Evaluated activity and osmotic coefficients for aqueous solutions: iron chloride and the bi-univalent compounds of nickel and cobalt

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Evaluated Activity and Osmotic Coefficients for Aqueous Solutions: Iron Chloride and the Bi-Univalent Compounds of Nickel and Cobalt

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A critical evaluation of the mean activity and osmotic coefficients in aqueous solutions of iron chloride, nickel chloride, perchlorate, and nitrate and twenty-nine bi-univalent compounds of cobalt at 298.15 K is presented. Osmotic coefficients were calculated from direct vapor pressure measurements, from isopiestic measurements, from freezing point depression measurements, and from vapor pressure osmometry measurements. Given are empirical coefficients for three different correlating equations, obtained by a weighted least squares fit of the experimental data, and tables consisting of the activity coefficients of the compounds, the osmotic coefficients and activity of water, and the excess Gibbs energy of the solution as functions of the molality for each electrolyte system. The literature coverage is through the computerized version of Chemical Abstracts of April 1979.

Key words: Activity coefficient; cobalt; critical evaluation; electrolyte; excess Gibbs energy; iron; nickel; osmotic coefficients; solutions; thermodynamic properties.

Contents

1. Introduction

This paper presents a continuation of work at the National Bureau of Standards on the evaluation of activity and osmotic coefficients in aqueous solutions. Previously, evaluations have been made for the uni-univalent electrolytes [1][1], calcium chloride [2], the alkaline earth metal halides [3], and sulfuric acid [4]. The evaluation procedures have been described [2,3,5] in substantial detail and a bibliography [6] giving the results of a search of the scientific literature for relevant sources of experimental data has been published.

We present our evaluations in detail so that any potential users of the data, as well as future data evaluators, can have a better view of the status of the measurements on these systems. We also give coefficients, obtained by a weighted least squares fit of the experimental data, for three different correlating equations and tables consisting of the mean activity coefficients of the electrolyte, the osmotic coefficient and activity of water, and the excess Gibbs energy of the solution as functions of the molality for each electrolyte system at 298.15. The literature coverage is through the computerized version of Chemical Abstracts of April 1979.

The reader is referred to the glossary of symbols at the end of this paper for the definitions of the various symbols used throughout this paper. In general, we have attempted to adhere to the recommendations of the IUPAC [7] with regard to nomenclature and units.

2. Osmotic Coefficients from Vapor Pressure Osmometry

To date in our evaluations we have considered activity and osmotic coefficient data based upon direct and indirect vapor pressure measurements, freezing point depression measurements, electromotive force measurements with and without transference and diffusion measurements. In 1963 Burge [8] proposed the use of a "thermoelectric differential vapor pressure method", first described by A. V. Hill [9], for the measurement of osmotic coefficients; this method has subsequently been known as vapor pressure osmometry. The use of this method has been described by Burge [8]: "Two thermistor beads forming two arms of a Wheatstone bridge are suspended in a saturated solvent atmosphere in a chamber whose temperature is very carefully controlled. The bridge is balanced with solvent drops on both beads, and then the solvent on one bead is replaced by a drop of solution. Condensation from the saturated atmosphere warms the bead thus changing its resistance and unbalancing the bridge. The experimentally observed quantity is the amount of resistance change required to re-balance the bridge, which can be related to the temperature change of the bead". If the observed temparature difference is proportional to the chemical potential difference ($\Delta\mu$) between the pure solvent and the solvent in the solution, then it can be shown that

$$\Delta\mu = \frac{\nu M_1 RTm\phi}{1000}$$

and

$$\phi = \frac{(\Delta \mathrm{Res})}{\nu km}$$

where m is the molality of the electrolyte solution, ϕ the osmotic coefficient, (ΔRes) is the difference in resistance between the thermistors, and k is an experimental calibration constant.

It should be noted that the measured change in resistance (which for small temperature differences is very nearly proportional to the temperature difference between the two thermistors) will be dependent not only upon the vapor pressure but also upon the transport properties of the solution under investigation. The method of vapor pressure osmometry should be valid if the transport properties of the solution under investigation and the solvent are the same. This ideal case is approached as the solution becomes more dilute. We are not aware of any detailed theoretical analysis that has been performed for the vapor pressure osmometer type experiment and, in the absence of such an analysis, we must look to the agreement (or lack of it) between measurements obtained with a vapor pressure osmometer and other more rigorous and established methods. The tests performed by Burge [8] using five different electrolyte solutions indicate a maximum difference of 0.012 and an average difference of 0.005 in the osmotic coefficient for eighteen different measurements at molalities up to 0.4 mol·kg^{-1}. For the compound $[Co(NH_3)_5NO_2]Cl_2$, Harkins, Hall, and Roberts [10] report freezing point depression data from which we have obtained osmotic coefficients at 25° C. Comparison of these results with the osmotic coefficients of Masterton and Scola [11] obtained with a vapor pressure osmometer show a difference of 0.022 in the osmotic coefficient at a molality of 0.01 mol·kg^{-1}. This difference is not unreasonable. Based upon these comparisons and also the fact that there are no other data available, we have decided to include in this compilation data for a series of cobalt compounds based upon the work of Masterton and Scola [11] and Berka and Masterton [12]. Insofar as the results for these systems are based upon a method that is not completely rigorous and since there are no comparison results on these systems, one must use these results with some degree of caution.

3. Evaluated Activity and Osmotic Coefficients

3.1. Presentation of Data

We have arranged the presentation of data according to compound. For each compound that has been evaluated we present:

[1] Figures in brackets indicate literature references.

1. The recommended values of the activity and osmotic coefficients, the activity of water, and the excess Gibbs energy per kilogram of solvent at selected molalities, including, where possible, values at saturation. The latter molalities, indicated by (sat) in the tables, were calculated from the data given in the compilation of Linke and Seidell [13]. Estimates of the standard deviations of the calculated values of the osmotic coefficient [$\sigma(\phi)$], the activity coefficient [$\sigma(\gamma)$], and the natural logarithm of the activity coefficient [$\sigma(\ln\gamma)$], all at selected molalities are given at the bottom of each table.

2. The coefficients, standard deviations of the coefficients [σ(coeff)], and standard deviation for observations of unit weights [σ(eqtn)] for as many as three different correlating equations. The correlating equations we have used are:

$$\ln\gamma = -\frac{A_1 I^{1/2}}{1+BI^{1/2}} + Cm + Dm^2 + Em^3 + \ldots, \quad (1a)$$

$$\ln\gamma = -A_1 I^{1/2} - A_2 I \ln I + \Sigma_{i=1}^{N} B_i m^{(i+1)/2}, \quad (2a)$$

$$\ln\gamma = -A_1 I^{1/2} + \Sigma_{i=1}^{N} B_i m^{(i+1)/2}. \quad (3a)$$

The corresponding equations for the osmotic coefficient become:

$$\phi = 1 + \frac{A_1}{B^3 I}\{-(1+BI^{1/2}) + 2\ln(1+BI^{1/2}) \quad (1b)$$

$$+ 1/(1+BI^{1/2})\} + 1/2\,Cm + 2/3\,Dm^2 + 3/4\,Em^3 + \ldots,$$

$$\phi = 1 - \frac{A_1}{3} I^{1/2} - \frac{A_2}{2} I\,[\ln I + 1/2]$$

$$+ \Sigma_{i=1}^{N} B^i \frac{(i+1)}{(i+3)} m^{(i+1)/2}, \quad (2b)$$

and

$$\phi = 1 - \frac{A_1}{3} I^{1/2} + \Sigma_{i=1}^{N} B^i \frac{(i+1)}{(i+3)} m^{(i+1)/2} \quad (3b)$$

For 2–1 electrolytes in water at 25 °C, $A_1 = 2.3525$ $\mathrm{mol^{-1/2}\cdot kg^{1/2}}$ and $A_2 = \frac{2}{3}A^2 = 0.92238$ $\mathrm{mol^{-1}\cdot kg}$. A is the constant in the Debye-Hückel equation and is equal to 1.17625 $\mathrm{kg^{1/2}\cdot mol^{-1/2}}$ at 25°C. The user should note that in our tables where we have given the coefficients of these correlating equations for the various systems that have been evaluated, we have used a shorthand notation to designate the various parameters, i.e., parameter 1 corresponds to either B in eqs 1, or B_1 in eqs 2 or 3, parameter 2 corresponds to either C in eqs 1 or B_2 in eqs 2 or 3, parameter 3 corresponds to either D in eqs 1 or B_3 in eqs 2 or 3, etc. Also, powers of ten are implied in the representation of a number, e.g., 0.499–02 is 0.499×10^{-2}. We have retained ten digits for the coefficients in order to avoid a loss of potentially useful information which might be of value for some applications in which the derivative of the activity coefficient with respect to the molality is of interest. The digits in excess of those required to ensure a precision of 0.001 or better in the calculation of ϕ or $\ln\gamma$ have not been underlined. Unless indicated otherwise the coefficients for eqs (1a) and (1b) were used to produce the activity and osmotic coefficients given in the tables of recommended values.

3. The calculated values of ϕ obtained from the experimental measurement reported by the various authors and the weights assigned to the various data sets. It should be noted that, in most cases, these are not original data, but rather the result of an intermediate calculation. Individual data points designated by an asterisk (*) were given zero weight.

4. A deviation plot in $\Delta\phi$ as a function of the molality. In these plots the symbol Δ means "observed minus calculated" values.

The excess Gibbs energy, ΔG^{ex}, is given by $\Delta G^{ex} = G - G\text{ ideal} = \nu mRT\,(1 - \phi + \ln\gamma)$.

3.2. Sinusoidal Behavior Observed in the Fitting of Several Data Sets

While fitting several data sets ($CoBr_2$, CoI_2, $[Co(NH_3)_5CH_3CH_2COO]Br_2$, $[Co(NH_3)_5CH_3CH_2COO]Cl_2$, $[Co(NH_3)_5CH_3COO]Cl_2$, $[Co(NH_3)_5(CH_3)_2CHCOO](NO_3)_2$, $[Co(NH_3)_5(CH_3)_2CHCOO]Cl_2$, *trans*-$[Co(C_2H_8N_2)_2NH_3NO_2]Br_2$, *trans*-$[Co(C_2H_8N_2)_2NH_3NO_2]Cl_2$, and *cis*-$[Co(C_2H_8N_2)_2NH_3NO_2]Cl_2$ with the three different correlating equations, it was observed that there was a sinusoidal behavior in the deviation plots for these data sets. This phenomenon was observed using all three correlating equations and could not be eliminated by using any reasonable number of additional parameters. We note that this sinusoidal behavior is, in all cases, well within a reasonable assignment of the experimental accuracy of the measurements, and we do not believe that it is physically real. It is probably attributable to some artifact(s) inherent in the experimental procedures.

3.3. Supersaturated Solutions

For four systems considered herein ($NiCl_2$, $CoBr_2$, CoI_2, and $Co(NO_3)_2$) the data apparently extend beyond the solubility limit and we have assumed that they pertain to reasonably stable supersaturated solutions. While the solubilities tabulated by Linke and Seidell [13] appear, with the exception of CoI_2, to be reliable, the workers [37, 49, 51] who reported the isopiestic data made no mention of the solubilities or the stabilities of the solutions. We suggest that it would be desirable if future experimental work took more cognizance of these matters.

3.4. Evaluated Systems

$FeCl_2$

Recommended Values for the mean activity and osmotic coefficient of $FeCl_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ϕ	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8879	.9619	.999948	-1.
.002	.8496	.9487	.999897	-2.
.003	.8230	.9394	.999848	-3.
.004	.8020	.9321	.999799	-5.
.005	.7847	.9261	.999750	-6.
.006	.7698	.9209	.999701	-8.
.007	.7568	.9164	.999653	-10.
.008	.7452	.9124	.999606	-12.
.009	.7348	.9088	.999558	-15.
.010	.7252	.9055	.999511	-17.
.020	.6594	.8835	.999046	-45.
.030	.6196	.8710	.998589	-78.
.040	.5915	.8630	.998136	-115.
.050	.5702	.8575	.997685	-156.
.060	.5533	.8537	.997235	-199.
.070	.5394	.8510	.996785	-244.
.080	.5278	.8493	.996335	-291.
.090	.5179	.8481	.995883	-339.
.100	.5093	.8475	.995430	-388.
.200	.4625	.8555	.990796	-932.
.300	.4459	.8740	.985928	-1521.
.400	.4411	.8964	.980807	-2127.
.500	.4427	.9208	.975425	-2735.
.600	.4487	.9463	.969778	-3336.
.700	.4579	.9728	.963865	-3925.
.800	.4696	1.0000	.957683	-4497.
.900	.4837	1.0279	.951231	-5049.
1.000	.4998	1.0564	.944507	-5577.
1.250	.5491	1.1300	.926501	-6781.
1.500	.6114	1.2070	.906783	-7797.
1.750	.6882	1.2874	.885357	-8604.
2.000	.7818	1.3712	.862246	-9181.
2.050	.8029	1.3883	.857425	-9268.

m/mol·kg^{-1}	$\sigma(\phi)$	$\sigma(\ln\gamma)$	$\sigma(\gamma)$
.001	.0002	.0003	.0003
.010	.0011	.0024	.0018
.100	.0035	.0101	.0052
1.000	.0027	.0124	.0062
2.000	.0040	.0137	.0107
2.050	.0045	.0142	.0114

Coefficients of Correlating Equations

	Eqs 1		Eqs 2		Eqs 3	
Par	coefficient	σ(coeff)	coefficient	σ(coeff)	coefficient	σ(coeff)
1	.1454574343+01	.611-01	.2249978466+01	.123+00	.7437321432+01	.275+00
2	.4201237072+00	.355-01	.5129329559+01	.186+00	-.7056917492+01	.681+00
3	.4413168866-01	.109-01	-.8714662847+00	.742-01	.3695358343+01	.587+00
4					-.7481810268+00	.170+00

σ(eqs 1) = .517-02
σ(eqs 2) = .888-02
σ(eqs 3) = .546-02

Experimental Data Employed in Generation of Correlating Equations

Kangro and Groeneveld [30]. Vapor pressure measurements. Assigned weight is zero.

