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SOLUBILITY OF THE TOXIC GASES, HYDROGEN SULFIDE AND SULFUR DIOXIDE IN SOME POLAR AND NON-POLAR SOLVENTS

by

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ABSTRACT

The solubilities of the reactive gases, hydrogen sulfide and sulfur dioxide were measured in the following solvents : n-hexane, acetonitrile, dimethylformamide, N-N-dimethylacetamide and ethylacetate. In addition to the previously mentioned solvents, sulfur dioxide solubilities were also measured in acetone, methanol , chlorobenzene, and ethylene glycol. The solubility measurements were made at a total pressure of one atmosphere and at temperatures of -5°C, 25 °C and 60 °C where possible. The solubilities of sulfur dioxide were much higher than those for hydrogen sulfide in the same solvents and at the same temperatures. The solubility of sulfur dioxide in n-hexane was the highest obtained among the solvents used. In contrast, sulfur dioxide was least soluble in ethylene glycol and chlorobenzene. Finally, the highest, and lowest , solubilities of hydrogen sulfide were observed in dimethylacetamide, and n-hexane, respectively.

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NOMENCLATURE

C	correction factor
F	solvent flow rate, cm^3/min.
G	Gibbs-Heltz free energy, J
H	heat of vaporization, J
K	Henry's constant
L	Ostwald coefficient
P	pressure, atm
R	gas constant, J/mole
S	entropy, J
T	temperature, °K and °C
V	volume, cm^3
X	mole fraction in liquid phase
Y	mole fraction in gas phase
Z	slope
α,b,c	parameters in equation (44)
f	fugacity, atm

NOMENCLATURE, CONTINUED:

m	mole
α	hydrogen-bonding factor
γ	activity coefficient
ρ	density, g/cm^3
θ	elapsed time, s
ψ	volume fraction
ϕ	fugacity coefficient

* * *

SUPERSCRIPTS

G	gas phase
i	ideal
L	liquid phase
s	saturation
v	vapor
$\wedge$	mixture
o	pure
$-$	partial molal quantity

NOMENCLATURE, CONTINUED:

SUBSCRIPTS

g	gas
i	component
P_i	partial pressure of ith component
r	room temperature
s	experimental temperature
t	total
1	solvent
2	solute

INTRODUCTION

In the chemical engineering design of absorption or separation equipment ~~for~~ chemical processes it is frequently necessary to have data for the solubilities of gases in liquids at various temperatures and pressures. This makes the equilibrium gas solubility an important subject to study. Numerous studies have been conducted based on industrial necessities. A completely reliable theory for perdicting gas solubility in liquids has not been presented so far, although three models for predicting gas solubility have been reported .These models all have some limitations. These models include the regular solution theory and the concept of the ideal gas solubility as presented by Hildebrand [1], the cavity model theory as suggested by Uhlig [2], and the statistical thermodynamics model as suggested by Guggenheim [3]. Because of limitations in these theories, experimental research is still considered useful and necessary. Many experimental data for gas solubilities have been reported, but only a few of them are for highly soluble gases. The solubilities of trans-2-butene in carbon disulfide [4] and of n-butane in dodecane, heptane, hexane, and octane [5] corresponded to a concentration of nearly 80 mol% at -5 °C. The solubilities of isobutylene in hexane and ethylacetate were also approximately 60 mol% [6] at -5 °C. Finally ,the solubility of ammonia in ethylene glycol at -10 °C was observed to be 65 mol% [7]. Solubilities of toxic gases have been studied the least. Investigations on their solubilities are useful for separating and purifying sulfur dioxide and hydrogen sulfide from mixtures of gases (for example separating hydrogen sulfide from a mixture of gases coming out of oil wells or for manufacturing sulfuric acid).

In this work the solubilities of sulfur dioxide and hydrogen sulfide were measured in n-hexane and the polar solvents chlorobenzene, methanol, ethylacetate, dimethylformamide(DMF), acetone, N-N-dimethylacetamide(DMA), acetonitrile, and ethylene glycol. The measurements were conducted at a total pressure of one atmosphere and at temperatures ranging from -5°C to 60°C.

BASIC THERMODYNAMICS OF VAPOR OR GAS - LIQUID EQUILIBRIA

Let us consider a liquid mixture which, at a temperature , T, and pressure, P, is in equilibrium with a vapor mixture at the same temperature and pressure. For every component i which exists in both mixtures, the condition of thermodynamics equilibrium is given by [8] :

$$f_i^v = f_i^L \ , \qquad (1)$$

The fugacities are obtained as follows:

$$d\bar{G}^v = RT\,d\ln \hat{f}_i^v \qquad (2)$$

$$d\bar{G}^L = RT\,d\ln \hat{f}_i^L \qquad (3)$$

In the expressions above $\bar{G}^v$ and $\bar{G}^L$ are the partial molal Gibbs-Helmholtz free energies, f is the fugacity, the superscript v refers to the vapor, and superscript L refers to the liquid. The fugacity of a component in a mixture depends on the temperature, pressure, and composition of that mixture. The relationship of f_i^v and f_i^L to temperature, pressure and mole fraction is given below [8] :

$$f_i^v = \Phi_i P_t y_i \qquad (4)$$

$$f_i^L = \gamma_i x_i f_i^o \qquad (5)$$

The fugacity coefficient of component, i (ϕ_i) in a gas mixture is a function of temperature only. The activity coefficient (γ_i) at a certain temperature and pressure is defined by:

$$\gamma_i \equiv \frac{a_i}{X_i} \qquad (6)$$

In the above expressions a_i is the activity of component i , X_i and Y_i are compositions of component i in the liquid and vapor, respectively, f_i° , is the fugacity of component i in pure liquid and P_t , is the total pressure. The fugacity coefficient (ϕ_i) is defined as follows [8] :

$$RT\ln\phi_i = RT\ln\frac{\hat{f}_i^v}{P_t Y_i} = -\int_{\infty}^{\underline{V}}\left\{\left[\frac{\partial P}{\partial N_i}\right]_{P,\underline{V},N_j[i]} - RT\right\}d\underline{V} \qquad (7)$$

For a mixture of ideal gases the fugacity coefficient is normalized such that as P ⟶ 0 , $\phi_i = 1$ for all components at low pressure. Substitution of equations (4), (5), and (7) in equation (1) gives:

$$Y_i P_t = \gamma_i X_i P_{vP_i} C_i \qquad (8)$$

$$C_i = \frac{\phi_i^S}{\phi_i}\exp\int_{P_{vP_i}}^{P}\frac{V_i^L}{RT}\,dP \qquad (9)$$

The term, C_i is a correction factor whose value is near unity when the total pressure is sufficiently low. If in addition to setting $C_i = 1$ we assume that $\gamma_i = 1$, then equation (8) reduces to the familiar relation known as "Raoult's Law" :

$$P_i = x_i P_{vp_i} \qquad (10)$$

Based on equation (10) an ideal gas solubility can be defined for a binary gas-liquid system. For a gas partial pressure of one atmosphere, equation (10) reduces to an expression for the ideal gas solubility :

$$x_2^i = \frac{1}{P_2^\circ} \qquad (11)$$

It is noted that the ideal solubility is dependent on temperature and the nature of the solute, but it is independent of solvent. Also, for a constant partial pressure the solubility of a gas decreases with increasing temperature. One of the useful characteristics of the ideal gas solubility relationship is that, when the system temperature is reduced to the normal boiling point of the solute gas, the ideal gas solubility becomes unity . The gas vapor pressure decreases with decreasing temperature to the normal boiling point of the solute gas. For this to actually occur, the solvent must not freeze at the gas normal boiling point. The solubility of a gas varies greatly from solvent to solvent and in some instances it increases with increasing temperature, especially for gases of low solubility [4].

THE SOLUBILITY EQUATION BASED ON THE REGULAR SOLUTION THEORY

In 1929 Hildebrand [1] proposed the regular solution theory. This theory is meant to apply to solutions which are characterized by the absence of specific interactions between molecules. According to this theory, the change in Gibbs energy for transfer into the solution from the pure liquid state is as follows [9] :

$$\Delta\bar{G}_2 = RT \ln x_2 + V_2 \psi_1^2 (\delta_1 - \delta_2)^2 \qquad (12)$$

where,

$$\delta = \left(\frac{\Delta E^v}{V}\right)^{\frac{1}{2}} \qquad (13)$$

In the above expression δ is the solubility parameter and since it changes gradually with temperature, it should be calculated at the temperature at which the solubility is measured. The units for solubility parameter are $(cal/cm^3)^{\frac{1}{2}}$. Also in the above expression ψ_1 , is a volume fraction for component 1 and V_2 , is the molar volume of pure liquid component 2. Because gas solubilities are relatively small, it is considered that the condition that $\psi_1 = 1$ is valid . By using suitable thermodynamic relationships it can be shown that:

$$\Delta E^v = \Delta H^v - RT \qquad (14)$$

By substitution of equation (14) into equation (13), δ can be written as :

$$\delta = \left(\frac{\Delta H^{v} - RT}{V} \right)^{\frac{1}{2}} \qquad (15)$$

In the above expression, ΔH^{v} is the heat of vaporization at the boiling point, and V is the liquid molar volume . On the other hand, on dissolution the Gibbs-free energy of a solute component is expressed in terms of the fugacities :

$$\Delta \bar{G}_2 = RT \, Ln \frac{f_2}{f_2^{\circ}} \qquad (16)$$

When the vapor pressure is low or the gases are ideal, the fugacities can be replaced by the corresponding pressure f=P :

$$\frac{f_2}{f_2^{\circ}} = \frac{P_2}{P_2^{\circ}} \qquad (17)$$

By inserting equation (16) into equation (12), the following is obtained:

$$Ln\, x_2 = Ln\, x_2^{i} - \frac{V_2}{RT} \left(\delta_1 - \delta_2 \right)^2 \qquad (18)$$

This last expression is considered very important for the prediction of solubilities of gases in liquids based on the regular solution theory [10],[11], and [12]. It is not possible to estimate the solubility by means of equation (18) when the solubility is affected by a specific interaction between solute and solvent. The prediction of gas solubility by means of this equation is at least partially successful for a solution where both solute and solvent are non-polar or only slightly polar substances. It is evident from equation (18) and (11) that solubility of a gas is proportional to its vapor pressure (Henry's law). The ratio of the fugacities, rather than the ratio of vapor pressures, should be used in order to obtain the solubility more precisely, because the saturated vapor pressure of the gas P_2° is usually large, and the temperature at which the solubility is sought is, in many cases, higher than the critical temperature of the gas.

The effect of a changing temperature on gas solubility was assessed by Hildebrand et al. [11]. This effect was obtained from the entropy of solution of the gas . The relationship between the Gibbs-free energy and mole fraction solubility at equilibrium is as follows:

$$\Delta G_2 = RT \ln x_2 \qquad (19)$$

$$\Delta G_2 = \bar{G}_2^{L} - \bar{G}_2^{G} \qquad (20)$$

$$x_2 = \frac{\bar{f}_2^{L}}{\bar{f}_2^{G}} \qquad (21)$$

From thermodynamic relationships it is known that:

$$\left(\frac{\partial G}{\partial T}\right)_{P,x} = -S \qquad (22)$$

The following relationship can be written for a solute component in solution :

$$\left(\frac{\partial \bar{G}_2^L}{\partial T}\right)_{P,x} - \left(\frac{\partial G_2^G}{\partial T}\right)_{P,x} = -\bar{S}_2^L + S_2^G \qquad (23)$$

Substituting equation (19) in equation (23) results in :

$$\bar{S}_2^L - S_2^G = \left[\frac{\partial(\bar{G}_2^L - G_2^G)}{\partial \ln x_2}\right]_{P,T} \cdot \left(\frac{\partial \ln x_2}{\partial T}\right)_{(\bar{G}_2^L - G_2^G),P} \qquad (24)$$

Because the fugacity of gas , f_2^G ,is not a function of composition (X_2) equation (24) can easily be reduced to the following expression :

$$\bar{S}_2^L - S_2^G = R\left[\frac{\partial \ln \hat{f}_2^L}{\partial \ln x_2}\right]_{P,T} \cdot \left(\frac{\partial \ln x_2}{\partial \ln T}\right)_{Sat.,P} \qquad (25)$$

In the above expression the arbitrary standard state of the gas is taken as one atmosphere. When the pressure is low or the solubility is low, the activity coefficient can be considered independent of X_2 and the term, $\frac{\partial \ln \hat{f}_2^L}{\partial \ln x_2}$ can be considered approximately equal to unity then:

$$\bar{S}_2^L - \bar{S}_2^G = \Delta\bar{S} = R\left[\frac{\partial \ln x_2}{\partial \ln T}\right]_{sat., P} \qquad (26)$$

It may be observed from equation (26) that plots of Log X_2 versus Log T, or plots of Log X_2 versus $\frac{1}{T}$, are linear with slopes $\Delta\bar{S}_2$, and $\Delta\bar{H}_2$, respectively . In addition it may be observed from the above expression that the solubility of a gas is expected to increase with decreasing temperature.

The effect of molecular interaction on gas solubility in liquids is a strong function of the intermolecular forces between solute and solvent molecules. If x is a solvent and y a solute, the y molecules will dissolve in x only if x-y interactions are energetically more favourable than the average of x-x interactions. The intermolecular forces between chemically similar species lead to a smaller endothermic enthalpy of solution than those between dissimilar species.. This interaction is "chemical" or "physical" affinity which sometimes causes enhancement in the solubility of gases in liquids. The solubility may be affected by the following considerations :

(a) The occurrence of a reversible chemical reaction between the solute and solvent molecules, such as that which takes place between sulfurous acid and water, or ammonia and water. In this case the extent of solubility is higher than the ideal gas solubility.

(b) The occurrence of hydrogen-bonding [13],[14] between solvent-solvent molecules or solute-solvent molecules. For gases which tend to combine with the solvent by means of hydrogen-bonding or other complex formation, the solubility is enhanced when compared with that for a non-reacting gas. Conversely, if the hydrogen-bonding takes place between solvent molecules, then the solute molecules are excluded from penetrating into the solvent. Thus the solubility in such a solvent, with strong hydrogen-bonding tendencies, is less than that in a solvent with weaker hydrogen-bonds [16]. In solubility systems in which solvent hydrogen-bonding is predominant, the gas solubility is usually less than the ideal gas solubility.

(c) Existence of only a weak physical attraction between solute and solvent molecules. In this case the intermolecular force is attributed to internal pressure or solubility parameter which is a function of the heat of vaporization. The resulting solubilities are normal or near the ideal gas solubility.

There are two sorts of solvents. One type has hydrogen attached to an electronegative atom and is known as a "protic solvent". Another type of solvent has no hydrogen atom attached to the electronegative atom. This type is known as an "aprotic solvent". These two kinds of solvents can enhance the gas solubility by forming hydrogen-bonding between solvent and solute molecules. An increase in electronegativity of an electronegative atom with an attached hydrogen atom makes the hydrogen-bond stronger and more stable. For example, hydrogen bond strengths in hydrogen sulfide are weaker than those in H_2O or HF. The solvents used in this work are : n-hexane, chlorobenzene, acetonitrile, methanol, ethylacetate, acetone, N-N-dimethylacetamide, dimethylformamide, and ethylene glycol. Among these solvents, only methanol and ethylene glycol are protic solvents because in their molecules there is a hydrogen atom attached to an oxygen atom. In a methanol molecule there is one hydrogen atom attached to a oxygen atom with a tendency to form a hydrogen bond with another negative atom. Thus, the methanol molecules in the liquid phase have hydrogen bonds among themselves. In that case, the attactive forces between the solute and methanol become small. This is also true for ethylene glycol which has two such hydrogen groups. Because the ethylene glycol has two hydrogen groups and methanol only one the solubility of gases used in ethylene glycol is expected to be lower than that in methanol . This was confirmed experimentally by this work and Sahgals work[7]. The gases used in this work are hydrogen sulfide and sulfur dioxide . These gases are so reactive and polar as to be highly soluble in polar solvents because of the existence of chemical reaction or hydrogen-bonding between solute and solvent molecules.

For predicting gas solubility in a hydrogen-bonding or associating solvents when some solubility data are available, Hayduk and Laudie [16] have utilized a hydrogen-bonding factor based on the ideal solubility. This factor is defined as the ratio of the actual solubility to the ideal gas solubility, and is applicable for polar and hydrogen-bonding systems:

$$\alpha = \frac{X_2}{X_2^i} \tag{27}$$

$$X_2^i = \frac{P_2}{P_2^\circ} \tag{28}$$

It is assumed that hydrogen-bonding in a polar solvent causes solute gas molecules to be excluded or "squeezed out" from the liquid and hence the solubility of non-reactive gases is reduced. The solubility of a gas may be predicted from the relationship between hydrogen bonding-factors in different solvents, provided that the solubility is available in a reference solvent [16].

EXPERIMENTAL APPARATUS AND PROCEDURE

Originally Morrisson and Billet [26] suggested a spiral tube-type of solubility apparatus for measurement of gas solubilities. This apparatus was modified by Hayduk and Cheng [17] and others; the resulting apparatus as used in this work is shown in figures 1,and 2. Figure 1 shows the solvent degassing apparatus and figure 2 the apparatus for solubility determinations. The procedure for degassing the solvent will now be described.

First about 30-40 cm^3 of solvent was put into the vacuum flask and a vacuum was applied. If the boiling point of the solvent was high, a tape heater was wrapped around the flask to raise the solvent temperature to its boiling point. After enough boiling had taken place for complete degassing of the solvent, (about 30 minutes) the stopcock was opened and the partially degassed solvent was allowed to flow into the packed bead column and degassing was continued for 10 minutes longer. Then the vacuum was stopped and the degassed solvent was temporarily stored in the packed column. The solvent was removed by means of a syringe using the septum rubber put at the end of the tube attached to the packed column. This solvent was subsequently slowly injected into the spiral tube of the solubility apparatus by means of a syringe driven by an infusion pump whose speed could be varied by changing its motor.

