine passed into liquid in upper bulb until constant gauge reading attained. Sample then run into lower bulb for weighing and iodometric titration. Saturation at a total pressure $p_T$ of about 2 atm. Partial pressure $p_{Cl_2}$ derived from $p_{Cl_2} = p_T - p_{CCl_4}$, assuming Raoult's law. Basis of adjustment to $p_{Cl_2} = 1$ atm probably Henry's law, mole fraction form.

SOURCE AND PURITY OF MATERIALS:

1. $Cl_2$ : from cylinder (The Matheson Co.).
2. $CCl_4$ : distilled.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. Tetrachloromethane; $CCl_4$; [56-23-5]

ORIGINAL MEASUREMENTS:

Kogan, L.M.; Kol'tsov, N.S.; Litvinov, N.D.

*Zh. Fiz. Khim.* 1963, *37*, 1914-7.

VARIABLES:

Temperature

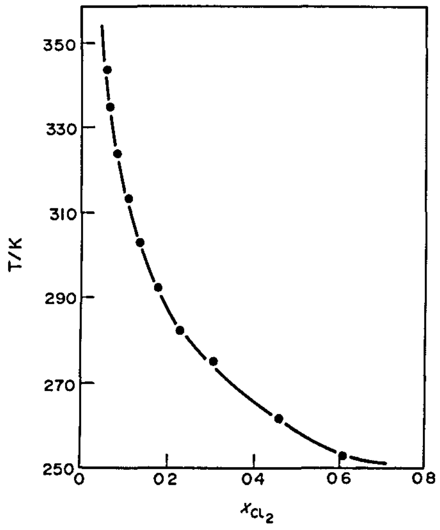
PREPARED BY:

W. Gerrard

EXPERIMENTAL VALUES:

| T/K | Mole fraction of chlorine, $x_{Cl_2}$ |
|---|---|
| 253.16 | 0.603 |
| 262.16 | 0.456 |
| 273.16 | 0.309 |
| 283.46 | 0.228 |
| 292.36 | 0.177 |
| 303.16 | 0.136 |
| 313.16 | 0.102 |
| 324.16 | 0.0755 |
| 335.66 | 0.0625 |
| 344.16 | 0.0518 |

1 atm = 1.013 x $10^5$ Pascal



AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Thermostatted double gas buret, null manometer, magnet-striker and stirrer. Diagram of elaborate assembly is given in the original paper.

A weighed amount of liquid in a sealed tube was placed in the absorption vessel. The system was evacuated, filled with gas, and the sealed tube was broken. The volume of gas absorbed was measured at a fixed pressure (total). Light was excluded.

Volume of chlorine measured at constant pressure, which was not stated. Henry's law was used to calculate the mole fraction values for $p_{Cl_2}$ = 1 atm; but details were not disclosed. Allowance for $p_{CCl_4}$ was not mentioned.

SOURCE AND PURITY OF MATERIALS:

$Cl_2$ conformed with USSR standard GOST 6718-53; purity stated to be 99.97.

$CCl_4$ was dried, distilled and checked by physical data.

ESTIMATED ERROR:

Temperature control was ±0.02 to ±0.05°C. Volume could be read to 0.05 $cm^3$. The reproducibility of the volume measurements was stated to be within ±0.25%.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Tetrachloromethane; $CCl_4$; [56-23-5] | Curda, M., Holas, J.<br>*Chem. Prumysl.* 1964, *14*, 547-8. |
| VARIABLES: | PREPARED BY: |
| Temperature | W. Gerrard |

EXPERIMENTAL VALUES:

| T/K | $Cl_2$ wt % ($p_T$ about 1 atm) | $x_{Cl_2}$ (Calc. by compiler) |
|---|---|---|
| 273.16 | 15.4 | 0.283 |
| 283.16 | 10.8 | 0.208 |
| 293.16 | 8.0 | 0.159 |
| 303.16 | 6.0 | 0.122 |
| 323.16 | 2.9 | 0.0609 |
| 343.16 | 0.6 | 0.0129 |

1 atm = $1.013 \times 10^5$ Pascal.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Jacketted bubbler tube. Diagram in original paper.

Sample removed by a tap at the bottom of the tube. Chlorine determined iodometrically. Temperature measured within 0.5°C.

Saturation at barometric pressure, total.

SOURCE AND PURITY OF MATERIALS:

$Cl_2$, of technical grade, of 99.2% purity.

$CCl_4$, distilled, b.p. 77°C.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. Tetrachloromethane; $CCl_4$; [56-23-5]

ORIGINAL MEASUREMENTS:

Vdovichenko, V. T.; Kondratenko, V. I.
*Khim. Prom.*
<u>1967</u>, *43*, 290-291.

VARIABLES:

Temperature

PREPARED BY:

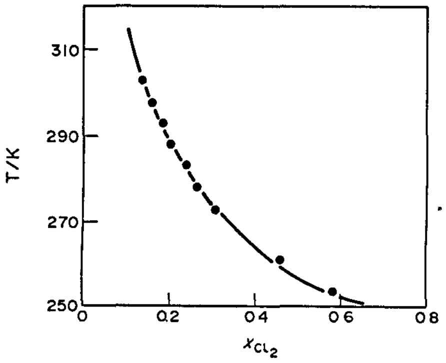
W. Gerrard

EXPERIMENTAL VALUES:

| T/K | $x_{Cl_2}$ |
|---|---|
| 253.16 | 0.592 |
| 261.16 | 0.464 |
| 273.16 | 0.303 |
| 278.16 | 0.264 |
| 283.16 | 0.232 |
| 288.16 | 0.201 |
| 293.16 | 0.186 |
| 298.16 | 0.158 |
| 303.16 | 0.139 |

Note: Mole fraction values, $x_{Cl_2}$ are for $p_{Cl_2}$ = 1 atm.

1 atm = 1.013 × $10^5$ Pascal



AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method described by Taylor and Hildebrand was used (1).

SOURCE AND PURITY OF MATERIALS:

1. $Cl_2$ : GOST 6718-53 (All Union Standard).
2. $CCl_4$ : b.p., $d_4^{20}$, and $n_D^{20}$ given as 76.7-76.8 °C, 1.5970 and 1.4602, respectively.

ESTIMATED ERROR:

REFERENCES:

1. Taylor, N. W.; Hildebrand, J. H. *J. Amer. Chem. Soc.* <u>1923</u>, *45*, 682.

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. Tetrachloromethane; $CCl_4$; [56-23-5]

ORIGINAL MEASUREMENTS:

Raskina, A.D; Zetkin, V.I.; Zakharov, E.V.; Kolesnikov, I.M.; Kosorotov, V.I.

*Zh. Prikl. Khim.* 1972, *45*, 1333-4.

VARIABLES:

Temperature

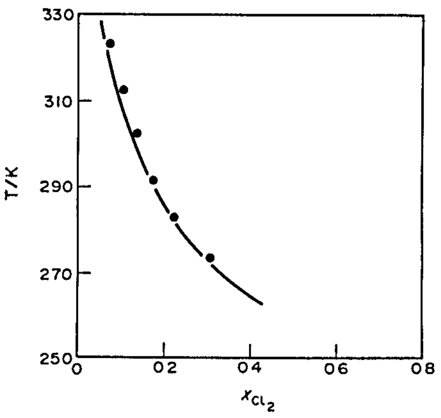
PREPARED BY:

W. Gerrard.

EXPERIMENTAL VALUES:

| T/K | | $x_{Cl_2}$ |
|---|---|---|
| 273.16 | | 0.309 |
| 283.16 | (283.46) | 0.228 |
| 292.16 | (292.36) | 0.177 |
| 303.16 | (303.06) | 0.136 |
| 313.16 | | 0.102 |
| 324.16 | | 0.0755 |

1 atm = 1.013 x $10^5$ Pascal



AUXILIARY INFORMATION

METHOD /APPARATUS/PROCEDURE:

Chlorine bubbled through liquid until saturated at total pressure, $p_T$, apparently atmospheric.

Thermostatted cylinder, 100 $cm^3$ capacity protected from light. Reflux condenser, bubbler fitted Schott porous plate. $Cl_2$ or ($Cl_2$+ $N_2$) passed through liquid (70 $cm^3$). Samples withdrawn periodically for iodometric analysis, until constant result obtained. Three successive analyses stated to show satisfactory reproducibility.

From the variation of the partial pressure, $p_{Cl_2}$, by dilution with nitrogen it was concluded that Henry's law was obeyed. Allowance for the partial pressure of $CCl_4$ was not mentioned. Results were given as mole %, presumably for $p_{Cl_2}$ = 1 atm, but this was not explicitly stated. The numbers are identical with those of ref. 1, cited by authors, but three T/K ( ) are slightly different.

SOURCE AND PURITY OF MATERIALS:

Cl : GOST 6318-55 standard. Dried by sulfuric acid.

CCl : technical grade, GOST 4-65, dried and distilled.

ESTIMATED ERROR:

REFERENCES:

1. Kogan, L.M.; Kol'tsov, N.S.; Litvinov, N.D.; *Zh. Fiz. Khim.* 1963, *37*, 1914.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Tetrachloromethane; $CCl_4$; [56-23-5] | Egunov, A. V.; Konobeev, B. I.; Ryabov, E. A.; Gubanova, T. I.<br>*Zh. Prikl. Khim.*<br>1973, *46*, 1855-6. |
| VARIABLES: | PREPARED BY: |
| Temperature | W. Gerrard |

EXPERIMENTAL VALUES:

| T/K | wt-% | $x^*_{Cl_2}$ |
|---|---|---|
| 313.16 | 5.27 | 0.108 |
| 323.16 | 3.9 | 0.081 |
| 333.16 | 3.5 | 0.073 |

$^*p_{total} \approx$ 1 atm = $1.013 \times 10^5$ Pascal (calculated by compiler)

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Bubbler tube, differential manometer, and rheometer. Diagram given in paper. Chlorine from cylinder was passed through concentrated sulfuric acid and a rheometer into a known weight of liquid (15-20 g) until equilibrium was reached as indicated by a differential manometer.
Amount absorbed was determined by increase in weight. Light was excluded.
Chlorine bubbled through liquid until equilibrium attained at a total pressure (barometric, unspecified).

SOURCE AND PURITY OF MATERIALS:

1. $Cl_2$: Unspecified.

2. $CCl_4$: Chemically pure grade.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. Trichloromethanesulfenyl chloride; $CCl_4S$; [594-42-3]

ORIGINAL MEASUREMENTS:

Raskina, A.D.; Zetkin, V.I.; Zakharov, E.V.; Kolesnikov, I.M.; Kosorotov, V.I.;

*Zh. Prik. Khim. (Leningrad)*, 1972, *42*, 1333-1334.

VARIABLES:

Temperature

PREPARED BY:

P.G.T. Fogg

EXPERIMENTAL VALUES:

| T/K | $g_{Cl_2}$/100g of solution | Mole fraction $x_{Cl_2}$ |
|---|---|---|
| 275 | 16.0 * | 0.225 |
| 278 | 8.9 | 0.204 |
| 283 | 7.4 | 0.168 |
| 288 | 6.0 | 0.145 |
| 293 | 5.0 | 0.121 |
| 295 | 4.1 | 0.102 |
| 303 | 3.4 * | 0.098 |
| 308 | 2.8 | 0.070 |

The total pressure was apparently equal to barometric pressure (unspecified).

* these values are not consistent with the corresponding values of the mole fraction given by the authors.

The authors have given the following equation :

$$\log_{10} (100x_{Cl_2}) = (1250/(T/K)) - 3.20$$

The compiler has calculated that values of $x_{Cl_2}$ quoted above fit this equation with a standard deviation of 0.007.

The authors have given the heat of solution of chlorine, calculated from the variation of solubility with temperature, as - 5.7 kcal $mol^{-1}$

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine or chlorine/nitrogen mixtures were bubbled through $CCl_4S$ until the concentration of chlorine in the liquid phase, as determined by iodometry, was constant. The apparatus was protected from light. The total pressure of gas was apparently equal to barometric pressure although this is not explicitly stated. Variations of solubility when chlorine was diluted with nitrogen is said to indicate that Henry's law is obeyed although these experimental measurements are not reported. No allowances seem to have been made for the partial pressure of the $CCl_4S$.