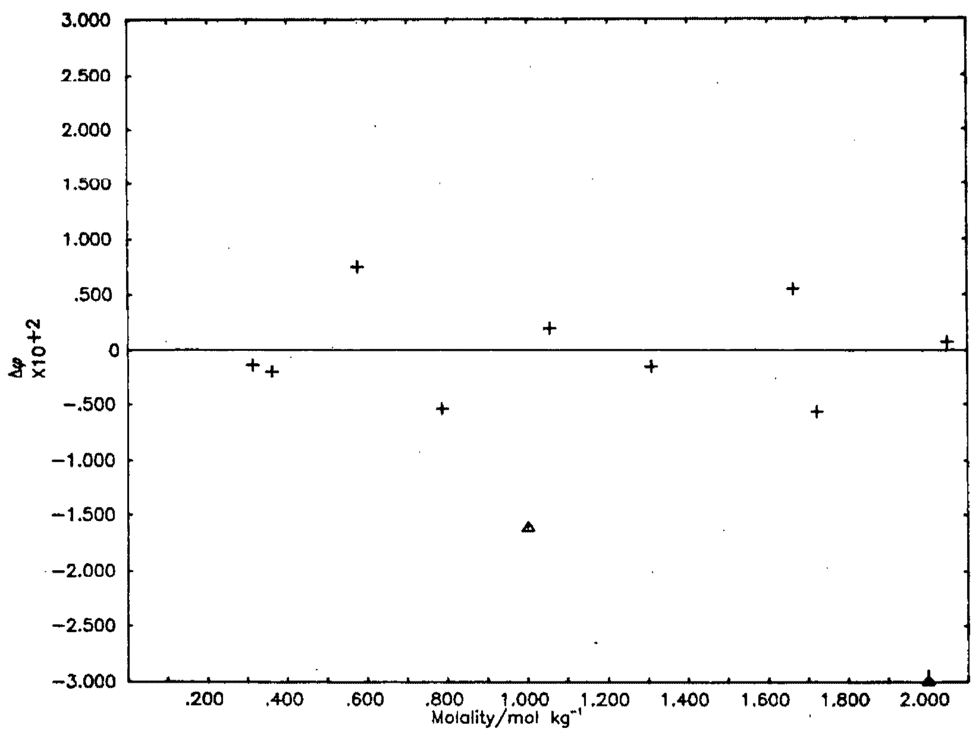
m/mol·kg^{-1}	$\phi_{298.15}$
1.000	1.0402
2.000	1.3401
3.000	1.6162
4.000	1.8015
5.000	1.9425

Stokes and Robinson [31]. Isopiestic measurements, reference salt is KCl. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
.313200	.8755
.362500	.8858
.570000	.9476
.787600	.9912
1.056000	1.0745
1.309000	1.1464
1.664000	1.2649
1.723000	1.2729
2.050000	1.3891

Comments

The isopiestic data of Stokes and Robinson [31] are preferred to the vapor pressure measurements of Kangro and Groeneveld [30] and the old freezing point depression measurements of Biltz [38].



Deviation Plot For $FeCl_2$: $\Delta\phi$ vs molality

▲ Kangro and Groeneveld [30], vapor pressure

+ Stokes and Robinson [31], isopiestic vs KCl

$NiCl_2$

Recommended Values for the mean activity and osmotic coefficient of $NiCl_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ϕ	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8890	.9626	.999948	-1.
.002	.8517	.9498	.999897	-2.
.003	.8257	.9410	.999847	-3.
.004	.8055	.9341	.999798	-4.
.005	.7887	.9285	.999749	-6.
.006	.7744	.9236	.999701	-8.
.007	.7619	.9194	.999652	-10.
.008	.7508	.9157	.999604	-12.
.009	.7408	.9124	.999556	-14.
.010	.7317	.9094	.999509	-16.
.020	.6689	.8895	.999039	-43.
.030	.6312	.8785	.998577	-76.
.040	.6047	.8715	.998118	-111.
.050	.5845	.8668	.997660	-150.
.060	.5684	.8636	.997204	-191.
.070	.5553	.8613	.996747	-234.
.080	.5442	.8599	.996289	-279.
.090	.5348	.8589	.995831	-324.
.100	.5266	.8585	.995371	-372.
.200	.4818	.8662	.990681	-887.
.300	.4659	.8837	.985774	-1445.
.400	.4619	.9056	.980613	-2017.
.500	.4647	.9303	.975175	-2590.
.600	.4725	.9571	.969439	-3154.
.700	.4841	.9858	.963391	-3703.
.800	.4990	1.0161	.957019	-4232.
.900	.5169	1.0477	.950315	-4736.
1.000	.5378	1.0805	.943273	-5212.
1.250	.6024	1.1670	.924190	-6263.
1.500	.6857	1.2580	.903044	-7087.
1.750	.7892	1.3517	.879987	-7659.
2.000	.9150	1.4466	.855247	-7963.
2.250	1.0658	1.5411	.829113	-7987.
2.500	1.2440	1.6338	.801912	-7725.
2.750	1.4520	1.7238	.773986	-7175.
3.000	1.6919	1.8100	.745677	-6339.
3.250	1.9650	1.8915	.717309	-5221.
3.500	2.2723	1.9679	.689178	-3830.
3.750	2.6137	2.0387	.661540	-2173.
4.000	2.9885	2.1035	.634606	-261.
4.250	3.3950	2.1624	.608540	1894.
4.500	3.8315	2.2154	.583453	4280.
4.750	4.2955	2.2627	.559410	6885.
5.000	4.7854	2.3048	.536423	9696.
5.060(sat)	4.9067	2.3142	.531061	10400.
5.250	5.3001	2.3424	.514463	12703.
5.500	5.8401	2.3762	.493453	15894.
5.714	6.3247	2.4028	.476139	18766.

m/mol·kg^{-1}	$\sigma(\phi)$	$\sigma(\ln\gamma)$	$\sigma(\gamma)$
.001	.0001	.0002	.0002
.010	.0006	.0014	.0011
.100	.0019	.0056	.0030
1.000	.0014	.0073	.0039
2.000	.0010	.0069	.0063
5.000	.0017	.0071	.0338
5.714	.0036	.0081	.0514

Coefficients of Correlating Equations

	Eqs 1		Eqs 2		Eqs 3	
Par	coefficient	σ(coeff)	coefficient	σ(coeff)	coefficient	σ(coeff)
1	.1696340541+01	.382-01	.2070223884+01	.395-01	.8914750111+01	.153+00
2	.2467283620+00	.193-01	.5615103283+01	.590-01	-.1155991114+02	.483+00
3	.2060360886+00	.973-02	-.1263167631+01	.311-01	.9401176965+01	.630+00
4	-.4083972677-01	.216-02	.1189064951+00	.554-02	-.4201470999+01	.460+00
5	.2383360533-02	.169-03			.9595911444+00	.128+00
6					-.8868857702-01	.158-01

σ(eqs 1) = .371-02
σ(eqs 2) = .454-02
σ(eqs 3) = .372-02

Experimental Data Employed in Generation of Correlating Equations

Dieterici [32]. Vapor pressure measurments at 0°C. Assigned weight is zero. These measurements were adjusted to 25°C using the Φ_L and Φ_C data given for $NiCl_2$ in the table of auxiliary data.

m/mol·kg^{-1}	$\phi_{298.15}$
.994000	1.0410
2.006000	1.3620
2.576000	1.7520

Jones et al. [33]. Freezing point depression measurements. Assigned weight is zero.

.037000	.9856
.074100	.9098
.149300	.9102
.223800	.9234
.298400	.9368
.374300	.9563
.449400	.9622
.525700	.9844
.753200	1.0574
.812000	1.0510
.915600	1.0944
1.019700	1.1239
1.548600	1.3183
2.093500	1.5926
2.656600	1.8993
3.240100	1.9369
3.825500	2.0056

Pearce and Eckstrom [34]. Vapor pressure measurements. Assigned weight is zero.

.100000	.8169
.200000	.8281
.400000	.8648
.600000	.9087
.800000	.9598
1.000000	1.0167
1.500000	1.1742
2.000000	1.3422
2.500000	1.5176
3.000000	1.6969
4.000000	2.0643
4.911600	2.4032

Robinson and Stokes [35]. Isopiestic measurements, reference salt is KCl. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
.116800	.8549
.197500	.8638
.215800	.8712
.538000	.9434
.786400	1.0145
.943000	1.0638
1.212000	1.1535
1.443000	1.2372
1.831000	1.3823
2.123000	1.4962

Shul'ts et al. [36]. Isopiestic measurements, reference salt is NaCl. Assigned weight is 0.2.

1.052100	1.0904
1.245300	1.1590
1.407200	1.2243
1.573500	1.2758
1.931400	1.4346
2.047400	1.4619
2.143700	1.5044
2.374400	1.5850
2.503000	1.6366
2.695300	1.7165
2.765300	1.7531

Shul'ts et al. [36]. Isopiestic measurements, reference salt is KCl. Assigned weight is 0.2.

1.052100	1.0863
1.245300	1.1542
1.407200	1.2213
1.573500	1.2788
1.931400	1.4234

Shul'ts et al. [36]. Isopiestic measurements, reference salt is $CaCl_2$. Assigned weight is 0.2.

m/mol·kg^{-1}	$\phi_{298.15}$
2.503000	1.6238
2.695300	1.7004
2.765300	1.7367
2.843000	1.7547
3.101400	1.8382
3.519300	1.9768
3.937500	2.0765
4.321700	2.1697
4.539500	2.2147
4.920300	2.2914

Shul'ts et al. [36]. Isopiestic measurements, reference salt is NH_4Cl. Assigned weight is 0.2.

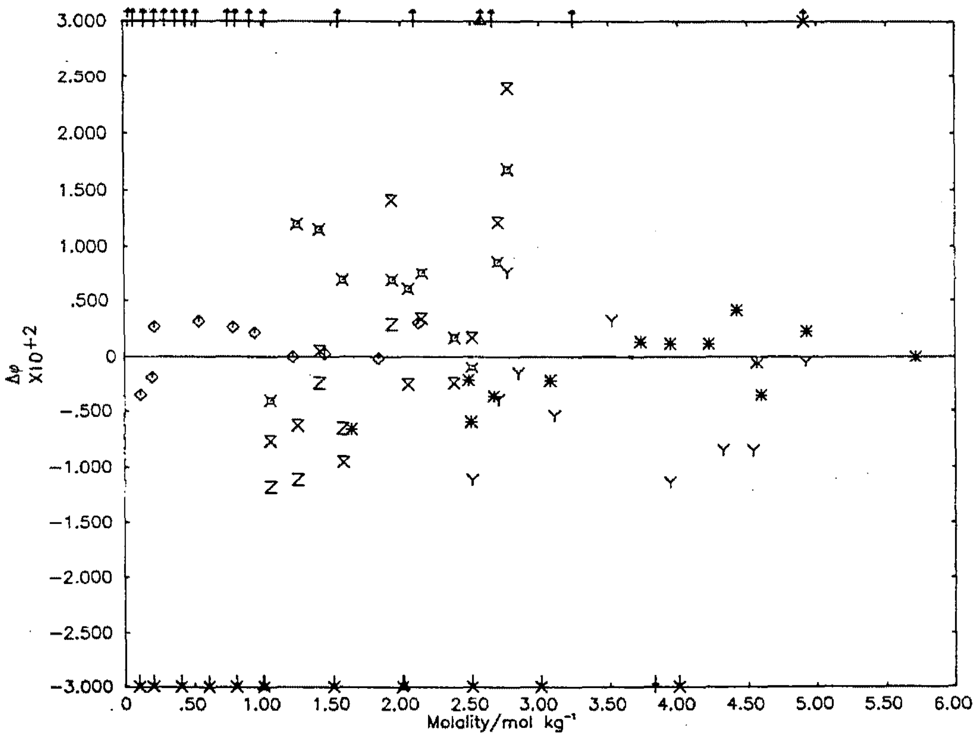
m/mol·kg^{-1}	$\phi_{298.15}$
1.052100	1.0940
1.245300	1.1773
1.407200	1.2353
1.573500	1.2922
1.931400	1.4274
2.047400	1.4706
2.143700	1.5085
2.374400	1.5892
2.503000	1.6339
2.695300	1.7130
2.765300	1.7460

Stokes [37]. Isopiestic measurements, reference salt is $CaCl_2$. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
1.634000	1.3014
2.479000	1.6239
2.496000	1.6264
2.660000	1.6881
3.073000	1.8320
3.725000	2.0332
3.941000	2.0899
4.217000	2.1561
4.422000	2.2036
4.567000	2.2279
4.595000	2.2304
4.926000	2.2951
5.714000	2.4028

Comments

The most reliable data for this system appear to be the isopiestic data of Robinson and Stokes [35] and of Stokes [37] which are more precise than the isopiestic data of Shul'ts et al. [36], which are, nevertheless, in good agreement with the results of the former workers. The freezing point depression measurements of Jones et al. [33] and of Biltz [38] are not very accurate and were given zero weight. Again, trusting the isopiestic data, we have given zero weight to the vapor pressure measurements of Pearce and Eckstrom [34] and of Dieterici [32]. The emf measurements of Hass and Jellineck [39] involve unknown liquid junction potentials and cannot be treated rigorously.



Deviation Plot For $NiCl_2$: $\Delta\phi$ vs molality

- ▲ Dieterici, [32], vapor pressure
- + Jones et al. [33], freezing point depression
- × Pearce and Eckstrom [34], vapor pressure
- ◇ Robinson and Stokes [35], isopiestic vs KCl
- ⨯ Shul'ts et al. [36], isopiestic vs NaCl
- Z Shul'ts et al. [36], isopiestic vs KCl
- Y Shul'ts et al. [36], isopiestic vs $CaCl_2$
- ⌘ Shul'ts et al. [36], isopiestic vs NH_4Cl
- ✱ Stokes [37], isopiestic vs $CaCl_2$

$Ni(ClO_4)_2$

Recommended Values for the mean activity and osmotic coefficient of $Ni(ClO_4)_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	∅	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8911	.9637	.999948	-1.
.002	.8555	.9520	.999897	-2.
.003	.8310	.9440	.999847	-3.
.004	.8121	.9380	.999797	-4.
.005	.7966	.9331	.999748	-6.
.006	.7835	.9290	.999699	-8.
.007	.7721	.9256	.999650	-10.
.008	.7620	.9225	.999601	-12.
.009	.7529	.9199	.999553	-14.
.010	.7447	.9175	.999504	-16.
.020	.6898	.9032	.999024	-41.
.030	.6581	.8968	.998547	-70.
.040	.6367	.8939	.998069	-103.
.050	.6211	.8929	.997590	-137.
.060	.6092	.8931	.997108	-173.
.070	.5999	.8941	.996623	-211.
.080	.5925	.8957	.996135	-249.
.090	.5866	.8978	.995643	-289.
.100	.5817	.9002	.995147	-329.
.200	.5666	.9335	.989960	-746.
.300	.5789	.9743	.984327	-1162.
.400	.6042	1.0186	.978220	-1554.
.500	.6391	1.0656	.971615	-1908.
.600	.6825	1.1149	.964492	-2217.
.700	.7342	1.1664	.956833	-2475.
.800	.7947	1.2199	.948621	-2675.
.900	.8649	1.2754	.939846	-2815.
1.000	.9458	1.3329	.930497	-2890.
1.250	1.2045	1.4843	.904585	-2773.
1.500	1.5689	1.6462	.875064	-2184.
1.750	2.0833	1.8174	.842070	-1086.
2.000	2.8125	1.9968	.805868	555.
2.250	3.8519	2.1832	.766838	2768.
2.500	5.3407	2.3754	.725459	5577.
2.750	7.4822	2.5723	.682284	9004.
3.000	10.5726	2.7726	.637915	13066.
3.250	15.0408	2.9753	.592974	17777.
3.500	21.5051	3.1789	.548079	23149.
3.501	21.5454	3.1800	.547847	23178.

m/mol·kg^{-1}	σ(∅)	σ(ℓnγ)	σ(γ)
.001	.0031	.0003	.0003
.010	.0008	.0019	.0014
.100	.0021	.0066	.0038
1.000	.0015	.0074	.0070
2.000	.0022	.0078	.0220
3.501	.0045	.0084	.1816

Coefficients of Correlating Equations

	Eqs 1		Eqs 2		Eqs 3	
Par	coefficient	σ(coeff)	coefficient	σ(coeff)	coefficient	σ(coeff)
1	.2034414594+01	.534-01	.2535082534+01	.156+00	.1161235347+02	.322+00
2	.6564378817+00	.219-01	.6357417713+01	.456+00	-.1943715100+02	.131+01
3	.2059946779+00	.114-01	-.2618148959+01	.521+00	.2144353725+02	.221+01
4	-.1746069568-01	.193-02	.9705194801+00	.264+00	-.1360468076+02	.183+01
5			-.1677338781+00	.493-01	.4639229414+01	.744+00
6					-.6546251526+00	.118+00

σ(eqs 1) = .508-02
σ(eqs 2) = .493-02
σ(eqs 3) = .478-02

Experimental Data Employed in Generation of Correlating Equations

Libus and Sadowska [40]. Isopiestic measurements, reference salt is KCl. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
.098100	.8936
.103600	.9012
.181800	.9289
.195900	.9357
.357800	.9995
.425500	1.0304
.538200	1.0840
.568300	1.0965
.585500	1.1047
.739000	1.1855
.768500	1.2055
.893000	1.2736
.960700	1.3084
.985500	1.3276
1.222100	1.4699
1.235300	1.4782
1.297400	1.5117
1.325300	1.5365
1.449700	1.6199
1.556200	1.6854

Libus and Sadowska [41], isopiestic measurements, reference salt is $Mg(ClO_4)_2$. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
2.363800	2.2750
2.794700	2.6136
3.145300	2.8909
3.501300	3.1774

Libus and Sadowska [40], isopiestic measurements, reference salt is $NaClO_4$. Assigned weight is 1.0.

