

MELTING POINT, LATENT HEAT OF FUSION  
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INTRODUCTION

Commercial laboratories as well as educational laboratories which are working with organic compounds are constantly confronted with questions having to do with solubility and choice of solvent for use in purifications. In the great majority of cases the desired information is not available from the published data. In such cases it is necessary either to determine the solubility experimentally or to resort to some method of calculation. The more successful of the various methods used for calculating solubility generally employ an equation involving Raoult's freezing point law together with the second law of thermodynamics. Perhaps the simplest and most useful of these expressions is,—

$$\log N = \frac{-L}{4.58T} + I \dots \dots \dots (1)$$

In this expression  $N$  represents the mole fraction of the solute. (By solute is meant, that component which first crystallizes out in the pure state upon cooling the system).  $L$  is the molecular latent heat of fusion,  $T$  is the absolute temperature of the melting point of the system and  $I$  is an integration constant.

In general it may be said that these equations have been successful only for the so called "ideal" mixtures. By ideal mixture is meant those binary systems, the components of which may be considered to have the same thermodynamic environment when both are in the liquid state and both are at the same temperature. Two of the criteria for such a system are that there shall be neither any heat effect nor any volume change when the two liquid components are mixed. The complete absence of any secondary molecular effects, such as association and compound formation, is implied in the definition. Therefore, if in any case the heat effect for the solution process of dissolving a solid in a liquid differs from the latent heat of fusion of the solute at the temperature

in question, then this simple form of the solubility law does not express the true solubility.

Hildebrand,<sup>1</sup> in a series of very able papers, has shown that the degree to which a given binary mixture of non-polar substances departs from the formula for ideal mixtures is closely related to the magnitude of the differences in internal pressures of the components. In the fourth paper of the series, he has described a method for evaluating solubility data, and has indicated how the solubility of many substances may be approximately calculated providing the solubility of the given substance has been determined in solvents having a similar internal pressure to that of the solvent in question.

In evaluating solubility data Hildebrand plots the common logarithm of the mole fraction of solute against the reciprocal of the absolute temperature of the melting point of the system. The experimental solubility points when plotted in this manner should, if there are no secondary molecular effects, lie on a straight or only slightly curved line over fairly wide ranges of temperature. When the solubility curves of a given solute in a variety of solvents are plotted in this way, there is obtained a series of lines, which converge to a point at the melting temperature of the solute where  $N = 1.0$  ( $\text{Log } N = 0.0$ )

According to the hypothesis put forward by Hildebrand, the nearer the internal pressures of the liquified solute is to that of the solvent in question, the nearer will the experimental curve approach to the ideal solubility curve calculated from the latent heat of fusion of the solute. Therefore, if two solvents should be found to have exactly the same internal pressures, then the molecular solubility of each solute should be the same for the two solvents. Hildebrand<sup>2</sup> has prepared a table of relative internal pressures from which, having a series of solubility curves for each solute, the solubility curve of any such solute may be located approximately for any other solvent, the position of which, in the table of relative internal pressures, is known.

The obvious disadvantages of this method of calculating solubilities are: first, the internal pressures are known for only a relatively small number of substances.

Second, the method has not been applied to polar solvents. Third, in any case, the solubility must have been determined in a series of selected solvents before the solubility in other solvents may be calculated.

In the pages which follow we have described a method of calculating solubilities which requires but a minimum of physical measurements and which will apply to polar as well as to non-polar solvents providing there are no molecular compounds or solid solutions produced. It should be possible also to tell which systems will give partially miscible and which immiscible liquid systems.

#### DEVELOPMENT OF METHOD

From equation (1) it is evident that the slope of the  $\log N$  vs.  $1/T$  curves is related to the latent heat of fusion of the solute in the following manner,

$$\text{Slope} = S = \frac{\Delta \log N}{\Delta (1/T)} = \frac{-L}{4.58} \dots \dots \dots (2)$$

Equation (2) applies only to those binary mixtures in which the heat effect of the solution process is equal to the latent heat of fusion of the solute. Now it is a general rule, providing no secondary molecular effects are produced, that the negative heat effect accompanying the solution process is greater than the latent heat of fusion. In all such cases the slope of the logarithmic curves must be greater than that of the ideal slope. This is well shown in Table 1.