SOURCE AND PURITY OF MATERIALS:

$Cl_2$ : to USSR standard GOST 6718-53 dried over $H_2SO_4$.

$N_2$ : to GOST 9293-59; dried over $H_2SO_4$.

$CCl_4S$ : made by chlorination of $CS_2$; purified by distillation to 99.5%

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. Carbon disulfide; $CS_2$; [75-15-0]
3. Trichloromethanesulfenyl chloride; $CCl_4S$; [594-42-3]
4. Tetrachloromethane; $CCl_4$; [56-23-5]

ORIGINAL MEASUREMENTS:

Raskina, A.D.; Zetkin, V.I.
Zakharov, E.V.; Kolesnikov, I.M.;
Kosorotov, V.I.

*Zh. Prik. Khim. (Leningrad),* 1972, *45,* 1333-1334.

VARIABLES:

Composition

PREPARED BY:

P.G.T. Fogg

EXPERIMENTAL VALUES:

| Composition before passage of chlorine (mole %) | | | g $Cl_2$/100g solution | Mole fraction $x_{Cl_2}$ |
|---|---|---|---|---|
| $CS_2$ | $CCl_4S$ | $CCl_4$ | | |
| 15.6 | 18.4 | 66.0 | 14.3 | 0.263 |
| 15.6 | 66.0 | 18.4 | 12.2 | 0.240 |
| 62.5 | 7.5 | 30.0 | 21.8 | 0.263(0.297)* |
| 62.5 | 18.7 | 18.8 | 20.1 | 0.250(0.283)* |
| 88.0 | 5.4 | 6.6 | 21.4 | 0.248 |
| 42.7 | 23.0 | 34.3 | 16.4 | 0.263 |

Temperature : 275 K

The total pressure was apparently equal to barometric pressure (unspecified).

* values recalculated by the compiler from wt % of $Cl_2$ given by the authors.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine was bubbled through the liquid until the concentration of chlorine in the liquid phase, as determined by iodometry, was constant. The apparatus was protected from light.

The total pressure of gas was apparently equal to barometric pressure although this is not explicitly stated.

SOURCE AND PURITY OF MATERIALS:

$Cl_2$ : to USSR standard GOST 6718-53; additionally dried over $H_2SO_4$.

$CS_2$ : to GOST 1541-42; distilled and dried over ignited $CaCl_2$.

$CCl_4S$: made by chlorination of $CS_2$; purified by distillation to 99.5%

$CCl_4$ : technical grade (GOST 4-65); dried over ignited $CaCl_2$.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. 1,2-Dibromoethane; $C_2H_4Br_2$; [106-93-4]

ORIGINAL MEASUREMENTS:

Taylor, N. W.; Hildebrand, J. H.
*J. Amer. Chem. Soc.* 1923, *45*,
682-694.

VARIABLES:

Temperature

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

| T/K | g $Cl_2$/g of solution | $p_{Cl_2}$/mmHg | Mole fractions<br>$x_{Cl_2}$ | <br>$x_{Cl_2}$(1 atm) |
|---|---|---|---|---|
| 293.16 | 0.0813 | 752 | 0.190 | 0.192 |
| 313.16 | 0.0469 | 736 | 0.1151 | 0.119 |

760 mmHg = 1 atm

1 atm = 1.013 × $10^5$ Pascal

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Saturator tube (1). Chlorine was bubbled through liquid. Samples of saturated liquid were run into a weighed flask containing aqueous KI, and iodine was titrated with standard solution of thiosulfate. Temperature control was manual to 0.1 K.
Saturation was at barometric pressure, $p_{total}$. The value of $p_{C_2H_4Br_2}$ was estimated by Raoult's law from vapor pressure data given in ref. (2). Hence:

$$p_{Cl_2} = p_{total} - p_{C_2H_4Br_2}$$

The authors then used Henry's law (mole fraction form) to calculate $x_{Cl_2}$ ( 1 atm) from $x_{Cl_2}$.

SOURCE AND PURITY OF MATERIALS:

1. $Cl_2$: from an electrolytic supply; contained less than 0.1% of free acid.

2. $C_2H_4Br_2$: not specified.

ESTIMATED ERROR:

REFERENCES:

1. Bichowsky, F. R.; Storch, H. *J. Amer. Chem. Soc.* 1915, *37*, 2695.
2. Landolt-Börnstein Tabellen.

| | |
|---|---|
| COMPONENTS:<br>1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Tetrachloroethene; $C_2Cl_4$; [127-18-4] | ORIGINAL MEASUREMENTS:<br>Curda, M.; Holas, J.<br>*Chem. Prum.* 1964, *14*, 547-548. |
| VARIABLES:<br>Temperature | PREPARED BY:<br>P. G. T. Fogg |

EXPERIMENTAL VALUES:

| T/K | g $_{Cl_2}$/100 g soln. | Mole fraction,* $x_{Cl_2}$ |
|---|---|---|
| 273.2 | 15.4 | 0.299 |
| 283.2 | 10.8 | 0.221 |
| 293.2 | 8.1 | 0.171 |
| 303.2 | 6.4 | 0.138 |
| 323.2 | 3.8 | 0.085 |
| 343.2 | 2.2 | 0.050 |
| 363.2 | 1.0 | 0.023 |

The pressure of $Cl_2$ plus $C_2Cl_4$ was equal to barometric pressure.

* Calculated by compiler.

AUXILIARY INFORMATION

| | |
|---|---|
| METHOD/APPARATUS/PROCEDURE:<br>Chlorine was passed into the $C_2Cl_4$ in a jacketted bubbler tube (diagram in original paper). Samples were withdrawn through a tap at the bottom of the tube. Temperature was controlled to ± 0.5 °C. The total pressure was equal to barometric pressure (unspecified). | SOURCE AND PURITY OF MATERIALS:<br>1. $Cl_2$: technical grade, 99.2% pure.<br>2. $C_2Cl_4$: technical grade; distilled; b.p. 120 °C. |
| | ESTIMATED ERROR: |
| | REFERENCES: |

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. 1,1,2,2-Tetrachloroethane;
$C_2H_2Cl_4$; [79-34-5]

ORIGINAL MEASUREMENTS:

Kalz, G.; Naumann, A.
*Plaste Kautsch.* 1971, *18*, 500-501.

VARIABLES:

Temperature

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

| T/K | g $Cl_2$dm$^{-3}$ | Mole fraction*, $x_{Cl_2}$ |
|---|---|---|
| 298.2 | 51.77 | 0.072 |
| 323.2 | 50.25 | 0.071 |
| 348.2 | 33.05 | 0.049 |
| 363.2 | 18.72 | 0.029 |
| 383.2 | 17.87 | 0.028 |

The pressure of $Cl_2$ plus $C_2H_2Cl_4$ was apparently equal to barometric pressure (unspecified).

* Approximate values calculated by compiler on the assumption that dissolution of $Cl_2$ causes no change in volume of the liquid phase. Densities of $C_2H_2Cl_4$ at 293.2 K and 298.2 K are given in ref. (1). Densities at other temperatures were obtained by extrapolation.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine from a cylinder was passed into 400 cm$^3$ of the solvent in a flask fitted with stirrer and reflux condenser. Temperatures were controlled by a thermostat. The chlorine which dissolved was determined by iodometry. The extent of irreversible reaction between chlorine and tetrachloroethane was measured by estimation of chloride ions produced. At 90 °C about 3% of the tetrachloroethane reacted but at other temperatures there was less than 0.2% reaction.

SOURCE AND PURITY OF MATERIALS:

1. $Cl_2$: from a cylinder.

2. $C_2H_2Cl_4$: b.p. 146.2 °C (barometric pressure unspecified); density (20 °C) 1.5950 g cm$^{-3}$; $n_D$ (20 °C) 1.4938.

ESTIMATED ERROR:

REFERENCES:

1. J. Timmermans, *"Physico-Chemical Constants of Pure Organic Compounds"*, Vol. 2, Elsevier, London. 1965.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. 1,1,2,3,4,4-Hexachloro-1,3-butadiene; $C_4Cl_6$; [87-68-3] | Kogan, L. M.; Kol'tsov, N. S.; Litvinov, N. D. *Zh. Fiz. Khim.* 1963, *37*, 1014-1016. |
| **VARIABLES:** | **PREPARED BY:** |
| Temperature, pressure | P. G. T. Fogg |

EXPERIMENTAL VALUES:

| T = 303.2 K | | $p_{Cl_2}$ = 760 mmHg | |
|---|---|---|---|
| $p_{Cl_2}$/mmHg | Mole fraction $x_{Cl_2}$ | T/K | Mole fraction $x_{Cl_2}$ |
| 408.4 | 0.0844 | 253.5 | 0.607 |
| 600.8 | 0.125 | 261.7 | 0.467 |
| 745.7 | 0.155 | 266.0 | 0.421 |
| 773.7 | 0.160 | 271.8 | 0.358 |
| 926.2 | 0.191 | 272.8 | 0.353 |
| 974.2 | 0.202 | 283.0 | 0.250 |
| | | 293.4 | 0.199 |
| | | 303.2 | 0.158 |
| | | 334.4 | 0.083 |
| | | 352.9 | 0.059 |
| | | 365.3 | 0.052 |

760 mmHg = 1 atm

1 atm = 1.013 × $10^5$ Pascal

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The volumes of gas absorbed by weighed quantities of hexachlorobutadiene were determined by a static method using a thermostatted gas burette connected to absorption vessels and a vacuum line as described in ref. (1). Pressures were measured by a mercury manometer. Chlorine did not come into contact with any metal surfaces. Temperatures were controlled to ± 0.02 K in the range 283 K - 353 K and to ± 0.05 outside this range. The apparatus was shielded from light.

SOURCE AND PURITY OF MATERIALS:

1. $Cl_2$: to USSR standard GOST 6718-53.

2. $C_4Cl_6$: m.p. 18.7 °C; density (20 °C) 1.6793 g $cm^{-3}$; $n_D$ (20 °C) 1.5558.

ESTIMATED ERROR:

REFERENCES:

1. Kogan, L. M.; Kol'tsov, N. S.; Litvinov, N. D. *Zh. Fiz. Khim.* 1963, *37*, 1040.

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. Hexadecafluoroheptane; (Perfluoroheptane); $C_7F_{16}$; [335-57-9]

ORIGINAL MEASUREMENTS:

Gjaldbaek, J. C.; Hildebrand, J. H.
*J. Amer. Chem. Soc.* 1950, *72*, 609-611.

VARIABLES:

Temperature

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

| T/K | Bunsen coefficient | Mole fraction, $x_{Cl_2}$ (1 atm) |
|---|---|---|
| 273.16 | 20.1 | 0.164[a] |
| 288.76 | | 0.1165 |
| 288.96 | | 0.1174 |
| 292.96 | | 0.1101[b] |
| 293.16 | 12.3 | 0.110[b] |
| 295.16 | | 0.1051 |
| 298.16 | 10.7 | 0.0977 |
| 298.46 | | 0.0975 |

[a] Extrapolated

[b] Interpolated

1 atm = $1.013 \times 10^5$ Pascal

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine was bubbled through solvent for about 1 hour and the chlorine in a weighed sample of the solution estimated by iodometry. Temperature control was manual to 0.1 K. Saturation was at barometric pressure, $p_{total}$. The value of $p_{C_7F_{16}}$ was estimated by Raoult's law from vapor pressure data for $C_7F_{16}$ in ref. (1). Hence:

$$p_{Cl_2} = p_{total} - p_{C_7F_{16}}$$

The authors then used Henry's law (mole fraction form) to calculate $x_{Cl_2}$ (1 atm).

SOURCE AND PURITY OF MATERIALS:

1. $Cl_2$: from a cylinder (Ohio Chem. Co.)

2. $C_7F_{16}$: distilled, b.p. 355.49 - 355.58 K (753.8 mmHg).