A 5-cm^3 gas-tight Hamilton syringe was used in

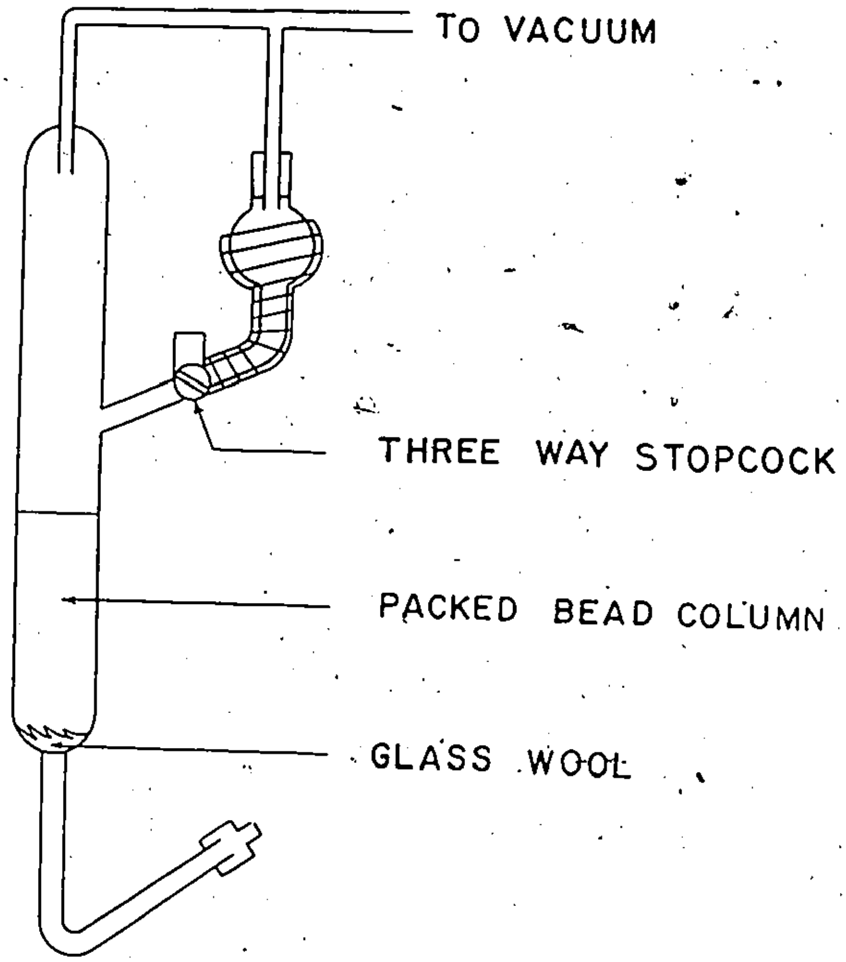

Figure 1

Degassing apparatus

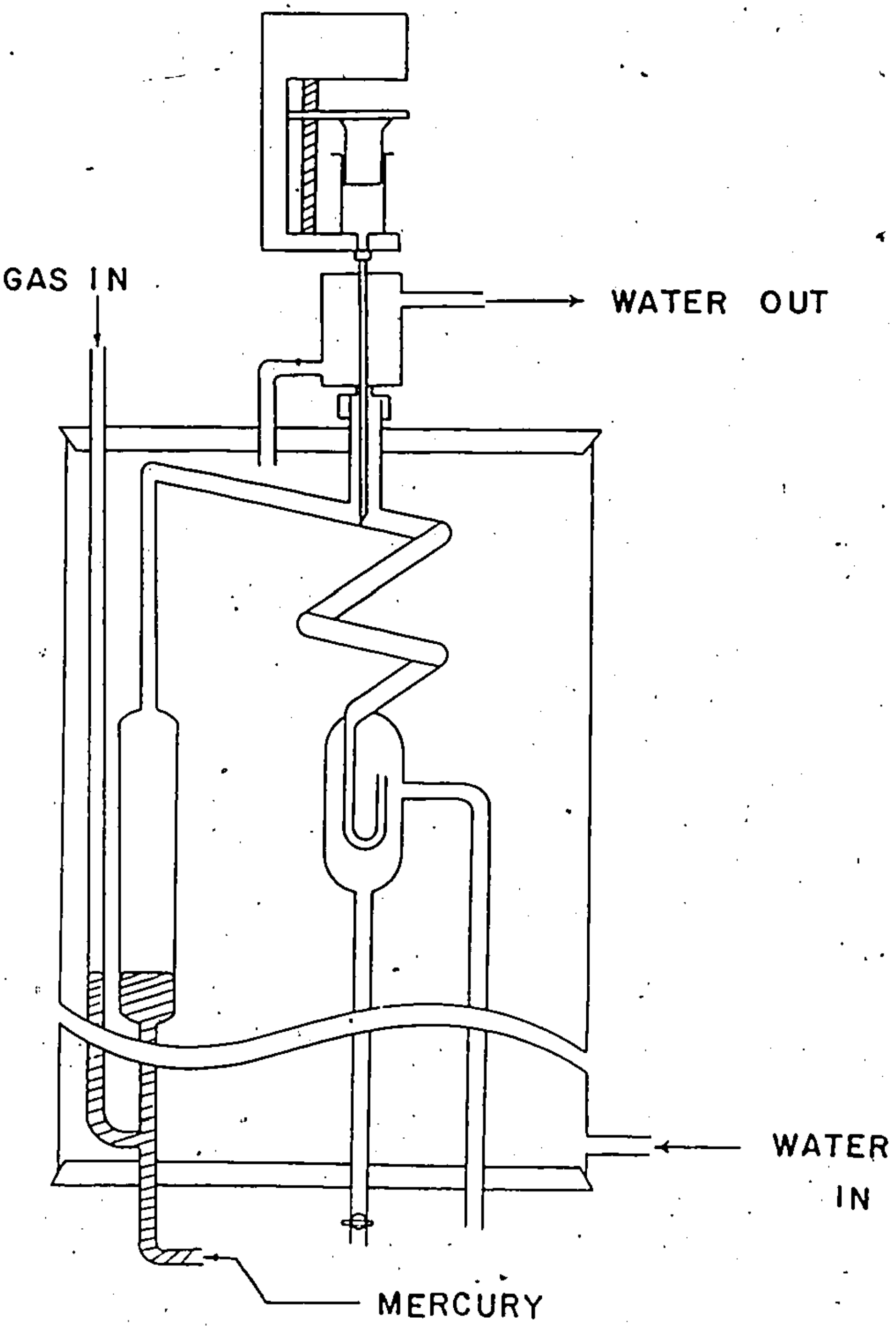

Figure 2

Solubility apparatus

conjunction with a syringe pump equipped with a motor chosen to give the necessary solvent flows . Three motor speeds, 0.5 rpm , 0.2 rpm , and 0.1 rpm were used to give the three different solvent flow rates of 0.04404 cm^3/min., 0.01754 cm^3/min., and 0.008687 cm^3/min. , respectively. These solvent flow rates were accurately measured by using distilled water at room temperature. For each combination of syringe and syringe-pump motor, at least three calibrations were made and the average of results was calculated. For calibration of the syringe pump, distilled water was injected into a closed vial with the needle penetrating the cap (to prevent evaporation) during a two to three hour period. The water so injected was weighed by means of a very accurate balance (10^{-5} g). The solubility apparatus consisted of a gas burette, a spiral tube, a capillary U-tube monometer and a solution collecting burette. All of the components were of glass and were fixed inside a big tube which served as a jacket in which a water-glycol solution was circulated at constant temperature (±0.05 °C). To obtain a temperature of -5 °C, a Neslab Instruments refrigerating system was used. The temperature rise through the apparatus was less than 0.5 °C ; to compensate for the temperature rise the inlet temperature was maintained at -5.25 °C and outlet temperature was -4.75°C. Thus the average temperature inside the apparatus was maintained at -5 °C.

The top of the spiral tube was connected to the upper end of the gas burette. The tip of the long solvent supply needle of the syringe was located at the top of the spiral tube . The lower end of the spiral tube was joined to the U-tube manometer . The solvent becomes saturated while flowing down the spiral tube to the U-tube. The pressure in the absorption spiral tube was observed by means of this U-tube, one side of which was open to the atmosphere. The inside pressure of the gas confined between the mercury surface and the surface of saturated solvent in the U-tube was controlled at atmospheric pressure. The size of the gas burette and spiral tube depended upon the gas solubility being measured. Three sizes of gas burette were used: 50 cm^3, 100 cm^3, and 250 cm^3. The biggest size gas burette was used for high gas solubilities and the smaller sizes for lower solubilities. Several parameters were considered when selecting the design of spiral tube. First, when the solubility was high, the spiral tube was made longer because, in this case, the necessary residence time for saturating the solvent was considered to be long. The solvent residence time was the duration of time from the initial starting time of the syringe pump to the time when the first drop of liquid was observed in the U-tube manometer. The residence time for gases of low solubility was usually in the range of 10 -25 minutes. Because the flow rate of solvent was low, the solubility took place easily. Thus the required residence time for saturating the solvent was also low ; therefore the necessary length of spiral tube for getting saturated solvent was also short.

This was confirmed experimentally by changing the solvent flow rate. Two different flow rates were used for the same solubility determinations in which the residence times were different. The solubility results, however, were found to be essentially identical. As the number of the coils in the spiral tube, the radius of the spiral coil, and the radius of the spiral tube itself were reduced in size, the residence time became shorter. The angle of descent of the spiral tube also had an effect on the residence time. By changing the slope of the spiral tube the residence time could be modified. In addition to the parameters mentioned, the solvent viscosity also influenced its residence time. At low temperatures the viscosity of solvent was higher, therefore the flow of liquid in the spiral tube was slower. If the slope of the spiral tube was too low , the liquid accumulated in the spiral tube and then suddenly moved. This phenomenon caused some fluctuations in the liquid levels in the U-tube. As a result, controlling the pressure of gas inside the apparatus became difficult. Hence, a large angle of descent for the spiral tube was used for high viscosity solvents.

For solubility measurements at temperatures higher than room temperature a heat exchanger was used to preheat the solvent to the experimental temperature. One heat exchanger was used to heat the long syringe needle. The syringe itself was also equipped with a heating (or cooling) jacket. The inlet water to the heat exchangers came from the outlet of the column. In this way the heat exchanger temperature was adjusted to the system temperature. This method of preheating solvent in the syringe was not suitable for high temperatures because of the formation of some bubbles inside the syringe that affected the solvent flowrate. In addition, the calibration of the syringe for determining the liquid flow rate was seriously changed for temperatures which were higher or lower than room temperature. Hence, the syringe pump was calibrated at essentially room temperature, and the heat exchanger was used for the syringe needle only. The inner diameter of the long needle used was about 0.6 mm and the maximum solvent flow rate was 0.01754 cm^3/min. ; thus the maximum liquid velocity passing through the needle was about 6.2 cm/min. Because the length of the heat exchanger was about 10 cm , the residence time of liquid in the needle of about 1.6 minutes was sufficiently long for the solvent to essentially reach the experimental temperature.

The first steps in the procedure for making a solubility determination involved degassing the solvent and purging the solubility apparatus with solute gas. Then the syringe which had been cleaned well and completely dried was filled with about 2-4 cm^3 of degassed solvent and connected to the infusion pump. The needle of the syringe was passed through the heat exchanger and then put into the spiral tube. The tip of the needle was extended into the apparatus until it touched the wall of the spiral tube for the purpose of ensuring a continuous flow of solvent in the spiral tube. It was found that if the solvent flow to the spiral tube was dropwise, the inside pressure of gas inside the apparatus could not be controlled well. After closing the stopcock in the solution burette, the infusion pump was switched on. After the first droplet of solution appeared in the U-tube manometer, an additional waiting time was required for a steady-state condition to be achieved. Then the flow of solute gas was shut off and the mercury level was raised by means of the mercury-lift device driven by [illegible] variable-speed motor. The rate of the mercury-lift device could be adjusted as required so that the internal pressure was essentialy atmospheric pressure as observed with the help of the U-tube manometer. The volume of mercury displaced was equal to the amount of solute gas dissolved in the spiral tube. This volume of mercury was recorded every five minutes; or instead, the elapsed time was recorded for every 10 cm^3 of mercury that had replaced dissolving gas. From the reduction in gas volume and solvent flow rate, the solubility was calculated.

PROPERTIES OF TEST FLUIDS

Hydrogen sulfide and sulfur dioxide were purchased from the Matheson Company of Canada, and Air Product Chemical Company, respectively. The minimum purities of these gases were specified as 99.5 % , and 99.9 % respectively. The molar volumes for sulfur dioxide were obtained from the literature [18]. The molar volumes for hydrogen sulfide at a temperature of 25 °C was obtained from reference [6], for a temperature of 60 °C by extrapolating from the literature [19], and for a temperature of -5 °C from another literature source [18]. These gas molar volumes are shown in table 1 .

The n-hexane, ethylacetate, dimethylacetamide, and acetone were purchased from Fisher Scientific Company. These solvents had specified minimum purities of 99+% , 99+%, 99+% , and 99.5% respectively. The chlorobenzene and ethylene glycol, both of which had a specified minimum purity of 99+% , were supplied by the Aldrich Chemical Company. Dimethylformamide and methanol were obtained from J.T. Baker with specified purities of 99+% , and 100% , respectively. Acetonitrile was obtained from Matheson with a specified purity of 99+% . Vapor pressures of solvents were calculated by means of Antoine equation [8]. The densities of the solvents for a temperature of 25 °C were obtained directly from the literature [2],[7], and [6]. The densities for a temperature of -5 °C, for the solvents, chlorobenzene, methanol, n-hexane, and ethylene glycol were also obtained from the literature, [20],[21],[22], and [23], respectively. For a temperature of 60°C, for chlorobenzene, n-hexane, and ethylene glycol, densities were obtained from [20] ,[21], and [23] respectively. For the remaining solvents, densities were obtained by means of interpolating or extrapolating available data in the literature [6]. Yet another source of densities for a temperature of 20°C was [24]. At room temperature (ranging from 21°C to 27°C) the densities of the solvents were considered to be a linear function of temperature.

CHEMICAL FORMOLA AND IMPURITIES OF SOLVENTS

Solvent	Chemical Formula
Acetone	CH_3COCH_3
Acetonitrile	CH_3CN
Chlorobenzene	C_6H_5Cl
Dimethylformamide	$HCON(CH_3)_2$
N-N-Dimethlacetamide	$CH_3CON(CH_3)_2$
N-Hexane	C_6H_{14}
Ethylene glycol	$HOCH_2CH_2OH$
Ethyacetate	$CH_3COOC_2H_5$
Methanol	CH_3OH

TABLE 1

PROPERTIES OF TEST FLUIDS

	gas molar volumes , m^3/kmol.	
temp. K	SO_2	H_2S
268.15	21.423	21.723
298.15	24.047	24.264
333.15	27.021	27.181

* * *

PROPERTIES OF SOLVENTS

solvent	temp. K	density kg/m^3	vapor pressure mmHg
n-Hexane	268.15	682.7	34.46
	298.15	654.4	151.28
Ethylacetate	268.15	933.0	18.66
	298.15	894.2	96.81
	333.15	850.6	420.35
Chlorobenzene	268.15	1133	1.759
	298.15	1100.9	11.968
	333.15	1074.6	66.38

TABLE 1 (CONTINUED)

Solvent	Temp. K	Density Kg/m^3	Vapor Pressure mmHg
Dimethyl	268.15	971.6	0.0
acetamide	298.15	936.8	0.0
	333.15	905.9	15.944
Dimethyl	268.15	981.8	0.0
formamide	298.15	944.3	0.0
	333.15	912.1	25.89
Acetonitrile	268.15	810.2	17.08
	298.15	777.3	86.33
	333.15	739.1	370.95
Methanol	268.15	814.7	21.76
	298.15	787.3	126.88
Ethylene	268.15	1131.1	0.0078
glycol	298.15	1110.1	0.127
	333.15	1085.6	0.647
Acetone	268.15	827.1	54.0
	298.15	785.3	30.65

TREATMENT OF DATA

The solvent flow rate was measured at room temperature but the experiments were performed not only at room temperature but also at other temperatures. The difference between room temperature (syringe temperature) and the system temperature caused a slight volume expansion or contraction of solvent in the apparatus; thus the solvent flow rate , F_r , had to be corrected to obtain the actual liquid flow rate inside the solubility apparatus . This correction , to obtain the flow rate in the equipment , F, is as follows:

$$F \cdot \rho_s = F_r \cdot \rho_r \tag{29}$$

$$F = F_r \cdot \frac{\rho_r}{\rho_s} \tag{30}$$

In the above equation ρ_r ,is the density of the solvent at room temperature and ρ_s is the density of the solvent at the experimental temperature. The linear relation between the absorption rate of dry gas and the constant solvent rate to the apparatus was confirmed by results of all the experiments. The best slope for this linear relationship (solute gas volume- time) was calculated by means of a least-squares method. The Ostwald coefficient, L , is defined as the ratio of the volume of the solute gas absorbed in the solvent to the volume of solvent. The Ostwald coefficient is virtually independent of pressure for small changes in pressure for which Henry's law holds. By applying Henry s law the mole fraction solubility of dissolved gas at a gas partial pressure, P_2 can be calculated as shown below :

$$\frac{P_2}{X_{2,P_2}} = \frac{101.325}{X_2} = K \qquad (31)$$

In the above expression X_2 is the mole fraction of solute gas when the solute gas partial pressure is 101.325kPa and X_{2,P_2} is the mole fraction solute gas when the solute gas partial pressure is P_2 . The equation for the gas partial pressure is then :

$$P_2 = \frac{X_{2,P_2}}{X_2} \cdot (101.325) \qquad (32)$$

By considering that Raoult's law can be applied to the solvent for the purpose of estimating the partial pressure of solvent vapor $P_i = X_i P_i^o$, P_2 , can be written as follows :

$$P_2 = 101.325 \left(\frac{1 - \frac{P_1}{P_1^o}}{X_2} \right) \qquad (33)$$

$$P_2 = 101.325 \left(\frac{P_1^o - P_t + P_2}{P_1^o X_2} \right) \qquad (34)$$

Hence, the expression for the partial pressure of gas is reduced to :

$$P_2 = \frac{101.325(P_t - P_1^\circ)}{101.325 - P_1^\circ X_2} \qquad (35)$$

By definition, the Ostwald coefficient is first written in words and then expressed as an equation :

$$\frac{\text{volume of gas (saturated) dissolved in solvent}}{\text{volume of solvent}}$$

$$L = \frac{V_{w.g}}{V_{Solv.}} \qquad (36)$$

The volume of dry gas corresponding to wet gas dissolved in the solvent is expressed as :

$$V_g = \frac{P_2}{P_t} \cdot V_{w \cdot g} \qquad (37)$$

Substituting equation (37) in equation (36) yields :

$$L = \frac{V_g}{V_{Solv.}} \times \frac{P_t}{P_2} \qquad (38)$$

In the above equation the volume of solvent is the product of the solvent flow rate and the time .

Thus :

$$L = \frac{V_g}{\theta \cdot F} \cdot \frac{P_t}{P_2} \qquad (39)$$

In order to obtain the Ostwald coefficient from equation (39) and (35) the solubility needs to be known beforehand. From the definition of mole fraction of solute gas :

$$X_2 = \frac{m_2}{m_1 + m_2} \qquad (40)$$

On the other hand ,the equation for Ostwald coefficient is:

$$L = \frac{V_g}{V_{Solv.}} = \frac{m_2 V_2}{m_1 V_1} \qquad (41)$$

In the above equation , V_1 ,and V_2 are the molar volumes of solvent and solute gas ,respectively ;then it follows that :

$$\frac{m_1}{m_2} = \frac{V_2}{L V_1} \qquad (42)$$

By inserting equation (42) into equation (40) we obtain:

$$X_2 = \frac{1}{1 + \frac{V_2}{L V_1}} \qquad (43)$$

From equation (35) , (39) ,and (43) the Ostwald coefficient can be expressed as shown below:

$$L = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \tag{44}$$

The constants in the latter equation can be shown to be :

$$a = 101.325\left(P_t - P_1^\circ\right) \tag{45}$$

$$b = 101.325\left(P_t - P_1^\circ\right)\frac{V_2}{V_1} - P_t\, Z\left(101.325 - P_1^\circ\right) \tag{46}$$

$$c = -101.325\, P_t \cdot Z \cdot \frac{V_2}{V_1} \tag{47}$$

The slope of the absorption rate of (dry gas - solvent rate) relation , Z , is :

$$Z = \frac{V_g}{\theta \cdot F} \tag{48}$$

The value of Z was calculated by applying the least-squares method using the data obtained from the above experiments. The mole fraction solubility, X_2 , was finally obtained by inserting equation (44) in equation (43). The basic computer program and the detailed results of the calculations are given in the Appendix.

RESULTS AND DISCUSSION

Sulfur dioxide and hydrogen sulfide solubilities corresponding to a gas partial pressure of one atmosphere (101.325 kPa) and for temperatures of -5 °C ,25 °C, and 60 °C in the solvents, n-hexane, acetone, methanol, dimethylformamide, N-N-dimethylacetamide, acetonitrile, ethylacetate, chlorobenzene, and ethylene glycol are listed in tables 3 and 5 as Ostwald coefficients. In tables 2 and 4 the results are listed as mole fractions and graphically indicated in figures 3 and 4. The solubilities were not obtained in methanol, n-hexane, acetone at 60 °C because these solvents are above or near their normal boiling points at that temperature. Also, in tables 2 and 4 the average solubility is given for each system. For the purpose of confirming the accuracy of the experimental method , certain solubilities reported by Horiuti[25] were available for comparison. The solubilities of sulfur dioxide in chlorobenzene at 25 °C and 60 °C, as reported by Horiuti, are 0.182 and 0.0614 mole fraction, respectively ; the values of Horiuti may be compared with those from this work which are listed in the same order and are, 0.1848 and 0.0617 mole fraction, respectively. The deviation between the two results are 1.5% and 0.33%, respectively. The solubility of hydrogen sulfide in chlorobenzene at 25 °C was previously reported (Sahgal and Hayduk [7]) to be 0.0505 mole fraction . The solubility from this work is 0.05055 , with a

TABLE 2

SULFUR DIOXIDE SOLUBILITY , MOLE FRACTION , X_2

Solvent	Temp. K	1	2	3	Avg.
Ethylacetate	268.15	.8101	.8101		.8101
	298.15	.4351	.4397	-	.4374
	333.15	.220	.2145	.2196	.2198
Acetonitrile	268.15	.8096	.8120	.8077	.8098
	298.15	.3655	.3657	.3657	.3656
	333.15	.1518	.1545	.1524	.1529
Dimethylformamide	268.15	.8593	.8595	.8595	.8594
	298.15	.5875	.5916	.5927	.5906
	333.15	.3879	.3880	.3878	.3879
Dimethylacetamide	268.15	.8594	.8590	.8608	.8597
	298.15	.5969	.5901		.5935
	333.15	.4096	.4088	.4073	.4085
n-Hexane	268.15	.8989	.900	.9011	.900
	298.15	.6265	.6306	.6291	.6287
Acetone	268.15	.8350	.833	.835	.834
	298.15	.4494	.4488		.4491
Methanol	268.15	.699	.695	.698	.697
	298.15	.2584	.2568		.2576
Chlorobenzene	268.15	.7353	.739	.7365	.7369
	298.15	.1861	.1835		.1848
	333.15	.0616	.0618		.0617
Ethylene glycol	268.15	.535	.5354		.535
	298.15	.187	.1865	.1869	.1868
	333.15	.0671	.06763	.06629	.06701

TABLE 3

SULFUR DIOXIDE SOLUBILITY , OSTWALD COEFFICIENT , L

Solvent	Temp. K	1	2	3	Avg.
Ethylacetate	268.15	968.2	967.9		968.05
	298.15	202.9	188	191.6	194.17
	333.15	71.3	73.4	73.6	72.77
Acetonitrile	268.15	1779.6	1826.2	1798	1800.3
	298.15	262.3	262.6		262.45
	333.15	87.1	88.9	87.5	87.83
Dimethyl-formamide	268.15	1761.6	1760.7	1758	1760.1
	298.15	450	452.1	442.4	448.2
	333.15	213.6	213.67	213.8	213.7
Dimethyl-acetamide	268.15	1432.5	1455.8	1460	1449
	298.15	383	372.4		377.7
	333.15	193	194	194.9	194
n-Hexane	268.15	1510	1546	1510	1533
	298.15	309.8	311.7	306.3	309
Acetone	268.15	1524	1547.9	1551	1540.97
	298.15	265.5	264.7		265.1
Methanol	268.15	1267	1241.7	1262.9	1257.2
	298.15	205.9	204.2		205

TABLE 3 (CONTINUED)