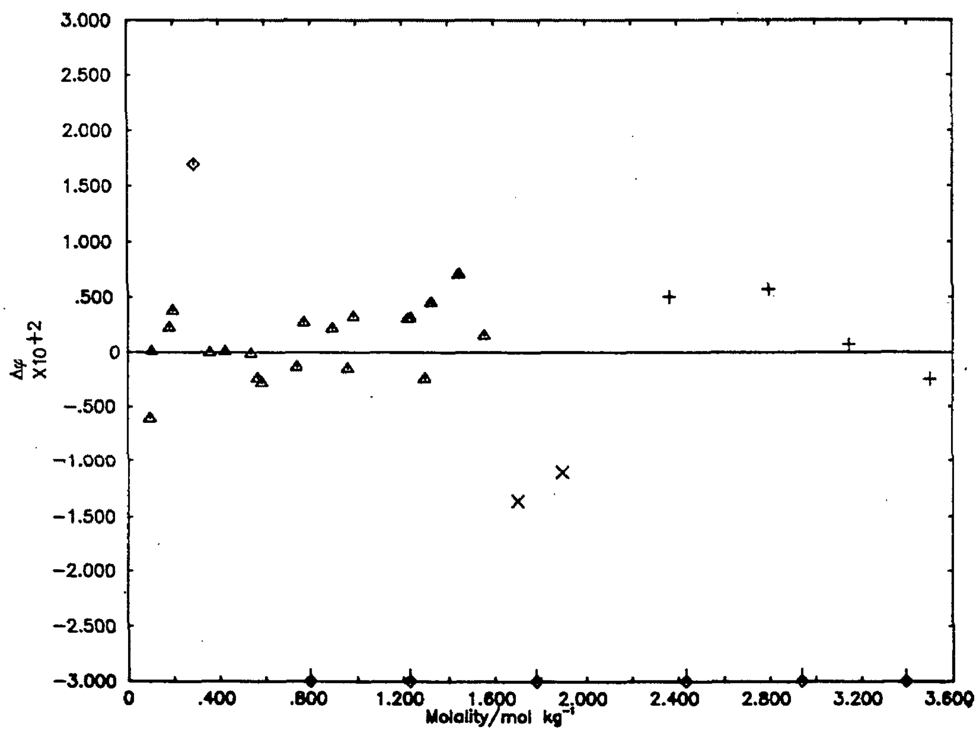
m/mol·kg^{-1}	$\phi_{298.15}$
1.701500	1.7699
1.895200	1.9096

Lilich and Andreev [41]. Vapor pressure measurements. Assigned weight is zero.

m/mol·kg^{-1}	$\phi_{298.15}$
.291000	.9874
.794000	1.1345
1.229000	1.4244
1.781000	1.7670
2.434000	2.2446
2.938000	2.6081
3.394000	2.9470

Comments

We prefer the isopiestic measurements of Libus and Sadowska [40] over the vapor pressure measurements of Lilich and Andreev [41].



Deviation Plot for $Ni(ClO_4)_2$: $\Delta\phi$ vs molality

▲ Libus and Sadowska [40], isopiestic vs KCl

✚ Libus and Sadowska [40], isopiestic vs $Mg(ClO_4)_2$

✕ Libus and Sadowska [40], isopiestic vs $NaClO_4$

◇ Lilich and Andreev [41], vapor pressure

$NiBr_2$

Recommended Values for the mean activity and osmotic coefficient of $NiBr_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ϕ	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8895	.9628	.999948	-1.
.002	.8526	.9504	.999897	-2.
.003	.8271	.9418	.999847	-3.
.004	.8072	.9352	.999798	-4.
.005	.7909	.9298	.999749	-6.
.006	.7769	.9252	.999700	-8.
.007	.7647	.9212	.999652	-10.
.008	.7539	.9177	.999603	-12.
.009	.7442	.9146	.999555	-14.
.010	.7354	.9118	.999507	-16.
.020	.6752	.8938	.999034	-43.
.030	.6396	.8846	.998567	-74.
.040	.6149	.8793	.998101	-109.
.050	.5965	.8762	.997635	-146.
.060	.5821	.8745	.997168	-185.
.070	.5705	.8738	.996700	-226.
.080	.5610	.8738	.996229	-269.
.090	.5530	.8743	.995756	-312.
.100	.5463	.8752	.995281	-357.
.200	.5144	.8961	.990360	-834.
.300	.5108	.9257	.985102	-1333.
.400	.5192	.9590	.979481	-1828.
.500	.5352	.9946	.973480	-2305.
.600	.5569	1.0321	.967086	-2755.
.700	.5836	1.0711	.960289	-3173.
.800	.6151	1.1116	.953080	-3555.
.900	.6513	1.1532	.945453	-3895.
1.000	.6924	1.1961	.937403	-4192.
1.250	.8188	1.3080	.915423	-4722.
1.500	.9846	1.4259	.890834	-4925.
1.750	1.1994	1.5485	.863761	-4772.
2.000	1.4763	1.6747	.834414	-4242.
2.250	1.8315	1.8034	.803078	-3318.
2.500	2.2854	1.9335	.770095	-1988.
2.750	2.8628	2.0637	.735858	-243.
3.000	3.5936	2.1929	.700783	1924.
3.250	4.5121	2.3200	.665305	4514.
3.500	5.6571	2.4438	.629854	7526.
3.750	7.0702	2.5630	.594842	10956.
4.000	8.7935	2.6766	.560656	14796.
4.250	10.8661	2.7834	.527645	19036.
4.500	13.3180	2.8821	.496116	23661.
4.693	15.4806	2.9520	.472957	27486.

m/mol·kg^{-1}	$\sigma(\phi)$	$\sigma(\ell n\gamma)$	$\sigma(\gamma)$
.001	.0001	.0001	.0001
.010	.0004	.0008	.0006
.100	.0011	.0031	.0017
1.000	.0008	.0041	.0028
2.000	.0009	.0038	.0056
4.693	.0027	.0045	.0696

Coefficients of Correlating Equations

Par	Eqs 1 coefficient	Eqs 1 σ(coeff)	Eqs 2 coefficient	Eqs 2 σ(coeff)	Eqs 3 coefficient	Eqs 3 σ(coeff)
1	.1754027013+01	.210-01	.1839112459+01	.160+00	.9609761265+01	.193+00
2	.5102956934+00	.857-02	.7512801735+01	.558+00	-.1308178632+02	.671+00
3	.1481756515+00	.321-02	-.4013641655+01	.799+00	.1158014343+02	.961+00
4	-.1697362496-01	.399-03	.1927238658+01	.568+00	-.5830112806+01	.684+00
5			-.5472702726+00	.198+00	.1572972292+01	.239+00
6			.6228601921-01	.271-01	-.1787678878+00	.326-01

σ(eqs 1) = .341-02
σ(eqs 2) = .335-02
σ(eqs 3) = .403-02

Experimental Data Employed in Generation of Correlating Equations

Libus et al. [50a]. Isopiestic measurements, reference salt is $Mg(ClO_4)_2$. Assigned weight is 1.0.

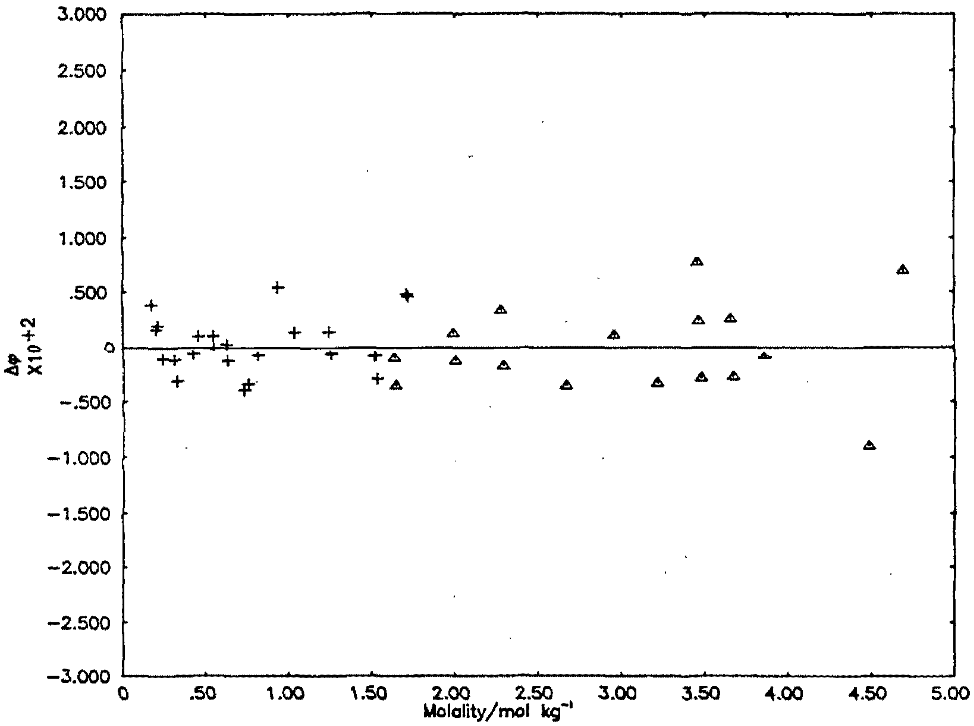
m_{ref}/mol·kg^{-1}	m/mol·kg^{-1}	$\phi_{298.15}$
1.499	1.631000	1.4885
1.509	1.644000	1.4924
1.821	1.994000	1.6730
1.828	2.004000	1.6754
2.073	2.281000	1.8229
2.080	2.293000	1.8239
2.403	2.669000	2.0179
2.653	2.959000	2.1730
2.865	3.215000	2.2990
3.074	3.458000	2.4309
3.077	3.466000	2.4296
3.084	3.479000	2.4306
3.235	3.659000	2.5228
3.241	3.671000	2.5231
3.394	3.859000	2.6125
3.630	4.485000	2.8674
3.876	4.693000	2.9589

Libus et al. [50a]. Isopiestic measurements, reference salt is KCl. Assigned weight is 1.0.

m_{ref}/mol·kg^{-1}	m/mol·kg^{-1}	$\phi_{298.15}$
0.2595	.175900	.8938
0.3101	.208100	.9000
0.3194	.213800	.9019
0.3626	.241000	.9065
0.4860	.314000	.9290
0.516	.331800	.9329
0.689	.426300	.9675
0.761	.463500	.9825
0.933	.551000	1.0135
0.934	.551000	1.0146
1.104	.633000	1.0451
1.113	.638000	1.0454
1.325	.736000	1.0815
1.371	.756000	1.0901
1.511	.815000	1.1168
1.834	.944000	1.1773
2.085	1.044000	1.2167
2.635	1.245000	1.3072
2.648	1.251000	1.3078
3.418	1.510000	1.4298
3.446	1.519000	1.4342
3.485	1.533000	1.4389
4.084	1.715000	1.5359
4.100	1.720000	1.5382

Comments

In a recent, careful study, Libus et al. [50a] performed isopiestic measurements on $NiBr_2$. Unfortunately, in their data tables, there exists an erroneous setting of the columns for the data for $NiBr_2$ and $CuBr_2$. The correct [50b] experimental data for this system is given above along with the calculated osmotic coefficients.



Deviation Plot for $NiBr_2$: $\Delta\phi$ vs molality

▲ Libus et al. [50a], isopiestic vs $Mg(ClO_4)_2$

✚ Libus et al. [50a], isopiestic vs KCl

$Ni(NO_3)_2$

Recommended Values for the mean activity and osmotic coefficient of $Ni(NO_3)_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ϕ	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8886	.9623	.999948	−1.
.002	.8510	.9495	.999857	−2.
.003	.8248	.9405	.999848	−3.
.004	.8043	.9335	.999798	−4.
.005	.7874	.9277	.999749	−6.
.006	.7729	.9228	.999701	−8.
.007	.7603	.9185	.999653	−10.
.008	.7490	.9147	.999605	−12.
.009	.7389	.9113	.999557	−14.
.010	.7297	.9083	.999509	−17.
.020	.6662	.8879	.999041	−44.
.030	.6281	.8768	.998579	−76.
.040	.6015	.8699	.998121	−113.
.050	.5813	.8653	.997664	−152.
.060	.5653	.8623	.997208	−193.
.070	.5522	.8603	.996751	−230.
.080	.5413	.8591	.996293	−281.
.090	.5321	.8585	.995833	−328.
.100	.5241	.8583	.995372	−375.
.200	.4814	.8691	.990649	−893.
.300	.4672	.8888	.985692	−1450.
.400	.4643	.9114	.980489	−2019.
.500	.4675	.9354	.975039	−2587.
.600	.4746	.9602	.969343	−3148.
.700	.4847	.9855	.963401	−3694.
.800	.4973	1.0113	.957216	−4224.
.900	.5119	1.0375	.950788	−4733.
1.000	.5284	1.0639	.944120	−5219.
1.250	.5777	1.1316	.926403	−6324.
1.500	.6382	1.2011	.907215	−7253.
1.750	.7110	1.2727	.886589	−7989.
2.000	.7975	1.3463	.864570	−8517.
2.250	.8998	1.4219	.841210	−8826.
2.500	1.0209	1.4997	.816578	−8906.
2.750	1.1641	1.5796	.790751	−8746.
3.000	1.3337	1.6617	.763820	−8338.
3.250	1.5349	1.7459	.735889	−7673.
3.500	1.7743	1.8324	.707070	−6742.
3.750	2.0597	1.9211	.677487	−5538.
4.000	2.4010	2.0121	.647273	−4053.
4.250	2.8101	2.1053	.616568	−2279.
4.500	3.3022	2.2008	.585519	−208.
4.623	3.5802	2.2486	.570163	921.

m/mol·kg^{-1}	$\sigma(\phi)$	$\sigma(\ln\gamma)$	$\sigma(\gamma)$
.001	.0003	.0006	.0005
.010	.0019	.0042	.0030
.100	.0063	.0177	.0093
1.000	.0044	.0271	.0143
2.000	.0053	.0240	.0191
4.623	.0392	.0621	.2225

Coefficients of Correlating Equations

	Eqs 1		Eqs 2		Eqs 3	
Par	coefficient	σ(coeff)	coefficient	σ(coeff)	coefficient	σ(coeff)
1	.1592802472+01	.103+00	.2834408378+01	.813-01	.7720545072+01	.238+00
2	.4177466957+00	.355-01	.4331827343+01	.968-01	-.7270364465+01	.472+00
3	.2845173944-01	.751-02	-.5906189949+00	.307-01	.3598839648+01	.323+00
4					-.6719760416+00	.743-01

σ(eqs 1) = .159-01
σ(eqs 2) = .153-01
σ(eqs 3) = .130-01

Experimental Data Employed in Generation of Correlation Equations

Dieterici [32]. Vapor pressure measurements. Assigned weight is zero.

m/mol·kg^{-1}	$\phi_{298.15}$
1.001000	.8680
1.969000	1.1000

Frolov et al. [42]. Isopiestic measurements, reference salt was not specified by these workers. Assigned weight is zero.

m/mol·kg^{-1}	$\phi_{298.15}$
.740000	1.0210
.856200	1.0220
1.050000	1.0600
1.229600	1.0550
1.291000	1.1470
1.597000	1.1260
1.875000	1.1830
2.553000	1.3430
2.707000	1.3900
3.838000	1.6690

Jones et al. [33]. Freezing point depression measurements. Φ_L and Φ_C data for $NiCl_2$ were used in treating these measurements. Assigned weight is zero.

m/mol·kg^{-1}	$\phi_{298.15}$
.076300	.8755
.153100	.8661
.308000	.8732

Jones and Pearce [43]. Freezing point depression measurements. Assigned weight is zero.

m/mol·kg^{-1}	$\phi_{298.15}$
.010050	.9762
.025025	.9239
.050096	.8816
.075213	.8637
.100380	.8753
.252420	.8740

King et al. [14]. Freezing point depression measurements. Assigned weight is zero.

m/mol·kg^{-1}	$\phi_{298.15}$
.050000	.9453
.075000	.9274
.100000	.9217
.125000	.9180
.150000	.9130
.175000	.9011
.200000	.8903
.225000	.8897
.250000	.8884
.275000	.8906
.300000	.8935

Ryabov et al. [44]. Isopiestic measurements, reference salt was not specified by these workers. Assigned weight is 1.0.