ESTIMATED ERROR:

REFERENCES:

1. Fowler, R. D.; Hamilton, J. M.; Kasper, J. S.; Weber, C. E.; Burford, W. B.; Anderson, H. C. *Ind. Eng. Chem.* 1947, *39*, 375.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. 1,2-Dichlorobenzene; $C_6H_4Cl_2$; [95-50-1] | Zetkin, V.I.; Kosorotov, V.I.; Stul, B.Ya.; Dzhagatspanyan, R.V.;<br>*Khim. Prom.* 1971, *47*, 102-103. |
| VARIABLES: Temperature | PREPARED BY: P.G.T. Fogg. |

EXPERIMENTAL VALUES:

| T/K | $x_{Cl_2}$ |
|---|---|
| 288.2 | 0.249 |
| 293.2 | 0.230 |
| 303.2 | 0.158 |
| 313.2 | 0.120 |
| 323.2 | 0.100 |
| 333.2 | 0.083 |

The pressure of $Cl_2$ plus $C_6H_4Cl_2$ was apparently equal to barometric pressure.

The following equation was given :

$$\log_{10} x_{Cl_2} = (960/(T/K)) - 4.02.$$

The heat of solution of $Cl_2$ calculated from the variation of solubility with temperature was given as - 4400 cal $mol^{-1}$.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method and apparatus were described in ref. (1). Chlorine was bubbled through a measured quantity of dichlorobenzene in a thermostatted vessel of capacity 100 $cm^3$. Samples were withdrawn periodically for iodometric analysis until consistent results were obtained.

SOURCE AND PURITY OF MATERIALS:

$Cl_2$ : to USSR standard GOST 6718-53.

$C_6H_4Cl_2$: 99% pure. Dried with $CaCl_2$

ESTIMATED ERROR:

REFERENCES:

1. Zetkin, V.I. et. al.
*Zh. Fiz. Khim.* 1970, *44*, 830.

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. 1,2,4-Trichlorobenzene; $C_6H_3Cl_3$; [120-82-1]

ORIGINAL MEASUREMENTS:

Zetkin, V.I. Kosorotov, V.I.; Stul, B.Ya.; Dzhagatspanyan, R.V.;

*Khim. Prom.* 1971, *47*, 102-103.

VARIABLES:

Temperature

PREPARED BY:

P.G.T. Fogg.

EXPERIMENTAL VALUES:

| T/K | $x_{Cl_2}$ |
|---|---|
| 288.2 | 0.254 |
| 293.2 | 0.210 |
| 303.2 | 0.151 |
| 313.2 | 0.117 |
| 323.2 | 0.091 |
| 333.2 | 0.070 |

The pressure of $Cl_2$ plus $C_6H_3Cl_3$ was apparently equal to barometric pressure.

The following equation was given :

$$\log_{10} x_{Cl_2} = (1050/(T/K)) - 4.29$$

The heat of solution of $Cl_2$ calculated from the variation of solubility with temperature was given as - 4800 cal $mol^{-1}$.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method and apparatus were described in ref. (1). Chlorine was bubbled through a measured quantity of trichlorobenzene in a thermostatted vessel of capacity 100 $cm^3$. Samples were withdrawn periodically for iodometric analysis until consistent results were obtained.

SOURCE AND PURITY OF MATERIALS:

$Cl_2$ : to USSR standard GOST 6718-53.

$C_6H_3Cl_3$: 99% pure. Dried with $CaCl_2$

ESTIMATED ERROR:

REFERENCES:

1. Zetkin, V.I. et. al.; *Zh. Fiz. Khim.* 1970, *44*, 830.

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. Chlorobenzene; $C_6H_5Cl$; [108-90-7]

ORIGINAL MEASUREMENTS:

Silberstein, B.; Date, R. V.; Butt, J. B.
*J. Chem. Engng. Data*
1969, *14*, 253-4.

VARIABLES:

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

| T/K | Solubility†, S/mol dm$^{-3}$ | Mole fraction†* of chlorine in liquid, $x_{Cl_2}$ |
|---|---|---|
| 303.15 | 1.56 | 0.138 |
| 318.15 | 1.10 | 0.103 |
| 333.15 | 0.78 | 0.076 |

† at a partial pressure of 101.3 kPa.

* calculated by compiler assuming solubility is given as mol dm$^{-3}$ (solvent).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorobenzene saturated with gas by bubbling chlorine through at 283 K. Temperature then raised to experimental temperature and chlorine allowed to equilibriate. Then stannic chloride in chlorobenzene solution added to cause chlorine to react with chlorobenzene to give dichlorobenzene.

SOURCE AND PURITY OF MATERIALS:

1. Matheson high purity grade; purity better than 99.5 mole per cent.
2. Fisher Scientific certified reagent, dried over $CaCl_2$, distilled middle fraction stored over calcium hydride in dark.

ESTIMATED ERROR:

$\delta T/K = \pm 0.05$; $\delta x_{Cl_2} = \pm 3\%$.

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. Chlorobenzene; $C_6H_5Cl$; [108-90-7]

ORIGINAL MEASUREMENTS:

Cervinka, M.
*Chem. Prum.* 1960, *10*, 249-251.

VARIABLES:

Pressure, temperature

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

| T/K | $H$/mmHg | Mole fraction, $x_{Cl_2}$ (1 atm) (calculated by compiler) |
|---|---|---|
| 298.2 | $6.61 \times 10^3$ | 0.115 |
| 317.2 | $8.32 \times 10^3$ | 0.0913 |
| 338.2 | $12.4 \times 10^3$ | 0.0613 |

The Henry's law constant, $H$, was taken to be the slope of a plot of pressure of $Cl_2$ in the gas phase against mole fraction of $Cl_2$ in the liquid phase. The author has given the following equation:

$$\log_{10}H = 6.0234 - 659.8/(T/K)$$

The compiler has calculated that the experimental values of $H$ quoted above fit this equation with a standard deviation of $0.54 \times 10^3$.

The heat of solution of chlorine, calculated by the author from the variation of $H$ with temperature, is -3.01 kcal $mol^{-1}$.

760 mmHg = 1 atm
1 atm = $1.013 \times 10^5$ Pascal

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The absorption of chlorine at partial pressures up to 1 atm was determined by passing mixtures of chlorine and air into chlorobenzene in an absorption vessel. The apparatus is described in ref. (1). Temperatures were controlled to ± 0.5 K. The chlorine content of the gas phase and the liquid phase were determined by iodometry.

SOURCE AND PURITY OF MATERIALS:

1. $Cl_2$ & air: dried with concentrated $H_2SO_4$.
2. $C_6H_5Cl$: distilled before use.

ESTIMATED ERROR:

REFERENCES:

1. Balej, J.; Regner, A.
*Chem. Listy* 1956, *50*, 1374.

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. Chlorobenzene; $C_6H_5Cl$; [108-90-7]

ORIGINAL MEASUREMENTS:

Zetkin, V.I.; Kosorotov, V.I.; Stul, B.Ya.; Dzhagatspanyan, R.V.;

*Khim. Prom.* 1971, *47*, 102-103.

VARIABLES:

Temperature

PREPARED BY:

P.G.T. Fogg.

EXPERIMENTAL VALUES:

| T/K | $x_{Cl_2}$ |
|---|---|
| 283.2 | 0.250 |
| 293.2 | 0.178 |
| 303.2 | 0.141 |
| 313.2 | 0.112 |
| 323.2 | 0.079 |
| 333.2 | 0.071 |

The pressure of $Cl_2$ plus $C_6H_5Cl$ was apparently equal to barometric pressure.

The following equation was given :

$$\log_{10} x_{Cl_2} = 980/(T/K) - 4.08$$

The heat of solution of $Cl_2$ calculated from the variation of solubility with temperature was given as - 4500 cal $mol^{-1}$.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The method and apparatus were described in ref. (1). Chlorine was bubbled through a measured quantity of chlorobenzene in a thermostatted vessel of capacity 100 $cm^3$. Samples were withdrawn periodically for iodometric analysis until consistent results were obtained.

SOURCE AND PURITY OF MATERIALS:

$Cl_2$ : to USSR standard GOST 6718-53 Dried by passing through $H_2SO_4$.

$C_6H_5Cl$:99% pure. Dried with $CaCl_2$.

ESTIMATED ERROR:

REFERENCES:

1. Zetkin, V.I.; et al.; *Zh. Fiz. Khim.* 1970, *44*, 830

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. Chlorobenzene; $C_6H_5Cl$; [108-90-7]

ORIGINAL MEASUREMENTS:

Krentsel, L. B.; Litmanovich, A. D.; Shtern, V. Ya.

*Zh. Prik. Khim. (Leningrad)* 1972, *45*, 1875-1876.

VARIABLES:

Pressure, temperature

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

| T/K | $H$/mmHg | Mole fraction, $x_{Cl_2}$ (1 atm) (calculated by compiler) |
|---|---|---|
| 313.2 | $7.6\times10^3$ | 0.100 |
| 323.2 | $9.3\times10^3$ | 0.082 |
| 333.2 | $11.4\times10^3$ | 0.067 |
| 343.2 | $13.5\times10^3$ | 0.056 |

760 mmHg = 1 atm
1 atm = $1.013 \times 10^5$ Pascal

The Henry's law constant, $H$, was taken to be the slope of a plot of pressure of $Cl_2$ in the gas phase against mole fraction of $Cl_2$ in the liquid phase. The authors stated that values fit the equation:

$$\log_{10}H = 6.83 - 925/(T/K)).$$

The compiler has calculated that the values of $H$ which have been given fit this equation with a standard deviation of $0.09 \times 10^3$.

The heat of solution of chlorine in chlorobenzene, calculated by the authors from the variation of $H$ with T, was given as -4.3 kcal mol$^{-1}$.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

A high vacuum assembly was used. The amount of chlorine dissolved by a measured volume of chlorobenzene was calculated from the decrease in pressure of a known volume of chlorine. Pressures were measured by a mercury manometer but direct contact between mercury and chlorine was prevented by the use of a glass Bourdon type gauge as a null instrument. Benzoquinone (0.1 wt-%) was added to the chlorobenzene and experiments were conducted in a darkened room.

The authors stated that reproducible results were obtained and that this was evidence that there was no irreversible reaction between chlorine and chlorobenzene under the conditions of the experiment.

SOURCE AND PURITY OF MATERIALS:

1. $Cl_2$: condensed and degassed under vacuum.

2. $C_6H_5Cl$: degassed under vacuum; vapor pressure agreed with literature values in ref. (1).

ESTIMATED ERROR:

REFERENCES:

1. Stull, D. R. *Vapor Pressures of Pure Substances* (Russian translation), *Izd. Inostr. Lit.* 1949.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. (Trifluoromethyl)benzene; (Benzotrifluoride); $C_7H_5F_3$; [98-08-8] | Ushakov, A.A.; Kosorotov, V.I.; Stul, B. Ya.; Motsarev, G.V.; Dzhagatspanyan, R.V.<br>*Zhur. Prikl. Khim.* 1977, *50*, 425-7. |
| VARIABLES:<br>Temperature | PREPARED BY:<br>C.L. Young |

EXPERIMENTAL VALUES:

| T/K | Mole ratio solubility | Wt. % solubility g $Cl_2$/g $C_7H_5F_3$ | Mole fraction of chlorine in liquid, $x_{Cl_2}$ + |
|---|---|---|---|
| 279 | 0.2550 | 12.40 | 0.2035 |
| 298 | 0.1406 | 6.84 | 0.1235 |
| 313 | 0.0896 | 4.36 | 0.0824 |
| 323 | 0.0646 | 3.14 | 0.0608 |
| 333 | 0.0489 | 2.38 | 0.0468 |
| 353 | 0.0276 | 1.30 | 0.0261 |

\+ calculated by compiler

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solvent saturated with gas by bubbling chlorine through at a rate of 0.3 mol $h^{-1}$. Samples withdrawn and concentration of chlorine determined by iodometric titration.