SULFUR DIOXIDE SOLUBILITY , OSTWALD COEFFICIENT , L

Solvent	Temp. K	1	2	3	Avg.
Chlorobenzene	268.15	602.9	607.5	610.6	607
	298.15	53.78	52.9		53.34
	333.15	16.93	16.99		16.96
Ethylene glycol	268.15	449.9	449.2		449.6
	298.15	98.9	98.6	98.8	98.8
	333.15	33.99	34.28	33.55	33.94

TABLE 4

HYDROGEN SULFIDE SOLUBILITY , MOLE FRACTION , X_2

Solvent	Temp. K	1	2	3	Avg.
n-Hexane	268.15	.0951	.0943	.09444	.0946
	298.15	.0370	.03656		.0368
Ethylacetate	268.15	.1853	.1874	.1840	.1855
	298.15	.08546	.08603		.08574
	333.15	.04035	.04041		.0404
Acetonitrile	268.15	.1030	.1026	.1022	.1026
	298.15	.0463	.04717		.04673
	333.15	.02098	.02077		.02088
Dimethylformamide	268.15	.2509	.2500	.2513	.2507
	298.15	.1162	.1150		.1156
	333.15	.05436	.05412	.0537	.0541
Dimethylacetamide	268.15	.2999	.3018	.3009	.3009
	298.15	.1457	.1456		.1456
	333.15	.06617	.06662		.0664
Chlorobenzene	298.15	.0506	.0505		.05055

TABLE 5

HYDROGEN SULFIDE SOLUBILITY , OSTWALD COEFF. , L

Solvent	Temp. K	1	2	3	Avg.
Ethylacetate	268.15	53.33	53	51.88	52.74
	298.15	23.17	23		23.08
	333.15	11.03	11.05	13.23	11.77
Dimethyl-formamide	268.15	97.7	97.2	97.9	97.6
	298.15	40.7	41.23		40.97
	333.15	19.5	19.4	19.24	19.38
Dimethyl-acetamide	268.15	103.8	104.7	104.3	104.3
	298.15	44.5	44.5		44.5
	333.15	20	20.2		20.1
Acetonitrile	268.15	49.24	49.05	48.84	49.04
	298.15	22.3	22.7		22.5
	333.15	10.38	10.48		10.43
n-Hexane	268.15	17.9	17.9	18	17.9
	298.15	6.99	7.08		7.04
Chlorobenzene	298.15	12.65	12.64		12.645

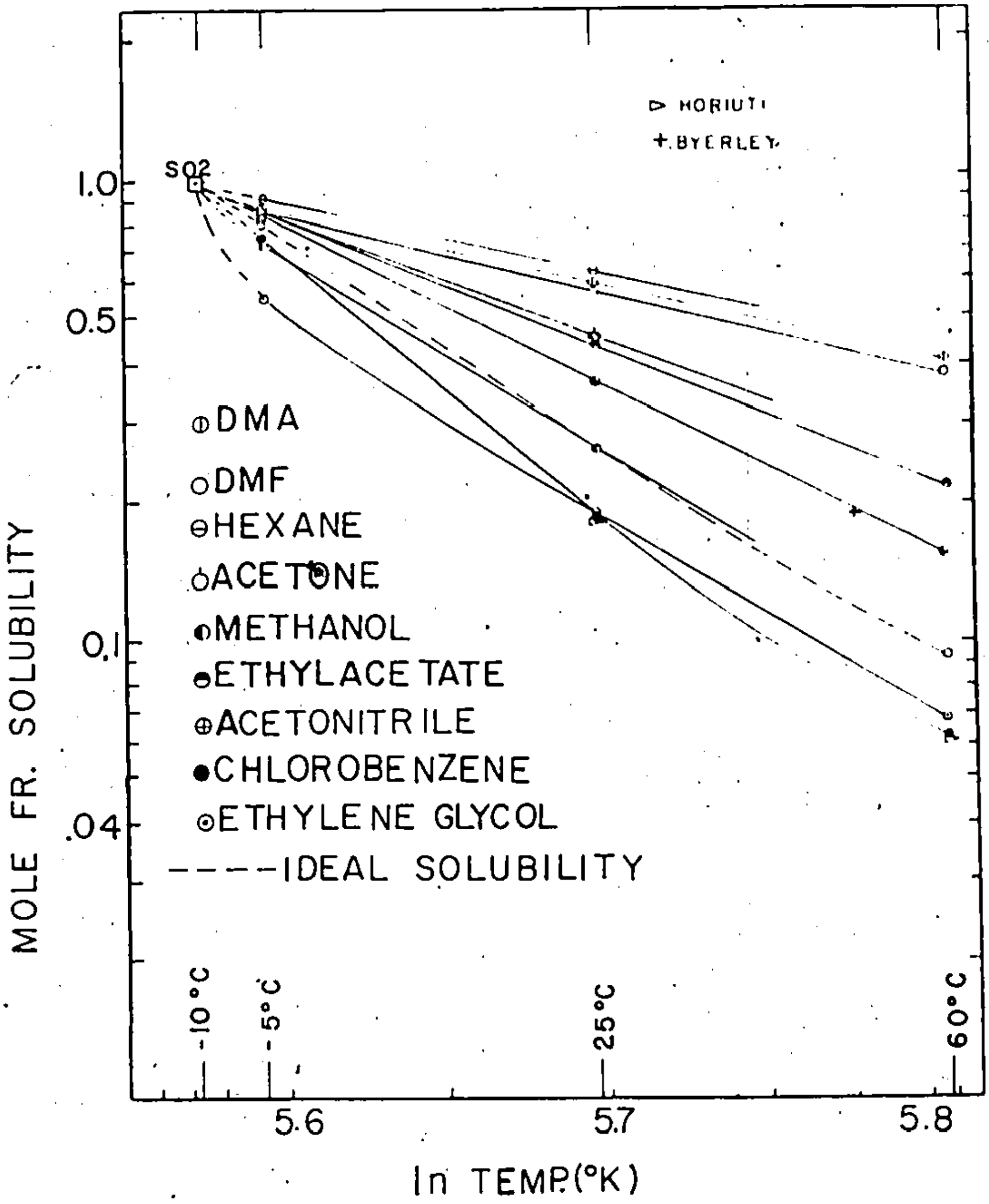

Figure 3

Solubilities of sulfur dioxide

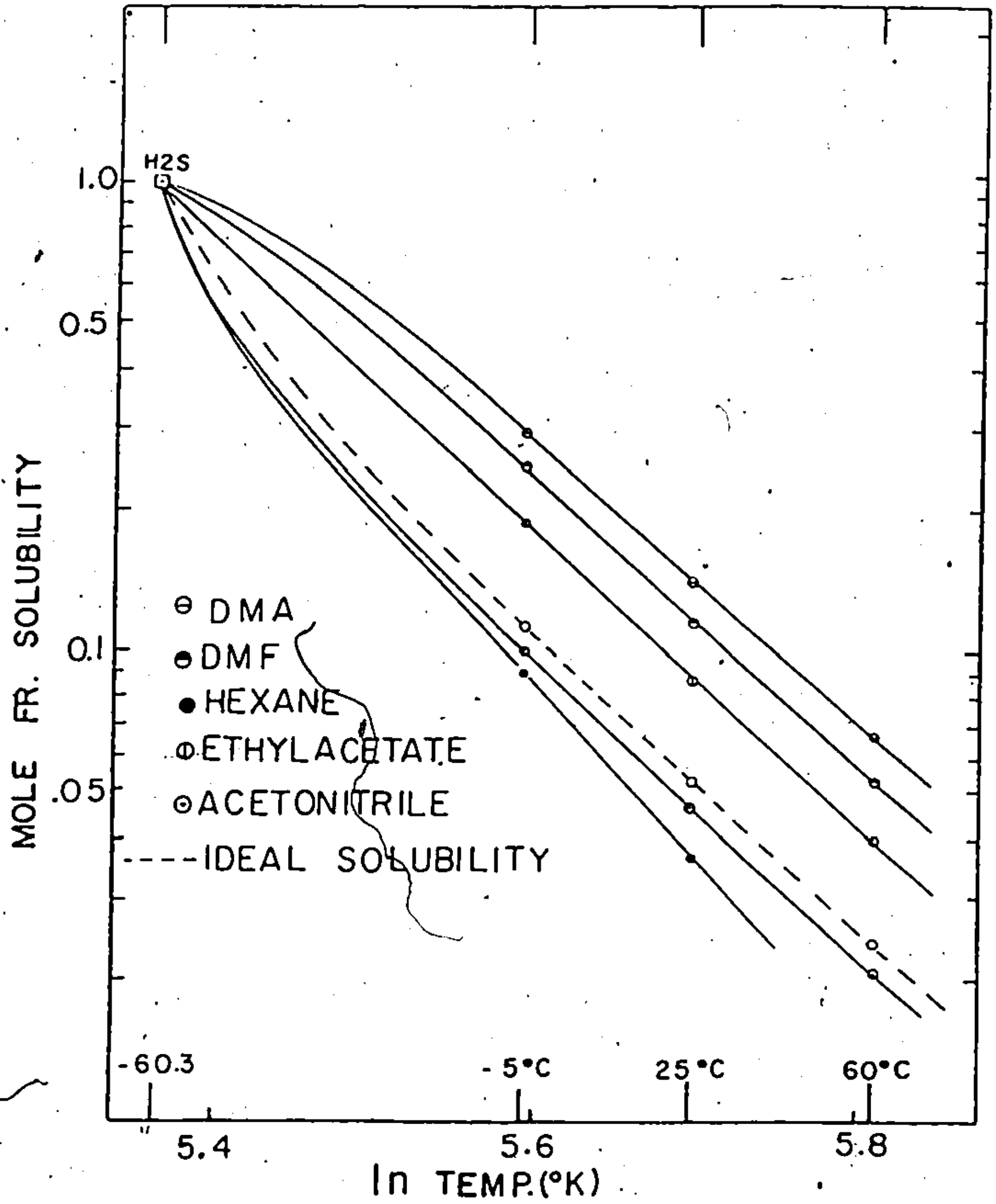

Figure 4

Solubilities of hydrogen sulfide

deviation of 0.1% . Solubility of sulfur dioxide in acetonitrile at 50 °C from this work as obtained by interpolating is 0.183 mole fraction while the value obtained by Byerley and Rempel [27] is 0.181 mole fraction. The deviation between the last two results is 1.1% . Also, the solubility of sulfur dioxide in acetone at 25 °C, as reported in the work of Horiuti is 0.451 mole fraction, and that from this work is 0.449 mole fraction. the deviation is 0.4% .All these comparisons show deviations from previously reported solubilities of less than 2%. It is considered that the apparatus used and method followed give results which are of good accuracy. Figure 4 shows that the solubility of hydrogen sulfide in n-hexane at 20 °C is about 0.041 mole fraction ; a comparable value was reported by Stephen and Stephen [29] as 0.0341 mole fraction. The deviation is large, with the previously reported value being 17% lower than that obtained in this work. Also, the solubility of sulfur dioxide in methanol at 25 °C from this work is 0.2576 mole fraction, while that from [29] is 0.201 mole fraction obtained by interpolation. The difference again is high, with the previously reported value being 22% lower than that obtained in this work. There is no apparent reason for these discrepancies . Common sources of error in the measurement of gas solubilities result in solubilities which are too low. In the case of the large deviations mentioned above, it is considered likely that the results previously reported are incorrect. In figures 3 and

4 are shown the gas solubilities which may be observed to increase with decreasing temperature ; in other words, the mole fractions solubility tend to become higher as the equilibrium temperature is reduced toward the boiling point of the gas. Large differences are observed for the solubilities of both gases in the various solvents. The results of the experiments show that the solubilities of sulfur dioxide are significantly higher in all solvents than the results for hydrogen sulfide. This is consistent with the observation that solubilities of gases increase in most solvents in the order of increasing normal boiling point. In figures 3 and 4 the ideal gas solubilities have been shown by a dashed line. In figure 3 it is observed that except for chlorobenzene and ethylene glycol, all the solubilities of sulfur dioxide are higher than the ideal solubility. This suggests that some strong association or chemical reaction occurs between sulfur dioxide and these solvents. It is difficult to explain the actual solubilities of sulfur dioxide in chlorobenzene and ethylene glycol. On the one hand chlorobenzene is only slightly polar, while on the other, ethylene glycol is highly self-associated.

The highest solubility of sulfur dioxide in the solvents used was obtained in n-hexane. Although n-hexane is a non-polar solvent, the solubility of sulfur dioxide in it is a maximum value among the solvents used. It has been postulated that for most gas solubilities above the ideal, a chemical association occurs between the gas and solvent.

Thus one may postulate that there is an association between sulfur dioxide and n-hexane which results in a usually high solubility. On the other hand, strong molecular self-association in the solvent often results in a reduced gas solubility. Thus the solubility of most gases is unusually low in ethylene glycol. There is a noticeable increase in sulfur dioxide solubility as the degree of molecular association in the solvent increases [28]. The solubility of the polar gas seems to increase as the polarity of solvent increases. These statements appear to be true for hydrogen sulfide as may be observed in figure 4. Also, as the polarity and association of solvent increases , so does the solubility of hydrogen sulfide. The solvents chlorobenzene, methanol, acetonitrile, ethylacetate, acetone, dimethylformamide, and N-N-dimethylacetamide are in the order of increasing gas solubility corresponding to figure 3 and are at the same time, in the order of increasing polarity and degree of association.

In figures 3 and 4 it can be observed that the solubilities have a general tendency to change with temperature in a way similar to that for the ideal gas solubility. It would also appear that as the temperature decreases toward the gas normal boiling point, the solubilities of most of these gases approach a mole fraction of unity. With an increase in temperature, sulfur dioxide is more soluble than hydrogen sulfide. This is probably due to the fact that sulfur dioxide is a more reactive and polar gas. In table 6 the ratios of gas solubilities for sulfur dioxide to those of hydrogen sulfide in the same solvents and temperatures are shown. This comparison of solubilities may be used for choosing the best solvent to separate these two gases from each other. It should be noted, however, that there are several other considerations for selecting the best solvent. As table 6 shows, the largest ratio of solubility of sulfur dioxide to that of hydrogen sulfide occurs for the solvent ethylene glycol. Thus it can be concluded that ethylene glycol is the most effective solvent when compared with the other solvents used in this work for separating sulfur dioxide from hydrogen sulfide in the gas phase.

The hydrogen-bonding factor (H.B.F) is considered to be a measure of the effect of molecular association on gas solubility. The relation between the various H.B.F can be used to estimate solubilities in these and other associated solvents [16]. In figures 5 and 6 is shown the relation between H.B.F for a number of gases in ethylacetate, dimethylformamide, N-N-dimethlacetamide, acetone, ethylene glycol, and methanol at 25°C. The solvents dimethylformamide and acetone which are highly polar and associated were selected as reference solvents. The new data obtained in this research were converted into H.B.F and shown in these figures. From figures 5 and 6 it may be observed that for the solvents shown, except for the H.B.F of ethylene glycol and methanol for sulfur dioxide, the remainder are greater

TABLE 6

RATIO SOLUBILITY OF SULFUR DIOXIDE TO HYDROGEN SULFIDE

Solvent	Temp. K	Ratio Solubility
n-Hexane	268.15	3.144
	298.15	4.65
Ethylacetate	268.15	4.367
	298.15	5.10
	333.15	5.44
Acetonitrile	268.15	7.89
	298.15	7.83
	333.15	6.07
Dimethylformamide	268.15	3.43
	298.15	5.10
	333.15	7.17
Dimethylacetamide	268.15	2.89
	298.15	4.074
	333.15	6.15
Chlorobenzene	298.15	3.66
	333.15	2.06
Acetone	298.15	6.43
Ethylene glycol	298.15	15.31
	333.15	9.33
Methanol	298.15	9.33

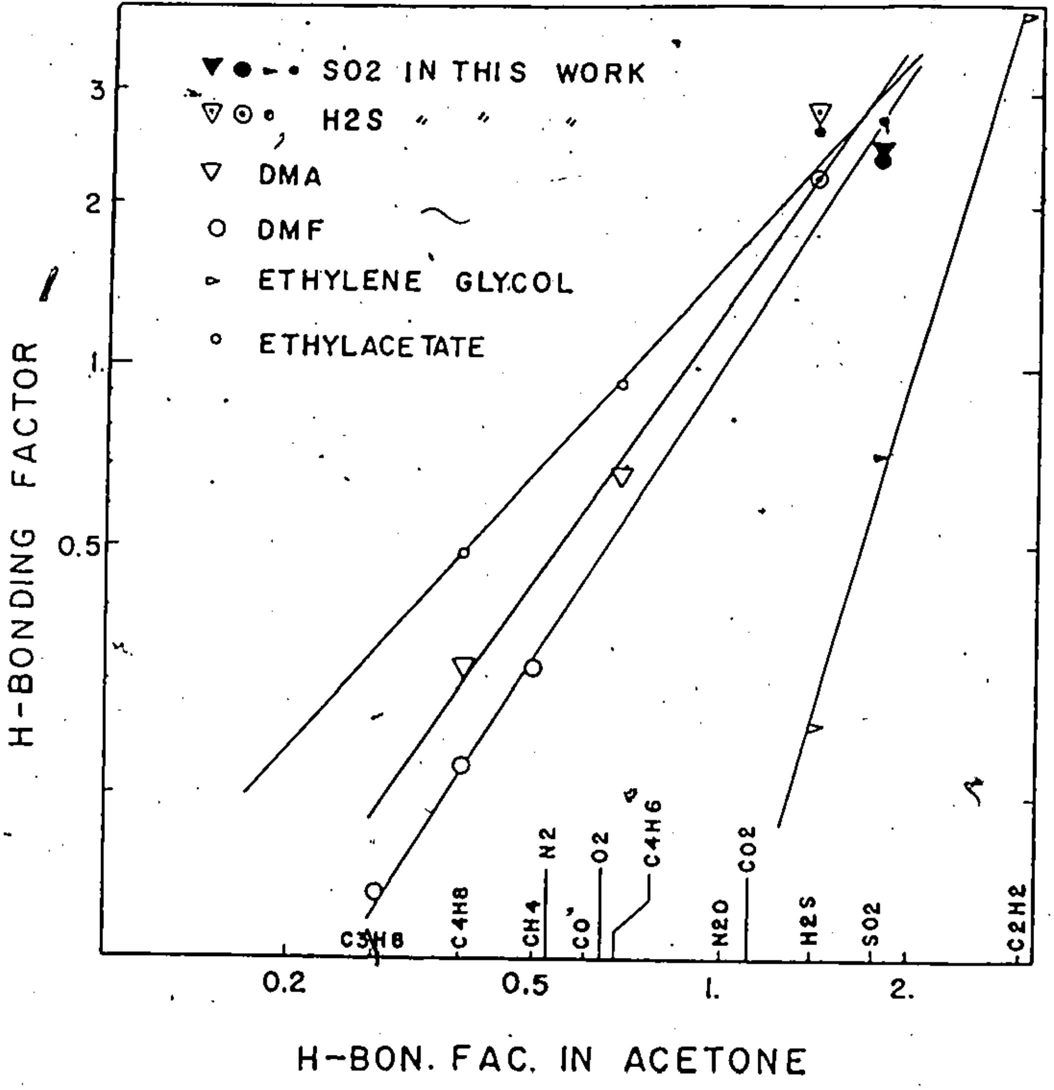

Figure 5

Hydrogen-bonding factor correlation

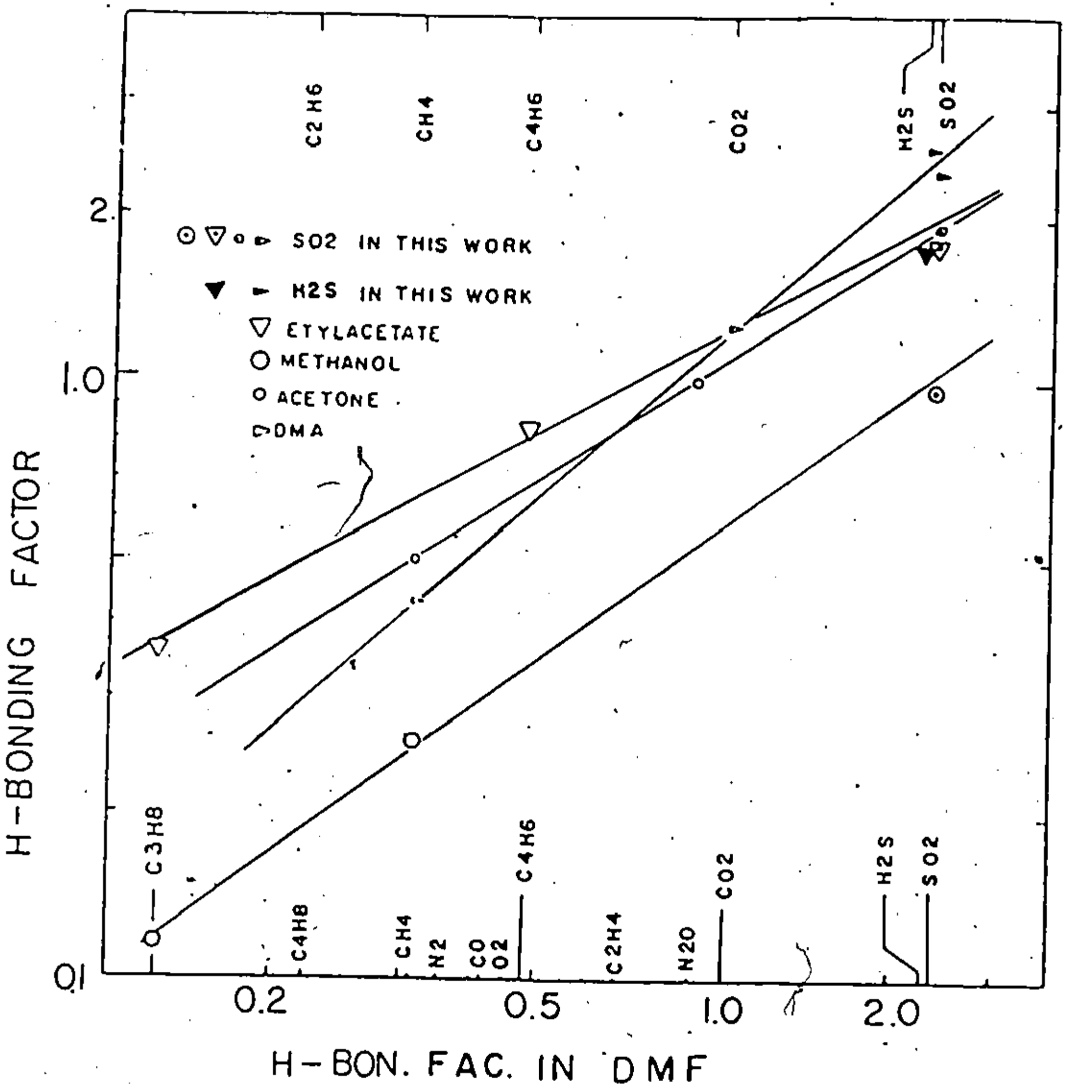

Figure 6

Hydrogen-bonding factor correlation

than one. Such high solubilities suggest that some chemical bonding occurs between these solvents and gases. These figures also indicate that it is possible to estimate the gas solubility from the relationship between H.B.F in the solvents shown, provided that the solubility is known in at least one of them. Data for the H.B.F, shown in figures 5 and 6 are from sources given in table 7 ; the H.B.F obtained from this work are shown in tables 8 and 9.