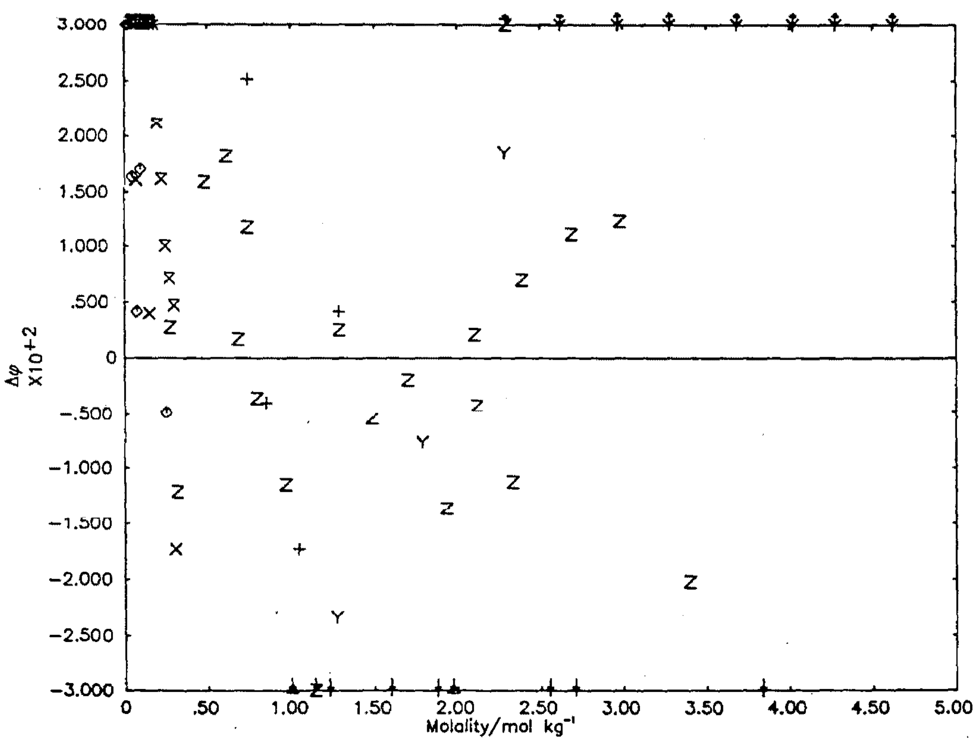
m/mol·kg^{-1}	$\phi_{298.15}$
.278600	.8870
.319200	.8809
.485500	.9478
.615800	.9824
.684600	.9833
.740000	1.0075
.799200	1.0075
.970600	1.0447
1.144800	1.0681
1.290800	1.1453
1.489600	1.1927
1.701700	1.2568
1.933900	1.3130
2.107600	1.3807
2.118500	1.3776
2.292900	1.4698
2.332000	1.4360
2.390300	1.4723
2.691600	1.5718
2.981300	1.6677
3.398000	1.7767

Yakimov and Guzhavina [45]. Vapor pressure measurements. Assigned weight is zero.

$m/\mathrm{mol\cdot kg^{-1}}$	$\phi_{298.15}$
4.623000	2.4008
4.276000	2.2605
4.020000	2.1353
3.685000	2.0099
3.277000	1.8867
2.969000	1.7674
2.622000	1.6065
2.284000	1.4509
1.787000	1.2758
1.274000	1.1148

Comments

There is an unusally large amount of scatter for $Ni(NO_3)_2$ system and we have relied entirely on the isopiestic results of Ryabov et al [44], who, unfortunately neither gave their experimental measurements nor did they state the reference electrolyte they used. The vapor pressure data of Yakimov and Guzhavina [45] scatter about the isopiestic data as do most of the freezing point depression data [33,43,14]. A more carefully documented isopiestic investigation would be of value here.



Deviation Plot For $Ni(NO_3)_2$: $\Delta\phi$ vs molality

- ▲ Dieterici [32], vapor pressure
- + Frolov et al. [42], isopiestic vs ?
- X Jones et al. [33], freezing point depression
- ◇ Jones and Pearce [43], freezing point depression
- X̄ King et al. [14], freezing point depression
- Z Ryabov et al. [44], isopiestic vs ?
- Y Yakimov and Guzhavina [45], vapor pressure

$CoCl_2$

Recommended Values for the mean activity and osmotic coefficient of $CoCl_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ϕ	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8891	.9626	.999948	-1.
.002	.8519	.9500	.999897	-2.
.003	.8260	.9412	.999847	-3.
.004	.8059	.9343	.999798	-4.
.005	.7892	.9287	.999749	-6.
.006	.7750	.9239	.999700	-8.
.007	.7625	.9198	.999652	-10.
.008	.7514	.9161	.999604	-12.
.009	.7415	.9128	.999556	-14.
.010	.7324	.9098	.999508	-16.
.020	.6700	.8901	.999038	-43.
.030	.6325	.8793	.998575	-75.
.040	.6061	.8724	.998116	-111.
.050	.5860	.8677	.997658	-150.
.060	.5700	.8645	.997200	-190.
.070	.5569	.8623	.996743	-233.
.080	.5459	.8608	.996285	-277.
.090	.5365	.8599	.995826	-323.
.100	.5284	.8594	.995366	-370.
.200	.4834	.8666	.990676	-883.
.300	.4671	.8834	.985778	-1438.
.400	.4626	.9044	.980638	-2009.
.500	.4648	.9281	.975232	-2581.
.600	.4718	.9538	.969544	-3146.
.700	.4824	.9812	.963560	-3697.
.800	.4962	1.0100	.957270	-4229.
.900	.5128	1.0400	.950671	-4738.
1.000	.5320	1.0710	.943759	-5221.
1.250	.5912	1.1519	.925128	-6299.
1.500	.6659	1.2359	.904662	-7167.
1.750	.7566	1.3209	.882560	-7806.
2.000	.8639	1.4051	.859093	-8201.
2.250	.9882	1.4670	.834581	-8348.
2.500	1.1205	1.5553	.809368	-8246.
2.750	1.2877	1.6390	.783799	-7897.
3.000	1.4617	1.7072	.758203	-7308.
3.250	1.6501	1.7693	.732874	-6489.
3.500	1.8508	1.8250	.708064	-5450.
3.750	2.0614	1.8741	.683973	-4204.
4.000	2.2794	1.9168	.660743	-2765.
4.118	2.3840	1.9348	.650111	-2023.

m/mol·kg^{-1}	$\sigma(\phi)$	$\sigma(\ln\gamma)$	$\sigma(\gamma)$
.001	.0002	.0004	.0003
.010	.0011	.0025	.0018
.100	.0029	.0090	.0048
1.000	.0021	.0097	.0052
2.000	.0022	.0103	.0089
4.118	.0058	.0120	.0287

Coefficients of Correlating Equations

	Eqs 1		Eqs 2		Eqs 3	
Par	coefficient	σ(coeff)	coefficient	σ(coeff)	coefficient	σ(coeff)
1	.1724803367+01	.696-01	.2034073132+01	.773-01	.8835017198+01	.181+00
2	.2257683320+00	.471-01	.5710716949+01	.142+01	-.1102415691+02	.486+00
3	.2103460579+00	.328-01	-.1349883870+01	.911-01	.8190289847+01	.507+00
4	-.4852062356-01	.103-01	.1344546927+00	.196-01	-.3023801793+01	.235+00
5	.3238217201-02	.113-02			.4298568295+00	.402-01

σ(eqs 1) = .875-02
σ(eqs 2) = .997-02
σ(eqs 3) = .948-02

Experimental Data Employed in Generation of Correlating Equations

Isopiestic data of Downes [20]. Reference salt is $CaCl_2$. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
1.534600	1.2483
1.815300	1.3412
2.181700	1.4621
2.762000	1.6425
3.018000	1.7198
3.223800	1.7682
3.384800	1.8120
3.451000	1.8243
3.790300	1.8952
4.117900	1.9606

Isopiestic data of Downes [20]. Reference salt is NaCl. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
.609800	.9547
.668000	.9707
.746500	.9926
1.336600	1.1776
1.539300	1.2448
1.634900	1.2790
1.794800	1.3352
1.992800	1.3985
2.429100	1.5478

Freezing point depression data of Hall and Harkins [46]. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
.001730	.9626
.002090	.9508
.008920	.9155
.010080	.9116
.022510	.8886
.023750	.8891
.054750	.8687
.059730	.8680
.125600	.8639
.277200	.8938
.421700	.9239

Freezing point depression data of Jones and Getman [47]. Assigned weight is zero.

m/mol·kg^{-1}	$\phi_{298.15}$
.063960	.8993
.128200	.8708
.192800	.8700
.321400	.9081
.450900	.9573

Freezing point depression data of Jones and Pearce [43]. Assigned weight is zero.

m/mol·kg^{-1}	$\phi_{298.15}$
.010003	1.1142
.025010	.9913
.050040	.9239
.075090	.7893
.100150	.9026
.251000	.9235
.504300	.9994

Isopiestic data of Robinson [48]. Reference salt is KCl. Assigned weight is 1.0.

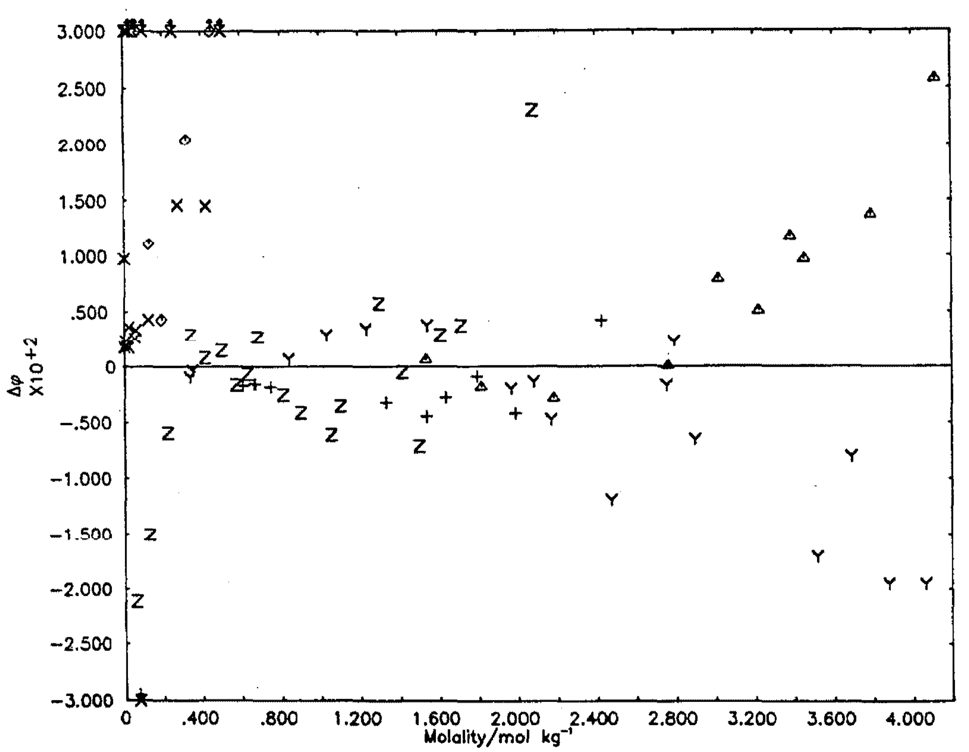
m/mol·kg^{-1}	$\phi_{298.15}$
.058710	.8438
.128400	.8446
.224600	.8643
.341200	.8946
.415000	.9086
.501100	.9298
.572900	.9450
.632000	.9617
.684600	.9796
.810600	1.0106
.903400	1.0369
1.057000	1.0830
1.106000	1.1013
1.303000	1.1753
1.416000	1.2070
1.500000	1.2288
1.612000	1.2769
1.718000	1.3138
2.084000	1.4560

Isopiestic data of Robinson and Brown [49]. Reference salt is $CaCl_2$. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
.335100	.8895
.349200	.8930
.839800	1.0225
1.033000	1.0844
1.235000	1.1505
1.543000	1.2543
1.970000	1.3931
2.081000	1.4306
2.170000	1.4564
2.473000	1.5452
2.754000	1.6385
2.794000	1.6538
2.898000	1.6736
3.512000	1.8104
3.687000	1.8544
3.878000	1.8773
4.064000	1.9073

Comments

For $CoCl_2$, freezing point depression measurements have been reported by Biltz [38], Hall and Harkins [48], Jones et al [33], Jones and Getman [47], and Jones and Pearce [43]. The old results of Biltz [38] are totally unreasonable and are not given above. The data sets of Jones and Getman [47] and Jones et al [33] appear to be identical, but none of Jones' results were given any weight. Only the careful measurements of Hall and Harkins [46], which were found to merge well with the isopiestic data, were found to be of any value from these various data sets based on freezing point depression measurements. It should be noted that the various isopiestic measurements, based on these different reference salts, are in good agreement up to about 2.5 $mol \cdot kg^{-1}$, but that at greater molalities the more recent results of Downes [20] differ systematically from the earlier results of Robinson and Brown [49]. Downes [20] has noted that this systematic difference may be attributable, in part, to experimental difficulties with the analyses of the stock solutions. We have weighted equally the results of Downes [20] and of Robinson and Brown [49]. It should be noted that the freezing point depression data of Hall and Harkins [46], even though given unit weight, differ systematically from our final fit. This is attributable to two constraints imposed during the fitting process: (a) that the limiting slope be given by Debye-Hückel theory and (b) the large amount of isopiestic data that also must be accomodated.