The ideal slope for any solute is that slope which would be obtained with a solvent which gives a thermodynamically ideal mixture. It is evident from Equation (2) that the value of the ideal slope may be calculated by dividing the latent heat of fusion of the solute (in small calories per mole) by the constant 4.58.

If now the experimental values of the slopes of the  $\log N$  vs  $1/T$  curves for a given solute in a variety of solvents be divided by the value of the ideal slope for that solute, there is obtained a series of factors the magnitude of which is a measure of the non-ideality of the mixture.

In Table 1 are given values of the slopes and of the factors which have been calculated for the four solutes,

Naphthalene, Fluorene, Benzoic Acid and Urethane. A glance at the solubility relations of these four substances shows that the solvents which come the most nearly to forming ideal solutions are the aromatic hydrocarbons with their halogen and nitro derivatives. These are followed by the substances having lower internal pressures such as ether, carbon tetrachloride, the esters and acid anhydrides and also by the substances having higher internal pressures, the amines, acids, alcohols and water.

Comparing the solubility relations of naphthalene and fluorene, it is found that the relative positions of the log  $N$  vs.  $1/T$  curves are the same for both substances. Hence it may be concluded that the internal pressures of these two solutes are nearly the same.

When we come to consider the solubility relations of benzoic acid, it must be remembered that this substance is moderately polar; hence the moderately polar solvents, or those having moderately high internal pressures, come the most nearly to giving ideal mixtures. Finally, it is evident from Table 1 that urethane has an internal pressure corresponding to that of the lower alcohols. The very high slope obtained for this substance in toluene should be noted. It will be observed that the highly polar substance, water, is a better solvent than is toluene.

In order to coordinate these solubility relations and many others which have been studied we have made use of the chart shown in Fig. 1. It will be observed that the

TABLE 1.

Slopes of the log  $N$  vs.  $1/T$  curves for the solutes Naphthalene, Fluorene, Benzoic Acid, and Urethane and the values of the factors obtained by dividing the experimental slope by the ideal slope.

SOLUTE—NAPHTHALENE.		Slope of the log $N$ vs. $1/T$ curves	Experi- mental slope Ideal slope	Factor taken from Fig. 1
Ideal solvent	.....	970	1	1
Diphenylamine	.....	960	1-	1-
Fluorene	.....	970	1	1
Phenanthrene	.....	970	1	1
Chlorobenzene	.....	970	1	1
Ethylene dichloride	.....	980	1.01	1.01
Ethylene dibromide	.....	990	1.02	1.02
Nitro benzene	.....	1010	1.04	1.05

SOLUTE—NAPHTHALENE—Concluded.

Solute	Solvent	Slope of the log N vs. 1/T curves	Experi- mental slope Ideal slope	Factor taken from Fig. 1
Benzene	.....	1020	1.05	1.06
Toluene	.....	1030	1.06	1.07
Phthalic anhydride	.....	1040	1.07	1.09
Carbon disulfide	.....	1050	1.08	1.11
Pyridine	.....	1060	1.08	1.10
Ethyl acetate	.....	1160	1.20	1.19
Ether	.....	1180	1.22	1.22
Thymol	.....	1200	1.24	1.30
Acetone	.....	1260	1.30	1.33
Para toluidine	.....	1270	1.31	1.35
Alpha naphthylamine	.....	1270	1.31	1.32
Alpha naphthol	.....	1310	1.35	1.40
Aniline	.....	1430	1.47	1.45
Phenol	.....	1700	1.75	1.75
Hexane	.....	1740	1.80	1.80

SOLUTE—FLUORENE.