The gases sulfur dioxide and hydrogen sulfide are toxic and perilous to human health. Hydrogen sulfide is both an irritant and an asphyxiant. At concentrations above 150 ppm the action of the gas on the nervous system becomes more pronounced . Exposure to 500 ppm results in a headache, and at 800-1000 ppm may be fatal in 30 minutes. Sulfur dioxide is dangerous to the eyes because it causes irritation and inflammation. It combines with water to form sulfurous acid. At a concentration of 6-12 ppm it causes immediate irritation of the nose and throat and with concentration of 400-500 ppm it is immediately dangerous to life. Maximum permissible concentration for exposures of 30-60 minute is 50-100 ppm [30].

For the above reasons all experiments involving hydrogen sulfide and sulfur dioxide were accomplished under a large fume hood for safety reasons. The gases discharged from the apparatus which had a high concentration of sulfur dioxide or hydrogen sulfide, were neutralized before coming out of the apparatus. An absorber solution was used at the source of discharge of the gases for this purpose. The gases were diluted by means of dry air for improving the absorption. For absorbing sulfur dioxide, a solution of potassium permanganate (10 N), and for hydrogen sulfide a solution of lead acetate(10% aqueous acetic acid solution) was used, both of which had a high capacity for absorbing these reactive gases.

TABLE 7

SOLUBILITY DATA SOURCES FOR FIGURES 5, AND 6

Solvent	Gases and Sources
Methanol	: C_3H_8, CH_4 (27), SO_2 (This work)
Acetone	: N_2O, CH_4, N_2, C_2H_2, O_2 (23) CO, CO_2 (Gjaldbaek and Anderson, 1954) C_3H_8 (19), H_2S (6), SO_2 (This work)
Ethylacetate	C_4H_8, C_4H_6 (3), C_2H_6 (Mc Daniel, 1911) SO_2, H_2S (This work)
Dimethylformamide	: C_2H_2, C_2H_6, C_3H_8, CH_4, CO_2 (Howard et al., 1954) C_4H_8 (3), SO_2, H_2S (This work)
Ethylene glycol	: C_2H_2 (26), H_2S (6), SO_2 (This work)

TABLE 8

HYDROGEN-BONDING FACTORS FOR SULFUR DIOXIDE, α

Solvent	Temp. K	X_2	X_2^i	α
Ethylacetate	268.15	.8101	.8038	1.008
	298.15	.4374	.2584	1.69
	333.15	.2198	.09187	2.392
Acetonitrile	268.15	.8098	.8036	1.008
	298.15	.3656	.2584	1.42
	333.15	.1529	.09187	1.66
Dimethylformamide	268.15	.8594	.8036	1.07
	298.15	.5906	.2584	2.29
	333.15	.3879	.09187	4.22
Dimrethylacetamide	268.15	.8598	.8036	1.07
	298.15	.5935	.2584	2.3
	333.15	.4085	.09187	4.45
n-Hexane	268.15	.9000	.8036	1.12
	298.15	.6287	.2584	2.43
Acetone	268.15	.834	.8036	1.038
	298.15	.4491	.2584	1.74

TABLE 8 (CONTINUED)

HYDROGEN-BONDING FACTORS FOR SULFUR DIOXIDE , α

Solvent	Temp. K	X_2	X_2^i	α
Methanol	268.15	.697	.8036	.867
	298.15	.2576	.2584	.997
Chlorobenzene	268.15	.7369	.8036	.917
	298.15	.1847	.2584	.72
	333.15	.0617	.09187	.67
Ethylene glycol	268.15	.535	.8036	.67
	298.15	.1868	.2584	.72
	333.15	.06701	.09187	.73

TABLE 9

HYDROGEN-BONDING FACTORS FOR HYDROGEN SULFIDE , α

Solvent	Temp. K	X_2	X_2^i	α
n-Hexane	268.15	.2862	.1145	2.5
	298.15	.1351	.0512	2.64
Ethylacetate	268.15	.1855	.1145	1.62
	298.15	.08574	.0512	1.67
	333.15	.0404	.02445	1.65
Acetonitrile	268.15	.1026	.1145	.90
	298.15	.0467	.0512	.91
	333.15	.02517	.02445	1.03
Dimethylformamide	268.15	.2507	.1145	2.19
	298.15	.1156	.0512	2.26
	333.15	.0541	.02445	1.85
Dimethylacetamide	268.15	.3009	.1145	2.63
	298.15	.14565	.0512	2.84
	333.15	.0664	.02445	2.72
Chlorobenzene	298.15	.05055	.0512	.99

CONCLUSIONS

In this work it was found that the solubility of sulfur dioxide is much higher than that of hydrogen sulfide. In the same solvent and temperature it is higher by a factor which varies from 3 to 7.5 . This result indicates that the tendency for sulfur dioxide to combine with the solvents used is greater than that for hydrogen sulfide in the same solvents and at the same temperatures. It was also found that the gas solubilities of the two gases studied had the maximum difference in ethylene glycol solvent. Thus this solvent was the most suitable absorbing solvent for separating sulfur dioxide from hydrogen sulfide. The plot of hydrogen-bonding factor in one solvent versus those in the other solvents was useful as a semi-empirical correlation for relating solubilities of sulfur dioxide and hydrogen sulfide in polar or associating solvents.