SOURCE AND PURITY OF MATERIALS:

1. Dried with sulfuric acid and calcium chloride.
2. Distilled, purity not less than 99.5 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.3$; $\delta x_{Cl_2} = \pm 2\%$.

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. (Trichloromethyl)benzene; $C_7H_5Cl_3$; [98-07-7]

ORIGINAL MEASUREMENTS:

Egunov, A. V.; Konobeev, B. I.; Ryabov, E. A.; Gubanova, T. I.

*Zh. Prik. Khim. (Leningrad)* 1973, *46*, 1855-1856.

VARIABLES:

Temperature

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

| T/K | Mole fraction, $x_{Cl_2}$ |
|---|---|
| 303.2 | 0.124 |
| 313.2 | 0.105 |
| 323.2 | 0.084 |
| 333.2 | 0.071 |
| 343.2 | 0.060 |
| 353.2 | 0.050 |
| 363.2 | 0.047 |
| 373.2 | 0.035 |
| 393.2 | 0.022 |
| 423.2 | 0.014 |

The partial pressure of chlorine plus the partial pressure of benzotrichloride was apparently equal to barometric pressure (unspecified).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine was bubbled through a weighed portion of the solvent (15-20 g) until a differential manometer registered no pressure drop when the chlorine supply was discontinued. The chlorine absorbed was found from the increase in weight of the solution. Loss of solvent in the gas stream was shown to be negligible in comparison with other experimental errors which the authors estimate to be ± 5%. Light was excluded. Products of further chlorination were estimated by gas chromatography and appropriate corrections made.

SOURCE AND PURITY OF MATERIALS:

1. $Cl_2$: from a cylinder; dried over $H_2SO_4$.

2. $C_7H_5Cl_3$: "pure" grade.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. (Dichloromethyl)benzene; $C_7H_6Cl_2$; [98-87-3]

ORIGINAL MEASUREMENTS:

Egunov, A. V.; Konobeev, B. I.; Ryabov, E. A.; Gubanova, T. I.

*Zh. Prik. Khim. (Leningrad)* 1973, *46*, 1855-1856.

VARIABLES:

Temperature

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

| T/K | Mole fraction, $x_{Cl_2}$ |
|---|---|
| 303.2 | 0.124 |
| 313.2 | 0.107 |
| 323.2 | 0.089 |
| 333.2 | 0.072 |
| 343.2 | 0.067 |
| 353.2 | 0.053 |
| 363.2 | 0.045 |
| 373.2 | 0.034 |
| 383.2 | 0.029 |
| 403.2 | 0.020 |

The partial pressure of chlorine plus partial pressure of benzal· chloride was apparently equal to barometric pressure (unspecified).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine was bubbled through a weighed portion of the solvent (15-20 g) until a differential manometer registered no pressure drop when the chlorine supply was discontinued. The chlorine absorbed was found from the increase in weight of the solution. Loss of solvent in the gas stream was shown to be negliglble in comparison with other experimental errors which the authors estimate to be ± 5%. Light was excluded. Products of further chlorination were estimated by gas chromatography and appropriate corrections made.

SOURCE AND PURITY OF MATERIALS:

1. $Cl_2$: from a cylinder; dried over $H_2SO_4$.

2. $C_7H_6Cl_2$: by fractionation of products of chlorination of toluene; contained 1.2 wt-% of benzotrichloride.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. (Chloromethyl)benzene; $C_7H_7Cl$; [100-44-7]

ORIGINAL MEASUREMENTS:

Egunov, A. V.; Konobeev, B. I.; Ryabov, E. A.; Gubanova, T. I.

*Zh. Prik. Khim. (Leningrad)* 1973, *46*, 1855-1856.

VARIABLES:

Temperature

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

| T/K | Mole fraction, $x_{Cl_2}$ |
|---|---|
| 303.2 | 0.125 |
| 313.2 | 0.108 |
| 323.2 | 0.087 |
| 333.2 | 0.074 |
| 343.2 | 0.062 |
| 353.2 | 0.052 |
| 363.2 | 0.044 |
| 373.2 | 0.037 |
| 383.2 | 0.027 |

The partial pressure of chlorine plus the partial pressure of benzyl chloride was apparently equal to barometric pressure (unspecified).

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine was bubbled through a weighed portion of the solvent (15-20 g) until a differential manometer registered no pressure drop when the chlorine supply was discontinued. The chlorine absorbed was found from the increase in weight of the solution. Loss of solvent in the gas stream was shown to be negligible in comparison with other experimental errors which the authors estimate to be ± 5%. Light was excluded. Products of further chlorination were estimated by gas chromatography and appropriate corrections made during calculation of solubility.

SOURCE AND PURITY OF MATERIALS:

1. $Cl_2$: from a cylinder; dried over $H_2SO_4$.

2. $C_7H_7Cl$ : "pure" grade.

ESTIMATED ERROR:

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. 1-Chloro-2-methylbenzene (2-Chlorotoluene); $C_7H_7Cl$; [95-49-8] | Lohse, M.; Deckwer, W.-D.<br>*J. Chem. Eng. Data*<br>1981, *26*, 159-161. |
| VARIABLES: | PREPARED BY: |
| Temperature | C. L. Young |

EXPERIMENTAL VALUES:

| T/K | Solubility[§], $S$/mol $dm^{-3}$ (soln.) |
|---|---|
| 288.15 | 2.306 |
| 298.15 | 1.745 |
| 308.15 | 1.311 |
| 318.15 | 1.036 |
| 328.15 | 0.842 |
| 338.15 | 0.674 |
| 348.15 | 0.547 |

[§] at a partial pressure of 101.3 kPa.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solvent saturated with chlorine in dark (∿1% phenol added to prevent photochemical chlorination). Samples withdrawn added to known amount of additional solvent and then 250 $cm^3$ of potassium iodide solution. Released iodine titrated with thiosulfate.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta S = \pm 3\%$
(estimated by compiler).

REFERENCES:

| | |
|---|---|
| COMPONENTS:<br>1. Chlorine; $Cl_2$; [7782-50-5]<br>2. 1-Chloro-3-methylbenzene (3-Chlorotoluene); $C_7H_7Cl$; [108-41-8] | ORIGINAL MEASUREMENTS:<br>Lohse, M.; Deckwer, W.-D.<br>*J. Chem. Eng. Data*<br>1981, *26*, 159-161. |
| VARIABLES:<br>Temperature | PREPARED BY:<br>C. L. Young |

EXPERIMENTAL VALUES:

| T/K | Solubility§, *S*/mol $dm^{-3}$ (soln.) |
|---|---|
| 298.15 | 1.398 |
| 308.15 | 1.180 |
| 318.15 | 0.940 |
| 338.15 | 0.624 |
| 348.15 | 0.499 |

§ at a partial pressure of 101.3 kPa.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solvent saturated with chlorine in dark (∿1% phenol added to prevent photochemical chlorination). Samples withdrawn added to known amount of additional solvent and then 250 $cm^3$ of potassium iodide solution. Released iodine titrated with thiosulfate.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta S = \pm 3\%$ (estimated by compiler).

REFERENCES:

| | |
|---|---|
| COMPONENTS:<br>1. Chlorine; $Cl_2$; [7782-50-5]<br>2. 1-Chloro-4-methylbenzene (4-Chlorotoluene); $C_7H_7Cl$; [106-43-4] | ORIGINAL MEASUREMENTS:<br>Lohse, M.; Deckwer, W.-D.<br>*J. Chem. Eng. Data*<br>1981, *26*, 159-161. |
| VARIABLES:<br>Temperature | PREPARED BY:<br>C. L. Young |

EXPERIMENTAL VALUES:

| T/K | Solubility[§] $S$/mol dm$^{-3}$ (soln.) |
|---|---|
| 298.15 | 1.386 |
| 318.15 | 0.884 |
| 328.15 | 0.741 |
| 338.15 | 0.552 |
| 348.15 | 0.479 |

[§] at a partial pressure of 101.3 KPa.

AUXILIARY INFORMATION

| | |
|---|---|
| METHOD/APPARATUS/PROCEDURE:<br>Solvent saturated with chlorine in dark (∿1% phenol added to prevent photochemical chlorination). Samples withdrawn added to known amount of additional solvent and then 250 cm$^3$ of potassium iodide solution. Released iodine titrated with thiosulfate. | SOURCE AND PURITY OF MATERIALS:<br>No details given.<br>ESTIMATED ERROR:<br>δT/K = ±0.1; δ$S$ = ±3% (estimated by compiler).<br>REFERENCES: |

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. (Trifluoromethyl) benzene, (Benzotrifluoride); $C_7H_5F_3$; [98-08-8]
3. Chloro(trifluoromethyl)benzene; $C_7H_4Cl_3F$; [52181-51-8]
4. Dichloro(trifluoromethyl)benzene; $C_7H_3Cl_2F_3$;

ORIGINAL MEASUREMENTS:

Ushakov, A.A.; Kosorotov, V.I.
Stul, B. Ya., Motsarev, G.V.;
Dzhagatspanyan, R.V.

*Zhur. Prikl. Khim.* 1977, *50*, 425-7

VARIABLES:

Temperature, composition

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

Mixture containing 58.29 Wt % $C_7H_5F_3$, 39.47 Wt % $C_7H_4ClF_3$ and 2.24 Wt % $C_7H_3Cl_2F_3$.

| T/K | Mole ratio solubility | Wt. % solubility g $Cl_2$/100g(2+3+4) | Mole fraction of chlorine in liquid, $x_{Cl_2}$ + |
|---|---|---|---|
| 298 | 0.1543 | 6.80 | 0.1325 |
| 313 | 0.1040 | 4.58 | 0.0933 |
| 323 | 0.0799 | 3.52 | 0.0733 |
| 333 | 0.0604 | 2.66 | 0.0563 |
| 353 | 0.0381 | 1.68 | 0.0363 |

Mixture containing 22.82 Wt % $C_7H_5F_3$, 60.86 Wt % $C_7H_4ClF_3$, and 16.32 Wt % $C_7H_3Cl_2F_3$.

| T/K | Mole ratio solubility | Wt. % solubility g $Cl_2$/100g(2+3+4) | Mole fraction of chlorine in liquid, $x_{Cl_2}$ + |
|---|---|---|---|
| 298 | 0.1727 | 6.88 | 0.1457 |
| 313 | 0.1255 | 5.00 | 0.1102 |
| 323 | 0.1024 | 4.08 | 0.0918 |
| 333 | 0.0833 | 3.32 | 0.0760 |
| 353 | 0.0587 | 2.20 | 0.0517 |

+ calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solvent saturated with gas by bubbling chlorine through at a rate of 0.3 mol $h^{-1}$. Samples withdrawn and concentration of chlorine determined by iodometric titration.

SOURCE AND PURITY OF MATERIALS:

1. Dried with sulfuric acid and calcium chloride.
2. Distilled, purity not less than 99.5 mole per cent.
3. and 4. Prepared by chlorination of benzotrifluoride in presence of ferric chloride at 60°C.

ESTIMATED ERROR:

$\delta T/K = \pm 0.3$; $\delta x_{Cl_2} = \pm 2\%$.

(estimated by compiler).

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. (Trifluoromethyl)benzene; (Benzotrifluoride); $C_7H_5F_3$; [98-08-8]
3. Chloro(trifluoromethyl)benzene; $C_7H_4ClF_3$

ORIGINAL MEASUREMENTS:

Ushakov, A.A.; Kosorotov, V.I.; Stul, B.Ya.; Motsarev, G.V. Dzhagatspanyan, R.V.

*Zhur. Prikl. Khim.* 1977, *50*, 425-7.

VARIABLES:

Temperature

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

Mixture containing 84.84 weight percent of benzotrifluoride before passage of chlorine

| T/K | Mole ratio solubility | Wt. % solubility g $Cl_2$/g (2+3) | Mole fraction of chlorine in liquid, $x_{Cl_2}$ + |
|---|---|---|---|
| 298 | 0.1340 | 6.60 | 0.1229 |
| 313 | 0.0870 | 4.58 | 0.0886 |
| 323 | 0.0660 | 3.62 | 0.0713 |
| 333 | 0.0510 | 2.80 | 0.0561 |
| 353 | 0.0324 | 1.70 | 0.0348 |

\+ calculated by compiler

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Solvent saturated with gas by bubbling chlorine through at a rate of 0.3 mol $h^{-1}$. Samples withdrawn and concentration of chlorine determined by iodometric titration.