Ideal solvent	.....	1050	1	1
Chlorbenzene	.....	1060	1.01	1.01
Nitro benzene	.....	1090	1.04	1.04
Benzene	.....	1180	1.12	1.10
Pyridine	.....	1200	1.14	1.10
Carbon disulfide	.....	1210	1.15	1.12
Carbon tetrachloride	.....	1320	1.25	1.22
Aniline	.....	1510	1.44	1.35
Acetone	.....	1580	1.50	1.37

SOLUTE—BENZOIC ACID.

Ideal solvent	.....	900	1	1
Acetone	.....	940	1.04	1.04
Benzil	.....	940	1.04	1.04
Acetophenone	.....	940	1.04	1.04
Phenol	.....	1190	1.32	1.35
Nitro benzene	.....	1200	1.33	1.34
Toluene	.....	1370	1.52	1.47
Benzene	.....	1380	1.53	1.45
Acetic acid	.....	1460	1.62	1.58
Carbon tetrachloride	.....	1530	1.70	1.67

SOLUTE—URETHANE.

Ideal solvent	.....	795	1	1
Methyl alcohol	.....	925	1.17	1.22
Acetamid	.....	950	1.19	1.22
Acetanilid	.....	950	1.19	1.22
Ethyl alcohol	.....	1060	1.33	1.43
Probyl alcohol	.....	1200?	1.50-1.75	1.62
Amyl alcohol	.....	1500?	1.75-2.00	1.90
Water	.....	2000?	2.25-	2.35?
Toluene	.....	2600?	3.00-	3.65?

right and left sides of this chart are the same, except that one side is the inverse of the other. On the left side of the chart the internal pressures increase downward while on the right side they necessarily increase upward. The figures in the middle of the chart, increasing both upward and downward from unity, are the factors ob-

FIG. 1. CHART OF RELATIVE INTERNAL PRESSURES	1.
	resorcin
hexane	acetamid urethane
paraaldehyde ether ethyl acetate, acetic anhydride carbon tetrachloride	hydrochinone methyl alcohol
phthalic anhydride toluole benzole, dihalides, bromo derivatives acenaphthene naphthalene, phenanthrene, diphenylamine	ethyl alcohol
fluorene anthracene, nitro derivatives di- and tri phenylmethanes nitro halides, pyridine, pyrrol carbazole, carbon disulphide nitro phenols benzanthrone anthraquinone benzopinone, benzil, thynol acetophenone, alpha and beta naphthylamine o— m— p— toluidines benzoic acid alpha and beta naphthol, trichloroacetic acid cresols, aniline	propyl alcohol  butyl alcohol
phenol acetic acid	2
	1

	2	acetic acid phenol
butyl alcohol		aniline etc A- and B- naphthol benzoic acid o- m- p- toluidines acetone etc. benzophenone etc. anthracinone benzothrone nitro phenols carbon disulph. nitro halides triphenyl methane nitro derivatives fluorene
propyl alcohol	3.	
ethyl alcohol		naphthalene etc. acenaphthene benzole etc. toluole phthalic anhydride carbon tetrachloride ethyl acetate etc. ether paraldehyde
methyl alcohol hydrochinone urethane acetamid	4	
resoroin	5	hexane

tained by dividing the experimental slopes of the log  $N$  vs.  $1/T$  curves by the ideal slope calculated from the latent heat of fusion.