Deviation Plot For $CoCl_2$: $\Delta\phi$ vs molality

- ▲ Downes [20], isopiestic vs $CaCl_2$
- + Downes [20], isopiestic vs NaCl
- X Hall and Harkins [46], freezing point depression
- ◇ Jones and Getman [47], freezing point depression
- ⌘ Jones and Pearce [43], freezing point depression
- Z Robinson [48], isopiestic vs KCl
- Y Robinson and Brown [49], isopiestic vs $CaCl_2$

$Co(ClO_4)_2$

Recommended Values for the mean activity and osmotic coefficient of $Co(ClO_4)_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ϕ	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8913	.9638	.999948	-1.
.002	.8558	.9521	.999897	-2.
.003	.8315	.9443	.999847	-3.
.004	.8127	.9383	.999797	-4.
.005	.7973	.9335	.999748	-6.
.006	.7843	.9295	.999699	-8.
.007	.7729	.9261	.999650	-10.
.008	.7629	.9231	.999601	-12.
.009	.7539	.9205	.999552	-14.
.010	.7458	.9182	.999504	-16.
.020	.6914	.9042	.999023	-41.
.030	.6602	.8981	.998545	-70.
.040	.6391	.8954	.998066	-102.
.050	.6238	.8946	.997585	-136.
.060	.6122	.8950	.997102	-172.
.070	.6031	.8962	.996615	-209.
.080	.5959	.8979	.996125	-247.
.090	.5901	.9001	.995631	-286.
.100	.5855	.9026	.995134	-326.
.200	.5719	.9368	.989925	-737.
.300	.5855	.9783	.984264	-1146.
.400	.6123	1.0232	.978123	-1528.
.500	.6487	1.0707	.971480	-1872.
.600	.6938	1.1206	.964315	-2169.
.700	.7474	1.1725	.956610	-2414.
.800	.8101	1.2265	.948350	-2601.
.900	.8827	1.2825	.939524	-2726.
1.000	.9663	1.3403	.930125	-2785.
1.250	1.2336	1.4924	.904094	-2626.
1.500	1.6094	1.6544	.874484	-1991.
1.750	2.1386	1.8251	.841458	-845.
2.000	2.8863	2.0032	.805309	845.
2.250	3.9468	2.1874	.766445	3105.
2.500	5.4560	2.3763	.725366	5957.
2.750	7.6087	2.5687	.682643	9419.
3.000	10.6829	2.7633	.638885	13507.
3.250	15.0710	2.9585	.594718	18230.
3.500	21.3221	3.1532	.550752	23595.
3.514	21.7566	3.1645	.548220	23926.

m/mol·kg^{-1}	$\sigma(\phi)$	$\sigma(\ln\gamma)$	$\sigma(\gamma)$
.001	.0001	.0003	.0003
.010	.0009	.0020	.0015
.100	.0022	.0071	.0041
1.000	.0016	.0082	.0079
2.000	.0020	.0083	.0239
3.514	.0048	.0092	.1991

Coefficients of Correlating Equations

	Eqs 1		Eqs 2		Eqs 3	
Par	coefficient	σ(coeff)	coefficient	σ(coeff)	coefficient	σ(coeff)
1	.2069877024+01	.573-01	.2744591642+01	.167+00	.1374348933+02	.868+00
2	.6650962889+00	.216-01	.5798858975+01	.486+00	-.3096638506+02	.462+01
3	.2088219562+00	.109-01	-.1988615659+01	.554+00	.4788305655+02	.103+02
4	-.1952381040-01	.182-02	.6558508463+00	.281+00	-.4529889078+02	.120+02
5			-.1113246387+00	.526-01	.2541915831+02	.768+01
6					-.7711748831+01	.254+01
7					.9705587929+00	.342+00

σ(eqs 1) = .517-02
σ(eqs 2) = .527-02
σ(eqs 3) = .496-02

Experimental Data Employed in Generation of Correlating Equations

Libus and Sadowska [40], is- isopiestic measurements, reference salt is KCl. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
.097200	.9019
.110400	.9043
.182000	.9279
.195100	.9396
.424100	1.0338
.566400	1.1001
.582800	1.1098
.736400	1.1897
.765300	1.2106
.910400	1.2904
.957000	1.3134
.981100	1.3335
1.075800	1.3876
1.217800	1.4751
1.293900	1.5158
1.321200	1.5412
1.476000	1.6455

Libus and Sadowska [40], isopiestic measurements, reference salt is $Mg(ClO_4)_2$. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
2.187700	2.1613
2.410400	2.3302
2.796700	2.6289
3.057200	2.8245
3.514500	3.1819

Libus and Sadowska [40], isopiestic measurements, reference salt is $NaClO_4$. Assigned weight is 1.0.

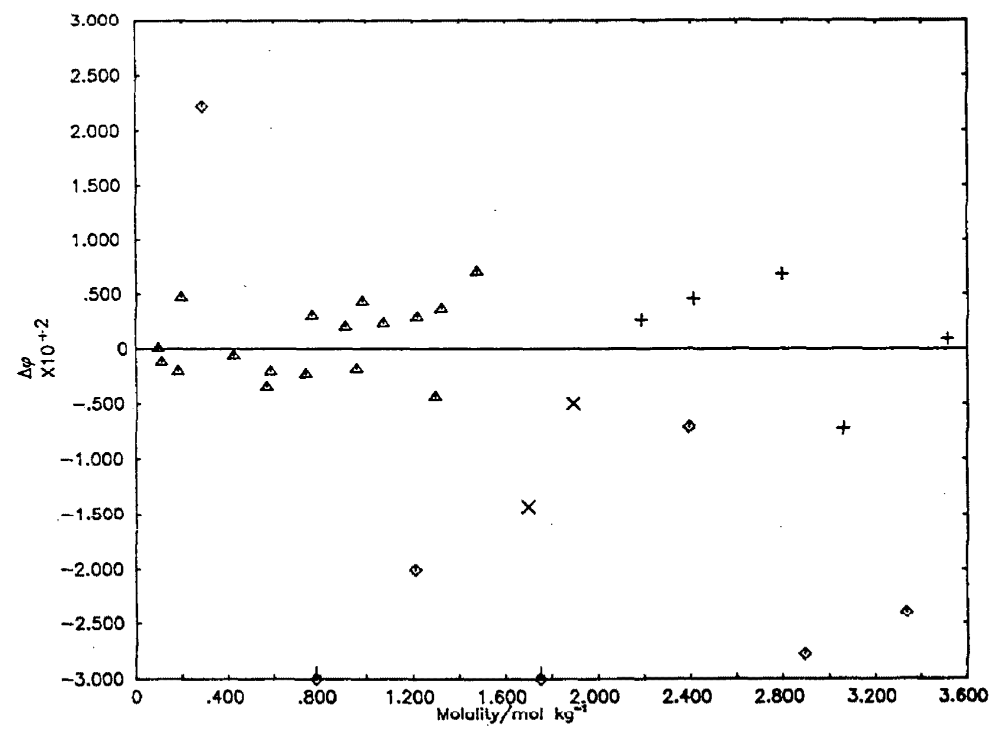
m/mol·kg^{-1}	$\phi_{298.15}$
1.696300	1.7735
1.891500	1.9201

Lilich and Andreev [41]. Vapor pressure measurements. Assigned weight is zero.

m/mol·kg^{-1}	$\phi_{298.15}$
.288800	.9956
.782000	1.1529
1.210000	1.4473
1.752000	1.7958
2.390000	2.2856
2.891000	2.6505
3.334000	3.0002

Comments

We prefer the isopiestic measurements of Libus and Sadowska [40] over the vapor pressure measurements of Lilich and Andreev [41].



Deviation Plot for $Co(ClO_4)_2$: $\Delta\phi$ vs molality

▲ Libus and Sadowska [40], isopiestic vs KCl

✕ Libus and Sadowska [40], isopiestic vs $NaClO_4$

+ Libus and Sadowska [40], isopiestic vs $Mg(ClO_4)_2$

◇ Lilich and Andreev [41], vapor pressure

$CoBr_2$

Recommended Values for the mean activity and osmotic coefficient of $CoBr_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ϕ	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8904	.9633	.999948	-1.
.002	.8541	.9512	.999897	-2.
.003	.8291	.9429	.999847	-3.
.004	.8097	.9365	.999796	-4.
.005	.7937	.9314	.999748	-6.
.006	.7801	.9270	.999699	-8.
.007	.7683	.9232	.999651	-10.
.008	.7578	.9199	.999602	-12.
.009	.7483	.9170	.999554	-14.
.010	.7398	.9144	.999506	-16.
.020	.6815	.8976	.999030	-42.
.030	.6471	.8891	.998559	-72.
.040	.6233	.8842	.998090	-106.
.050	.6054	.8813	.997621	-142.
.060	.5914	.8797	.997151	-181.
.070	.5801	.8790	.996680	-220.
.080	.5707	.8789	.996207	-262.
.090	.5629	.8793	.995732	-304.
.100	.5562	.8800	.995255	-347.
.200	.5235	.8979	.990341	-811.
.300	.5181	.9241	.985129	-1298.
.400	.5244	.9541	.979585	-1783.
.500	.5383	.9869	.973682	-2254.
.600	.5579	1.0220	.967401	-2702.
.700	.5826	1.0591	.960723	-3121.
.800	.6120	1.0980	.953636	-3504.
.900	.6461	1.1384	.946132	-3850.
1.000	.6851	1.1802	.938204	-4153.
1.250	.8054	1.2901	.916535	-4709.
1.500	.9628	1.4056	.892301	-4948.
1.750	1.1650	1.5248	.865701	-4842.
2.000	1.4214	1.6458	.837029	-4375.
2.250	1.7435	1.7669	.806650	-3532.
2.500	2.1441	1.8867	.774973	-2306.
2.750	2.6377	2.0039	.742423	-695.
3.000	3.2402	2.1174	.709419	1300.
3.250	3.9679	2.2262	.676355	3674.
3.500	4.8378	2.3297	.643587	6422.
3.750	5.8665	2.4274	.611417	9533.
4.000	7.0703	2.5190	.580092	12997.
4.250	8.4647	2.6043	.549800	16802.
4.500	10.0648	2.6835	.520667	20935.
4.750	11.8861	2.7568	.492764	25383.
5.000	13.9461	2.8248	.466107	30135.
5.250	16.2662	2.8881	.440665	35178.
5.445(sat)	18.2746	2.9348	.421618	39308.
5.500	18.8753	2.9476	.416365	40503.
5.672	20.8589	2.9870	.400254	44325.

m/mol·kg^{-1}	$\sigma(\phi)$	$\sigma(\ln\gamma)$	$\sigma(\gamma)$
.001	.0004	.0009	.0008
.010	.0025	.0056	.0042
.100	.0065	.0202	.0112
1.000	.0049	.0220	.0151
2.000	.0044	.0215	.0306
5.000	.0080	.0217	.3024
5.672	.0160	.0289	.6026

Coefficients of Correlating Equations

	Eqs 1		Eqs 2		Eqs 3	
Par	coefficient	σ(coeff)	coefficient	σ(coeff)	coefficient	σ(coeff)
1	.1937945402+01	.159+00	.2498602848+01	.990-01	.8642748306+01	.254+00
2	.3606771568+00	.715-01	.5255313068+01	.158+00	-.9636782913+01	.599+00
3	.2399520593+00	.382-01	-.1067261033+01	.877-01	.6489740636+01	.543+00
4	-.4623972375-01	.885-02	.8385252431-01	.163-01	-.2138147480+01	.217+00
5	.2694683656-02	.717-03			.2678063229+00	.320-01

σ(eqs 1) = .168-01
σ(eqs 2) = .172-01
σ(eqs 3) = .170-01

Experimental Data Employed in Generation of Correlating Equations

Libus et al. [50a]. Reference salt is KCl. Assigned weight is 1.0.

m/mol•kg^{-1}	$\phi_{298.15}$
.179000	.8909
.241400	.9060
.244700	.8998
.317700	.9217
.403500	.9572
.442500	.9685
.555000	1.0073
.637000	1.0385
.642000	1.0389
.740000	1.0756
.759000	1.0858
.893000	1.1373
.967000	1.1655
1.089000	1.2152
1.248000	1.2834
1.554000	1.4019

Robinson, McCoach and Lim [51]. Reference electrolyte is $CaBr_2$. Assigned weight is 1.0.

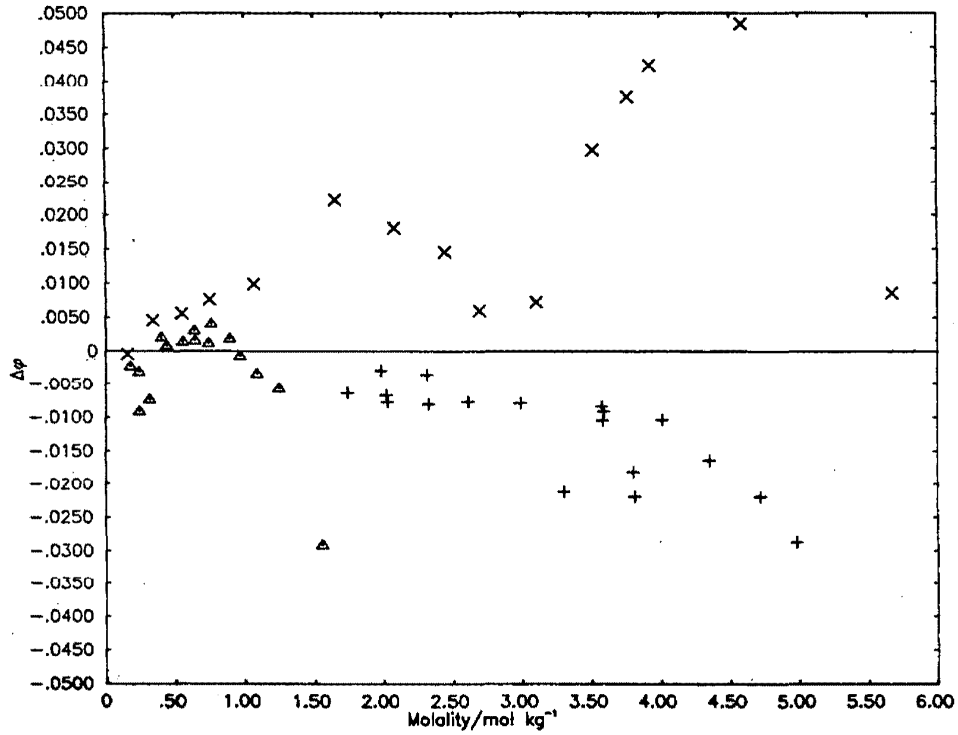
m/mol•kg^{-1}	$\phi_{298.15}$
.159300	.8887
.343500	.9413
.550300	1.0099
.749100	1.0856
1.068000	1.2193
1.658000	1.5028
2.085000	1.7051
2.446000	1.8756
2.694000	1.9840
3.107000	2.1718
3.516000	2.3659
3.768000	2.4717
3.930000	2.5363
4.589000	2.7586
5.672000	2.9955

Libus et al. [50a]. Reference salt is $Mg(ClO_4)_2$. Assigned weight is 1.0.

m/mol•kg^{-1}	$\phi_{298.15}$
1.741000	1.5141
1.983000	1.6347
2.022000	1.6498
2.031000	1.6531
2.316000	1.7953
2.328000	1.7965
2.608000	1.9301
2.989000	2.1046
3.306000	2.2287
3.575000	2.3513
3.581000	2.3516
3.589000	2.3561
3.801000	2.4286
3.813000	2.4292
4.012000	2.5129
4.352000	2.6210
4.718000	2.7258
4.977000	2.7900

Comments

There is a fair amount of scatter in the data for this system. A part of it may be attributable to the uncertainties in the data for the reference salts, particularly in the data for $CaBr_2$, the reference salt used by Robinson et al. [51].