SOURCE AND PURITY OF MATERIALS:

1. Dried with sulfuric acid and calcium chloride.
2. Distilled, purity not less than 99.5 mole per cent.
3. Prepared by chlorination of benzotrifluoride in presence of ferric chloride at 60°C.

ESTIMATED ERROR:

$\delta T/K = \pm 0.3$; $\delta x_{Cl_2} = \pm 2\%$.

(estimated by compiler)

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. 3,4,5-Trichloro-2-(trichloromethyl)-pyridine; $C_6HCl_6N$; [1201-30-5] | Kosorotov, V. I.; Stul, B. Ya.; Dzhagatspanyan, R. V.<br>*Zh. Prikl. Khim.* 1978, *51*, 887-889 (*J. Appl. Chem. USSR* 1978, *51*, 858-860). |
| VARIABLES: | PREPARED BY: |
| Temperature | C. L. Young |

EXPERIMENTAL VALUES:

Pressure, $p$ = 101.3 kPa

| T/K | Solubility, $S$/mol dm$^{-3}$ |
|---|---|
| 378.2 | 0.21 |
| 393.2 | 0.17 |
| 408.2 | 0.13 |
| 423.2 | 0.11 |
| 473.2 | 0.056 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine was bubbled through the liquid until equilibrium was attained at a total pressure equal to the barometric pressure. The results were corrected to 101.3 kPa pressure. The chlorine in solution was determined by iodometry. Reaction of chlorine and solvent was minimised by 0.2 mole per cent phenol.

SOURCE AND PURITY OF MATERIALS:

1. No details given.

2. Purity 95-99 mole per cent as determined by chromatography. 0.2 mole per cent phenol added as a chlorination inhibitor.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta S/S = \pm 0.07$.

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. 3,4,5-Trichloro-2-(dichloromethyl)pyridine; $C_6H_2Cl_5N$; [7041-22-7]

ORIGINAL MEASUREMENTS:

Kosorotov, V. I.; Stul, B. Ya.; Dzhagatspanyan, R. V.
*Zh. Prikl. Khim.* 1978, *51*, 887-889
(*J. Appl. Chem. USSR* 1978, *51*, 858-860).

VARIABLES:

Temperature

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

Pressure, $p$ = 101.3 kPa

| T/K | Solubility, $S$/mol $dm^{-3}$ |
|---|---|
| 333.2 | 0.51 |
| 363.2 | 0.26 |
| 378.2 | 0.19 |
| 408.2 | 0.12 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine was bubbled through the liquid until equilibrium was attained at a total pressure equal to the barometric pressure. The results were corrected to 101.3 kPa pressure. The chlorine in solution was determined by iodometry. Reaction of chlorine and solvent was minimised by 0.2 mole per cent phenol.

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. Purity 95-99 mole per cent as determined by chromatography. 0.2 mole per cent phenol added as a chlorination inhibitor.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta S/S = \pm 0.05$.

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. 3,5-Dichloro-2-(trichloromethyl)-pyridine; $C_6H_2Cl_5N$; [1128-16-1]

ORIGINAL MEASUREMENTS:

Kosorotov, V. I.; Stul, B. Ya.; Dzhagatspanyan, R. V.
*Zh. Prikl. Khim.* 1978, *51*, 887-889
(*J. Appl. Chem. USSR* 1978, *51*, 858-860).

VARIABLES:

Temperature

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

Pressure, $p$ = 101.3 kPa

| T/K | Solubility, $S$/mol dm$^{-3}$ |
|---|---|
| 333.2 | 0.50 |
| 363.2 | 0.26 |
| 393.2 | 0.15 |
| 423.2 | 0.10 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine was bubbled through the liquid until equilibrium was attained at a total pressure equal to the barometric pressure. The results were corrected to 101.3 kPa pressure. The chlorine in solution was determined by iodometry. Reaction of chlorine and solvent was minimised by 0.2 mole per cent phenol.

SOURCE AND PURITY OF MATERIALS:

1. No details given.

2. Purity 95-99 mole per cent as determined by chromatography. 0.2 mole per cent phenol added as a chlorination inhibitor.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta S/S = \pm 0.05$.

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. 1,2-Dichloro-4-nitrobenzene; $C_6H_3Cl_2NO_2$; [99-54-7]

ORIGINAL MEASUREMENTS:

Zetkin, V.I.; Kolesnikov, I.M.
Zakharov, E.V.; Dzhagatspanyan, R.V.

*Khim. Prom.* 1966, *42*, 624-626.

VARIABLES:

Temperature

PREPARED BY:

P.G.T. Fogg

EXPERIMENTAL VALUES:

| T/K | $mol_{Cl_2}/mol_{C_6H_3Cl_2NO_2}$ | $g_{Cl_2}/100g_{C_6H_3Cl_2NO_2}$ | Mole fraction* $x_{Cl_2}$ |
|---|---|---|---|
| 333 | 0.0517 | 1.911 | 0.0492 |
| 353 | 0.0363 | 1.342 | 0.0351 |
| 373 | 0.0258 | 0.954 | 0.0252 |
| 393 | 0.0188 | 0.695 | 0.0185 |
| 413 | 0.0146 | 0.540 | 0.0144 |
| 433 | 0.0114 | 0.421 | 0.0113 |

The total pressure was apparently equal to barometric pressure (unspecified).

The heat of solution of $Cl_2$, calculated from the variation of solubility with temperature, was given by the authors as - 4340 cal $mol^{-1}$.

* Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine was bubbled through the solvent in a thermostatted vessel of capacity 100 $cm^3$. Samples were withdrawn periodically for iodometric analysis until consistent results were obtained.

SOURCE AND PURITY OF MATERIALS:

$Cl_2$ : to USSR standard GOST 6718-53

$C_6H_3Cl_2NO_2$: prepared by chlorination of 1-chloro-4-nitrobenzene; recrystallised before use.

ESTIMATED ERROR:

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. 1,4-Dichloro-2-nitrobenzene; $C_6H_3Cl_2NO_2$; [89-61-2] | Zetkin, V.I.; Kolesnikov, I.M.; Zakharov, E.V.; Dzhagatspanyan, R.V.<br>*Khim. Prom.* <u>1966</u>, *42*, 624-626. |
| VARIABLES:<br>Temperature | PREPARED BY:<br>P.G.T. Fogg |

EXPERIMENTAL VALUES:

| T/K | $mol_{Cl_2}/mol_{C_6H_3Cl_2NO_2}$ | $g_{Cl_2}/100g_{C_6H_3Cl_2NO_2}$ | Mole fraction* $x_{Cl_2}$ |
|---|---|---|---|
| 333 | 0.0675 | 2.495 | 0.0632 |
| 353 | 0.0463 | 1.712 | 0.0443 |
| 373 | 0.0316 | 1.168 | 0.0306 |
| 393 | 0.0233 | 0.861 | 0.0228 |
| 413 | 0.0177 | 0.654 | 0.0174 |
| 433 | 0.0137 | 0.506 | 0.0135 |

The total pressure was apparently equal to barometric pressure (unspecified).

The heat of solution of $Cl_2$ , calculated from the variation of solubility with temperature, was given by the authors as - 4580 cal $mol^{-1}$.

* Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine was bubbled through the solvent in a thermostatted vessel of capacity 100 $cm^3$. Samples were withdrawn periodically for iodometric analysis until consistent results were obtained.

SOURCE AND PURITY OF MATERIALS:

| | |
|---|---|
| $Cl_2$ | : to USSR standard GOST 6718-53. Dried with $H_2SO_4$ and with $CaCl_2$. |
| $C_6H_3Cl_2NO_2$ | : to standard TU GAP-U 539-54. Recrystallised before use. |

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. 2-Chloro-6-(trichloromethyl)-pyridine; $C_6H_3Cl_4N$; [1929-82-4]

ORIGINAL MEASUREMENTS:

Kosorotov, V. I.; Stul, B. Ya.; Dzhagatspanyan, R. V.
*Zh. Prikl. Khim.* 1978, *51*, 887-889 (*J. Appl. Chem. USSR* 1978, *51*, 858-860).

VARIABLES:

Temperature

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

Pressure, $p$ = 101.3 kPa

| T/K | Solubility, $S$/mol dm$^{-3}$ |
|---|---|
| 363.2 | 0.13 |
| 393.2 | 0.10 |
| 423.2 | 0.08 |
| 443.2 | 0.066 |
| 473.2 | 0.05 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine was bubbled through the liquid until equilibrium was attained at a total pressure equal to the barometric pressure. The results were corrected to 101.3 kPa pressure. The chlorine in solution was determined by iodometry. Reaction of chlorine and solvent was minimised by 0.2 mole per cent phenol.

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. Purity 95-99 mole per cent as determined by chromatography. 0.2 mole per cent phenol added as a chlorination inhibitor.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta S/S = \pm 0.07$.

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. 5-Chloro-2-(trichloromethyl)-pyridine; $C_6H_3Cl_4N$; [1197-03-1]
3. 3,5-Dichloro-2-(dichloromethyl)-pyridine; $C_6H_3Cl_4N$; [7041-25-0]

ORIGINAL MEASUREMENTS:

Kosorotov, V. I.; Stul, B. Ya.; Dzhagatspanyan, R. V.

*Zh. Prikl. Khim.* 1978, *51*, 887-889 (*J. Appl. Chem. USSR* 1978, *51*, 858-860).

VARIABLES:

Temperature

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

Pressure, $p$ = 101.3 kPa

| T/K | Solubility, $S$/mol dm$^{-3}$ |
|---|---|
| 333.2 | 0.57 |
| 363.2 | 0.36 |
| 393.2 | 0.26 |
| 423.2 | 0.17 |
| 443.2 | 0.12 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine was bubbled through the liquid until equilibrium was attained at a total pressure equal to the barometric pressure. The results were corrected to 101.3 kPa pressure. The chlorine in solution was determined by iodometry. Reaction of chlorine and solvent was minimised by 0.2 mole per cent phenol.

SOURCE AND PURITY OF MATERIALS:

1. No details given.
2. Purity 95-99 mole per cent as determined by chromatography. 0.2 mole per cent phenol added as a chlorination inhibitor.
3. As in 2 above.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta S/S = \pm 0.05$.

REFERENCES:

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| 1. Chlorine; $Cl_2$; [7782-50-5]<br>2. 1-Chloro-2-nitrobenzene; $C_6H_4ClNO_2$; [88-73-3] | Zetkin, V.I.; Kolesnikov, I.M.; Zakharov, E.V.; Dzhagatspanyan, R.V.<br>*Khim. Prom.* 1966, *42*, 624-626. |
| VARIABLES: | PREPARED BY: |
| Temperature | P.G.T. Fogg |

EXPERIMENTAL VALUES:

| T/K | $mol_{Cl_2}/mol_{C_6H_4ClNO_2}$ | $g_{Cl_2}/100g_{C_6H_4ClNO_2}$ | Mole fraction* $x_{Cl_2}$ |
|---|---|---|---|
| 313 | 0.0732 | 3.298 | 0.0682 |
| 333 | 0.0482 | 2.172 | 0.0460 |
| 353 | 0.0337 | 1.518 | 0.0326 |
| 373 | 0.0231 | 1.041 | 0.0226 |
| 393 | 0.0176 | 0.793 | 0.0173 |
| 413 | 0.0134 | 0.604 | 0.0132 |
| 433 | 0.0106 | 0.478 | 0.0105 |

The total pressure was apparently equal to barometric pressure (unspecified).

The heat of solution of $Cl_2$ calculated from the variation of solubility with temperature was given by the authors as - 4340 cal $mol^{-1}$.

* Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine was bubbled through the solvent in a thermostatted vessel of capacity 100 $cm^3$. Samples were withdrawn periodically for iodometric analysis until consistent results were obtained.