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APPENDIX

```
10      COMPUTER PROGRAM AND CALCULATION PRINTOUTS
20      ****************************************************
30   MAJOR PARAMETERS IN THE PROGRAM
40   TR = ROOM TEMPERATURE °C
50   TE = EXPRIMENTAL TEMPERATURE °C
60   V1 = SOLUTE GAS MOLAR VOLUME  CM³
70   V2 = SOLVENT MOLAR VOLUME  CM³
80   DR = DENSITY OF SOLVENT AT ROOM TEMP.  G/CM³
90   DE = DENSITY OF SOLVENT AT EXPERIMENTAL TEMP.  G/CM³
100  PA = ATMOSPHERIC PRESSURE  KPA
110  PO2= SOLVENT VAPOR PRESSURE  KPA
120  FR = INFUTION RATE  CM³/MIN.
130   S = SLOPE
140   X = MOLE FRACTION SOLUBILITY
150   L = OSTWALD COEFFICIENT
200   CLS
210   ST=0
220   SV=0
230   STT=0
240   SVV=0
250   STV=0
260   INPUT"ENTER 3 NUMBERS  :  ",G,T,V
270   IF G=0 GOTO 430
280   N=G
290   IF G>9 GOTO 330
300   T(G)=T
310   V(G)=V
320   GOTO 360
330   M=G-9
340   P(M)=T
350   Q(M)=V
360   IF G<4 GOTO 210
370   ST=ST+T
380   STT=STT+T*T
390   SV=SV+V
400   SVV=SVV+V*V
410   STV=STV+V*T
420   GOTO 260
430   N=N-3
440   K=M
450   S=(N*STV-ST*SV)/(N*STT-ST*ST)
460   V0=(SV*STT-ST*STV)/(N*STT-ST*ST)
470   INPUT"ENTER 10 NUMBERS  : ",TE,TR,PA,V1,DD,DE,D25,PO2,FR,M
480   INPUT"WHAT IS THE SYSTEM :",SYS$
490   PA=PA*101.325/760
500   V2=M/DE
```

```
510  DR=D25+(25-TR)*DD
520  PO2=PO2*101.325/760
530  F=FR*DR/DE
540  A=101.325*(PA-PO2)
550  B=101.325*(PA-PO2)*V1/V2-PA*S*(101.325-PO2)/F
560  C=-101.325*PA*S*V1/(F*V2)
570  L=(-B+(B^2-4*A*C)^.5)/(2*A)
580  X=1/(1+V1/(V2*L))
590 LPRINT." "
600 LPRINT  SYS$
610 LPRINT " "
620 LPRINT TAB(5) "TR = " TAB(10) TR TAB(30) "TE = " TAB(35) TE
630 LPRINT TAB(5) "V1 = " TAB(10) V1 TAB(30) "V2 = " TAB(35) V2
640 LPRINT TAB(5) "DR = " TAB(10) DR TAB(30) "DE = " TAB(35) DE
650 LPRINT TAB(5) "PO2= " TAB(10) PO2 TAB(30) "PA = " TAB(35) PA
660 LPRINT TAB(5) "FR = " TAB(10) FR TAB(30) "R  = "  TAB(35) R
670 LPRINT TAB(5) "S  = " TAB(10) S  TAB(30) "VO = " TAB(35) VO
680 LPRINT TAB(5) "L  = " TAB(10) L  TAB(30) "X  = " TAB(35) X
690 LPRINT""
700 LPRINT " TIME IN MIN.          VOL. IN CC                DEV. IN (%)"
710 LPRINT "     0                   0                         0"
720  FOR G=1 TO 9
730  VL=S*T(G)+VO
740  DEV.=(V(G)-VL)/VL*100
750 LPRINT TAB(4) T(G) TAB(25) V(G) TAB(45) DEV.
760  NEXT G
770  FOR M=1 TO K
780  VL=S*P(M)+VO
790  DEV.=(Q(M)-VL)/VL*100
800  LPRINT TAB(4) P(M) TAB(25) Q(M) TAB(45) DEV.
810  NEXT M
820 LPRINT"  "
830  LPRINT "************************************************************"
840  END
```

```
SO2 - ETHYLENE GLYCOL

      TR =  24.8                     TE =  25
      V1 =  24047.26                 V2 =  55.91298
      DR =  1.11024                  DE =  1.1101
      PO8=  1.693194E-02             PA =  100.805
      FR =  2.923334E-04             R  =  0
      S  =  2.892607E-02             VO = -.2622215
      L  =  98.94999                 X  =  .1870391

   TIME-IN SEC.            VOL. IN CC                DEV. IN (%)
      0                        0                          0
      146                      4                       .9849837
      284                      8                       .5937213
      424                      12                     -2.026942E-02
      562                      16                      3.608375E-02
      701                      20                     -.0747122
      839                      24                     -2.812548E-02
      977                      28                      5.18417E-03
      1115                     32                      3.018098E-02
      1253                     36                      4.962628E-02
      1392                     40                     -7.171117E-03
      1530                     44                      .0121218
      1669                     48                     -3.204908E-02

*****************************************************************************

SO2 - ETHYLENE GLYCOL

      TR =  24.1                     TE =  25
      V1 =  24047.26                 V2 =  55.91298
      DR =  1.11073                  DE =  1.1101
      PO2=  1.693194E-02             PA =  99.80511
      FR =  2.923334E-04             R  =  0
      S  =  .0288426                 VO = -.1114127
      L  =  98.62108                 X  =  .1865334

   TIME-IN SEC.            VOL. IN CC                DEV. IN (%)
      0                        0                          0
      144                      4                      -1.03717
      284                      8                      -.9886841
      421                      12                     -.2603253
      559                      16                     -7.245056E-02
      698                      20                     -.1035
      836                      24                     -4.164205E-03
      974                      28                      6.691094E-02
      1113                     32                      3.001398E-02
      1251                     36                      8.152078E-02
      1390                     40                      5.053212E-02
      1530                     44                     -4.035014E-02
      1669                     48                     -5.598112E-02

*****************************************************************************
```

```
SO2 - ETHYLENE GLYCOL

    TR =  23.6                       TE =  25
    V1 =  24047.26                   V2 =  55.91298
    DR =  1.11108                    DE =  1.1101
    PO2=  1.693194E-02               PA =  99.99178
    FR =  2.923334E-04               R  =  0
    S  =  2.892963E-02               VO = -.1281985
    L  =  98.88728                   X  =  .1869427

 TIME IN SEC.          VOL. IN CC              DEV. IN (%)
    0                      0                       0
    107                    3                    1.102981
    212                    6                   -8.131404E-02
    316                    9                   -.1504855
    420                    12                  -.1850354
    523                    15                  -1.331152E-02
    626                    18                   .1014997
    730                    21                   4.548824E-02
    834                    24                   3.703572E-03
    938                    27                  -2.880621E-02
    1041                   30                   4.153307E-02
    1249                   36                  -1.762309E-02
    1456                   42                   1.584076E-02
    1664                   48                  -2.179511E-02

****************************************************************************

SO2 - ETHYLENE GLYCOL

    TR =  24.3                       TE =  60
    V1 =  27021.1                    V2 =  57.17484
    DR =  1.11059                    DE =  1.0856
    PO2=  .2195819                   PA =  99.55181
    FR =  2.923334E-04               R  =  0
    S  =  1.014694E-02               VO =  .1316301
    L  =  33.99881                   X  =  6.711127E-02

 TIME IN SEC.          VOL. IN CC              DEV. IN (%)
    0                      0                       0
    382                    4                   -.1936849
    673                    7                    .5671538
    870                    9                    .4523621
    1168                   12                   .1396936
    1465                   15                   2.065449E-02
    1761                   18                  -2.214595E-03
    2057                   21                  -1.853418E-02
    2353                   24                  -3.077831E-02
    2649                   27                  -4.029239E-02
    2945                   30                  -4.770871E-02
    3240                   33                  -2.341445E-02
    3536                   36                  -3.116484E-02
    3827                   39                   9.243037E-02

****************************************************************************
```

```
SO2 - ETHYLENE GLYCOL

     TR =   25                          TE =   60
     VI =   27021.1                     V2 =   57.17484
     DR =   1.1101                      DE =   1.0856
     PO2=   .2195819                    PA =   99.65847
     FR =   2.923334E-04                R  =   0
     S  =   1.022727E-02                VO =   .1272727
     L  =   34.28346                    X  =   6.763516E-02

  TIME IN SEC.            VOL. IN CC                DEV. IN (%)
     0                        0                          0
     287                      3                       -2.040816
     577                      6                       -.4712443
     870                      9                       -.2770041
     1162                     12                      -9.460233E-02
     1454                     15                       1.515936E-02
     1747                     18                       3.157659E-02
     2040                     21                       4.330648E-02
     2334                     24                       9.474062E-03
     2628                     27                      -1.683128E-02
     2921                     30                      -3.789122E-03
     3214                     33                       6.890049E-03
     3508                     36                      -.0126187

************************************************************
```

```
SO2 - ETHYLENE GLYCOL

     TR =   25.5                        TE =   60
     VI =   27021.1                     V2 =   57.17484
     DR =   1.10975                     DE =   1.0856
     PO2=   .2195819                    PA =   100.2984
     FR =   2.923334E-04                R  =   0
     S  =   .0100073                    VO =   .4816305
     L  =   33.5561                     X  =   6.629533E-02

  TIME IN SEC.            VOL. IN CC                DEV. IN (%)
     0                        0                          0
     289                      3                       -11.07811
     580                      6                       -4.547835
     885                      9                       -3.620626
     1179                     12                      -2.282063
     1474                     15                      -1.525664
     1767                     18                      -.9057959
     2061                     21                      -.505423
     2355                     24                      -.2030216
     2648                     27                       7.055807E-02
     2940                     30                       .324069
     3233                     33                       .5018031
     3527                     36                       .6222421
     3821                     39                       .7243778

************************************************************
```

```
SO2 - ETHYLENE GLYCOL

     TR =  27.2                    TE = -5
     V1 =  21423.7                 V2 =  54.8749
     DR =  1.10856                 DE =  1.1311
     PO2=  1.039914E-03            PA =  99.23184
     FR =  1.464333E-04            R  =  0
     S  =  6.456781E-02            VO = -.2982553
     L  =  449.9033                X  =  .5353996

 TIME IN SEC.            VOL. IN CC                  DEV. IN (%)
     0                       0                            0
     65                      4                         2.599569
     128                     8                         .4214751
     190                     12                        .2537474
     252                     16                        .1700905
     314                     20                        .1197729
     377                     24                       -.1321928
     439                     28                       -.167613
     500                     32                        4.487859E-02
     562                     36                        3.098203E-02
     624                     40                        1.986098E-02
     686                     44                        1.077768E-02
     748                     48                        5.202057E-03

*************************************************************************

SO2 - ETHYLENE GLYCOL

     TR =  23.4                    TE = -5
     V1 =  21423.7                 V2 =  54.8749
     DR =  1.10982                 DE =  1.1311
     PO2=  1.039914E-03            PA =  100.3517
     FR =  1.464333E-04            R  =  0
     S  =  6.455023E-02            VO = -4.561843E-02
     L  =  449.2703                X  =  .5350493

 TIME IN SEC.            VOL. IN CC                  DEV. IN (%)
     0                       0                            0
     64                      4                        -2.09507
     127                     8                        -1.867701
     186                     12                       -.3283758
     248                     16                        .2327961
     311                     20                       -.1472971
     373                     24                       -.1315609
     435                     28                       -.1203246
     496                     32                        8.978553E-02
     558                     36                        7.392198E-02
     620                     40                        6.123476E-02
     682                     44                        5.085667E-02
     745                     48                       -9.220673E-02

*************************************************************************
```

```
SO2 - n-HEXANE

    TR =  24.9                    TE = -5
    V1 =  21423.7                 V2 =  127.6959
    DR =  .6545                   DE =  .6827
    PO2=  4.595622                PA =  101.0983
    FR =  1.464333E-04            R  =  0
    S  =  .2109776                VO =  2.897228
    L  =  1510.154                X  =  .9000128

 TIME IN SEC.            VOL. IN CC              DEV. IN (%)
    0                        0                       0
    95                       20                   -12.81644
    188                      40                   -6.017298
    281                      60                   -3.508964
    373                      80                   -1.951028
    465                      100                  -.9918865
    556                      120                  -.1670395
    648                      140                   .2788231
    740                      160                   .6158472
    835                      180                   .5229692
    926                      200                   .8763572
    1018                     220                   1.069288
    1110                     240                   1.230628
    1202                     250                  -2.531202

********************************************************

SO2 - n-HEXANE

    TR =  24                      TE = -5
    V1 =  21423.7                 V2 =  126.2312
    DR =  .6554                   DE =  .6827
    PO2=  4.595622                PA =  100.9784
    FR =  1.464333E-04            R  =  0
    S  =  .2162916                VO =  1.049656
    L  =  1546.074                X  =  .9010848

 TIME IN SEC.            VOL. IN CC              DEV. IN (%)
    0                        0                       0
    90                       20                   -2.514634
    182                      40                   -1.026185
    273                      60                   -.1618432
    365                      80                    4.883051E-03
    458                      100                  -.1110825
    550                      120                  -8.366202E-03
    643                      140                  -8.931486E-02
    734                      160                   .1203362
    826                      180                   .1633149
    920                      200                  -1.896308E-02
    1013                     220                  -6.951785E-02
    1105                     240                  -2.161195E-02
    1151                     250                  -5.126927E-04

********************************************************
```

```
SO2 - n-HEXANE

    TR =  24.9                    TE = -5
    V1 =  21423.7                 V2 =  126.2312
    DR =  .6545                   DE =  .6827
    PO2=  4.595622                PA =  101.0983
    FR =  1.464333E-04            R  =  0
    S  =  .2109776                VO =  2.897228
    L  =  1510.227                X  =  .898974

  TIME IN SEC.          VOL. IN CC            DEV. IN (%)
     0                     0                      0
     95                    20                  -12.81644
     188                   40                  -6.017298
     281                   60                  -3.508964
     373                   80                  -1.951028
     465                   100                 -.9910865
     556                   120                 -.1670395
     648                   140                  .2708231
     740                   160                  .6158472
     835                   180                  .5229692
     926                   200                  .8763572
     1018                  220                  1.069288
     1110                  240                  1.230628
     1202                  250                 -2.531202

***********************************************************************

SO2 -  n-HEXANE

    TR =  25                      TE =  25
    V1 =  24047.26                V2 =  131.6901
    DR =  .6544                   DE =  .6544
    PO2=  20.16901                PA =  99.27184
    FR =  2.923334E-04            R  =  0
    S  =  8.152603E-02            VO =  .4157521
    L  =  306.3392                X  =  .6265321

  TIME IN SEC..         VOL. IN CC            DEV. IN (%)
     0                     0                      0
     118                   10                  -.3569595
     242                   20                  -.7200283
     363                   30                  -3.232547E-02
     485                   40                   .1104333
     731                   60                  -1.879021E-02
     976                   80                   1.857149E-02
     1222                  100                 -.0405338
     1468                  120                 -7.989852E-02
     1712                  140                  8.349435E-03
     1957                  160                  2.363764E-02
     2203                  180                 -9.773148E-03
     2447                  200                  4.504097E-02
     2693                  220                  1.575371E-02
     2939                  240                 -8.645099E-03
     3062                  250                 -1.937491E-02

***********************************************************************
```

```
SO2 -  n-HEXANE

    TR =   24.5                         TE =   25
    V1 =   24047.26                     V2 =   131.6901
    DR =   .6549                        DE =   .6544
    PO2=   20.16901                     PA =   99.53848
    FR =   2.923334E-04                 R  =   0
    S  =   8.314811E-02                 VO = -1.789729
    L  =   311.6956                     X  =   .6305791

  TIME IN SEC.            VOL. IN CC               DEV. IN (%)
     0                       0                         0
     127                     10                      14.02404
     253                     20                      3.913689
     378                     30                      1.213698
     500                     40                      .5421114
     622                     50                      .1434168
     745                     60                     -.2586777
     985                     80                     -.1337575
     0                       0                      -100
     1466                    120                    -8.774998E-02
     1705                    140                     1.587166E-02
     1946                    160                    -1.029862E-02
     2187                    180                    -3.064382E-02
     2427                    200                    -5.363177E-03
     2666                    220                     5.315657E-02
     2908                    240                    -2.066252E-03
     3028                    250                     6.909657E-03

*********************************************************************

SO2 -  n-HEXANE

    TR =   24                           TE =   25
    V1 =   24047.26                     V2 =   131.6901
    DR =   .6554                        DE =   .6544
    PO2=   20.16901                     PA =   99.40515
    FR =   2.923334E-04                 R  =   0
    S  =   8.265758E-02                 VO =   .321969
    L  =   309.8246                     X  =   .6291756

  TIME IN SEC.            VOL. IN CC               DEV. IN (%)
     0                       0                         0
     122                     10                     -3.903384
     242                     20                     -1.599518
     361                     30                     -.5349758
     482                     40                     -.4056526
     601                     50                      1.647976E-03
     842                     70                      .1149107
     1085                    90                     -6.052287E-03
     1327                    110                    -7.802181E-03
     1568                    130                     5.459757E-02
     1810                    150                     4.521697E-02
     2052                    170                     3.805374E-02
     2415                    200                     2.999251E-02
     2658                    220                    -1.174095E-02
     2901                    240                    -.0464859
     3021                    250                    -1.221164E-02
```

```
SO2 - ACETONE

     TR =   23.1                     TE =  25
     V1 =   24047.26                 V2 =  73.959
     DR =   .7870481                 DE =  .7853
     PO2=   4.086331                 PA =  100.6317
     FR =   2.923334E-04             R  =  0
     S  =   7.599522E-02             VO = -1.010946
     L  =   265.461                  X  =  .4494737

   TIME IN SEC.          VOL. IN CC              DEV. IN (%)
      0                      0                       0
      142                    10                     2.245563
      280                    20                   -1.320896
      416                    30                   -1.970605
      545                    40                   -1.0059
      676                    50                   -.718449
      805                    60                   -.2745888
      1062                   80                     .3814794
      1323                   100                    .4714813
      1589                   120                    .2125671
      1852                   140                    .1916464
      2117                   160                    .0807269
      2381                   180                    3.685508E-02
      2646                   200                   -.036196
      2911                   220                   -9.585576E-02
      3175                   240                   -.1139803

**************************************************************

SO2 - ACETONE

     TR =   24                       TE =  25
     V1 =   24047.26                 V2 =  73.959
     DR =   .78622                   DE =  .7853
     PO2=   4.086331                 PA =  99.99178
     FR =   2.923334E-04             R  =  0
     S  =   7.569791E-02             VO = -.6743506
     L  =   264.78                   X  =  .4408381

   TIME IN SEC.          VOL. IN CC              DEV. IN (%)
      0                      0                       0
      139                    10                     1.546976
      277                    20                   -1.448568
      408                    30                   -.6964415
      538                    40                   -.1276578
      670                    50                   -8.642731E-02
      801                    60                    6.724744E-02
      934                    70                   -3.926506E-02
      1065                   80                    7.014423E-02
      1329                   100                   7.187475E-02
      1593                   120                   7.302845E-02
      1857                   140                   7.385255E-02
      2126                   160                  -.1618717
      2388                   180                  -5.123479E-02
      2651                   200                  -4.119056E-04
      2914                   220                   4.120877E-02
      3047                   230                   9.912561E-03
```

```
SO2 - ACETONE

    TR =  25.4                TE = -5
    V1 =  21423.7             V2 =  70.22126
    DR =  .786932             DE =  .8271
    PO2=  7.199408            PA =  100.8184
    FR =  1.464333E-04        R  =  0
    S  =  .2095899            VO = -3.699273
    L  =  1524.134            X  =  .8332141

  TIME IN SEC.          VOL. IN CC             DEV. IN (%)
    0                       0                      0
    123                     20                  -9.421471
    170                     30                  -6.047459
    217                     40                  -4.264404
    263                     50                  -2.767014
    308                     60                  -1.404045
    402                     80                  -.6900523
    496                     100                 -.2566714
    592                     120                 -.3139842
    685                     140                  9.307798E-02
    776                     160                  .6653318
    866                     180                  1.234155
    960                     200                  1.262208
    1053                    220                  1.382995
    1146                    240                  1.48387
    1253                    250                 -3.443924

*********************************************************************

SO2 - ACETONE

    TR =  26.9                TE = -5
    V1 =  21423.7             V2 =  70.22126
    DR =  .785552             DE =  .8271
    PO2=  7.199408            PA =  100.7517
    FR =  1.464333E-04        R  =  0
    S  =  .2125113            VO = -39.43102
    L  =  1547.921            X  =  .8353552

  TIME IN SEC.          VOL. IN CC             DEV. IN (%)
    0                       0                      0
    114                     20                  -231.5379
    373                     40                   .4124993
    468                     60                  -4.039404E-02
    563                     80                  -.2653121
    657                     100                 -.1885096
    749                     120                  .2172156
    844                     140                  5.112126E-02
    938                     160                  5.969748E-02
    1032                    180                  6.638586E-02
    1126                    200                  7.172193E-02
    1221                    220                 -2.055353E-02
    1315                    240                 -8.862028E-03
    1363                    250                 -8.864206E-02

*********************************************************************
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```
SO2 - ACETONE

    TR =  26.9                 TE = -5
    V1 =  21423.7              V2 =  70.22126
    DR =  .783552              DE =  .8271
    PO2=  7.199408             PA =  100.7517
    FR =  1.464333E-04         R  =  0
    S  =  .2125113             VO = -39.43102
    L  =  1551.831             X  =  .8357018

 TIME IN SEC.         VOL. IN CC                DEV. IN (%)
    0                     0                          0
    114                   20                      -231.5379
    373                   40                       .4124993
    468                   60                      -4.039404E-02
    563                   80                      -.2653121
    657                   100                     -.1885096
    749                   120                      .2172156
    844                   140                      5.112126E-02
    938                   160                      5.969748E-02
    1032                  180                      6.638586E-02
    1126                  200                      7.172193E-02
    1221                  220                     -2.055338E-02
    1315                  240                     -8.862029E-03
    1363                  250                     -8.864206E-02

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SO2 - METHANOL

    TR =  24.5                 TE = -5
    V1 =  21423.7              V2 =  39.32982
    DR =  .78771               DE =  .8147
    PO2=  2.901095             PA =  101.4717
    FR =  1.464333E-04         R  =  0
    S  =  .1778828             VO =  2.831655
    L  =  1267.469             X  =  .6994137

 TIME IN SEC.         VOL. IN CC                DEV. IN (%)
    0                     0                          0
    51                    10                      -15.99234
    103                   20                      -5.453372
    154                   30                      -.7464036
    262                   50                       1.13894
    319                   60                       .7112507
    432                   80                       .4053555
    546                   100                      4.436171E-02
    661                   120                     -.3423059
    774                   140                     -.365037
    888                   160                     -.4922926
    1001                  180                     -.4932873
    1114                  200                     -.494083
    1216                  220                      .3937577
    1329                  240                      .3185661
    1386                  250                      .2497433

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```
SO2 - METHANOL

     TR =   26.1               TE = -5
     V1 =   21423.7            V2 =  39.32982
     DR =   .786398            DE =  .8147
     PO2=   2.901095           [illegible] =  99.85845
     FR =   1.464333E-04       R  =  0
     S  =   .1738767           VO =  2.907258
     L  =   1241.741           X  =  .6950846

  TIME IN SEC.          VOL. IN CC              DEV. IN (%)
     0                      0                       0
     52                     10                   -16.30992
     105                    20                   -5.501309
     159                    30                   -1.812083
     215                    40                   -.721645
     328                    60                    .1020646
     443                    80                    8.175853E-02
     559                    100                  -.1042385
     672                    120                   .2067444
     787                    140                   .1801488
     903                    160                   5.131493E-02
     1019                   180                  -.0486688
     1134                   200                  -4.171538E-02
     1249                   220                  -3.603244E-02
     1364                   240                  -.0312898
     1421                   250                   5.560612E-03

*************************************************************

SO2 - METHANOL

     TR =   26                 TE = -5
     V1 =   21423.7            V2 =  39.32982
     DR =   .78648             DE =  .8147
     PO2=   2.901095           PA =  100.5117
     FR =   1.464333E-04       R  =  0
     S  =   .1769131           VO = -2.76522
     L  =   1262.914           X  =  .6986561

  TIME IN SEC.          VOL. IN CC              DEV. IN (%)
     0                      0                       0
     59                     10                    30.33305
     116                    20                    12.63357
     174                    30                    7.075345
     230                    40                    5.471922
     342                    50                   -13.40349
     456                    80                    2.686359
     571                    100                   1.77895
     686                    120                   1.182874
     801                    140                   .7613683
     914                    160                   .67115
     1030                   180                   .3035683
     1146                   200                   1.143014E-02
     1261                   220                  -.1462148
     1377                   240                  -.3504698
     1435                   250                  -.4400715
```

```
SO2 - METHANOL

      TR  =   23.4                       TE  =   25
      V1  =   24047.26                   V2  =   40.69859
      DR  =   .788612                    DE  =   .7873
      PO2=    16.91594                   PA  =   100.5784
      FR  =   2.923334E-04               R   =   0
      S   =   .05243                     VO  =   .2660093
      L   =   205.9656                   X   =   .2584819

    TIME IN SEC.           VOL. IN CC.              DEV. IN (%)
      0                       0                          0
      186                     10                     -.1795591
      372                     20                      1.163552
      566                     30                      .1957585
      758                     40                     -1.986109E-02
      950                     50                     -.148788
      1142                    60                     -.234561
      1334                    70                     -.2957211
      1517                    80                      .2477283
      1898                    100                     .2223561
      2281                    120                     .1177838
      2472                    130                     9.782227E-02
      2664                    140                     4.322285E-02
      3049                    160                    -.0781021
      3241                    170                    -.1125907

*************************************************************************

SO2 - METHANOL

      TR  =   23                         TE  =   25
      V1  =   24047.26                   V2  =   40.69859
      DR  =   .78894                     DE  =   .7873
      PO2=    16.91594                   PA  =   98.79187
      FR  =   2.923334E-04               R   =   0
      S   =   5.180167E-02               VO  =   .4896744
      L   =   204.2173                   X   =   .2568514

    TIME IN SEC.           VOL. IN CC               DEV. IN (%)
      0                       0                          0
      190                     10                     -3.213236
      377                     20                     -9.441989E-02
      571                     30                     -.2275617
      763                     40                     -3.585483E-02
      957                     50                     -.127576
      1149                    60                     -1.631153E-02
      1341                    70                      6.330954E-02
      1726                    90                      .1119552
      2115                    110                    -4.561683E-02
      2499                    130                     4.461077E-02
      2887                    150                    -2.737694E-02
      3080                    160                    -2.424606E-02
      3272                    170                     8.985542E-03

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```
SO2 - ACETONITRILE

     TR =   25.4                      TE =  60
     V1 =   27021.1                   V2 =  55.54459
     DR =   .77662                    DE =  .7391
     PO2=   49.45326                  PA =  100.5251
     FR =   .01754                    R  =  0
     S  =   .9005098                  VO = -1.534744
     L  =   08.91821                  X  =  .15453[illegible]6

  TIME IN MIN.            VOL. IN CC              DEV. IN (%)
     0                       0                        0
     5                       3.5                    17.93226
     10                      7.5                    .3968412
     15                      11.98                  5.926162E-02
     20                      16.48                  2.759936E-02
     25                      20.97                 -3.814152E-02
     30                      25.47                 -4.140983E-02
     35                      29.98                 -1.034366E-02
     40                      34.51                  .0706068
     45                      38.99                  4.627944E-03
     50                      43.48                 -2.470871E-02
     55                      48                     1.396533E-02
     60                      52.5                   7.913399E-03
     65                      56.99                 -1.472381E-02
     70                      61.5                  -1.538261E-03

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SO2 - ACETONITRILE.

     TR =   24.8                      TE =  60
     V1 =   27021.1                   V2 =  55.54459
     DR =   .77764                    DE =  .7391
     PO2=   49.45326                  PA =  102.3916
     FR =   .01754                    R  =  0
     S  =   .9017858                  VO =  1.428571E-02
     L  =   87.48203                  X  =  .1524189

  TIME IN MIN.            VOL. IN CC              DEV. IN (%)
     0                       0                        0
     5                       4.55                   .5921862
     10                      9.05                   .1977006
     15                      13.55                  6.593495E-02
     20                      18.05                 -1.056703E-05
     25                      22.55                 [illegible]58613E-02
     30                      27.05                 -[illegible]659768
     35                      31.6                   7.351711E-02
     40                      36.1                   3.957861E-02
     45                      40.6                   1.319345E-02
     50                      45.1                  -7.924808E-03
     55                      49.6                  -.0251968
*****************************************************************
```

```
SO2 - ACETONITRILE

     TR =   24                         TE =   60
     V1 =   27021.1                    V2 =   55.54459
     DR =   .779                       DE =   .7391
     PO2=   49.45326                   PA =   102.2983
     FR =   .008786                    R  =   0
     S  =   .4500728                   VO = -4.198347E-03
     L  =   87.11148                   X  =   .1518714

  TIME IN MIN.          VOL. IN CC              DEV. IN (%)
     0                      0                      0
     5                      2.25                 .1707019
     10                     4.5                  7.717998E-02
     15                     6.74                -.102102
     20                     9                    3.040448E-02
     25                     11.24               -6.776335E-02
     30                     13.5                 1.492193E-02
     35                     15.75                1.047638E-02
     40                     18                   7.142472E-03
     45                     20.25                4.549587E-03
     50                     22.5                 2.475376E-03
     55                     24.75                7.783584E-04
     60                     27                  -6.357768E-04
     65                     29.25               -1.832325E-03
     70                     31.5                -2.857714E-03
**********************************************************************
```

```
SO2 - ACETONITRILE

     TR =   22.5                       TE =   25
     V1 =   24047.26                   V2 =   52.81480
     DR =   .78155                     DE =   .7773
     PO2=   11.50972                   PA =   100.725
     FR =   1.464333E-04               R  =   0
     S  =   3.572911E-02               VO = -.2871987
     L  =   262.5924                   X  =   .3657761

  TIME IN SEC.          VOL. IN CC              DEV. IN (%)