Deviation Plot for $CoBr_2$: $\Delta\phi$ vs molality

▲ Libus et al. [50a], isopiestic vs KCl

+ Libus et al. [50a], isopiestic vs $Mg(ClO_4)_2$

× Robinson, McCoach and Lim [51], isopiestic vs $CaBr_2$

CoI_2

Recommended Values for the mean activity and osmotic coefficient of CoI_2 in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ϕ	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8872	.9616	.999948	-1.
.002	.8486	.9482	.999898	-2.
.003	.8216	.9388	.999848	-3.
.004	.8006	.9315	.999799	-5.
.005	.7832	.9255	.999750	-6.
.006	.7684	.9204	.999702	-8.
.007	.7554	.9160	.999654	-10.
.008	.7439	.9121	.999606	-12.
.009	.7335	.9087	.999558	-15.
.010	.7242	.9056	.999511	-17.
.020	.6608	.8863	.999042	-45.
.030	.6242	.8774	.998578	-78.
.040	.5998	.8734	.998114	-114.
.050	.5823	.8722	.997646	-154.
.060	.5691	.8726	.997174	-195.
.070	.5590	.8743	.996698	-237.
.080	.5512	.8767	.996217	-281.
.090	.5450	.8797	.995730	-326.
.100	.5401	.8832	.995238	-371.
.200	.5273	.9272	.990028	-844.
.300	.5410	.9737	.984337	-1312.
.400	.5652	1.0188	.978215	-1753.
.500	.5962	1.0632	.971679	-2158.
.600	.6330	1.1076	.964721	-2521.
.700	.6756	1.1528	.957323	-2837.
.800	.7247	1.1995	.949458	-3103.
.900	.7810	1.2480	.941101	-3315.
1.000	.8453	1.2985	.932227	-3469.
1.250	1.0497	1.4341	.907660	-3584.
1.500	1.3353	1.5826	.879588	-3274.
1.750	1.7334	1.7419	.848102	-2497.
2.000	2.2872	1.9092	.813530	-1218.
2.250	3.0536	2.0812	.776401	587.
2.500	4.1071	2.2547	.737381	2937.
2.750	5.5415	2.4266	.697215	5842.
3.000	7.4709	2.5940	.656660	9304.
3.250	10.0269	2.7543	.616441	13317.
3.500	13.3535	2.9052	.577207	17871.
3.750	17.5953	3.0448	.539509	22948.
4.000	22.8813	3.1714	.503784	28526.
4.250	29.3046	3.2837	.470358	34578.
4.500	36.8994	3.3808	.439445	41076.
4.750	45.6198	3.4620	.411164	47983.
5.000	55.3261	3.5269	.385553	55269.
5.250	65.7807	3.5755	.362581	62894.
5.500	76.6589	3.6079	.342168	70823.
5.750	87.5747	3.6246	.324193	79017.
6.000	98.1179	3.6265	.308510	87441.
6.250	107.8979	3.6145	.294951	96059.
6.500(sat)	116.5874	3.5899	.283335	104837.
6.750	123.9578	3.5541	.273469	113743.
7.000	129.9023	3.5088	.265148	122750.
7.250	134.4436	3.4560	.258154	131832.
7.500	137.7281	3.3979	.252253	140968.
7.750	140.0092	3.3367	.247191	150142.
8.000	141.6273	3.2750	.242684	159341.
8.250	142.9896	3.2154	.238423	168559.
8.500	144.5589	3.1611	.234063	177795.
8.750	146.8532	3.1148	.229231	187056.
9.000	150.4643	3.0801	.223533	196353.
9.250	156.0999	3.0602	.216566	205707.
9.500	164.6606	3.0587	.207953	215143.
9.750	177.3711	3.0793	.197372	224698.
10.000	196.0000	3.1260	.184610	234414.
10.100	205.6676	3.1529	.178875	238357.

m/mol·kg^{-1}	σ(ø)	σ(ℓnγ)	σ(γ)
.001	.0002	.0005	.0004
.010	.0021	.0044	.0032
.100	.0129	.0296	.0160
1.000	.0157	.0696	.0588
2.000	.0166	.0600	.1373
5.000	.0165	.0661	3.6565
10.000	.0343	.0728	14.2765
10.100	.0379	.0763	15.6957

Coefficients of Correlating Equations

	Eqs 2		Eqs 3	
Par	coefficient	σ(coeff)	coefficient	σ(coeff)
1	.5465540478+01	.521+00	.9476445136+01	.527+00
2	-.5279072846+00	.901+00	-.1074768873+02	.911+00
3	.3531853068+01	.602+00	.7146954592+01	.608+00
4	-.1469357122+01	.178+00	-.2219520356+01	.180+00
5	.1860244467+00	.194-01	.2504491292+00	.196-01

σ(eqs 2) = .404-01
σ(eqs 3) = .408-01

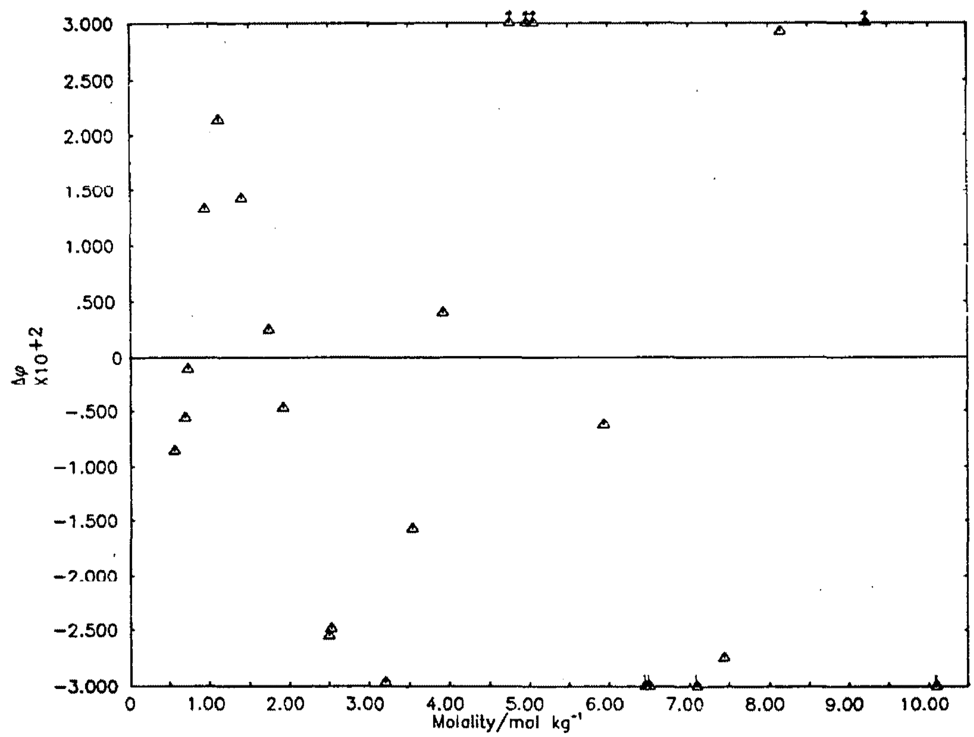
Experimental Data Employed in Generation of Correlating Equations

Robinson, McCoach, and Lim [51]. Isopiestic measurements, reference salt is $CaCl_2$. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
.561000	1.0816
.654500	1.1447
.726000	1.1638
.944500	1.2835
1.121000	1.3838
1.404000	1.5384
1.746000	1.7418
1.926000	1.8543
2.501000	2.2209
2.528000	2.2492
3.201000	2.6939
3.535000	2.9097
3.930000	3.1413
4.775000	3.5254
4.981000	3.5849
5.074000	3.5907
5.945000	3.6211
6.448000	3.5495
6.502000	3.5438
7.096000	3.4400
7.439000	3.3850
8.164000	3.2647
9.229000	3.1520
10.100000	3.1045

Comments

There is a fair amount of scatter in the isopiestic data of Robinson, McCoach, and Lim [51], probably attributable to slow decomposition of the salt in solution. A more precise set of measurements would be of value. Equations 1 could not be used to correlate the data and the table of recommended values and the deviation plot are based upon equations 3.



Deviation Plot For CoI_2: $\Delta\phi$ vs molality

▲ Robinson, McCoach, and Lim [51], isopiestic vs $CaCl_2$

$Co(NO_3)_2$

Recommended Values for the mean activity and osmotic coefficient of $Co(NO_3)_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ϕ	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8883	.9622	.999948	-1.
.002	.8504	.9491	.999897	-2.
.003	.8240	.9400	.999848	-3.
.004	.8034	.9329	.999798	-5.
.005	.7863	.9270	.999750	-6.
.006	.7716	.9220	.999701	-8.
.007	.7588	.9176	.999653	-10.
.008	.7474	.9137	.999605	-12.
.009	.7371	.9102	.999557	-14.
.010	.7277	.9070	.999510	-17.
.020	.6631	.8858	.999043	-44.
.030	.6241	.8739	.998584	-77.
.040	.5966	.8663	.998129	-114.
.050	.5758	.8611	.997676	-154.
.060	.5591	.8575	.997223	-196.
.070	.5455	.8550	.996771	-240.
.080	.5341	.8532	.996318	-286.
.090	.5243	.8521	.995864	-333.
.100	.5158	.8515	.995409	-382.
.200	.4690	.8583	.990766	-915.
.300	.4515	.8747	.985918	-1494.
.400	.4454	.8946	.980847	-2092.
.500	.4456	.9162	.975546	-2694.
.600	.4499	.9389	.970011	-3292.
.700	.4571	.9625	.964241	-3880.
.800	.4667	.9868	.958232	-4455.
.900	.4784	1.0116	.951984	-5013.
1.000	.4919	1.0370	.945496	-5551.
1.250	.5333	1.1024	.928227	-6797.
1.500	.5850	1.1704	.909475	-7882.
1.750	.6477	1.2407	.889281	-8785.
2.000	.7222	1.3127	.867711	-9492.
2.250	.8100	1.3864	.844855	-9991.
2.500	.9128	1.4613	.820828	-10273.
2.750	1.0326	1.5371	.795763	-10328.
3.000	1.1717	1.6135	.769810	-10152.
3.250	1.3328	1.6902	.743134	-9738.
3.500	1.5187	1.7668	.715908	-9082.
3.750	1.7324	1.8429	.688311	-8183.
4.000	1.9773	1.9184	.660525	-7039.
4.250	2.2569	1.9927	.632730	-5648.
4.500	2.5745	2.0656	.605101	-4012.
4.750	2.9337	2.1366	.577806	-2133.
5.000	3.3377	2.2056	.551002	-11.
5.250	3.7893	2.2720	.524834	2348.
5.500	4.2907	2.3357	.499432	4941.
5.620(sat)	4.5495	2.3651	.487547	6267.
5.750	4.8433	2.3961	.474914	7762.
5.790	4.9365	2.4054	.471080	8234.

m/mol·kg^{-1}	$\sigma(\phi)$	$\sigma(\ln\gamma)$	$\sigma(\gamma)$
.001	.0001	.0002	.0002
.010	.0008	.0017	.0013
.100	.0026	.0074	.0038
1.000	.0016	.0113	.0055
2.000	.0016	.0101	.0073
5.000	.0035	.0123	.0412
5.790	.0054	.0116	.0574

Coefficients of Correlating Equations

	Eqs 1		Eqs 2		Eqs 3	
Par	coefficient	σ(coeff)	coefficient	σ(coeff)	coefficient	σ(coeff)
1	.1548882687+01	.429-01	.9612031532+00	.295+00	.8409866200+01	.307+00
2	.3455882534+00	.169-01	.9095482822+01	.922+00	-.1019702100+02	.962+00
3	.5646717246-01	.521-02	-.5718314250+01	.119+01	.7838656857+01	.124+01
4	-.5060153065-02	.526-03	.2777416954+00	.766+00	-.3447124329+01	.799+00
5			-.7562225446+00	.241+00	.8078866323+00	.252+00
6			.8422392033-01	.298-01	-.7875830073	.310-01

σ(eqs 1) = .706-02
σ(eqs 2) = .717-02
σ(eqs 3) = .748 02

Experimental Data Employed in Generation of Correlating Equations

Frolov, et al. [42]. Isopiestic measurements, reference salt is not given. Assigned weight is zero.

m/mol•kg^{-1}	$\phi_{298.15}$
2.323000	1.4230
1.420000	1.2220
1.162000	1.0790
.814000	.9870
4.480000	2.0490
2.840000	1.5690
1.730300	1.2390
1.338200	1.1410

Jones and Getman [47]. Freezing point depression measurements. Φ_L and Φ_C data for $CoCl_2$ were used in treating these measurements. Assigned weight is zero.

m/mol•kg^{-1}	$\phi_{298.15}$
.074910	.8305
.150300	.8061
.302400	.8159
.456400	.8554

Jones and Pearce [43]. Freezing point depression measurements. Assigned weight is zero.

m/mol•kg^{-1}	$\phi_{298.15}$
.010038	.9833
.025030	.9526
.050100	.9095
.075210	.8967
.100380	.8818
.252400	.8945
.510100	.9422

Robinson and Brown [49]. Isopiestic measurements, reference salt is $CaCl_2$. Assigned weight is 1.0.

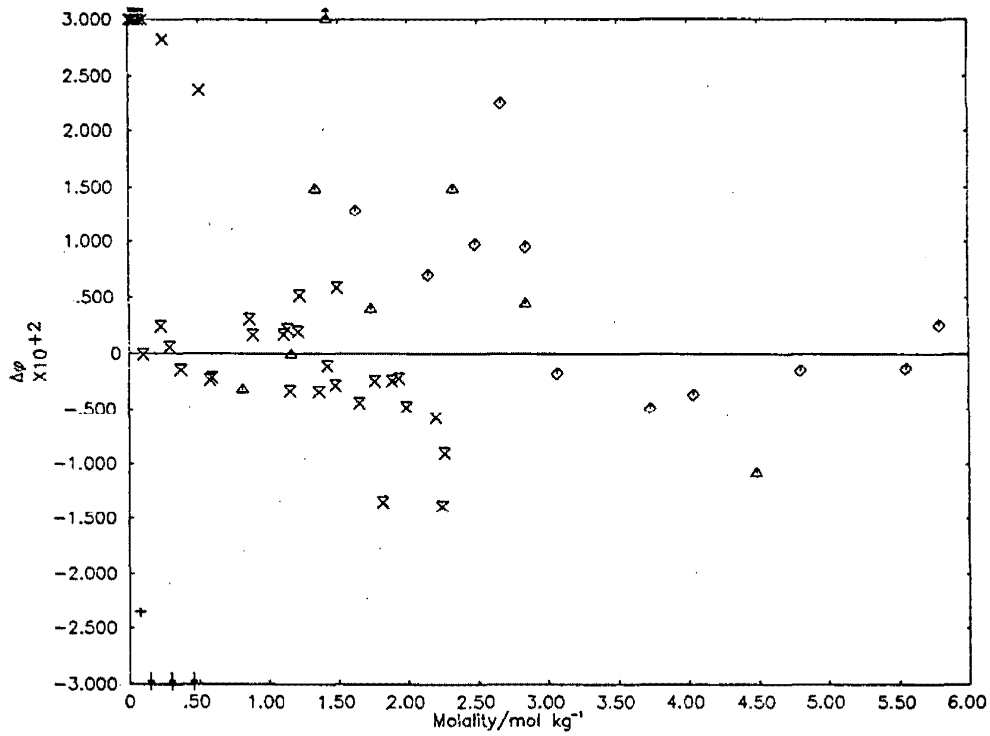
m/mol•kg^{-1}	$\phi_{298.15}$
1.624000	1.2179
2.144000	1.3620
2.483000	1.4659
2.673000	1.5363
2.846000	1.5759
3.067000	1.6323
3.729000	1.8317
4.039000	1.9264
4.802000	2.1497
5.552000	2.3472
5.790000	2.4080

Robinson, Wilson, and Ayling [52]. Isopiestic measurements, reference salt is KCl. Assigned weight is 1.0.

m/mol•kg^{-1}	$\phi_{298.15}$
.102200	.8513
.229700	.8650
.293200	.8740
.371500	.8872
.579800	.9319
.596200	.9359
.864500	1.0058
.888100	1.0103
1.109000	1.0669
1.137000	1.0747
1.155000	1.0739
1.214000	1.0948
1.223000	1.1004
1.362000	1.1292
1.421000	1.1476
1.477000	1.1612
1.487000	1.1727
1.650000	1.2079
1.760000	1.2410
1.815000	1.2458
1.886000	1.2772
1.935000	1.2916
1.990000	1.3050
2.198000	1.3651
2.244000	1.3708
2.261000	1.3806

Comments

The more recent isopiestic results of Frolov et al. [42], although less precise than the isopiestic results of Robinson et al. [49,52], are in fair agreement with them. The old freezing point depression measurements of Jones et al. [43,49] are given zero weight.