In this chart naphthalene has been taken as the starting point. The value of the ideal slope is taken to be 970. This corresponds to a latent heat of fusion of 4,450 calories per mole, a value which is somewhat less than

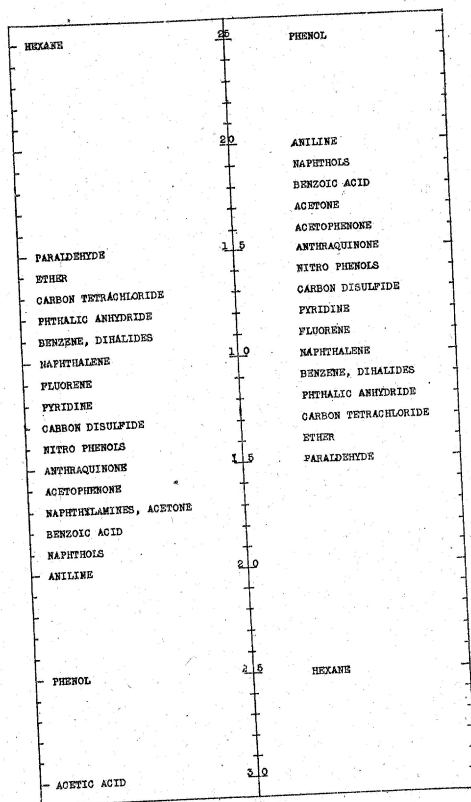


Fig. 1.  
Chart of Relative Internal Pressures.

that commonly accepted for naphthalene, viz., 4,550 calories. In order to fix the positions of the other substances relative to naphthalene, it was found convenient to locate first those substances which had been used as solvents for naphthalene. Now a large number of freezing point and solubility curves of binary systems involving naphthalene as solute are given in the literature.



Of this number about twenty appear to have been determined with the required degree of accuracy. The experimental slopes of each of these curves are given in Table 1, together with the value of the factors obtained by dividing the experimental slope by the ideal slope, 970. Each factor was then located on the middle line, and a straight edge was so placed across the chart that it passed through this factor and the point chosen for naphthalene. The point at which this line cuts the opposite side of the chart is the location of the substance in question. Having located these substances they were then used in finding the location of other substances, the binary systems with naphthalene of which had not been determined.

In making the calculations involved in finding the location of these other substances in the chart it was often found that the positions of the substances already fixed in the table could be checked repeatedly. In all cases shown the positions finally adopted are the mean values of several closely agreeing experiments using different solutes or solvents.

It will be observed that there may be some question, especially where the factor has a value near to unity, as to whether the factor should be slightly above or slightly below the ideal position. In deciding this question one may be guided somewhat by Hildebrand's table of relative internal pressures and also by the solubility relations in other systems.

In making the complete table we have calculated to mole fractions the solubility and freezing point measurements of over 400 binary mixtures. Not all of the substances studied appear in the chart. There have been a large number of isolated systems investigated which need only a few measurements in order to coordinate the complete solubility relations of these substances. We hope soon to make these measurements and to publish the results in a later communication.

#### USES AND LIMITATIONS OF THE CHART

The uses of this chart are quite evident from the foregoing discussion. In the first place it may be used to

calculate the freezing point curve or the solubility of any substance in the table with any other substance in the table providing the latent heat of fusion (ideal slope of the  $\log N$  vs.  $1/T$  curves) is known and the assumption is warranted that there are no complicating molecular effects. In making the calculation all that is necessary is to find the factor by which the ideal slope must be increased in order to make it equal to the slope which would be determined experimentally. This factor is found by placing a straight edge across the chart in such a position that it joins the components of the desired system. The point at which this cuts the line of factors will then be the ratio sought. Evidently, the nearer two substances are to one another in the table, the more nearly will their reciprocal solution approach to that of the ideal mixture. A comparison of columns 4 and 5, Table 1, will indicate the degree of precision to be expected.

In determining molecular weights by the melting point or boiling point methods, one should choose a solvent which has approximately the same position in the chart as the solute to be used. If this rule is not followed it will be observed that the "molecular association" of the solute will appear to increase in direct proportion to the magnitude of the factor relating the solute and solvent in the above chart.

In this connection, it is commonly assumed that acetic acid in benzene solution (benzene = solute) is associated into double molecules as determined from the Van't Hoff freezing point laws. In making that assumption, the further assumption has been made that the heat of the solution process is equal to the latent heat of fusion. In many ways it is more tenable to assume that in those systems which give fairly straight logarithmic solubility curves, at least, the variation from the normal is in the heat effect rather than in the molecular weight of the dissolved substance. This view is further supported by the fact that when molecular complexes are formed very highly curved solubility curves are obtained.