     0                      0                      0
     287                    10                   .3305358
     570                    20                  -.3904393
     850                    30                  -.2743928
     1129                   40                  -.1272488
     1408                   50                  -3.875756E-02
     1687                   60                   2.032375E-02
     1966                   70                   6.256746E-02
     2246                   80                   4.954885E-02
     2526                   90                   .0394256
     2807                   100                 -4.409596E-03
     3087                   110                 -7.781377E-03
     3368                   120                 -4.034957E-02
```

```
SO2 - ACETONITRILE

     TR =  23.1                   TE =  25
     V1 =  24047.26               V2 =  52.81488
     DR =  .78053                 DE =  .7773
     PO2=  11.50972               PA =  100.9917
     FR =  1.464333E-04           R  =  0
     S  =  .0356583               VO = -.5118156
     L  =  262.3321               X  =  .3655461

  TIME IN SEC.          VOL. IN CC               DEV. IN (%)
     0                      0                         0
     175                    6                     4.741529
     350                    12                    .2624468
     520                    18                   -.1691601
     688                    24                   -8.781186E-02
     855                    30                    7.996273E-02
     1024                   36                   -6.336234E-03
     1192                   42                    .0169692
     1360                   48                    .0344395
     1529                   54                   -1.801061E-02
     1698                   60                   -5.993111E-02
     1865                   66                    1.376949E-02
     2033                   72                    2.569223E-02
     2202                   78                   -9.946567E-03
     2370                   84                    1.961883E-03

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SO2 - ACETONITRILE

     TR =  23                     TE =  25
     V1 =  24047.26               V2 =  52.81488
     DR =  .7807                  DE =  .7773
     PO2=  11.50972               PA =  99.68514
     FR =  1.464333E-04           R  =  0
     S  =  3.564253E-02           VO = -1.073123
     L  =  262.5946               X  =  .365778

  TIME IN SEC.          VOL. IN CC               DEV. IN (%)
     0                      0                         0
     283                    10                    10.94207
     586                    20                    .9417952
     871                    30                    9.502531E-02
     1152                   40                    3.233047E-02
     1433                   50                   -5.24112E-03
     1714                   60                   -3.027953E-02
     1995                   70                   -4.815098E-02
     2274                   80                    2.751153E-02
     2555                   90                    7.172145E-03
     2835                   100                   2.655735E-02
     3116                   110                   1.000244E-02
     3397                   120                  -3.789122E-03
     3678                   130                  -1.546767E-02
```

```
SO2 - ACETONITRILE

      TR =  25.5                    TE = -5
      V1 =  21423.7                 V2 =  50.67021
      DR =  .77645                  DE =  .8102
      PO2=  2.277146                PA =  101.2183
      FR =  1.464333E-04            R  =  0
      S  =  .2482186                VO =  3.345938
      L  =  1776.637                X  =  .8077666

   TIME IN SEC.          VOL. IN CC            DEV. IN (%)
      0                      0                      0
      36                     10                 -18.57875
      73                     20                 -6.828939
      110                    30                 -2.120656
      150                    40                 -1.426167
      190                    50                 -1.004726
      229                    60                 -.3123352
      268                    70                  .1881892
      347                    90                  .5826273
      428                    110                 .330086
      509                    130                 .2396665
      590                    150                 .1369263
      669                    170                 .3517272
      752                    190                -3.308639E-03
      833                    210                -5.330467E-02
      915                    230                -.2021675
      995                    250                -.1291969

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SO2 - ACETONITRILE

      TR =  26.3                    TE = -5
      V1 =  21423.7                 V2 =  50.67021
      DR =  .77509                  DE =  .8102
      PO2=  2.277146                PA =  100.7517
      FR =  1.464333E-04            R  =  0
      S  =  .2546999                VO =  .842256
      L  =  1826.242                X  =  .8120065

   TIME IN SEC.          VOL. IN CC            DEV. IN (%)
      0                      0                      0
      37                     10                 -2.592514
      75                     20                  .2770257
      112                    30                  2.149766
      151                    40                  1.776154
      191                    50                  1.030648
      231                    60                  .539682
      473                    120                -1.0842
      553                    140                -1.19384
      633                    160                -1.275567
      704                    180                -.0838022
      0                      0                  -100
      775                    200                 .8905279
      856                    220                 .5184208
      897                    230                 .3017581

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```
SO2 - ACETONITRILE

     TR =   26.2                    TE = -5
     V1 =   21423.7                 V2 =  50.67021
     DR =   .77526                  DE =  .8102
     PO2=   2.277146                PA =  100.8184
     FR =   1.464333E-04            R  =  0
     S  =   .2509244                VO =  2.030794
     L  =   1798.845                X  =  .8096881

   TIME IN SEC.           VOL. IN CC             DEV. IN (%)
     0                       0                       0
     37                      20                    76.75657
     75                      20                   -4.077311
     112                     30                   -.4457669
     151                     40                    .1994479
     190                     50                    .5906107
     230                     60                    .4294961
     270                     70                    .3147299
     350                     90                    .1621158
     430                     110                   6.523918E-02
     512                     130                  -.3862633
     590                     150                  -5.076564E-02
     671                     170                  -.2353636
     751                     190                  -.2493878
     834                     210                  -.6160586
     915                     230                  -.7022585
     975                     250                   1.345017
************************************************************

SO2 - DIMETHYLACETAMIDE

     TR =   25.4                    TE = -5
     V1 =   21423.7                 V2 =  92.52549
     DR =   .936676                 DE =  .9416
     PO2=   0                       PA =  100.5917
     FR =   1.464333E-04            R  =  0
     S  =   .208599                 VO =  .8552717
     L  =   1432.479                X  =  .860853

   TIME IN SEC.           VOL. IN CC             DEV. IN (%)
     0                       0                       0
     46                      10                   -4.313781
     93                      20                   -1.258851
     140                     30                   -.196724
     188                     40                   -.179388
     236                     50                   -.1689873
     283                     60                    .185694
     331                     70                    .1408514
     428                     90                   -.1504961
     523                     110                   4.315244E-02
     620                     130                  -.1433793
     714                     150                   .1368753
     810                     170                   .1057114
     907                     190                  -2.871843E-02
     1003                    210                  -3.811791E-02
     1098                    230                   4.480794E-02
     1195                    250                  -5.240782E-02
```

```
SO2 - DIMETHYLACETAMIDE

     TR =   25                        TE = -5
     V1 =   21423.7                   V2 =  89.66859
     DR =   .9368                     DE =  .9716
     PO2=   0                         PA =  100.4317
     FR =   1.464333E-04              R  =  0
     S  =   .2055505                  VO =  3.361076
     L  =   1455.858                  X  =  .8590253

   TIME IN SEC.          VOL. IN CC             DEV. IN (%)
     0                       0                       0
     45                      10                   -20.70318
     90                      20                   -8.51128
     136                     30                   -4.202144
     182                     40                   -1.891683
     228                     50                   -.4511265
     275                     60                    .1879212
     370                     80                    .7369549
     469                     100                   .2363054
     567                     120                   7.656233E-02
     664                     140                   .1077001
     760                     160                   .263554
     859                     180                   3.950196E-02
     958                     200                  -.13902
     1055                    220                  -9.846087E-02
     1152                    240                  -6.463004E-02
     1200                    250                  -9.654036E-03

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SO2 - DIMETHYLACETAMIDE

     TR =   24.6                      TE = -5
     V1 =   21423.7                   V2 =  89.66859
     DR =   .937224                   DE =  .9716
     PO2=   0                         PA =  100.3251
     FR =   1.464333E-04              R  =  0
     S  =   .2062855                  VO =  3.787377
     L  =   1460.403                  X  =  .8594024

   TIME IN SEC.          VOL. IN CC             DEV. IN (%)
     0                       0                       0
     45                      10                   -23.49021
     88                      20                   -8.844367
     133                     30                   -3.718039
     180                     40                   -2.245323
     217                     50                    2.983806
     274                     60                   -.5133399
     370                     80                   -.140495
     467                     100                  -.122538
     564                     120                  -.1101981
     660                     140                   4.588461E-02
     758                     160                  -9.476256E-02
     853                     180                   .1397026
     951                     200                   1.757358E-02
     1048                    220                   1.157028E-02
     1145                    240                   6.568068E-03
     1194                    250                  -3.687605E-02
```

```
SO2 - DIMETHYLACETAMIDE


  TR  =  22.4                  TE  =  25
  V1  =  24047.26              V2  =  92.99958
  DR  =  .939556               DE  =  .9368
  PO2=   0                     PA  =  99.68514
  FR  =  1.464333E-04          R   =  0
  S   =  5.625189E-02          VO  = -1.602701
  L   =  383.0194              X   =  .5969816

 TIME IN SEC.          VOL. IN CC            DEV. IN (%)
    0                      0                     0
    182                    10                  15.80584
    365                    20                  5.65666
    546                    30                  3.054436
    728                    40                  1.655276
    909                    50                  .9483781
    1090                   60                  .4825624
    1271                   70                  .1524494
    1451                   80                 -2.348348E-02
    1632                   90                 -.2221481
    1813                   100                -.3805198
    1992                   110                -.4083777
    2355                   130                -.6651488
    2720                   150                -.9262863
    3084                   170                -1.0927
    3267                   180                -1.192394
    3302                   190                 3.181789
*****************************************************************
SO2 - DIMETHYLACETAMIDE


  TR  =  22.3                  TE  =  25
  V1  =  24047.26              V2  =  92.99958
  DR  =  .939662               DE  =  .9368
  PO2=   0                     PA  =  99.85845
  FR  =  1.464333E-04          R   =  0
  S   =  5.469768E-02          VO  = -5.407905E-02
  L   =  372.3953              X   =  .5901958

 TIME IN SEC.          VOL. IN CC            DEV. IN (%)
    0                      0                     0
    185                    10                 -.6457134
    370                    20                 -.9119129
    556                    30                 -1.178708
    738                    40                 -.775945
    920                    50                 -.5327151
    1101                   60                 -.2793181
    1465                   80                 -9.742772E-02
    1829                   100                 1.202537E-02
    2192                   120                 .1308116
    2555                   140                 .2158317
    2915                   160                 .3829305
    3276                   180                 .4825881
    3639                   200                 .5071751
    4062                   220                -.9579544
```

```
SO2 - DIMETHYLACETAMIDE

     TR =   25                         TE =   60
     V1 =   27021.1                    V2 =   96.17177
     DR =   .9368                      DE =   .9059
     PO2=   2.125692                   PA =   100.1118
     FR =   2.923334E-04               R  =   0
     S  =   5.762607E-02               VO =   .1797727
     L  =   193.0936                   X  =   .4073183

  TIME IN SEC.          VOL. IN CC              DEV. IN (%)
     0                     0                          0
     174                   10                     -2.025217
     343                   20                      .2731708
     513                   30                      .8676393
     690                   40                      .1458193
     864                   50                      6.264603E-02
     1038                  60                      7.286602E-03
     1386                  80                     -6.183613E-02
     1733                  100                    -4.572493E-02
     2080                  120                    -3.479125E-02
     2427                  140                    -2.730577E-02
     2773                  160                     1.445979E-02
     3120                  180                     1.497889E-02
     3294                  190                    -2.407282E-05
     3467                  200                     1.532217E-02

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SO2 - DIMETHYLACETAMIDE

     TR =   26.1                       TE =   60
     V1 =   27021.1                    V2 =   96.17177
     DR =   .935634                    DE =   .9059
     PO2=   2.125692                   PA =   100.1251
     FR =   2.923334E-04               R  =   0
     S  =   .057915                    VO =   .4792647
     L  =   194.2966                   X  =   .4088185

  TIME IN SEC.          VOL. IN CC              DEV. IN (%)
     0                     0                          0
     168                   10                     -2.047063
     338                   20                     -.2719426
     508                   30                      .3341614
     681                   40                      .2019566
     854                   50                      .1228008
     1028                  60                     -2.646699E-02
     1373                  80                      4.301256E-03
     1719                  100                    -3.513627E-02
     2065                  120                    -6.141703E-02
     2410                  140                    -3.885122E-02
     2756                  160                    -5.809269E-02
     3102                  180                    -7.306161E-02
     3275                  190                    -7.935496E-02
     3438                  200                     .204902

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```
SO2 - ETHYLACETATE

    TR =   25                      TE =   60
    V1 =   27021.1                 V2 =   103.5822
    DR =   .8942                   DE =   .8506
    PO2=   56.04206                PA =   101.3517
    FR =   .008786                 R  =   0
    S  =   .3459998                VO =   .41
    L  =   73.59651                X  =   .2200439

  TIME IN MIN.          VOL. IN CC              DEV. IN (%)
    0                    0                        0
    5                    2.2                     2.803804
    10                   3.9                     .7752613
    15                   5.6                     6.811964E-05
    20                   7.33                    7.155815E-05
    25                   9.060001                7.368835E-05
    30                   10.79                   7.070806E-05
    35                   12.52                   7.617213E-05
    40                   14.25                   7.361702E-05
    45                   15.98                   7.161515E-05
    50                   17.71                   6.461943E-05
    55                   19.44                   7.849178E-05
    60                   21.17                   7.207747E-05
    65                   22.9                    7.496136E-05
    70                   24.63                   6.96961E-05

*******************************************************************************

SO2 - DIMETHYLACETAMIDE

    TR =   25.6                    TE =   60
    V1 =   27021.1                 V2 =   96.17177
    DR =   .936164                 DE =   .9059
    PO2=   2.125692                PA =   100.1118
    FR =   2.923334E-04            R  =   0
    S  =   5.815553E-02            VO =  -.344945
    L  =   194.9899                X  =   .4096796

  TIME IN SEC.          VOL. IN CC              DEV. IN (%)
    0                    0                        0
    177                  10                      .5168213
    347                  20                      .8317512
    520                  30                      .3481098
    693                  40                      .1080344
    865                  50                      8.089119E-02
    1038                 60                     -.0341426
    1382                 80                     -3.248113E-02
    1726                 100                    -3.148423E-02
    2070                 120                    -3.081961E-02
    2414                 140                    -3.035577E-02
    2757                 160                     6.351875E-03
    3100                 180                     3.490394E-02
    3273                 190                     9.958467E-04
    3445                 200                    -4.272443E-04
```

```
SO2 - ETHYLACETATE

     TR =   24.2                    TE =   60
     V1 =   27021.1                 V2 =   103.5822
     DR =   .89516                  DE =   .8506
     PO2=   56.04206                PA =   101.3783
     FR =   .01754                  R  =   0
     S  =   .6676008                VO =   .6579835
     L  =   71.27534                X  =   .2145932

  TIME IN MIN.          VOL. IN CC              DEV. IN (%)
     0                     0                        0
     5                     3.4                   -14.91464
     10                    6.83                  -6.871984
     15                    10.28                 -3.673122
     20                    13.74                 -1.927185
     25                    17.18                 -.968418
     30                    20.63                 -.2707501
     35                    24.08                  .2330594
     40                    27.53                  .6139454
     45                    30.97                  .8794177
     50                    34.42                  1.122218
     55                    37.87                  1.32164
     60                    40.31                 -.9923507
     65                    43.76                 -.66293
     70                    47.21                 -.3798998

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SO2 - ETHYLACETATE

     TR =   25                      TE =   60
     V1 =   27021.1                 V2 =   103.5822
     DR =   .8942                   DE =   .8506
     PO2=   56.04206                PA =   101.405
     FR =   .01754                  R  =   0
     S  =   .6892733                VO =  -.304562
     L  =   73.41221                X  =   .2196139

  TIME IN MIN.          VOL. IN CC              DEV. IN (%)
     0                     0                        0
     5                     3.24                   3.125459
     10                    6.6                    .1795548
     15                    10.02                 -.1448682
     20                    13.47                 -8.088003E-02
     25                    16.92                 -4.294199E-02
     30                    20.38                  3.123112E-02
     35                    23.83                  4.197448E-02
     40                    27.27                  1.331874E-02
     45                    30.72                  2.365498E-02
     50                    34.17                  3.190538E-02
     55                    37.6                  -1.453635E-02
     60                    41.04                 -.028825
     65                    44.49                 -1.842273E-02
     70                    47.95                 -1.133798E-02

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```
SO2 - ETHYLACETATE

     TR =   23                         TE =   25
     V1 =   24047.26                   V2 =   98.53164
     DR =   .8966                      DE =   .8942
     PO2=   12.90707                   PA =   101.7116
     FR =   1.464333E-04               R  =   0
     S  =   2.551363E-02               VO =   .5932591
     L  =   188.0062                   X  =   .4351367

   TIME  IN  SEC.          VOL.  IN  CC             DEV.  IN  (%)
      0                       0                        0
      385                     10                    -4.001005
      769                     20                    -1.062485
      1155                    30                    -.2122497
      1545                    40                    -3.724618E-02
      1936                    50                     1.697065E-02
      2328                    60                     1.059962E-02
      2720                    70                     6.038485E-03
      3112                    80                     2.622673E-03
      3504                    90                    -2.543131E-05
      3896                    100                   -2.151443E-03
      4288                    110                   -3.89084E-03

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SO2 - ETHYLACETATE

     TR =   22.9                       TE =   25
     V1 =   24047.26                   V2 =   98.53164
     DR =   .8967201                   DE =   .8942
     PO2=   12.90707                   PA =   99.59181
     FR =   2.923334E-04               R  =   0
     S  =   5.178647E-02               VO =   .4386819
     L  =   191.5841                   X  =   .439776

   TIME  IN  SEC.          VOL.  IN  CC             DEV.  IN  (%)
      0                       0                        0
      190                     10                    -2.705853
      381                     20                    -.8395262
      573                     30                    -.3730286
      766                     40                    -.2670766
      956                     50                     .1070251
      1149                    60                     9.787275E-02
      1343                    70                     1.727811E-02
      1536                    80                     2.163401E-02
      1729                    90                     .0250222
      1923                    100                   -.0240497
      2116                    110                   -1.712852E-02
      2309                    120                   -1.136015E-02

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```
SO2 - ETHYLACETATE

    TR =  22.5                   TE = -5
    V1 =  21423.7                V2 =  94.43408
    DR =  .8972001               DE =  .933
    PO2=  2.487795               PA =  101.445
    FR =  1.464333E-04           R  =  0
    S  =  .1356946               VO =  .1857815
    L  =  968.2151               X  =  .8101682

 TIME IN SEC.          VOL. IN CC            DEV. IN (%)
    0                     0                      0
    70                    10                   3.208793
    145                   20                   .6973204
    220                   30                  -.1284981
    294                   40                  -.1996054
    368                   50                  -.242225
    513                   70                   .2906613
    661                   90                   .1335909
    808                   110                  .1574825
    957                   130                 -3.501253E-02
    1107                  150                 -.2657713
    1251                  170                  3.545784E-02
    1399                  190                 -1.186832E-02
    1546                  210                  1.444708E-02
    1693                  230                  3.620297E-02

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SO2 - ETHYLACETATE

    TR =  22.1                   TE = -5
    V1 =  21423.7                V2 =  94.43408
    DR =  .8976801               DE =  .933
    PO2=  2.487795               PA =  101.565
    FR =  1.464333E-04           R  =  0
    S  =  .135731                VO = -.4816661
    L  =  967.9289               X  =  .8101227

 TIME IN SEC.          VOL. IN CC            DEV. IN (%)
    0                     0                      0
    69                    10                   12.56402
    151                   20                  -6.850316E-02
    225                   30                  -.1922972
    298                   40                   8.467208E-02
    372                   50                  -2.050361E-02
    445                   60                   .1358285
    519                   70                   5.330337E-02
    593                   80                  -8.496516E-03
    668                   90                  -.2069294
    814                   110                 -3.037794E-03
    961                   130                  3.402694E-02
    1109                  150                 -2.930863E-02
    1256                  170                  2.100372E-03
    1403                  190                  2.691089E-02

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SO2 - CHLOROBENZENE

      TR =   23.5                        TE =   25
      V1 =   24047.26                    V2 =   102.2427
      DR =   1.10237                     DE =   1.1009
      PO2=   1.595602                    PA =   100.1518
      FR =   2.923334E-04                R  =   0
      S  =   1.553991E-02                VO =   2.149876E-02
      L  =   53.78862                    X  =   .1861285

   TIME IN SEC.             VOL. IN CC                DEV. IN (%)
      0                         0                          0
      664                       10                      -3.288203
      1304                      20                      -1.40762
      1939                      30                      -.5086957
      2578                      40                      -.208049
      3215                      50                       3.538239E-02
      3857                      60                       6.848253E-02
      4499                      70                       9.213891E-02
      5145                      80                       3.208236E-02
      5790                      90                       2.678837E-03
      6438                      100                     -6.740601E-02

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SO2 - CHLOROBENZENE

      TR =   22.6                        TE =   25
      V1 =   24047.26                    V2 =   102.2427
      DR =   1.103252                    DE =   1.1009
      PO2=   1.595602                    PA =   99.24517
      FR =   2.923334E-04                R  =   0
      S  =   1.528414E-02                VO =   1.095536
      L  =   52.87101                    X  =   .183536

   TIME IN SEC.             VOL. IN CC                DEV. IN (%)
      0                         0                          0
      694                       10                      -14.54982
      1330                      20                      -6.64429
      1952                      30                      -3.007317
      2576                      40                      -1.155171
      3196                      50                       .1128592
      3832                      60                       .5625726
      4496                      70                       .2678424
      5150                      80                       .239525
      5816                      90                       1.325995E-02
      6480                      100                     -.1365473
      7137                      110                     -.1619314

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SO2 - CHLOROBENZENE

     TR =  24                          TE =  60
     V1 =  27021.1                     V2 =  104.745
     DR =  1.10188                     DE =  1.0746
     PO2=  8.849938                    PA =  101.045
     FR =  .01754                      R  =  0
     S  =  .2793636                    VQ = -3.226446E-02
     L  =  16.93237                    X  =  6.159405E-02

   TIME IN MIN.          VOL. IN CC              DEV. IN (%)
     0                      0                        0
     5                      1.42                   4.063326
     10                     2.81                   1.761012
     15                     4.2                    1.005487
     20                     5.59                   .6299221
     25                     6.97                   .2614233
     30                     8.36                   .1860149
     35                     9.74                  -5.605323E-02
     40                     11.12                 -.1999653
     45                     12.5                  -.3118146
     50                     13.89                 -.3294836
     55                     15.27                 -.4091547
     60                     16.66                 -.4157515
     65                     18.4                   1.509559
     70                     19.43                 -.4773259

****************************************************************************

SO2 - CHLOROBENZENE

     TR =  24.7                        TE =  60
     V1 =  27021.1                     V2 =  104.745
     DR =  1.101194                    DE =  1.0746
     PO2=  8.849938                    PA =  101.285
     FR =  .01754                      R  =  0
     S  =  .2802913                    VQ =  3.507438E-02
     L  =  16.99499                    X  =  6.180777E-02

   TIME IN MIN.          VOL. IN CC              DEV. IN (%)
     0                      0                        0
     5                      1.4                   -2.542999
     10                     2.83                  -.2814578
     15                     4.24                   1.311474E-02
     20                     5.64                  -1.596811E-02
     25                     7.04                  -3.347577E-02
     30                     8.439999              -4.516613E-02
     35                     9.850001               4.804566E-02
     40                     11.24                 -5.981491E-02
     45                     12.65                  1.435648E-02
     50                     14.06                  7.378686E-02
     55                     15.46                  5.762377E-02
     60                     16.85                 -.0151433
     65                     18.25                 -2.196365E-02
     70                     19.65                 -2.781141E-02

****************************************************************************
```

```
S02 -CHLOROBENZENE

     TR =   24.1                      TE = -5
     V1 =   21723.7                   V2 =   99.34598
     DR =   1.101782                  DE =   1.133
     PO2=   .234514                   PA =   101.7116
     FR =   1.464333E-04              R  =   0
     S  =   8.646748E-02              VO =   1.157859
     L  =   607.5884                  X  =   .7353517

   TIME IN SEC.           VOL. IN CC              DEV. IN (%)
     0                       0                         0
     225                     20                    -2.974044
     453                     40                    -.8124091
     685                     60                    -.6426444
     915                     80                    -.3433131
     1145                    100                   -.1620508
     1375                    120                   -4.217911E-02
     1604                    140                    .1060519
     1834                    160                    .1632682
     2064                    180                    .2078064
     2294                    200                    .2434731
     2535                    220                   -.1601546
     2765                    240                   -.1000737
     2880                    250                   -.0726152

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S02 - CHLOROBENZENE

     TR =   24                        TE = -5
     V1 =   21423.7                   V2 =   99.34598
     DR =   1.10188                   DE =   1.133
     PO2=   .234514                   PA =   101.8316
     FR =   1.464333E-04              R  =   0
     S  =   8.691521E-02              VO =   .7694606
     L  =   610.6737                  X  =   .7390271

   TIME IN SEC.           VOL. IN CC              DEV. IN (%)
     0                       0                         0
     110                     10                    -3.19583
     222                     20                    -.3221495
     336                     30                     9.017804E-02
     451                     40                     7.951378E-02
     566                     50                     7.312014E-02
     797                     70                    -5.837437E-02
     1028                    90                    -.131265
     1257                    110                   -1.988796E-02
     1486                    130                    5.737073E-02
     1716                    150                    5.606169E-02
     1947                    170                    3.904608E-03
     2177                    190                    8.489426E-03
     2408                    210                   -2.917211E-02
     2638                    230                   -2.550497E-02
     2867                    250                    1.705597E-02

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```
SO2 - CHLOROBENZENE

     TR =   24.3                         TE = -5
     V1 =   21423.7                      V2 =  99.34598
     DR =   1.101586                     DE =  1.133
     PO2=   .234514                      PA =  101.6316
     FR =   1.464333E-04                 R  =  0
     S  =   8.578811E-02                 VO =  .5764347
     L  =   602.9215                     X  =  .7365556

  TIME IN SEC.            VOL. IN CC                 DEV. IN (%)
     0                       0                            0
     113                     10                        -2.624192
     227                     20                        -.2460704
     343                     30                        -2.517637E-03
     459                     40                         .1197053
     576                     50                         2.122948E-02
     693                     60                        -4.430714E-02
     926                     80                        -1.902218E-02
     1160                    100                       -8.955748E-02
     1392                    120                        6.269213E-03
     1625                    140                        1.349495E-02
     1858                    160                        1.891494E-02
     2091                    180                        2.313089E-02
     2325                    200                       -1.639288E-02
     2557                    220                        2.926382E-02
     2791                    240                       -4.189634E-03
     2708                    250                       -1.889901E-02

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SO2 - DIMETHYLFORMAMIDE

     TR =   24.5                         TE =  60
     V1 =   27021.1                      V2 =  80.14471
     DR =   .94474                       DE =  .9121
     PO2=   3.411986                     PA =  100.3917
     FR =   2.923334E-04                 R  =  0
     S  =   6.330489E-02                 VO =  .6115665
     L  =   213.598                      X  =  .3878298

  TIME IN SEC.            VOL. IN CC                 DEV. IN (%)
     0                       0                            0
     152                     10                        -2.285633
     309                     20                        -.8564868
     622                     40                         3.199647E-02
     780                     50                         2.125238E-02
     938                     60                         1.409093E-02
     1255                    80                        -7.394088E-02
     1570                    100                       -2.365107E-04
     1886                    120                       -3.814552E-03
     2201                    140                        3.885961E-02
     2517                    160                        3.128076E-02
     2834                    180                       -9.790098E-03
     2992                    190                       -1.041505E-02
     3150                    200                       -1.097749E-02
```

```
SO2 - DIMETHYLFORMAMIDE

     TR =  25.4                      TE =  60
     V1 =  27021.1                   V2 =  80.14471
     DR =  .943948                   DE =  .9121
     PO2=  3.451983                  PA =  100.7384
     FR =  2.923334E-04              R  =  0
     S  =  6.326595E-02              VO = -.1164487
     L  =  213.6736                  X  =  .3879138

  TIME IN SEC.          VOL. IN CC             DEV. IN (%)
     0                      0                      0
     158                    10                  1.21898