SOURCE AND PURITY OF MATERIALS:

| | |
|---|---|
| $Cl_2$ | : to USSR standard GOST 6718-53. Dried with $H_2SO_4$ and with $CaCl_2$. |
| $C_6H_4ClNO_2$ | : to standard TU GAP-U 451-53. Recrystallised before use. |

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. 1-Chloro-3-nitrobenzene; $C_6H_4ClNO_2$; [121-73-3]

ORIGINAL MEASUREMENTS:

Zetkin, V.I.; Kolesnikov, I.M.; Zakharov, E.V.; Dzhagatspanyan, R.V.

*Khim. Prom.* 1966, *42*, 624-626.

VARIABLES:

Temperature

PREPARED BY:

P.G.T. Fogg

EXPERIMENTAL VALUES:

| T/K | $mol_{Cl_2}/mol_{C_6H_4ClNO_2}$ | $g_{Cl_2}/100g_{C_6H_4ClNO_2}$ | Mole fraction* $x_{Cl_2}$ |
|---|---|---|---|
| 333 | 0.0468 | 2.109 | 0.0447 |
| 353 | 0.0321 | 1.446 | 0.0311 |
| 373 | 0.0219 | 0.987 | 0.0214 |
| 393 | 0.0157 | 0.707 | 0.0154 |
| 413 | 0.0117 | 0.527 | 0.0116 |
| 433 | 0.0091 | 0.410 | 0.0090 |

The total pressure was apparently equal to barometric pressure (unspecified).

The heat of solution of $Cl_2$ calculated from the variation of solubility with temperature was given by the authors as - 4700 cal $mol^{-1}$.

* Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine was bubbled through the solvent in a thermostatted vessel of capacity 100 $cm^3$. Samples were withdrawn periodically for iodometric analysis until consistent results were obtained.

SOURCE AND PURITY OF MATERIALS:

$Cl_2$ : to USSR standard GOST 6718-53. Dried with $H_2SO_4$ and with $CaCl_2$.

$C_6H_4ClNO_2$: prepared by chlorination of nitrobenzene. Purified by crystallisation.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. 1-Chloro-4-nitrobenzene; $C_6H_4ClNO_2$; [100-00-5]

ORIGINAL MEASUREMENTS:

Zetkin, V.I. Kolesnikov, I.M.; Zakharov, E.V.; Dzhagatspanyan, R.V.;

*Khim. Prom.* 1966, *42*, 624-626.

VARIABLES:

Temperature

PREPARED BY:

P.G.T. Fogg

EXPERIMENTAL VALUES:

| T/K | $mol_{Cl_2}/mol_{C_6H_4ClNO_2}$ | $g_{Cl_2}/100g_{C_6H_4ClNO_2}$ | Mole fraction* $x_{Cl_2}$ |
|---|---|---|---|
| 373 | 0.0274 | 1.235 | 0.0267 |
| 393 | 0.0185 | 0.834 | 0.0182 |
| 413 | 0.0132 | 0.595 | 0.0130 |
| 433 | 0.0097 | 0.437 | 0.0096 |

The total pressure was apparently equal to barometric pressure (unspecified).

The heat of solution of $Cl_2$ calculated from the variation of solubility with temperature was given by the authors as - 5560 cal $mol^{-1}$.

* Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine was bubbled through the solvent in a thermostatted vessel of capacity 100 $cm^3$. Samples were withdrawn periodically for iodometric analysis until consistent results were obtained.

SOURCE AND PURITY OF MATERIALS:

$Cl_2$ : to USSR standard GOST 6718-53. Dried with $H_2SO_4$ and with $CaCl_2$.

$C_6H_4ClNO_2$: to standard TU 9728-61. Recrystallised before use.

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. 2-(Trichloromethyl)-pyridine; $C_6H_4Cl_3N$; [4377-37-1]

ORIGINAL MEASUREMENTS:

Kosorotov, V.I.; Stul, B. Ya.; Dzhagatspanyan, R. V.

*Zh. Prikl. Khim.* 1978, *51*, 887-889 (*J. Appl. Chem. USSR* 1978, *51*, 858-860).

VARIABLES:

Temperature

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

Pressure, $p$ = 101.3 kPa

| T/K | Solubility, $S$/mol $dm^{-3}$ |
|---|---|
| 333.2 | 0.63 |
| 363.2 | 0.38 |
| 393.2 | 0.26 |
| 423.2 | 0.19 |
| 443.2 | 0.15 |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine was bubbled through the liquid until equilibrium was attained at a total pressure equal to the barometric pressure. The results were corrected to 101.3 kPa pressure. The chlorine in solution was determined by iodometry. Reaction of chlorine and solvent was minimised by 0.2 mole per cent phenol.

SOURCE AND PURITY OF MATERIALS:

1. No details given.

2. Purity 95-99 mole per cent as determined by chromatography. 0.2 mole per cent phenol added as a chlorination inhibitor.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta S/S = \pm 0.05$.

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. Dichlorodioxochromium; $Cl_2CrO_2$; [14977-61-8]

ORIGINAL MEASUREMENTS:

Roozeboom, H.W.B.;

*Rec. Trav. Chim.* 1885, *4*, 379-381.

VARIABLES:

Temperature, concentration

PREPARED BY:

P.G.T. Fogg.

EXPERIMENTAL VALUES:

| T/K | Quantity of chlorine *en atomes.* | $p_{Cl_2}$/mmHg | Mole fraction* $Cl_2$ |
|---|---|---|---|
| 273.2 | 1.70 | 1302 | 0.459 |
| 273.2 | 1.43 | 1208 | 0.417 |
| 273.2 | 1.40 | 1198 | 0.412 |
| 273.2 | 1.35 | 1189 | 0.403 |
| 273.2 | 1.30 | 1150 | 0.394 |
| 273.2 | 1.25 | 1125 | 0.385 |
| 273.2 | 1.20 | 1101 | 0.375 |
| 273.2 | 1.16 | 1069 | 0.367 |
| 273.2 | 1.12 | 1051 | 0.359 |
| 273.2 | 1.04 | 1016 | 0.342 |
| 273.2 | 1.00 | 984 | 0.333 |
| 273.2 | 0.91 | 923 | 0.313 |
| 273.2 | 0.78 | 824 | 0.281 |
| 273.2 | 0.68 | 753 | 0.254 |
| 247.2 | 3.08 | 765 | 0.606 |
| 249.2 | 3.08 | 791 | 0.606 |
| 251.2 | 3.08 | 844 | 0.606 |
| 251.2 | 2.77 | 820 | 0.581 |
| 251.2 | 2.31 | 734 | 0.536 |
| 253.2 | 3.08 | 896 | 0.606 |
| 253.2 | 2.77 | 862 | 0.581 |
| 253.2 | 2.31 | 780 | 0.536 |
| 255.2 | 2.77 | 905 | 0.581 |
| 255.2 | 2.31 | 831 | 0.536 |
| 257.2 | 2.00 | 851 | 0.500 |
| 258.2 | 2.77 | 1002 | 0.581 |

AUXILIARY INFORMATION

METHOD APPARATUS/PROCEDURE:

The pressure over a known weight of $Cl_2$ dissolved in a known weight of $Cl_2CrO_2$ in a small bulb at 247.2K to 273.2K was measured by a mercury manometer in which the mercury was protected by sulphuric acid. The concentration of $Cl_2$ was changed by removing gas through a side tap and collecting it over brine saturated with chlorine. The weight of $Cl_2$ removed, and the weight remaining in the flask, were calculated from the volume of gas collected. No allowance was made for the vapor pressure of $Cl_2CrO_2$.

SOURCE AND PURITY OF MATERIALS:

$Cl_2$ : not specified.

$Cl_2CrCO_2$: fractionally distilled under dry $CO_2$; b.p.117°C (barometric pressure unspecified.)

ESTIMATED ERROR:

REFERENCES:

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. Dichlorodioxochromium; $Cl_2CrO_2$; [14977-61-8]

ORIGINAL MEASUREMENTS:

Roozeboom, H.W.B.;
*Rec. Trav. Chim.* 1885, *4*, 379-381.

EXPERIMENTAL VALUES:

| T/K | Quantity of chlorine *en atomes* | $p_{Cl_2}$/mmHg | Mole fraction* $x_{Cl_2}$ |
|---|---|---|---|
| 259.2 | 2.00 | 902 | 0.500 |
| 259.2 | 1.24 | 754 | 0.383 |
| 261.2 | 2.77 | 1105 | 0.581 |
| 262.2 | 1.70 | 952 | 0.459 |
| 262.2 | 1.24 | 818 | 0.383 |
| 263.2 | 2.00 | 1015 | 0.500 |
| 264.2 | 1.70 | 995 | 0.459 |
| 264.2 | 1.24 | 870 | 0.383 |
| 265.2 | 1.39 | 930 | 0.410 |
| 266.2 | 1.39 | 948 | 0.410 |
| 266.2 | 1.24 | 921 | 0.383 |
| 268.2 | 1.24 | 975 | 0.383 |
| 270.2 | 1.24 | 1034 | 0.383 |
| 271.2 | 1.70 | 1232 | 0.459 |
| 273.2 | 1.70 | 1295 | 0.459 |
| 273.2 | 1.39 | 1185 | 0.410 |
| 273.2 | 1.24 | 1118 | 0.383 |
| 273.2 | 1.07 | 1031 | 0.349 |
| 273.2 | 0.76 | 825 | 0.275 |

760 mmHg = 1 atm; 1 atm = $1.013 \times 10^5$ Pascal.

* calculated by the compiler on the assumption that concentration *en atomes* is the ratio of atoms of dissolved chlorine to molecules of $Cl_2CrO_2$.

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]

2. Sulfuryl chloride; $Cl_2O_2S$; [7791-25-5]

ORIGINAL MEASUREMENTS:

Schulze, H.

*J. Prakt. Chem.* 1881, *24*, 168.

VARIABLES:

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

| T/K | Wt. of $Cl_2$ absorbed per unit wt. of $Cl_2O_2S$ | Vol. of $Cl_2$ absorbed per vol. of $Cl_2O_2S$ | Mole fraction,* $x_{Cl_2}$ |
|---|---|---|---|
| 273.2 | 0.136 | 71 | 0.206 |

The pressure of chlorine was apparently equal to barometric pressure (unspecified).

* Calculated by compiler.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Chlorine was bubbled through a weighed quantity of sulfuryl chloride in a stoppered cylinder fitted with inlet and outlet tube. Passage of gas was continued until bubbles of gas no longer appeared to be absorbed. The amount of chlorine absorbed was found by weighing.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

REFERENCES:

| | |
|---|---|
| COMPONENTS:<br>1. Chlorine; $Cl_2$; [7782-50-5]<br>2. Tetrachlorosilane, (Silicon tetrachloride); $SiCl_4$; [10026-04-7] | ORIGINAL MEASUREMENTS:<br>Taylor, N. W.; Hildebrand, J. H.<br>*J. Amer. Chem. Soc.* 1923, *45*, 682-694. |
| VARIABLES: | PREPARED BY:<br>P. G. T. Fogg |

EXPERIMENTAL VALUES:

| T/K | g $Cl_2$/g of solution | $p_{Cl_2}$/mmHg | Mole fractions $x_{Cl_2}$ | Mole fractions $x_{Cl_2}$(1 atm) |
|---|---|---|---|---|
| 273.16 | 0.131 | 681 | 0.266 | 0.288 |

760 mmHg = 1 atm

1 atm = $1.013 \times 10^5$ Pascal

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Saturator tube (1). Chlorine was bubbled through liquid. Samples of saturated liquid were run into a weighed flask containing aqueous KI, and iodine was titrated with standard solution of thiosulfate. Temperature control was manual to 0.1 K.
Saturation was at barometric pressure, $p_{total}$. The value of $p_{SiCl_4}$ was estimated by Raoult's law from vapor pressure data for $SiCl_4$ given in ref. (2). Hence:

$$p_{Cl_2} = p_{total} - p_{SiCl_4}$$

The authors also estimated $x_{Cl_2}$ (1 atm) from $x_{Cl_2}$ by Henry's law (mole fraction form).