This chart should also aid in the choice of solvent to be used in recrystallization and in the choice of extract-

ing solvents. In this connection the question may be asked, What mixtures of substances will form immiscible liquids? It has been observed that when the difference in internal pressures of the substances is so great that the factor connecting them in the above chart has a greater value than about 4.0—4.5 partially miscible liquids may be expected to occur. In general the higher the melting point of the components the greater must be the difference in internal pressure to cause a separation into two liquid phases. When the factor between two components is greater than 5.0—5.5 the substances may be considered as practically immiscible. Mixtures of two compounds containing enolic or ketonic oxygen may not follow this rule due to the formation of oxonium compounds.

In making the calculations involved in constructing this table some generalizations have been observed which, although probably well known, will be valuable in placing other substances in the table and also in showing the uses and limitations of this method of calculating solubility.

It has been found that structural isomers very seldom form mixed crystals or chemical compounds; phenanthrene and anthracene, however, do form an unbroken series of mixed crystals.

Structural isomers generally have very nearly the same internal pressures; hence the freezing point curves between isomers are useful in determining the "ideal slope". Resorcin and hydrochinone are apparently exceptions to this rule.

It has been observed that when substances containing hydroxyl groups enter into systems containing enolic or ketonic oxygen, positive deviations from Raoult's law may be expected to occur, i. e., the solubility will be greater than that calculated from the principles outlined above.

A typical exception to this rule is found in the system Resorcin-Water, the  $\log N$  vs.  $1/T$  curve for which is almost a straight line.

Binary systems of similarly constituted molecules may be expected to form mixed crystals. Examples are:

para chlor nitro benzol—para brom nitro benzol.  
para brom toluene—para iodo toluene.

It is interesting to note that substances having similar structures occupy approximately the same place in the table, thus:—

Acetone, benzophenone, acetophenone, benzil.

Pyridin, pyrrol, carbazol.

Ethers anhydrides, esters.

Simple amines.

Simple nitro derivatives.

Simple halogen derivatives.

In describing the above method of calculating solubility we have made the assumption that the  $\log N$  vs.  $1/T$  curves having the ideal slope is known or may be determined. We shall now consider some of the methods of obtaining this ideal slope in cases where it is not known.

#### METHODS OF FINDING LATENT HEAT OF FUSION AND IDEAL SLOPE

The method which has been found to give the most consistent results is the following. There is first obtained a complete freezing point curve of the substance in question, for convenience called A, with some other substance, B, the ideal slope for which is known and the position of which in the chart of relative internal pressures has been determined. In choosing the exact binary system to be used it is necessary that there shall be no molecular complexes formed in the solution, and it is convenient to choose as the second component a substance having about the same melting point as that of the substance to be investigated. The factor to be used between solute B and solvent A is first determined by dividing the value of the ideal slope for B into the value experimentally obtained when the substance A, of unknown internal pressure, is used as solvent for B. Having determined this factor, the position of the substance A in the chart may be found. If now the substance A be used as solute B, or any other substance whose position in the chart is known, be used

as solvent and the slope of the  $\log N$  vs.  $1/T$  curve of the system is determined, then the ideal slope for A is obtained by dividing this experimental slope by the appropriate factor obtained from the chart, Fig. 1.

From the ideal slope so obtained the latent heat of fusion of the solute may be calculated. This is done by multiplying this ideal slope by the constant 4.58 which gives the latent heat in calories per gram mole. In Table 2 are given some values of latent heats calculated in this way. It will be observed that these values compare favorably with those determined calorimetrically.