     317                    20                  .3066665
     475                    30                  .2175604
     633                    40                  .1730666
     792                    50                  1.965718E-02
     950                    60                  2.300792E-02
     1109                   70                 -6.492756E-02
     1267                   80                 -5.185298E-02
     1425                   90                 -4.167303E-02
     1583                   100                -3.352757E-02
     1740                   110                 3.065182E-02
     2057                   130                -1.660505E-02
     2372                   150                 3.310218E-02
     2689                   170                -3.329876E-03
     3005                   190                 1.212687E-03
     3163                   200                 3.14341E-03

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SO2 - DIMETHYLFORMAMIDE

     TR =  25                        TE =  60
     V1 =  27021.1                   V2 =  80.14471
     DR =  .9443                     DE =  .9121
     PO2=  3.411986                  PA =  100.3251
     FR =  2.923334E-04              R  =  0
     S  =  6.334045E-02              VO = -.3792005
     L  =  213.8203                  X  =  .3800768

  TIME IN SEC.          VOL. IN CC             DEV. IN (%)
     0                      0                      0
     165                    10                 -.7145854
     322                    20                 -8.204399E-02
     480                    30                 -.0806539
     638                    40                 -7.994931E-02
     796                    50                 -7.952655E-02
     954                    60                 -7.925106E-02
     1111                   70                  1.137999E-02
     1269                   80                  2.193456E-04
     1426                   90                  6.195514E-02
     1584                   100                 4.795048E-02
     1742                   110                 3.650957E-02
     2058                   130                 1.890099E-02
     2374                   150                 5.981803E-03
     2690                   170                -3.877377E-03
     3006                   190                -1.167563E-02
```

```
SO2 - DIMETHYLFORMAMIDE

    TR =  24.7                    TE = -5
    V1 =  21423.7                 V2 =  74.45508
    DR =  .944564                 DE =  .9818
    PO2=  0                       PA =  100.2718
    FR =  1.464333E-04            R  =  0
    S  =  .2481725                VO = -.4751921
    L  =  1761.592                X  =  .8595933

  TIME IN SEC.          VOL. IN CC                DEV. IN (%)
    0                     0                          0
    83                    20                       -.6118304
    123                   30                       -.1664502
    162                   40                        .6827688
    203                   50                        .192746
    243                   60                        .2829461
    325                   80                       -.2255491
    405                   100                      -3.464071E-02
    486                   120                      -.1137138
    567                   140                      -.1701289
    646                   160                       9.746506E-02
    726                   180                       .1680608
    808                   200                      -2.406495E-02
    889                   220                      -6.818801E-02
    969                   240                      -1.627578E-03
    1009                  250                       .027681

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SO2 - DIMETHYLFORMAMIDE

    TR =  24.3                    TE = -5
    V1 =  21423.7                 V2 =  74.45508
    DR =  .944916                 DE =  .9818
    PO2=  0                       PA =  100.3251
    FR =  1.464333E-04            R  =  0
    S  =  .2481471                VO =  2.386404
    L  =  1760.754                X  =  .8595358

  TIME IN SEC.          VOL. IN CC                DEV. IN (%)
    0                     0                          0
    76                    20                       -5.640719
    154                   40                       -1.358928
    233                   60                       -.2571344
    272                   70                        .239974
    313                   80                       -8.057899E-03
    394                   100                      -.106256
    474                   120                       3.489758E-02
    555                   140                      -4.145402E-02
    635                   160                       5.638439E-02
    717                   180                      -.1430666
    797                   200                      -5.480241E-02
    877                   220                       1.753681E-02
    957                   240                       7.789317E-02
    998                   250                       5.108904E-03

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SO2 - DIMETHYLFORMAMIDE .

     TR =   24.1                      TE = -5
     V1 =   21423.7                   V2 =   74.45508
     DR =   .945092                   DE =   .9818
     PO2=   0                         PA =   100.2584
     FR =   1.464333E-04              R  =   0
     S  =   .2478592                  VO =   3.337219
     L  =   1758.384                  X  =   .8593731

  TIME IN SEC.              VOL. IN CC                 DEV. IN (%)
      0                         0                           0
      74                        20                       -7.743965
      112                       30                       -3.529057
      151                       40                       -1.874092
      230                       60                       -.5714318
      312                       80                       -.8296604
      350                       90                       -9.760328E-02
      390                       100                      -2.296395E-03
      471                       120                      -6.570311E-02
      550                       140                       .243621
      629                       160                       .4768592
      709                       180                       .5196971
      789                       200                       .5539936
      877                       220                      -.3215612
      957                       240                      -.2238528
      998                       250                      -.2794901

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```
SO2 - DIMETHYLFORMAMIDE

     TR =   24                        TE =  25
     V1 =   24047.26                  V2 =   77.41184
     DR =   .94518                    DE =   .9443
     PO2=   0                         PA =   101.4317
     FR =   1.464333E-04              R  =   0
     S  =   .0648446                  VO =   .41476
     L  =   442.4143                  X  =   .5874928

  TIME IN SEC.              VOL. IN CC                 DEV. IN (%)
      0                         0                           0
      152                       10                       -2.639807
      304                       20                       -.6335491
      456                       30                        5.371434E-02
      608                       40                        .4009139
      761                       50                        .4792913
      914                       60                        .5316109
      1220                      80                        .5970919
      1555                      100                      -1.232715
      1850                      120                      -.3133903
      2156                      140                      -.1566908
      2462                      160                      -3.882807E-02
      2767                      180                       8.910588E-02
      2920                      190                       .1259632
      3073                      200                       .1591503
```

```
SO2-DIMETHYLFORMAMIDE

     TR =   23.9                      TE =   25
     V1 =   24047.26                  V2 =   77.41184
     DR =   .945268                   DE =   .9443
     PO2=   0                         PA =   99.61847
     FR =   1.464333E-04              R  =   0
     S  =   6.596686E-02              VO =   2.077667
     L  =   450.0294                  X  =   .5916225

   TIME IN SEC.              VOL. IN CC                DEV. IN (%)
     0                         0                            0
     145                       10                      -14.11047
     293                       20                      -6.568061
     443                       30                      -4.156372
     748                       50                      -2.763234
     1053                      70                      -2.153697
     1358                      90                      -1.811748
     1664                      110                     -1.65094
     1970                      130                     -1.539304
     2275                      170                      11.73018
     2578                      170                     -1.243305
     2883                      190                     -1.175552
     3188                      210                     -1.120642
     3494                      230                     -1.103288

*****************************************************************

SO2 - DIMETHYLFORMAMIDE

     TR =   22.9                      TE =   25
     V1 =   24047.26                  V2 =   77.41184
     DR =   .946148                   DE =   .9443
     PO2=   0                         PA =   100.0584
     FR =   1.464333E-04              R  =   0
     S  =   6.633925E-02              VO =  -1.56019
     L  =   452.149                   X  =   .5927572

   TIME IN SEC.              VOL. IN CC                DEV. IN (%)
     0                         0                            0
     171                       10                       2.209555
     322                       20                       1.004763
     472                       30                       .8337809
     624                       40                       .4129416
     776                       50                       .1621277
     928                       60                      -4.38671E-03
     1080                      70                      -.122987
     1231                      80                      -.1291132
     1383                      90                      -.2073346
     1536                      100                     -.33576
     1678                      110                      .221339
     1830                      120                      .1329853
     1982                      130                      5.834608E-02
     2134                      140                     -5.536454E-03

*****************************************************************
```

```
SH2 - CHLOROBENZENE

     TR  =   23.5                    TE  =   25
     V1  =   24264.5                 V2  =   102.2427
     DR  =   1.10237                 DE  =   1.1009
     PO2=    1.595602                PA  =   101.365
     FR  =   .01754                  R   =   0
     S   =   .2188589                VO  =  -5.916585E-02
     L   =   12.65018                X   =   5.060625E-02

   TIME IN MIN.              VOL. IN CC              DEV. IN (%)
      0                          0                        0
      5                          1.05                  1.436656
      10                         2.1                  -1.381747
      15                         3.19                 -1.045917
      20                         4.27                 -1.111906
      25                         5.39                 -.412143
      30                         6.49                 -.2551422
      35                         7.59                 -.1433417
      0                          0                    -100
      45                         9.79                  5.270327E-03
      50                         10.89                 5.716555E-02
      55                         11.98                 1.608291E-02
      60                         13.08                 5.838465E-02
      65                         14.18                 9.415124E-02
      70                         15.27                 5.726033E-02

***************************************************************

SH2 - CHLOROBENZENE

     TR  =   22.5                    TE  =   25
     V1  =   24264.5                 V2  =   102.2427
     DR  =   1.10335                 DE  =   1.1009
     PO2=    1.595602                PA  =   100.1384
     FR  =   .01754                  R   =   0
     S   =   .2188365                VO  =  -.3621818
     L   =   12.64005                X   =   5.056776E-02

   TIME IN MIN.              VOL. IN CC              DEV. IN (%)
      0                          0                        0
      5                          1                      36.61187
      10                         1.95                   6.700075
      15                         2.95                   1.014744
      20                         4                     -.3623895
      25                         5.1                   -.1707106
      30                         6.2                   -4.696946E-02
      35                         7.3                    3.979581E-02
      40                         8.399999               .1039222
      45                         9.5                    .1532742
      50                         10.6                   .1924089
      55                         11.7                   .2241993
      60                         12.75                 -.1410493
      65                         13.84                 -.1600901
      70                         14.95                 -4.261969E-02

***************************************************************
```

```
SH2 -n-HEXANE

    TR =   23                        TE =   25
    V1 =   24264.5                   V2 =   131.6901
    DR =   .6564                     DE =   .6544
    PO2=   20.16901                  PA =   100.805
    FR =   .01754                    R  =   0
    S  =   .1004285                  VO =   2.642857E-02
    L  =   7.08348                   X  =   3.702076E-02

  TIME IN MIN.           VOL. IN CC                DEV. IN (%)
     0                      0                         0
     5                     .52                     -1.621547
     10                    1.03                    -6.922075E-02
     15                    1.53                    -.1863199
     20                    2.02                    -.7370128
     25                    2.54                     .1126905
     30                    3.05                     .3526054
     35                    3.55                     .2421129
     40                    4.05                     .1590688
     45                    4.54                    -.1256366
     50                    5.04                    -.1555811

************************************************************************




SH2 -n-HEXANE

    TR =   22.4                      TE =   25
    V1 =   24264.5                   V2 =   131.6901
    DR =   .657                      DE =   .6544
    PO2=   20.16901                  PA =   101.085
    FR =   .01754                    R  =   0
    S  =   9.930211E-02              VO =   3.641505E-02
    L  =   6.993313                  X  =   3.656675E-02

  TIME IN MIN.           VOL. IN CC                DEV. IN (%)
     0                      0                         0
     2                     .24                      2.119285
     5                     .54                      1.327468
     8.5                   .87                     -1.190586
     10                    1.03                     5.477367E-02
     15                    1.53                     .2656289
     20                    2.02                    -.1214929
     24                    2.42                     1.382428E-02
     30                    3.01                    -.1816675
     35                    3.51                    -5.663138E-02
     40                    4.01                     3.744752E-02
     45                    4.51                     .1107784
     50                    5                       -.0303939

************************************************************************
```

```
SH2 -n-HEXANE

     TR  =  24.8                     TE  = -5
     V1  =  21723.19                 V2  =  126.2312
     DR  =  .6546                    DE  =  .6827
     PO2=   4.594289                 PA  =  100.0851
     FR  =  .000734                  R   =  0
     S   =  1.219597E-02             VO  = -8.355372E-03
     L   =  18.0845                  X   =  9.509396E-02

  TIME IN SEC.            VOL. IN CC                DEV. IN (%)
      0                       0                          0
      410                     5                        .1604361
      822                     10                      -.1670142
      1232                    15                      -.1137075
      1641                    20                      -2.611432E-02
      2050                    25                       2.651154E-02
      2460                    30                       2.093435E-02
      2871                    35                      -1.789418E-02
      3281                    40                      -1.651491E-02
      3690                    45                       .0116489

****************************************************************

SH2 -n-HEXANE

     TR  =  23.1                     TE  = -5
     V1  =  21723.19                 V2  =  126.2312
     DR  =  .6563                    DE  =  .6827
     PO2=   4.594289                 PA  =  100.5384
     FR  =  .000734                  R   =  0
     S   =  1.211743E-02             VO  =  1.088292E-03
     L   =  17.9182                  X   =  9.430198E-02

  TIME IN SEC.            VOL. IN CC                DEV. IN (%)
      0                       0                          0
      414                     5                       -.3528404
      826                     10                      -.100759
      1238                    15                      -.016445
      1650                    20                       2.575584E-02
      2063                    25                       2.609371E-03
      2476                    30                      -.0128221
      2889                    35                      -2.383073E-02
      3301                    40                      -1.811949E-03
      3713                    45                       1.532048E-02

****************************************************************
```

```
SH2 - HEXANE

    TR =  25.2                     TE = -5
    V1 =  21723.19                 V2 =  126.2312
    DR =  .6542                    DE =  .6827
    PO2=  4.594289                 PA =  100.1651
    FR =  .000734                  R  =  0
    S  =  .0120973                 VO =  4.698386E-02
    L  =  17.94898                 X  =  9.444863E-02

 TIME IN SEC.           VOL. IN CC             DEV. IN (%)
    0                       0                       0
    413                     5                   -.8560088
    827                     10                  -.5118926
    1239                    15                  -.2363835
    1651                    20                  -9.805591E-02
    2061                    25                   8.196869E-02
    2475                    30                   4.065576E-02
    2890                    35                  -2.339497E-02
    3303                    40                  -1.093745E-02
    3716                    45                  -1.246119E-03

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```
SH2 - ACETONITRILE

    TR =  24.1                     TE = -5
    V1 =  21723.19                 V2 =  50.67021
    DR =  .77883                   DE =  .8102
    PO2=  2.277146                 PA =  100.2851
    FR =  .000734                  R  =  0
    S  =  3.375715E-02             VO =  5.542417
    L  =  48.84208                 X  =  .1022744

 TIME IN SEC.           VOL. IN CC             DEV. IN (%)
    0                       0                       0
    141                     5                   -51.46656
    286                     15                  -1.296058
    432                     20                  -.6236139
    576                     25                   5.389256E-02
    725                     30                  -5.446963E-02
    1020                    40                   6.326861E-02
    1317                    50                  -1.167284E-03
    1614                    60                  -4.407211E-02
    1910                    70                  -2.653235E-02
    2205                    80                   2.883789E-02
    2502                    90                  -3.119477E-03
    2798                    100                  5.073805E-03
    3095                    110                 -1.890345E-02
    3390                    120                  1.737261E-02
    3687                    130                 -3.873235E-03
    3983                    140                  2.03818E-03

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```
SH2 - ACETONITRILE

    TR =  24.5                        TE = -5
    V1 =  21723.19                    V2 =  50.67021
    DR =  .77815                      DE =  .8102
    PO2=  2.277146                    PA =  99.72512
    FR =  .000734                     R  =  0
    S  =  .034002                     VO =  .4349062
    L  =  49.24519                    X  =  .1030315

  TIME IN SEC.         VOL. IN CC            DEV. IN (%)
    0                      0                     0
    141                    5                  -4.382869
    284                    10                 -.9064536
    429                    15                 -.1448881
    576                    20                 -.1001974
    724                    25                 -.2089816
    870                    30                 -5.546035E-02
    1164                   40                 -3.308155E-02
    1457                   50                  .0483785
    1751                   60                  4.600097E-02
    2044                   70                  9.294694E-02
    2339                   80                  4.302922E-02
    2633                   90                  4.204716E-02
    2928                   100                 7.233189E-03
    3223                   110                -2.123295E-02
    3517                   120                -1.662296E-02
    3812                   130                -3.085959E-02

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SH2 - ACETONITRILE

    TR =  24.4                        TE = -5
    V1 =  21723.19                    V2 =  50.67021
    DR =  .77832                      DE =  .8102
    PO2=  2.277146                    PA =  99.73846
    FR =  .000734                     R  =  0
    S  =  3.387801E-02                VO =  .5182057
    L  =  49.05489                    X  =  .1026743

  TIME IN SEC.         VOL. IN CC            DEV. IN (%)
    0                      0                     0
    139                    5                  -4.347395
    279                    10                  .2991923
    427                    15                  .1060083
    575                    20                  9.699808E-03
    723                    25                 -4.800399E-02
    871                    30                 -8.642986E-02
    1166                   40                 -4.989041E-02
    1460                   50                  3.981076E-02
    1755                   60                  4.316285E-02
    2052                   70                 -5.123237E-02
    2346                   80                  4.978428E-03
    2639                   90                  .0864394
    2935                   100                 4.986006E-02
    3232                   110                -1.084644E-02
    3528                   120                -3.317686E-02
    3823                   130                -2.601534E-02
```

```
SH2 - ACETONITRILE

    TR =  25                         TE =  25
    V1 =  24264.5                    V2 =  52.81488
    DR =  .7773                      DE =  .7773
    PO2=  11.50972                   PA =  100.0051
    FR =  .01754                     R  =  0
    S  =  .3481818                   VO =  .2863636
    L  =  22.31462                   X  =  4.632087E-02

 TIME IN MIN.           VOL. IN CC              DEV. IN (%)
    0                       0                       0
    5                       1.8                  -11.21076
    15                      3.6                  -34.65347
    15                      5.3                  -3.795376
    20                      7.1                  -2.068967
    25                      8.899999             -1.011122
    30                      10.7                 -.2964865
    35                      12.5                  .2186625
    40                      14.3                  .6076122
    45                      16                    .284903
    50                      17.8                  .5908048
    55                      19.6                  .8419124
    60                      21.4                  1.051726
    65                      23.2                  1.22968
    70                      24                   -2.672808

*************************************************************

SH2 - ACETONITRILE

    TR =  21.8                       TE =  25
    V1 =  24264.5                    V2 =  52.81488
    DR =  .78274                     DE =  .7773
    PO2=  11.50972                   PA =  101.3517
    FR =  .01754                     R  =  0
    S  =  .3578182                   VO = -.2509091
    L  =  22.73128                   X  =  4.714499E-02

 TIME IN MIN.           VOL. IN CC              DEV. IN (%)
    0                       0                       0
    5                       1.75                  13.77069
    10                      3.35                  .6830595
    15                      5.15                  .6574312
    20                      6.9                  -7.898886E-02
    25                      8.7                   6.272971E-02
    30                      10.48                -3.469515E-02
    35                      12.26                -.1037075
    40                      14.06                -1.292652E-02
    45                      15.87                 .1204389
    50                      17.64                 0
    55                      19.44                 5.615309E-02
    60                      21.22                 8.566725E-03
    65                      23.01                 1.185498E-02
    70                      24.78                -.0659901

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```
SH2 - ACETONITRILE

     TR =   23.4                        TE =   60
     V1 =   27180.7                     V2 =   55.54459
     DR =   .78002                      DE =   .7391
     PQ2=   49.45326                    PA =   102.0183
     FR =   .01754                      R  =   0
     S  =   .1000334                    VO =   5.310648E-02
     L  =   10.38137                    X  =   2.077394E-02

  TIME IN MIN.            VOL. IN CC              DEV. IN (%)
     0                       0                       0
     5                       .55                   -.5916688
     10                      1.05                  -.3266078
     15                      1.55                  -.2322176
     20                      2.05                  -.1838021
     25                      2.55                  -.1543501
     30                      3.06                   .1928826
     35                      3.56                   .1610374
     40                      4.06                   .137061
     45                      4.55                  -.1012175
     50                      5.05                  -9.450376E-02
     55                      5.55                  -8.899906E-02
     60                      6.06                   8.073401E-02

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SH2 - ACETONITRILE

     TR =   25                          TE =   60
     V1 =   27180.7                     V2 =   55.54459
     DR =   .7773                       DE =   .7391
     PO2=   49.45326                    PA =   101.285
     FR =   .01754                      R  =   0
     S  =   .1000333                    VO =  -2.222222E-04
     L  =   10.48828                    X  =   2.098338E-02

  TIME IN MIN.            VOL. IN CC              DEV. IN (%)
     0                       0                       0
     5                       .45                   -9.989942
     10                      1                     -1.104948E-02
     15                      1.5                   -1.845814E-02
     20                      2                     -.0221561
     25                      2.5                   -2.437951E-02
     30                      3.01                   .3073851
     35                      3.5                   -2.692043E-02
     40                      4                     -2.770848E-02
     45                      4.49                  -.2504911
     50                      5                     -2.882126E-02
     55                      5.5                   -2.922591E-02
     60                      6.01                   .1370581

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```
SH2 - ETHYLACETATE

    TR =  24.1                        TE =  60
    V1 =  27180.7                     V2 =  103.5822
    DR =  .89528                      DE =  .8506
    PO2=  56.04206                    PA =  100.765
    FR =  .01754                      R  =  0
    S  =  9.247617E-02                VO =  6.714286E-02
    L  =  11.03421                    X  =  4.035311E-02

  TIME IN MIN.          VOL. IN CC               DEV. IN (%)
    0                    0                          0
    5                    .5                       -5.575515
    10                   .98                      -1.200164
    15                   1.47                      1.080575
    20                   1.94                      1.217422
    25                   2.4                       .8807282
    30                   2.81                     -1.106067
    35                   3.28                     -.7206446
    40                   3.75                     -.4298662
    45                   4.23                      3.380712E-02
    50                   4.7                       .1928918
    55                   5.17                      .3234382

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SH2 - ETHYLACETATE

    TR =  23                          TE =  60
    V1 =  27180.7                     V2 =  103.5822
    DR =  .8966                       DE =  .8506
    PO2=  56.04206                    PA =  100.8184
    FR =  .01754                      R  =  0
    S  =  9.283331E-02                VO =  .0475
    L  =  11.05287                    X  =  4.041861E-02

  TIME IN MIN.          VOL. IN CC               DEV. IN (%)
    0                    0                          0
    5                    .5                       -2.280105
    10                   .97                      -.5977548
    15                   1.45                      .6944688
    20                   1.91                      .3063674
    25                   2.37                      .0703981
    30                   2.83                     -8.823804E-02
    35                   3.29                     -.2021954
    40                   3.76                     -2.213125E-02
    45                   4.22                     -.1183234
    50                   4.69                      .0177956
    55                   5.16                      .1293845

*************************************************************************
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```
SH2 --ETHYLACETATE

    TR =  22.8                    TE =  25
    V1 =  24264.4                 V2 =  98.53164
    DR =  .8968401                DE =  .8942
    PO2=  12.90694                PA =  101.765
    FR =  .01754                  R  =  0
    S  =  .36                     VO =  0
    L  =  23.17982                X  =  8.602968E-02

 TIME IN MIN.          VOL. IN CC            DEV. IN (%)
    0                    0                       0
    5.5                  1.9                   -4.040406
    10                   3.6                   -6.622738E-06
    15                   5.4                    0
    20                   7.2                   -6.622738E-06
    25                   9                      0
    30                   10.8                   0
    35                   12.6                   0
    40                   14.4                  -6.622738E-06
    45                   16.2                   0
    50                   18                     0
    55                   19.8                  -9.633073E-06
    60                   21.6                   0
    65                   23.4                  -8.151063E-06
    70                   25.2                   0

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SH2 - ETHYLACETATE

    TR =  22.6                    TE =  25
    V1 =  24264.5                 V2 =  98.53164
    DR =  .89708                  DE =  .8942
    PO2=  12.90694                PA =  100.805
    FR =  .01754                  R  =  0
    S  =  .357                    VO = -.2331736
    L  =  23.01401                X  =  8.546657E-02

 TIME IN MIN.          VOL. IN CC            DEV. IN (%)
    0                    0                       0
    5                    1.95                   25.65838
    10                   3.6                    7.886943
    15                   5.2                    1.526275
    20                   6.9                   -9.883556E-02
    25                   8.7                    9.403074E-02
    30                   10.5                   .2211866
    35                   12.3                   .3113213
    40                   14                    -.333359
    45                   15.8                  -.2010196
    50                   17.6                  -9.551453E-02
    55                   19.4                  -9.417876E-03
    60                   21.2                   6.218042E-02
    65                   23                     .1226435
    70                   24.75                 -2.757381E-02
```

```
SH2 - ETHYLACETATE

    TR =  23.5                 TE = -5
    V1 =  21723.19             V2 =  94.43408
    DR =  .896                 DE =  .933
    PO2=  2.487795             PA =  101.725
    FR =  .000734              R  =  0
    S  =  3.615402E-02         VO = -4.371133E-02
    L  =  52.33676             X  =  .1853467

 TIME IN SEC.          VOL. IN CC             DEV. IN (%)
    0                     0                       0
    139                   5                     .3674033
    278                   10                  -7.100782E-02
    417                   15                  -.216295
    555                   20                  -.108734
    831                   30                  -9.282344E-04
    1108                  40                  -3.734148E-02
    1384                  50                   1.310139E-02
    1660                  60                   4.673189E-02
    1937                  70                   1.912074E-02
    2214                  80                  -1.602147E-03
    2490                  90                   2.245242E-02
    2767                  100                  5.539248E-03
    3044                  110                 -8.294545E-03
    3321                  120                 -1.981978E-02
    3597                  130                 -1.760599E-03

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SH2 - ETHYLACETATE

    TR =  24.8                 TE = -5
    V1 =  21723.19             V2 =  94.43408
    DR =  .8944401             DE =  .933
    PO2=  2.487795             PA =  101.5783
    FR =  .000734              R  =  0
    S  =  3.658472E-02         VO =  .4225068
    L  =  53.05172             X  =  .1874042

 TIME IN SEC.          VOL. IN CC             DEV. IN (%)
    0                     0                       0
    138                   5                   -8.612346
    287                   10                  -8.444379
    423                   15                  -5.647585
    562                   20                  -4.685299
    700                   25                  -3.963661
    978                   35                  -3.321246
    1255                  45                  -2.883988
    1532                  55                  -2.603681
    1808                  65                  -2.355029
    2085                  75                  -2.218535
    2361                  85                  -2.072652
    2638                  95                  -1.994167
    2314                  105                  23.4139
    3191                  115                 -1.847285
    3468                  125                 -1.805469
    3745                  135                 -1.769815
```

```
SH2 - ETHYLACETATE

    TR =  24                       TE = -5
    V1 =  21723.19                 V2 =  94.43408
    DR =  .8954001                 DE =  .933
    PO2=  2.487795                 PA =  101.3917
    FR =  .000734                  R  =  0
    S  =  3.581485E-02             VO =  .4498368
    L  =  51.88652                 X  =  .1840456

  TIME IN SEC.          VOL. IN CC              DEV. IN (%)
    0                    0                          0
    135                  5                       -5.389784
    272                  10                      -1.878794
    410                  15                      -.8849352
    547                  20                      -.2023884
    686                  25                      -7.524546E-02
    826                  30                      -.1095587
    1103                 40                       .1160919
    1384                 50                      -3.516677E-02
    1664                 60                      -7.619135E-02
    1942                 70                      -3.258735E-03
    2219                 80                       9.635664E-02
    2498                 90                       9.415901E-02
    2777                 100                      9.240862E-02
    3056                 110                      9.096958E-02
    3343                 120                     -.1488501
    3619                 130                     -4.903882E-02

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SH2 - DIMETHYLFORMAMIDE

    TR =  25                       TE =  60
    V1 =  27180.7                  V2 =  80.14471
    DR =  .9443                    DE =  .9121
    PO2=  3.451983                 PA =  100.6584
    FR =  .01754                   R  =  0
    S  =  .3381818                 VO = -.1390909
    L  =  19.24922                 X  =  5.370958E-02

  TIME IN MIN.          VOL. IN CC              DEV. IN (%)
    0                    0                          0
    5                    1.63                     5.038073
    10                   3.25                     .2242779
    15                   4.9                     -.6817708
    20                   6.6                     -.3705261
    25                   8.3                     -.1858502
    30                   10                      -.0635887
    35                   11.7                     2.330932E-02
    40                   13.4                     8.827138E-02
    45                   15.1                     .1386706
    50                   16.79                    .1192633
    55                   18.5                     .2117508
    60                   20.2                     .2391022
    65                   21.79                   -.2413927
    70                   23.48                   -.1854211
```