SOURCE AND PURITY OF MATERIALS:

1. $Cl_2$: from an electrolytic supply; contained less than 0.1% of free acid.
2. $SiCl_4$: not specified.

ESTIMATED ERROR:

REFERENCES:

1. Bichowsky, F. R.; Storch, H. *J. Amer. Chem. Soc.* 1915, *37*, 2695.
2. Landolt Börnstein Tabellen.

COMPONENTS:

1. Chlorine; $Cl_2$; [7782-50-5]
2. Titanium chloride; $Cl_4Ti$; [7550-45-0]

ORIGINAL MEASUREMENTS:

Krieve, W. F.; Mason, D. M.

*J. Phys. Chem.* 1956, *60*, 374.

VARIABLES:

Temperature, pressure

PREPARED BY:

P. G. T. Fogg

EXPERIMENTAL VALUES:

| T/K | $p_{Cl_2}$/atm | Mole fraction $x_{Cl_2}$ | T/K | $p_{Cl_2}$/atm | Mole fraction $x_{Cl_2}$ |
|---|---|---|---|---|---|
| 293.2 | 1.50 | 0.2513 | 303.2 | 3.39 | 0.4227 |
| | 2.20 | 0.3585 | | 3.93 | 0.4844 |
| | 2.71 | 0.4358 | | 4.63 | 0.5571 |
| | 3.13 | 0.4964 | | 5.41 | 0.6412 |
| | 3.67 | 0.5674 | | 6.14 | 0.7107 |
| | 4.24 | 0.6499 | | | |
| | 4.76 | 0.7229 | | | |

The recovery of $Cl_2$ by dissolution in $Cl_4Ti$ on an industrial scale has been reported (1).

AUXILIARY INFORMATION

METHOD APPARATUS/PROCEDURE:

A known weight of chlorine, determined by the change in pressure in the bomb containing the gas, was added to a known weight of titanium tetrachloride in a second bomb. When equilibrium had been attained the pressure in the second bomb was recorded. All pressures were measured by calibrated stainless steel Bourdon gauge to ± 0.5%. Temperatures were controlled to ± 0.1 °C. Solubilities were calculated from the pressure data using published gas density data (2).

SOURCE AND PURITY OF MATERIALS:

1. $Cl_2$: A commercial sample was purified by fractional distillation to remove air and $CO_2$.
2. $TiCl_4$: from National Bureau of Standards; 99.999% pure.

ESTIMATED ERROR:

REFERENCES:

1. Anon.
*Res. Discl.* 1977, *157*, 15.
2. Hulme, R.E.; Tillman, A.B.
*Chem. Eng.* 1949, *56*, 99.

COMPONENTS:

1. Fluorine; $F_2$; [7782-41-4]
2. Hydrogen fluoride; HF; [7664-39-3]

ORIGINAL MEASUREMENTS:

Rewick, R. T.; Tolberg, W. E.; Hill, M. E.

*J. Chem. Engng. Data* 1970, *15*, 527-530.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

| T/K | Total pressure $P$/kPa | Partial pressure $P$/kPa | Conc. of fluorine /mol $kg^{-1}$ | Mole fraction of fluorine, $x_{F_2}$ * |
|---|---|---|---|---|
| 292.95 | 280.0 | 177.3 | 0.0356 | 0.000713 |
| | 538.6 | 434.6 | 0.0925 | 0.00185 |
| | 799.9 | 695.9 | 0.150 | 0.00300 |
| | 1064 | 959.9 | 0.204 | 0.00410 |
| | 1088 | 983.9 | 0.206 | 0.00414 |
| 272.94 | 364.0 | 316.0 | 0.0690 | 0.00138 |
| | 370.6 | 322.6 | 0.0697 | 0.00139 |
| | 729.3 | 681.3 | 0.148 | 0.00296 |
| | 950.6 | 903.0 | 0.196 | 0.00393 |
| | 1192 | 1144 | 0.247 | 0.00496 |
| 249.95 | 815.9 | 798.6 | 0.194 | 0.00389 |
| 207.95 | 637.3 | 634.6 | 0.187 | 0.00375 |
| 195.95 | 204.0 | 202.6 | 0.0675 | 0.00135 |
| | 209.3 | 208.0 | 0.0678 | 0.00136 |
| | 440.0 | 438.6 | 0.144 | 0.00288 |
| | 735.9 | 734.6 | 0.243 | 0.00486 |

* calculated by compiler

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell made of Monel metal. Known amounts of fluorine added to known amount of hydrogen fluoride in cell. Quantity of gas absorbed calculated from equilibrium pressure and cell volume.

SOURCE AND PURITY OF MATERIALS:

1. Purity 98 mole per cent obtained from Allied Chemical Corp. Fractionally distilled final purity better than 99 mole per cent. Major impurities nitrogen and oxygen.
2. Anhydrous sample obtained from Olin Corp. Conductivity $3 \times 10^5$ $ohm^{-1}$ $cm^{-1}$.

ESTIMATED ERROR:

$\delta T/K = \pm 0.02$; $\delta x_{F_2} = \pm 3\%$ (estimated by compiler).

REFERENCES:

COMPONENTS:

1. Chlorine monoxide; $Cl_2O$; [7791-21-1]
2. Water; $H_2O$; [7732-18-5]

ORIGINAL MEASUREMENTS:

Ourisson, M.M.J.; Kastner, M.

*Bull. Soc. Chim. France.* 1939, *6*, 1307-11.

VARIABLES:

Temperature

PREPARED BY:

R. Battino.

EXPERIMENTAL VALUES:

| T/K $^a$ | $m^b$ HOCl/mol 1000g $H_2O^{-1}$ | $P_{Cl_2}$/mm$^c$ | $P_{Cl_2O}$/mm$^d$ | T/K | $K_1$ | $K_2$ |
|---|---|---|---|---|---|---|
| 283.15 | 0.26 | 0.097 | 0.014 | 283.15 | 0.21 | 0.24 |
| | 0.57 | 0.29 | 0.068 | 293.15 | 0.65 | 0.70 |
| | 0.70 | 0.36 | 0.103 | | | |
| | 0.90 | 0.56 | 0.170 | | | |
| | 1.05 | 0.67 | 0.232 | | | |
| | 1.23 | 1.05 | 0.318 | | | |
| | 1.55 | 1.59 | 0.505 | | | |
| | 1.65 | 1.65 | 0.572 | | | |
| | 1.92 | 2.08 | 0.774 | | | |
| | 2.00 | 2.16 | 0.840 | | | |
| | 2.03 | 2.10 | 0.865 | | | |
| 293.15 | 0.148 | 0.16 | 0.014 | | | |
| | 0.149 | 0.15 | 0.014 | | | |
| | 0.178 | 0.18 | 0.021 | | | |
| | 0.175 | 0.13 | 0.020 | | | |
| | 0.189 | 0.15 | 0.023 | | | |
| | 0.222 | 0.23 | 0.032 | | | |
| | 0.287 | 0.21 | 0.054 | | | |
| | 0.287 | 0.19 | 0.023 | | | |
| | 0.327 | 0.36 | 0.070 | | | |
| | 0.545 | 0.68 | 0.19 | | | |
| | 0.553 | 0.74 | 0.20 | | | |
| | 0.641 | 1.11 | 0.27 | | | |
| | 0.651 | 1.2 | 0.28 | | | |

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

The amount of HOCl in solution is determined by chemical titration.

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

$\delta m_{HOCl}/m_{HOCl} = 0.03$.

compiler's estimate.

REFERENCES:

COMPONENTS:

1. Chlorine monoxide; $Cl_2O$;

2. Water; $H_2O$; [7732-18-5]

ORIGINAL MEASUREMENTS

Ourisson, M.M.J.; Kastner, M.

*Bull. Soc. Chim. France.* 1939, *6*, 1307-11.

EXPERIMENTAL VALUES

| T/K [a] | $m_{HOCl}$/mol 1000g $H_2O^{-1}$ | $P_{Cl_2}$/mm | $P_{Cl_2O}$/mm |
|---|---|---|---|
| 293.15 | 0.672 | 1.2 | 0.29 |
| | 0.747 | 1.2 | 0.36 |
| | 0.771 | 1.0 | 0.39 |
| | 0.812 | 1.1 | 0.43 |
| | 0.842 | 1.2 | 0.46 |
| | 0.943 | 1.4 | 0.58 |
| | 0.941 | 1.5 | 0.58 |
| | 1.22 | 2.7 | 0.97 |
| | 1.52 | 4.1 | 1.50 |
| | 2.55 | 10.3 | 4.23 |
| | 2.68 | 10.9 | 4.67 |
| 283.15 | 60.16 [e] | | 760. [e] |
| 293.15 | 34.19 [e] | | 760. [e] |

a. Temperature reported as 10 and 20° C.

b. Molality (moles HOCl/1000g $H_2O$) in solution.

c. $P_{Cl_2}$ is defined as $2P_{Cl_2O} + P_{HOCl}$. $P_{Cl_2}$ is also defined as $P_{Cl_2} = 2K_1[HOCl]^2 + K_2[HOCl]$.
$K_1 = P_{Cl_2O}/[HOCl]^2$. $K_2 = P_{HOCl}/[HOCl]$.

d. $P_{Cl_2O}$ calculated from $P_{Cl_2O} = K\,[HOCl]^2$

e. Extrapolated values to $P_{Cl_2O}$ = 1 atm. Since $[Cl_2O]$ in solution were not given it was not possible to calculate a mole fraction solubility for $Cl_2O$.

COMPONENTS:

(1) Chlorine monoxide; $Cl_2O$; [7791-21-1]

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

ORIGINAL MEASUREMENTS:

Secoy, C.H.; Cady, G.H.
*J. Amer. Chem. Soc.* 1941, *63*, 2504-8.

VARIABLES:

T/K: 276-293
*p*/mm Hg: 1-75

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

Solubility[a] of Chlorine Monoxide as g $Cl_2O$/100 g $H_2O$

| $p_{Cl_2O}$/mm | 0°C[b] | 10°C | 20°C |
|---|---|---|---|
| 1 | 7.6 | 5.2 | 3.5 |
| 5 | 16.7 | 12.3 | 8.0 |
| 10 | 23.7 | 17.4 | 11.1 |
| 20 | 33.6 | 24.2 | 15.4 |
| 30 | 40.7 | 29.2 | 18.7 |
| 40 | 46.9 | 33.0 | 21.3 |
| 50 | 52.4 | 36.2 | 23.7 |
| 60 | 56.7 | 39.0 | 25.8 |
| 70 | 60.2 | 41.4 | 27.7 |
| 75 | 61.6 | 42.5 | 28.6 |

a. Actual measurements were made at 3.46°C (1.27 to 247.6 mm), 6.00°C (15.17 to 15.70 mm), 9.92°C (0.918 to 75.62 mm), 16.00°C (32.38 to 33.66 mm), and 19.98°C (1.11 to 87.49 mm). The numbers in parentheses give the range of partial pressure of $Cl_2O$ at each temperature. The authors condensed these values to the above solubility table.

b. Temperatures reported to 0.01°C.

contd.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Two bulbs are connected by stopcocks. A solution of hypochlorous acid is introduced in one and the apparatus rotated so the solution moves through both bulbs. After equilibration samples of the gas and liquid phases are chemically analysed. The analysis of the gas samples used the method of Spinks (1). The pressure was altered during the run.

SOURCE AND PURITY OF MATERIALS:

(1) $Cl_2O$ - no comment by authors.

(2) $H_2O$ - no comment by authors.

ESTIMATED ERROR:

$\delta S/S$ = 0.02 to 0.05 (estimated by compiler).