A second method for determining the ideal slope and the position in the table may be called the "cut and try" method. This method may be used in those cases in which the solubility of a solute has been determined in a series of solvents whose positions in the chart have been determined. It is evident that there is only one position in the chart which will satisfy the demands of the factors of more than one solvent when the solute has been given any value for the ideal slope. The object is to find that set of values for the ideal slope and for the position in the chart which comes the most nearly to fitting all of the solvents involved. Evidently only two such solvents are needed, but if more have been investigated greater confidence may be placed in the results obtained.

A third method for determining the ideal slope of the  $\log N$  vs.  $1/T$  curves may be used in those cases in which  $L$ , the latent heat of fusion, is accurately known. This is seldom the case, however. It is regrettable that such an important physical property has been so long neglected. In cases where it has been determined the results are often so discordant that doubt is thrown upon much of the published data. This variation is due, partially at least, to the fact that many of the values have been calculated from Van't Hoff's equation and hence the values obtained will depend upon the nature of the solvent used.

In table 2, column 5, have been tabulated the latent heats of fusion of a representative number of organic compounds. These values have been taken largely from Landolt and Boernstein, Tabellen, and only those results which have been calorimetrically determined are includ-

ed. In the 4th column of this table are given the latent heats of fusion as calculated from the ideal slopes of the log N vs.  $1/T$  curves. Finally, in column 6 are given the quotients obtained by dividing the calculated molecular latent heat of fusion expressed in small calories by the absolute melting point of the substance. This, according to Walden,<sup>3</sup> should equal about 13.5. It will be observed from table 2 that the constant, 13.5, applies very well to most halides and nitro compounds and to many other isolated compounds, especially to those substances which have relative high molecular weights and moderately high melting points. In general, it may be said that the Walden constant for the more highly polar substances such as the hydroxide, ketones, amines, etc., has a value somewhat smaller than the normal. In any case, it should be possible, by reference to table 2, to calculate an approximate latent heat of fusion and hence the ideal slope for any substance whose structure and melting point are known. Presuming the structure to be known, it is then possible to locate approximately the position of the substance in the chart, Fig. 1. With this information it is then possible to calculate the solubility of the substance in question in all of the substances shown in the table which do not form molecular complexes or solid solutions. Thus it is seen that a fair idea may be had of the solubility relations of any given substance from only the melting point and structure of the solute.

The application of the principles outlined above should aid materially in the choice of solvent for crystallizations and also in the choice of solvent for use in molecular weight determinations.

TABLE 2.  
The Latent Heat of Fusion of Organic Compounds.

Substance	M. Pt. Abs. (T <sub>m</sub> )	Ideal Slope (S <sub>i</sub> )	HYDROCARBONS.		L calc. T <sub>m</sub>
			S <sub>i</sub> 4.58 (L calc.)	Lobs.	
Benzole .....	278.5	510	2330	2350	8.36
Para xylole .....	287.4	840	3840	4170	13.4
Diphenyl methane .....	299.3	810	3700	.....	12.4
Diphenyl .....	343.2	960	4390	4390	12.8
Naphthalene .....	353.1	970	4440	4550	12.6
Triphenyl methane .....	366.0	970	4440	.....	12.6

HYDROCARBONS—Concluded.

Substance	M. Pt. (Tm)	Abs. Slope (Si)	Sl. 4.58 (Lcalc.)	Lobs.	Lcalc. Tm
Acenaphthene	366.5	1090	5000	.....	13.6
Phenanthrene	371.0	980	4470	.....	12.1
Fluorene	386.5	1050	4800	.....	12.4
Pyrene	421.0	1150	5260	.....	12.5
Anthracene	489.6	1500	6870	6890	14.0

HALIDES.

Ethylene dibromide	282.8	550	2540	2540	9.0
P-brom toluole	299.8	800	3680	3650	12.2
P-dichlor benzole	325.5	960	4400	4390	13.5
P-dibrom benzole	360.0	1060	4850	4860	13.5
P-diiodo benzole	401.0	1200	5500	.....	13.7

NITRO COMPOUNDS.