Deviation Plot For $Co(NO_3)_2$: Δφ vs molality

- ▲ Frolov et al [42], isopiestic vs ?
- + Jones and Getman [49], freezing point depression
- × Jones and Pearce [43], freezing point depression
- ◇ Robinson and Brown [51], isopiestic vs $CaCl_2$
- ⧗ Robinson, Wilson and Ayling [52], isopiestic vs KCl

$[Co(NH_3)_5NO_2]Cl_2$

Recommended Values for the mean activity and osmotic coefficient of $[Co(NH_3)_5NO_2]Cl_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ø	a_w	ΔG^{ex}/J·kg^{-1}
.001	.9015	.9688	.999948	-1.
.002	.8715	.9597	.999896	-1.
.003	.8508	.9532	.999845	-3.
.004	.8344	.9479	.999795	-4.
.005	.8206	.9433	.999745	-5.
.006	.8084	.9392	.999695	-7.
.007	.7975	.9353	.999646	-8.
.008	.7876	.9316	.999597	-10.
.009	.7783	.9280	.999549	-12.
.010	.7697	.9246	.999500	-14.
.020	.7012	.8935	.999035	-37.
.030	.6487	.8644	.998599	-66.
.040	.6039	.8358	.998195	-101.
.050	.5641	.8073	.997821	-141.
.060	.5281	.7789	.997477	-186.
.070	.4951	.7506	.997165	-236.
.080	.4646	.7221	.996883	-291.
.090	.4363	.6937	.996631	-350.
.100	.4100	.6652	.996411	-414.

m/mol·kg^{-1}	σ(ø)	σ(ℓnγ)	σ(γ)
.001	.0033	.0074	.0067
.010	.0117	.0322	.0248
.100	.0178	.0743	.0304

Coefficients of Correlating Equations

Par	Eqs 1 coefficient	Eqs 1 σ(coeff)	Eqs 2 coefficient	Eqs 2 σ(coeff)	Eqs 3 coefficient	Eqs 3 σ(coeff)
1	.8966847299+00	.412-01	-.8542577948+01	.210+01	.6377358634+01	.674+00
2			.5416724643+02	.151+02	-.5825971431+01	.200+01
3			-.7397029192+02	.283+02		

σ(eqs 1) = .873-02
σ(eqs 2) = .984-02
σ(eqs 3) = .884-02

Experimental Data Employed in Generation of Correlating Equations

Freezing point depression measurements of Harkins, Hall, and Roberts [56]. Φ_L and Φ_c data for $CoCl_2$ were used in the absence of any direct measurements. Assigned weight is 1.0.

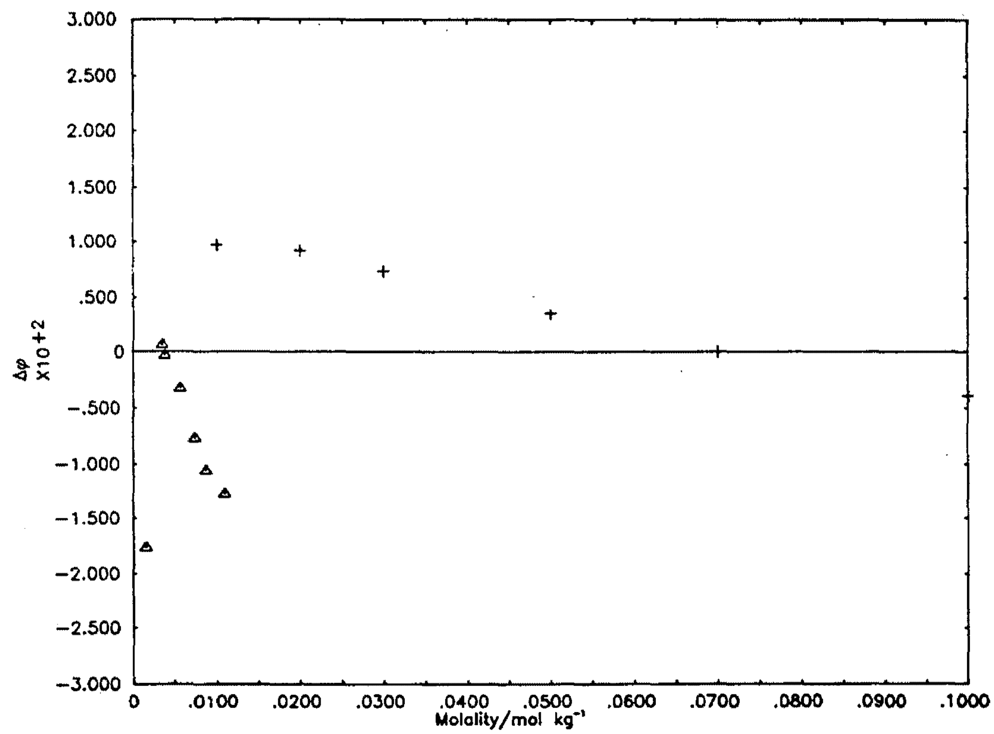
m/mol·kg^{-1}	$ø_{298.15}$
.001540	.9338
.003540	.9304
.003860	.9268
.005710	.9108
.007450	.8965
.008710	.8874
.010920	.8759

Vapor pressure osmometry data obtained at 37°C by Masterton and Scola [11]. Φ_L and Φ_c data for $CoCl_2$ were used to adjust the ϕ data to 25°C. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
.010000	.9020
.020000	.8700
.030000	.8480
.050000	.8180
.070000	.7980
.100000	.7780

Comments

The old freezing point depression data of Harkins, Hall, and Roberts [10] appear to have been carefully performed. The agreement with the vapor pressure osmometry data [11] is fair.



Deviation Plot For $[Co(NH_3)_5NO_2]Cl_2$: $\Delta\phi$ vs molality

▲ Harkins, Hall and Roberts [10] - freezing point depression

✚ Masterton and Scola [11] - vapor pressure osmometry

$[Co(NH_3)_5Cl]Cl_2$

Recommended Values for the mean activity and osmotic coefficient of $[Co(NH_3)_5Cl]Cl_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ϕ	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8897	.9629	.999948	-1.
.002	.8529	.9505	.999897	-2.
.003	.8274	.9419	.999847	-3.
.004	.8076	.9353	.999798	-4.
.005	.7912	.9299	.999749	-6.
.006	.7772	.9253	.999700	-8.
.007	.7651	.9213	.999652	-10.
.008	.7578	.9190	.999620	-11.

m/mol·kg^{-1}	$\sigma(\phi)$	$\sigma(\ln\gamma)$	$\sigma(\gamma)$
.001	.0010	.0022	.0019
.008	.0056	.0124	.0094

Coefficients of Correlating Equations

	Eqs 1		Eqs 3	
Par	coefficient	σ(coeff)	coefficient	σ(coeff)
1	.1815736355+01	.372+00	.1004990834+02	.169+01

σ(eqs 1) = .106-01
σ(eqs 3) = .113-01

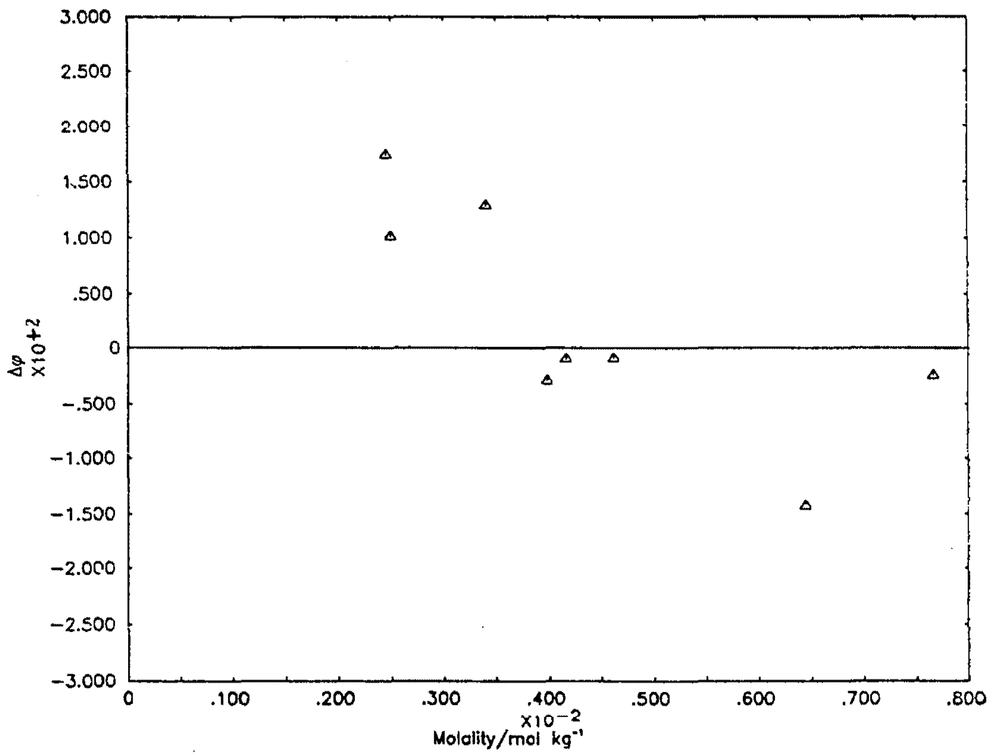
Experimental Data Employed in Generation of Correlating Equations

Harkins, Hall, and Roberts [10]. Freezing point depression measurements. Φ_L and Φ_c data for $CoCl_2$ were used in treating this data. A reasonable fit could not be obtained using eqs 2. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
.002450	.9637
.002490	.9561
.003400	.9520
.003980	.9325
.004160	.9334
.004620	.9309
.006440	.9092
.007660	.9165

Comments

While a slightly better fit can be obtained for eqs 1 using 2 parameters, the values of the B coefficients so obtained is equal to 12.05 and seems physically unreasonable if one attempts to interpret that value in terms of an ionic size.



Deviation Plot for $[Co(NH_3)_5Cl]Cl_2$: $\Delta\phi$ vs molality

▲ Harkins, Hall and Roberts [10] - freezing point depression

$[Co(NH_3)_5F]Cl_2$

Recommended Values for the mean activity and osmotic coefficient of $[Co(NH_3)_5F]Cl_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ϕ	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8853	.9605	.999948	-1.
.002	.8449	.9460	.999858	-2.
.003	.8162	.9354	.999848	-3.
.004	.7935	.9270	.999800	-5.
.005	.7744	.9198	.999751	-7.
.006	.7580	.9135	.999704	-9.
.007	.7435	.9079	.999657	-11.
.008	.7304	.9029	.999610	-13.
.009	.7186	.8982	.999563	-15.
.010	.7077	.8940	.999517	-18.
.020	.6308	.8628	.999068	-48.
.030	.5822	.8424	.998635	-86.
.040	.5467	.8270	.998214	-128.
.050	.5188	.8147	.997801	-175.
.060	.4960	.8044	.997395	-226.
.070	.4767	.7955	.996995	-279.
.080	.4600	.7877	.996600	-336.
.090	.4454	.7808	.996209	-395.
.100	.4324	.7746	.995823	-456.
.200	.3493	.7321	.992118	-1166.
.300	.3036	.7058	.988622	-2003.
.400	.2728	.6861	.985276	-2931.
.500	.2499	.6702	.982051	-3931.
.600	.2319	.6569	.978923	-4990.
.700	.2173	.6456	.975872	-6102.
.800	.2051	.6359	.972881	-7259.
.900	.1948	.6276	.969932	-8457.
1.000	.1859	.6207	.967009	-9691.

m/mol·kg^{-1}	$\sigma(\phi)$	$\sigma(\ln\gamma)$	$\sigma(\gamma)$
.001	.0001	.0001	.0001
.010	.0004	.0008	.0006
.100	.0011	.0033	.0014
1.000	.0023	.0045	.0008

Coefficients of Correlating Equations

	Eqs 1		Eqs 2		Eqs 3	
Par	coefficient	σ(coeff)	coefficient	σ(coeff)	coefficient	σ(coeff)
1	.1104760370+01	.223-01	-.2714555741+01	.196+00	.6939240652+01	.197+00
2	-.3655036706+00	.368-01	.1641391192+02	.770+00	-.1001455807+02	.774+00
3	.8167304991-01	.221-01	-.1239230111+02	.103+01	.8132463020+01	.104+01
4			.4145381384+01	.456+00	-.2666591011+01	.459+00

(eqs 1) = .235-02
(eqs 2) = .305-02
(eqs 3) = .306-02

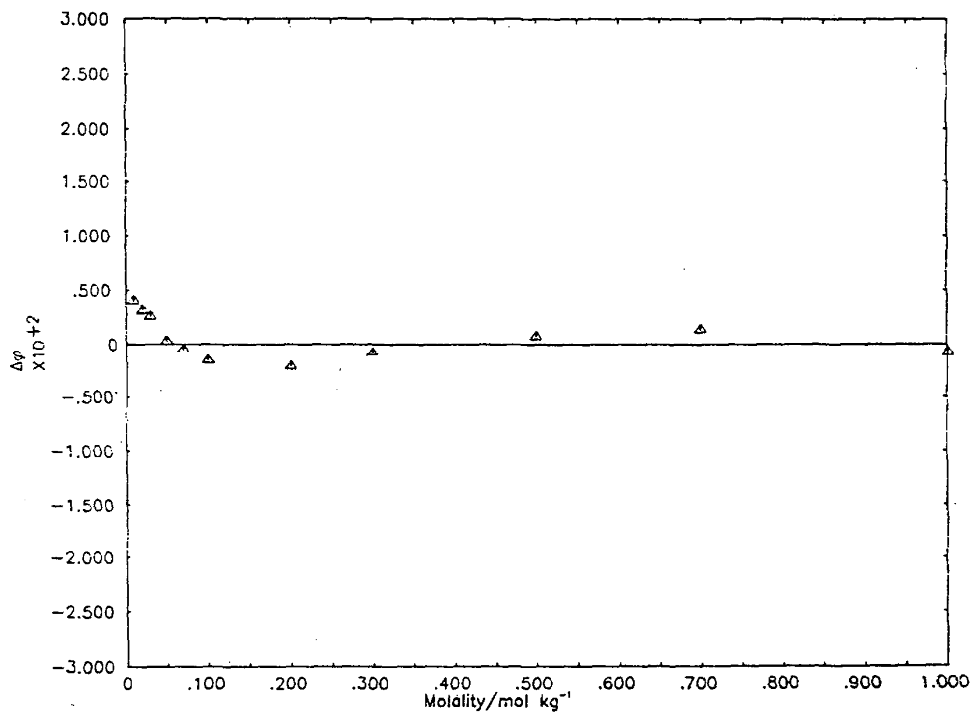
Experimental Data Employed in Generation of Correlating Equations

Masterton and Scola [11]. Vapor pressure osmometry measurements performed at 37°C. ϕ_L and ϕ_c data for $CoCl_2$ were used in adjusting this data to 25°C. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
.010000	.8980
.020000	.8660
.030000	.8450
.050000	.8150
.070000	.7950
.100000	.7730
.200000	.7300
.300000	.7050
.500000	.6710
.700000	.6470
1.000000	.6200

Comments

The above results are based solely upon vapor pressure osmometry measurements, as are the calculated results for the remaining cobalt compounds that follow.