REFERENCES:

(1) Spinks *J. Amer. Chem. Soc.* 1931, *53*, 3015.

| COMPONENTS: | ORIGINAL MEASUREMENTS: |
|---|---|
| (1) Chlorine monoxide; $Cl_2O$; [7791-21-1]<br>(2) Water; $H_2O$; [7732-18-5] | Secoy, C.H.; Cady, G.H.<br>*J. Amer. Chem. Soc.* 1941, *63*, 2504-8. |

Solubility[a] of Chlorine Monoxide

| T/K | $x_1$[b] | L[c] | S[d] |
|---|---|---|---|
| 273.15 | 0.5259 | 1375 | 533.3 |
| 283.15 | 0.4273 | 962 | 359.9 |
| 293.15 | 0.3353 | 672 | 243.4 |

a. All values calculated by compiler.
b. Mole fraction solubility (extrapolated) at 1 atm partial pressure of gas.
c. Ostwald coefficient (extrapolated).
d. Solubility as g $Cl_2O$/100 g $H_2O$ at 1 atm partial pressure of gas (extrapolated).

Equilibrium Constant K[a]

| t/°C | K |
|---|---|
| 3.46 | 0.41 ± 0.01 |
| 6.00 | 0.48 ± 0.01 |
| 9.92 | 0.62 ± 0.01 |
| 16.00 | 1.01 ± 0.01 |
| 19.98 | 1.47 ± 0.01 |

a. $K = P_{Cl_2O} \times a_{H_2O}/(a_{HOCl})^2$ for 2 HOCl(aq) = $Cl_2O(g) + H_2O(l)$.

Assume $a_{H_2O} = 1$ and $K^1 = P_{Cl_2O}/m^2$ where $m$ is the molal concentration of HOCl. The $K^1$ values are plotted against m and extrapolated to infinite dilution to give the values of K in this table.

COMPONENTS:

(1) Chlorine monoxide; $Cl_2O$;
[7791-21-1]

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

ORIGINAL MEASUREMENTS:

Roth, W.A. *Z. Physik. Chem.* 1942, *A191*, 248-50.

VARIABLES:

Concentration: molality HOCl, 1.8 to 5.1

PREPARED BY:

R. Battino

EXPERIMENTAL VALUES:

Solubility data at 3.46°C

| $m^a$ | $m_{HOCl}$ | $m_{Cl_2O}$ | $p_{Cl_2O}$/mmHg | K(Henry)[b] |
|---|---|---|---|---|
| 1.76 | 1.754 | 0.012 | 1.27 | 0.00945 |
| 2.49 | 2.478 | 0.024 | 2.54 | 0.00945 |
| 2.84 | 2.824 | 0.031 | 3.40 | 0.0091 |
| 3.60 | 3.575 | 0.050 | 5.31 | 0.0094 |
| 3.89 | 3.861 | 0.058 | 6.31 | 0.0092 |
| 4.48 | 4.441 | 0.078 | 8.27 | 0.0094 |
| 4.57 | 4.530 | 0.080 | 8.46 | 0.00945 |
| 4.88 | 4.834 | 0.092 | 10.10 | 0.0091 |
| 5.07 | 5.0205 | 0.099 | 10.62 | 0.00935 |
| | | | Average | 0.00937 |

a. $m = m_{HOCl} + 0.5\, m_{Cl_2O}$

b. Henry's Law constant (= $m_{Cl_2O}/p_{Cl_2O}$) refers to undissociated $Cl_2O$ only.

c. The extrapolated solubility at $p_{Cl_2O}$ = 1 atm is 7.12 moles $Cl_2O$/litre $H_2O$ or a mole fraction of 0.1137 for 1 atm partial pressure of gas. This is a mole fraction of 0.454 for total amount of $Cl_2O$ dissolved at $p_{Cl_2O}$ = 1 atm

$$K = m_{HOCl}^{2}/m_{Cl_2O} = 255$$

At 1 atm $m_{Cl_2O}$ = 7.21 and $m_{HOCl}$ = 42.61, therefore total $Cl_2O$ = 28.42 moles/litre $H_2O$, therefore x = 0.454.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Henry's Law constants determined from measuring hydrolysis constant of hydrolysis constant of hypochlorous acid solutions at different molalities. Author points out systematic errors in work of Secoy and Cady (1).

SOURCE AND PURITY OF MATERIALS:

No details given.

ESTIMATED ERROR:

δK/K = 0.005, estimate by author.

REFERENCES:

(1) Secoy, C.H.; Cady, G.H. *J. Amer. Chem. Soc.* 1941, *63*, 2504-8.

COMPONENTS:

1. Chlorine dioxide; $ClO_2$;

2. Water; $H_2O$; [7732-18-5]

EVALUATOR:

Rubin Battino,
Department of Chemistry,
Wright State University,
Dayton, Ohio, 45431,
U.S.A.

CRITICAL EVALUATION:

Both the data of Kepinski and Trzeszcynski (1) and that of Haller and Northgraves (2) were used for the smoothing equation. This comprised six data points from the former and three from the latter. The standard deviation of the fit was 4.6% indicating rather poor data (but the only data available for this system). The fitting equation is:

$$\ln x_1 = 7.91625 + 0.479133/(T/100\mathrm{K}) - 11.0593 \ln (T/100\mathrm{K}) \qquad ...(1)$$

where $x_1$ is the mole fraction solubility at 101.325 kPa (1 atm) partial pressure of gas. Table 1 gives smoothed values of the mole fraction (at 101.325 kPa) and the Ostwald coefficient at 5K intervals. Table 1 also gives the values of the thermodynamic functions $\Delta\bar{G}^\circ_1$, $\Delta\bar{H}^\circ_1$, $\Delta\bar{S}^\circ_1$ and $\Delta\bar{C}^\circ_{p_1}$ for the transfer of gas from the vapor phase at 101.325 kPa partial gas pressure to the (hypothetical) solution phase of unit mole fraction.

References

1. Kepinski, J.; Trzeszcynski, J. *Rocz. Chem.* 1964, *38*, 201.10.

2. Haller, J. F.; Northgraves, W. W. *Tappi* 1955, *38*, 199-202.

Table 1. Smoothed values of the solubility of chlorine dioxide in water and thermodynamic functions [a] at 101.325 kPa (1 atm) partial pressure of gas.

| T/K | $x_1 \times 10^2$ [b] | L [c] | $\Delta\bar{G}^\circ_1$/J mol$^{-1}$ | $\Delta\bar{H}^\circ_1$/J mol$^{-1}$ | $\Delta\bar{S}^\circ_1$/J mol$^{-1}$ K$^{-1}$ |
|---|---|---|---|---|---|
| 283.15 | 3.255 | 43.37 | 8.06 | -26.43 | -118.5 |
| 288.15 | 2.674 | 36.03 | 8.68 | -26.89 | -120.2 |
| 293.15 | 2.204 | 30.04 | 9.30 | -27.35 | -121.8 |
| 298.15 | 1.823 | 25.15 | 10.56 | -27.81 | -123.4 |
| 303.15 | 1.513 | 21.12 | 11.21 | -28.27 | -125.0 |
| 308.15 | 1.259 | 17.79 | 11.86 | -28.73 | -126.6 |
| 313.15 | 1.051 | 15.04 | 12.52 | -29.19 | -128.1 |
| 318.15 | 0.880 | 12.74 | 13.19 | -29.65 | -129.6 |
| 323.15 | 0.739 | 10.83 | 13.86 | -30.11 | -131.1 |
| 328.15 | 0.525 | 9.23 | 14.54 | -30.57 | -132.6 |
| 333.15 | 0.445 | 7.88 | 15.23 | -31.03 | -134.0 |

[a] $\Delta\bar{C}_{p_1}$ was independent of temperature and had the value -92 J K$^{-1}$ mol$^{-1}$.

[b] Mole fraction solubility at 101.325 kPa partial pressure of gas.

[c] Ostwald coefficient.

COMPONENTS:

1. Chlorine dioxide; $ClO_2$; [10049-04-4]
2. Water; $H_2O$; [7732-18-5]

ORIGINAL MEASUREMENTS:

Haller, J.F.; Northgraves, W.W.

*Tappi.* 1955, *38*, 199-202.

VARIABLES:

Temperature

PREPARED BY:

R. Battino,

EXPERIMENTAL VALUES:

| t/°C | $P_{ClO_2}$/mmHg | Solubility / g $l^{-1}$ |
|---|---|---|
| 25 | 34.5 | 3.01 |
| 25 | 22.1 | 1.82 |
| 25 | 13.4 | 1.13 |
| 25 | 8.4 | 0.69 |
| 40 | 56.2 | 2.63 |
| 40 | 34.3 | 1.60 |
| 40 | 18.9 | 0.83 |
| 40 | 9.9 | 0.47 |
| 60 | 105.9 | 2.65 |
| 60 | 53.7 | 1.18 |
| 60 | 21.3 | 0.58 |
| 60 | 12.0 | 0.26 |

| T/K[a] | $X$,x$10^2$ [b] | L [c] | Solubility [d] |
|---|---|---|---|
| 298.15 | 1.771 | 24.41 | 67.30 |
| 313.15 | 0.956 | 13.66 | 35.86 |
| 333.15 | 0.515 | 7.72 | 19.06 |

a. Temperature reported as 24,40,60°C.

b. Mole fraction solubility at 101.325kPa (1 atm) partial pressure of gas. Calculated by compiler. Extrapolated.

c. Ostwald coefficient. Calculated by compiler. Extrapolated.

d. Solubility in g $l^{-1}$. Extrapolated to 1 atm.

AUXILIARY INFORMATION

METHOD APPARATUS/PROCEDURE:

The data are taken from reference (1). No other details supplied.

SOURCE AND PURITY OF MATERIALS:

ESTIMATED ERROR:

REFERENCES:

1. Kirk, R.E.; Othmer, D.F. "Encyclopedia of Chemical Technology", Vol. 3., p.702. *Interscience Publishers*, (1952)

COMPONENTS:

1. Chlorine dioxide; $ClO_2$; [10049-04-4]
2. Water; $H_2O$; [7732-18-5]

ORIGINAL MEASUREMENTS:

Kepinski, J.; Trzeszczynski, J.

*Rocz. Chem.* 1964, *38*, 201-10.

VARIABLES:

Temperature

PREPARED BY:

R. Battino.

EXPERIMENTAL VALUES:

T/K = 283-318

| T/K [a] | $x_1 \times 10^2$ [b] | L [c] | H [d] | Pressure range /mm [e] |
|---|---|---|---|---|
| 283.15 | 3.271 | 43.60 | 0.1666 | 42-156 |
| 288.15 | 2.664 | 35.89 | 0.1347 | 14-163 |
| 293.15 | 2.208 | 30.09 | 0.1111 | 18-151 |
| 298.15 | 1.827 | 25.20 | 0.0914 | 21-154 |
| 308.15 | 1.296 | 18.32 | 0.0634 | 31-155 |
| 318.15 | 0.962 | 13.94 | 0.0474 | 38-154 |

a. Temperature reported as 10, 15,...,45°C.

b. Mole fraction solubility at 101.325 kPa (1 atm) partial pressure of gas. Calculated by compiler. Extrapolated.

c. Ostwald coefficient. Calculated by compiler. Extrapolated.

d. Henry's law constant. Units of (g $ClO_4$/ liter) /mmHg $ClO_4$.

e. Pressure range of actual measurements.

AUXILIARY INFORMATION

METHOD APPARATUS/PROCEDURE:

Used a dynamic saturation method along with a chemical method of analysis. A drawing and details given in the paper.

SOURCE AND PURITY OF MATERIALS:

1. Chlorine dioxide prepared according to reference (1).
2. Water - no comment by authors.

ESTIMATED ERROR:

$\delta H/H = 0.02$, compiler's estimate.

REFERENCES:

1. Kepinski, J.
*Przemysl. Chem.* 1955, *34*,124.

# SYSTEM INDEX

Underlined page numbers refer to evaluation text and those not underlined to compiled tables. All compounds are listed as in Chemical Abstracts. For example, toluene is listed as benzene, methyl- and dimethylsulfoxide is listed as methane, sulfinylbis-.

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# REGISTRY NUMBER INDEX

Underlined page numbers refer to evaluation text and those not underlined to compiled tables.

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# AUTHOR INDEX

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