P-nitro toluole	324.3	800	3660	.....	11.3
Alpha nitronaphthalene	328.0	950	4340	4380	13.2
1-3-4-dinitro toluole	332.0	990	4520	.....	13.6
1-2-6-dinitro toluole	338.0	1000	4570	.....	13.5
1-2-4-dinitro toluole	344.0	1020	4650	.....	13.5
M-dinitro benzole	363.0	1070	4900	4870	13.5
O-dinitro benzole	389.5	1160	5300	.....	13.6

NITRO HALIDES.

P-fluor nitrobenzole	299.5	710	3240	.....	10.7
O-chlor nitrobenzole	305.3	850	3900	.....	12.8
O-brom nitrobenzole	311.2	900	4110	.....	13.2
M-chlor nitrobenzole	315.8	930	4250	4630	13.5
P-chlor nitrobenzole	357.0	1060	4850	.....	13.6
P-brom nitrobenzole	396.5	1200	5490	.....	13.8
P-iodo nitrobenzole	446.0	1500	6850	.....	15.3
1-2-4-dichlor nitrobenzole	313.6	810	3700	.....	11.8

AMINO COMPOUNDS.

Aniline	267.5	425	1940	1940	7.26
P-toluidine	316.5	870	3980	.....	12.6
Alpha naphthylamine	317.7	680	3110	.....	9.8
Diphenyl amine	325.7	880	4020	4050	12.3
O-nitraniline	343.0	840	3840	.....	11.2
M-nitraniline	387.0	1000	4570	.....	11.8
P-nitraniline	421.0	1100	5030	.....	11.9

OXYGEN CONTAINING SUBSTANCES.

Meta cresol	277.3	380	1740	.....	6.3
Ortho cresol	303.7	475	2170	.....	7.15
Phenol	313.6	495	2260	2340	7.2
Alpha naphthol	367.5	1120	5120	.....	13.9
Beta naphthol	395.0	1150	5250	.....	13.3
Resorcinol	383.4	565	2580	.....	6.73
Hydrochinone	443.0	705	3220	.....	7.3
Thymol	322.2	650	2970	2980	9.2
Menthol	315.0	650	2970	2950	9.4
Paraldehyde	285.0	615	2820	.....	9.9
Phthalic anhydride	403.8	1070	4900	.....	12.1
Acetophenone	293.5	.....	.....	3980	.....

## OXYGEN CONTAINING SUBSTANCES—Concluded.

Substance	M. Pt. Abs. (Tm)	Ideal Slope (Si)	Si. 4.58 (Lcalc.)	Lobs. 4310	Lcalc. Tm
Benzophenone .....	322.0	830	3800	4650	11.8
Benzil .....	388.0	1020	4650	7780	12.0
Anthraquinone .....	558.0	3560	7780	2630	13.9
Acetic acid .....	289.4	320	1460	.....	5.05
Trichloroacetic acid .....	330.0	775	3540	.....	10.7
Beta oxynaphthoic acid.....	489.0	1440	6580	.....	13.5

## MISCELLANEOUS SUBSTANCES.

Urethane .....	318.2	795	3630	3630	8.03
Carbazole .....	518.0	1400	6400	7050	12.3
Acetamid .....	350.0	480	2200	.....	6.3
Ortho nitrophenol .....	319.0	810	3700	3720	11.6
Meta nitrophenol .....	367.5	1080	4950	.....	13.5
Para nitrophenol .....	386.0	1150	5260	.....	13.6
1-2-4-dinitrophenol .....	384.0	1140	5210	.....	13.6
Picric acid .....	395.5	910	4160	.....	10.5

## SUMMARY

There has been developed a method for calculating solubility based upon Raoult's ideal freezing point law and employing an empirical method for determining the actual deviation from the ideal.

A method for calculating the latent heat of fusion from solubility data has been described.

Some generalizations regarding the results to be expected with various types of binary systems are discussed.

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