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SH2 - DIMETHYLFORMAMIDE

     TR =   24.7                  TE =  60
     V1 =   27180.7               V2 =  80.14471
     DR =   .944564               DE =  .9121
     PO2=   3.451983              PA =  101.0317
     FR =   .01754                R  =  0
     S  =   .3427276              VO = -.3727355
     L  =   19.49941              X  =  5.436971E-02

  TIME IN MIN.         VOL. IN CC            DEV. IN (%)
     0                    0                     0
     5                    1.65                 23.05148
     10                   3.2                  4.762096
     15                   4.8                  .6673971
     20                   6.5                  .2805489
     25                   8.2                  5.548344E-02
     30                   9.899999            -9.173823E-02
     35                   11.6                -.1955476
     40                   13.3                -.2726793
     45                   15.05               -1.901012E-05
     50                   16.8                 .2168853
     55                   18.5                 .122974
     60                   20.2                 4.499401E-02
     65                   21.9                -2.079362E-02
     70                   23.6                -.0770266

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SH2 - DIMETHYLFORMAMIDE

     TR =   24.8                  TE =  60
     V1 =   27180.7               V2 =  80.14471
     DR =   .944476               DE =  .9121
     PO2=   3.451983              PA =  100.8717
     FR =   .01754                R  =  0
     S  =   .3410364              VO = -.6393636
     L  =   19.40609              X  =  .0541236

  TIME IN MIN.         VOL. IN CC            DEV. IN (%)
     0                    0                     0
     5                    1.55                 45.42815
     10                   3.05                 10.06855
     15                   4.55                 1.649123
     20                   6.2                  .3014751
     25                   7.9                  .1705878
     30                   9.600001             8.623281E-02
     35                   11.3                 2.734333E-02
     40                   13                  -1.609983E-02
     45                   14.68               -.185453
     50                   16.39               -.1368298
     55                   18.09               -.1525446
     60                   19.8                -.115127
     65                   21.5                -.1300715
     70                   23.32                .3736676

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SH2 - DIMETHYLFORMAMIDE
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SH2 - DIMETHYLFORMAMIDE

    TR =  23.6               TE =  25
    V1 =  24264.5            V2 =  77.41184
    DR =  .945532            DE =  .9443
    PO2=  0                  PA =  102.0583
    FR =  .01754             R  =  0
    S  =  .7156              VO =  .06
    L  =  40.74507           X  =  .1150367

  TIME IN MIN.          VOL. IN CC            DEV. IN (%)
     0                     0                      0
     5                     3.7                  1.704234
     10                    7.25                 .4711741
     15                    10.8                 5.558241E-02
     20                    14.4                 .1948158
     25                    18                   .2785579
     30                    21.6                 .3344505
     35                    25.2                 .374412
     40                    28.25               -1.513039
     45                    32.32                .1797739
     50                    35.89                .1395068
     55                    39.43                .0304357
     60                    43.04                .1023321
     65                    46.6                 5.581904E-02

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SH2 - DIMETHYLFORMAMIDE

    TR =  22.9               TE =  25
    V1 =  24264.5            V2 =  77.41184
    DR =  .946148            DE =  .9443
    PO2=  0                  PA =  101.9116
    FR =  .01754             R  =  0
    S  =  .7247273           VO = -.2109091
    L  =  41.2379            X  =  .1162663

  TIME IN MIN.          VOL. IN CC            DEV. IN (%)
     0                     0                      0
     5                     3.5                  2.557277
     10                    7.1                  .9043919
     15                    10.7                 .3752342
     20                    14.3                 .1145653
     25                    18                   .5178213
     30                    21.6                 .3208959
     35                    25.2                 .1807066
     40                    28.3                -1.661613
     45                    32.5                 .303016
     50                    36.1                 .2069282
     55                    39.7                 .1284038
     60                    43.3                 6.303067E-02
     65                    46.9                 7.760136E-03

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SH2 - DIMETHYLFORMAMIDE

      TR =   26.4                    TE = -5
      V1 =   21723.19                V2 =  74.45508
      DR =   .9430679                DE =  .9818
      PO2=   0                       PA =  100.7117
      FR =   .000734                 R  =  0
      S  =   6.890005E-02            VO =  1.010825
      L  =   97.72456                X  =  .2509059

   TIME IN SEC.          VOL. IN CC              DEV. IN (%)
      0                      0                       0
      137                    10                    -4.307424
      280                    20                    -1.491601
      422                    30                    -.2879917
      567                    40                    -.1925093
      714                    50                    -.4092376
      859                    60                    -.3255511
      1145                   80                     .1234241
      1435                   100                    .1177456
      1725                   120                    .1139539
      2014                   140                    .1606056
      2306                   160                    .0660856
      2596                   180                    6.927746E-02
      2885                   200                    .1063829
      3184                   220                   -.1763091
      3616                   250                   -6.132102E-02

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SH2 - DIMETHYLFORMAMIDE

      TR =   24.5                    TE = -5
      V1 =   21723.19                V2 =  74.45508
      DR =   .94474                  DE =  .9818
      PO2=   0                       PA =  100.765
      FR =   .000734                 R  =  0
      S  =   6.869208E-02            VO =  1.273845
      L  =   97.25685                X  =  .2500053

   TIME IN SEC.          VOL. IN CC              DEV. IN (%)
      0                      0                       0
      139                    10                    -7.596018
      277                    20                    -1.485363
      417                    30                     .2725955
      560                    40                     .6506833
      705                    50                     .6000528
      1004                   70                    -.3426677
      1293                   90                    -.1028993
      1587                   110                   -.2612881
      1876                   130                   -.1077283
      2165                   150                    5.198431E-03
      2455                   170                    5.125989E-02
      2749                   190                   -5.701126E-02
      3039                   210                   -1.384725E-02
      3329                   230                    2.183811E-02
      3618                   250                    7.934146E-02
```

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SH2 - DIMETHYLFORMAMIDE

    TR =   26.8                   TE = -5
    V1 =   21723.19               V2 =  74.45508
    DR =   .942716                DE =  .9818
    PO2=   0                      PA =  100.3917
    FR =   .000734                R  =  0
    S  =   6.902542E-02           VO =  .4011233
    L  =   97.93861               X  =  .2513173

  TIME IN SEC.          VOL. IN CC               DEV. IN (%)
     0                     0                         0
     140                   10                     -.6426632
     282                   20                      .6730444
     424                   30                      1.119391
     570                   40                      .6400376
     716                   50                      .3546084
     1024                  70                     -1.523783
     1295                  90                      .2349512
     1585                  110                     .1762996
     1874                  130                     .1890021
     2165                  150                     .1060083
     2457                  170                     2.010618E-03
     2746                  190                     2.899207E-02
     3038                  210                    -4.775099E-02
     3327                  230                    -2.116543E-02
     3617                  250                    -2.642124E-02

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SH2 - DIMETHYLACETAMIDE

    TR =   25                     TE = -5
    V1 =   21723.19               V2 =  89.66859
    DR =   .9368                  DE =  .9716
    PO2=   0                      PA =  100.0451
    FR =   .000734                R  =  0
    S  =   .0734484               VO =  1.005927
    L  =   103.7831               X  =  .2999131

  TIME IN SEC.          VOL. IN CC               DEV. IN (%)
     0                     0                         0
     130                   10                     -5.251155
     264                   20                     -1.943015
     398                   30                     -.7883623
     532                   40                     -.2007832
     667                   50                      7.980984E-03
     940                   70                     -6.769228E-02
     1211                  90                      .0534343
     1483                  110                     6.376689E-02
     1755                  130                     7.093323E-02
     2028                  150                     2.715785E-02
     2300                  170                     3.693991E-02
     2575                  190                    -.071288
     2847                  210                    -5.402324E-02
     3118                  230                    -7.834443E-03
     3389                  250                     3.099715E-02

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SH2 - DIMETHYLACETAMIDE

    TR =  24.5                    TE = -5
    V1 =  21723.19                V2 =  89.66859
    DR =  .93733                  DE =  .9716
    PO2=  0                       PA =  101.3517
    FR =  .000734                 R  =  0
    S  =  7.415845E-02            VO = -.8773879
    L  =  104.7272                X  =  .3018178

 TIME IN SEC.          VOL. IN CC             DEV. IN (%)
    0                     0                        0
    139                   10                     6.037393
    273                   20                     3.263826
    416                   30                     9.166847E-02
    551                   40                     4.023263E-02
    686                   50                     9.392667E-03
    957                   70                    -.131608
    1225                  90                     3.700778E-02
    1495                  110                    9.558464E-03
    1764                  130                    .0476301
    2034                  150                    2.608916E-02
    2305                  170                   -3.400656E-02
    2574                  190                   -3.388943E-03
    2844                  210                   -1.391989E-02
    3113                  230                    9.633868E-03
    3383                  250                   -2.56347E-04

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SH2 - DIMETHYLACETAMIDE

    TR =  25.5                    TE = -5
    V1 =  21723.19                V2 =  89.66859
    DR =  .93627                  DE =  .9716
    PO2=  0                       PA =  101.4717
    FR =  .000734                 R  =  0
    S  =  7.376336E-02            VO =  .3878813
    L  =  104.2872                X  =  .3009313

 TIME IN SEC.          VOL. IN CC             DEV. IN (%)
    0                     0                        0
    132                   10                    -1.231107
    266                   20                    -4.465016E-02
    402                   30                    -.1356571
    537                   40                     2.98509E-03
    673                   50                    -6.121129E-02
    944                   70                    -2.926651E-02
    1216                  90                    -9.338974E-02
    1485                  110                    6.689208E-02
    1757                  130                    7.606498E-03
    2027                  150                    6.255946E-02
    2299                  170                    1.773924E-02
    2570                  190                    2.120618E-02
    2842                  210                   -1.112315E-02
    3114                  230                   -3.780759E-02
    3384                  250                   -1.238998E-03

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SH2 - DIMETHYLACETAMIDE

    TR =   23                     TE =   25
    V1 =   24264.5                V2 =   92.99958
    DR =   .93892                 DE =   .9368
    PO2=   0                      PA =   101.4317
    FR =   .01754                 R  =   0
    S  =   .7821673               VO = -.1089259
    L  =   44.49258               X  =   .1456851

  TIME IN MIN.            VOL. IN CC           DEV. IN (%)
    0                         0                     0
    5                         3.9                2.580011
    10                        7.8                1.13129
    15                        11.6              -.2028846
    20                        15.5              -.2215665
    25                        19.45              2.440433E-02
    30                        23.35             -2.607527E-02
    35                        27.3               .121288
    40                        31.2               7.132576E-02
    45                        35.1               3.248438E-02
    50                        39                 1.44765E-03
    55                        42.9              -2.393172E-02
    60                        46.8              -.0450795

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SH2 - DIMETHYLACETAMIDE

    TR =   22.8                   TE =   25
    V1 =   24264.5                V2 =   92.99958
    DR =   .939132                DE =   .9368
    PO2=   0                      PA =   100.3651
    FR =   .01754                 R  =   0
    S  =   .783                   VO = -.07
    L  =   44.52996               X  =   .1457897

  TIME IN MIN.            VOL. IN CC           DEV. IN (%)
    0                         0                     0
    5                         3.9                1.430437
    10                        7.8                .5154696
    15                        11.7               .2141377
    20                        15.6               6.414515E-02
    25                        19.5              -2.563993E-02
    30                        23.4              -8.539904E-02
    35                        27.35              5.487946E-02
    40                        31.25              0
    45                        35.15             -4.265432E-02
    50                        39.1               5.116848E-02
    55                        43                 1.163174E-02
    60                        46.9              -2.131384E-02

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SH2 - DIMETHYLACETAMIDE

     TR =  24                          TE =  60
     V1 =  27180.7                     V2 =  96.17177
     DR =  .93786                      DE =  .9059
     PO2=  2.125692                    PA =  100.9517
     FR =  .01754                      R  =  0
     S  =  .3565455                    VO = -.2081818
     L  =  20.02931                    X  =  6.617849E-02

  TIME IN MIN.          VOL. IN CC              DEV. IN (%)
     0                     0                       0
     5                     1.7                    7.967675
     10                    3.35                  -.2166259
     15                    5.1                   -.7782095
     20                    6.9                   -.3282957
     25                    8.7                   -6.265111E-02
     30                    10.5                   .1126786
     35                    12.3                   .2370797
     40                    14.05                 -2.587487E-02
     45                    15.85                  8.611537E-02
     50                    17.6                  -.1083521
     55                    19.4                  -9.378556E-03
     60                    21.2                   7.295529E-02
     65                    22.95                 -7.519849E-02
     70                    24.75                  0

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SH2 - DIMETHYLACETAMIDE

     TR =  23.8                        TE =  60
     V1 =  27180.7                     V2 =  96.17177
     DR =  .938072                     DE =  .9059
     PO2=  2.125692                    PA =  100.6451
     FR =  .01754                      R  =  0
     S  =  .3591818                    VO = -.2540827
     L  =  20.17398                    X  =  6.662465E-02

  TIME IN MIN.          VOL. IN CC              DEV. IN (%)
     0                     0                       0
     5                     1.7                    10.25884
     10                    3.4                    1.86547
     15                    5.15                   .3185946
     20                    6.95                   .2950525
     25                    8.75                   .2812124
     30                    10.5                  -.2031279
     35                    12.3                  -.1402954
     40                    14.1                  -9.346058E-02
     45                    15.9                  -5.719373E-02
     50                    17.7                  -2.828972E-02
     55                    19.5                  -4.714352E-03
     60                    21.3                   1.490282E-02
     65                    23.1                   3.146051E-02
     70                    24.9                   4.562099E-02

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