Deviation Plot For $[Co(NH_3)_5F]Cl_2$: $\Delta\phi$ vs molality

Δ Masterton and Scola [11] - vapor pressure osmometry

$[Co(NH_3)_5Cl](ClO_4)_2$

Recommended Values for the mean activity and osmotic coefficient of $[Co(NH_3)_5Cl](ClO_4)_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ø	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8876	.9617	.999948	-1.
.002	.8487	.9480	.999898	-2.
.003	.8213	.9382	.999848	-3.
.004	.7996	.9303	.999799	-5.
.005	.7814	.9236	.999750	-6.
.006	.7657	.9177	.999702	-8.
.007	.7517	.9124	.999655	-10.
.008	.7392	.9076	.999608	-12.
.009	.7278	.9032	.999561	-15.
.010	.7173	.8991	.999514	-17.
.020	.6418	.8682	.999062	-46.
.030	.5929	.8466	.998628	-82.
.040	.5566	.8299	.998207	-124.
.050	.5278	.8164	.997796	-169.
.060	.5043	.8053	.997392	-219.
.070	.4846	.7962	.996992	-271.
.080	.4680	.7889	.996595	-326.
.090	.4538	.7833	.996197	-384.
.100	.4416	.7793	.995797	-444.

m/mol·kg^{-1}	σ(ø)	σ(ℓnγ)	σ(γ)
.001	.0001	.0003	.0003
.010	.0005	.0015	.0011
.100	.0008	.0019	.0008

Coefficients of Correlating Equations

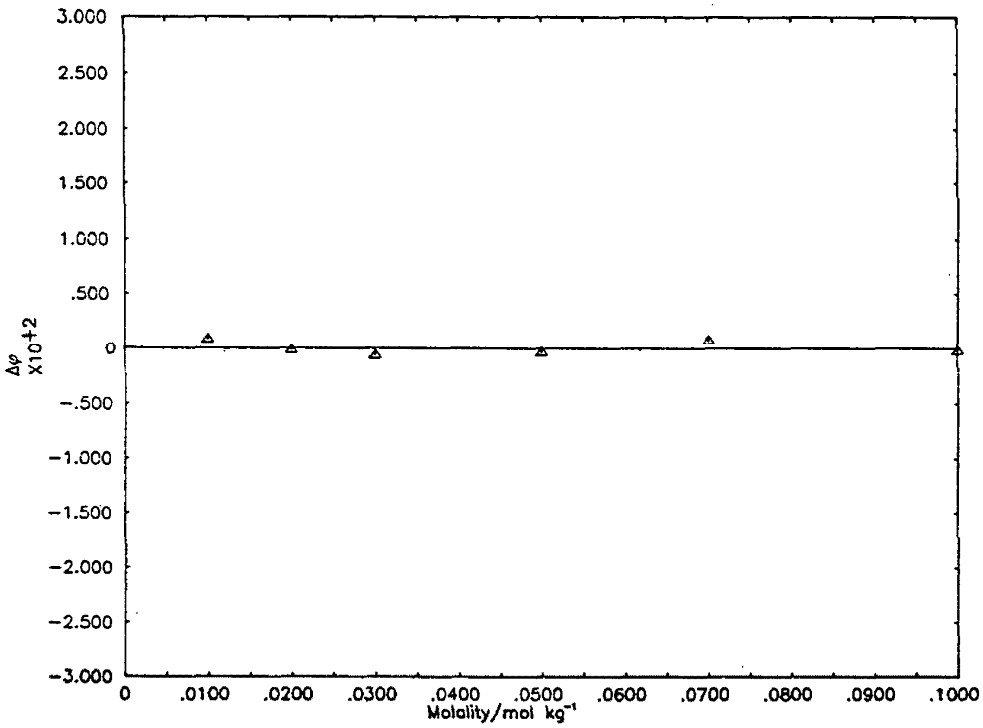
	Eqs 1		Eqs 2		Eqs 3	
Par	coefficient	σ(coeff)	coefficient	σ(coeff)	coefficient	σ(coeff)
1	.19434839640+01	.100+00	-.2344230953+01	.106+00	.6876510176+01	.381+00
2	.28338359161+01	.267+00	.1207929462+02	.313+00	-.7271154253+01	.112+01
3	.90269417562+01	.118+01				

σ(eqs 1) = .840-03
σ(eqs 2) = .124-02
σ(eqs 3) = .144-02

Experimental Data Employed in Generation of Correlating Equations

Masterton and Scola [11]. Vapor pressure osmometry measurements performed at 37°C. Φ_L and Φ_C data for $CoCl_2$ were used in adjusting this data to 25°C. Assigned weight is 1.0.

m/mol·kg^{-1}	$ø_{298.15}$
.010000	.9000
.020000	.8680
.030000	.8460
.050000	.8160
.070000	.7970
.100000	.7790



Deviation Plot For $[Co(NH_3)_5Cl](ClO_4)_2$: Δø vs molality

▲ Masterton and Scola [11] - vapor pressure osmometry

$[Co(NH_3)_5CH_3CH_2COO](NO_3)_2$

Recommended Values for the mean activity and osmotic coefficient of $[Co(NH_3)_5CH_3CH_2COO](NO_3)_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	Ø	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8845	.9601	.999948	-1.
.002	.8435	.9452	.999898	-2.
.003	.8142	.9343	.999849	-3.
.004	.7910	.9255	.999800	-5.
.005	.7715	.9180	.999752	-7.
.006	.7546	.9114	.999704	-9.
.007	.7397	.9055	.999657	-11.
.008	.7263	.9002	.999611	-13.
.009	.7141	.8953	.999565	-16.
.010	.7029	.8908	.999519	-18.
.020	.6232	.8574	.999074	-49.
.030	.5727	.8352	.998647	-88.
.040	.5358	.8183	.998233	-132.
.050	.5067	.8046	.997828	-180.
.060	.4829	.7931	.997432	-233.
.070	.4627	.7831	.997042	-288.
.080	.4453	.7744	.996658	-347.
.090	.4301	.7665	.996279	-408.
.100	.4165	.7594	.995904	-472.
.200	.3297	.7094	.992361	-1218.
.300	.2814	.6757	.989104	-2105.
.400	.2482	.6473	.986104	-3096.

m/mol·kg^{-1}	σ(Ø)	σ(ℓnγ)	σ(γ)
.001	.0001	.0001	.0001
.010	.0004	.0008	.0006
.100	.0007	.0023	.0010
.400	.0014	.0026	.0007

Coefficients of Correlating Equations

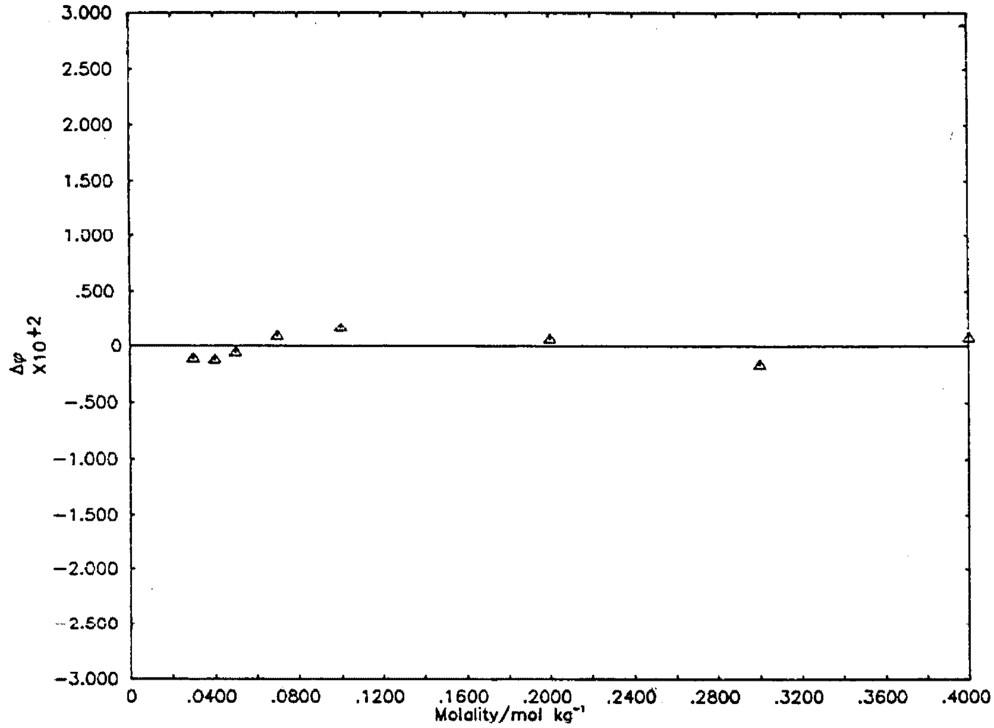
	Eqs 1		Eqs 2		Eqs 3	
Par	coefficient	σ(coeff)	coefficient	σ(coeff)	coefficient	σ(coeff)
1	.9541461770+00	.336-01	-.5645279676+01	.324+00	.5895451600+01	.398-01
2	-.2842869067+00	.970-01	.3156055849+02	.200+01	-.6633590679+01	.142+00
3	-.1232895187+00	.114+00	-.4124941550+02	.417+01	.3136811707+01	.133+00
4			.2245898278+02	.285+01		

σ(eqs 1) = .145-02
σ(eqs 2) = .157-02
σ(eqs 3) = .641-03

Experimental Data Employed in Generation of Correlating Equations

Berka and Masterton [12]. Vapor pressure osmometry measurements performed at 37°C. Φ_L and Φ_C data for $CoCl_2$ were used in adjusting this data to 25°C. Assigned weight is 1.0.

m/mol·kg^{-1}	$Ø_{298.15}$
.030000	.8340
.040000	.8170
.050000	.8040
.070000	.7840
.100000	.7610
.200000	.7100
.300000	.6740
.400000	.6480



Deviation Plot For $[Co(NH_3)_5CH_3CH_2COO](NO_3)_2$: Δφ vs molality

▲ Berka and Masterton [12] - vapor pressure osmometry

$[Co(NH_3)_5CH_3CH_2COO]I_2$

Recommended Values for the mean activity and osmotic coefficient of $[Co(NH_3)_5CH_3CH_2COO]I_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ϕ	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8843	.9600	.999948	-1.
.002	.8431	.9450	.999858	-2.
.003	.8138	.9340	.999849	-3.
.004	.7905	.9252	.999800	-5.
.005	.7709	.9177	.999752	-7.
.006	.7540	.9111	.999705	-9.
.007	.7390	.9052	.999658	-11.
.008	.7255	.8998	.999611	-13.
.009	.7133	.8949	.999565	-16.
.010	.7021	.8904	.999519	-18.
.020	.6225	.8572	.999074	-49.
.030	.5723	.8354	.998646	-88.
.040	.5358	.8192	.998231	-132.
.050	.5073	.8063	.997824	-180.
.060	.4840	.7956	.997423	-233.
.070	.4644	.7865	.997029	-288.
.080	.4476	.7787	.996639	-347.
.090	.4329	.7718	.996253	-408.
.100	.4199	.7656	.995871	-471.
.200	.3381	.7254	.992190	-1204.
.300	.2932	.6992	.988727	-2066.
.400	.2616	.6752	.985510	-3022.
.500	.2365	.6493	.982606	-4057.

m/mol·kg^{-1}	$\sigma(\phi)$	$\sigma(\ln\gamma)$	$\sigma(\gamma)$
.001	.0000	.0001	.0001
.010	.0002	.0005	.0004
.100	.0005	.0017	.0007
.500	.0011	.0020	.0005

Coefficients of Correlating Equations

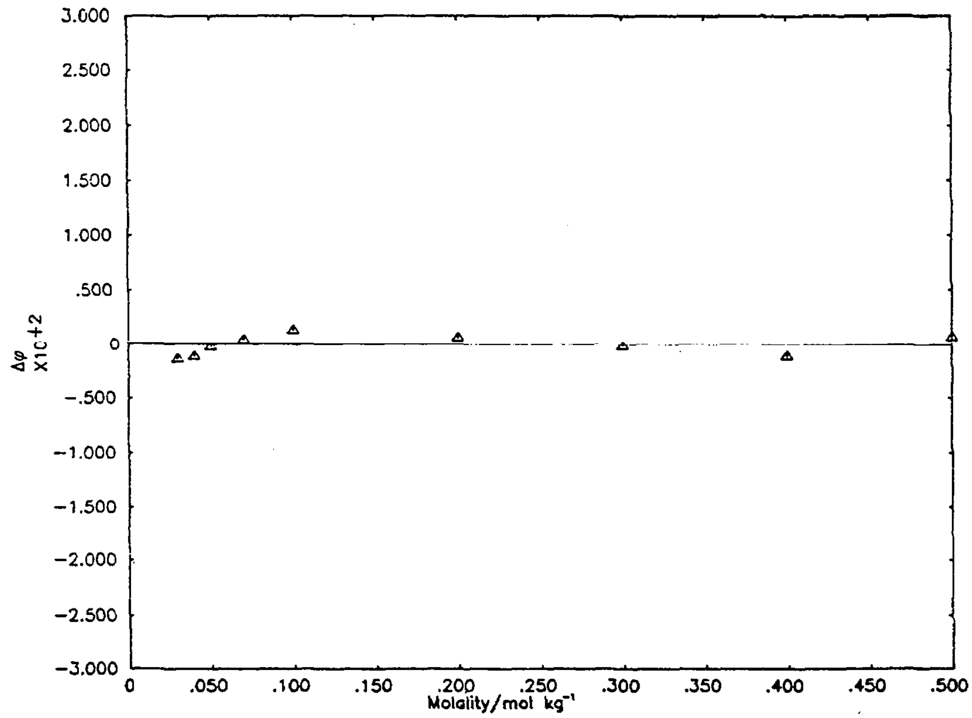
	Eqs 1		Eqs 2		Eqs 3	
Par	coefficient	σ(coeff)	coefficient	σ(coeff)	coefficient	σ(coeff)
1	.8466768420+00	.199-01	-.5099271970+01	.341+00	.4993484018+01	.930-01
2	.1713789975+00	.569-01	.2785496047+02	.190+01	-.3036828505+01	.122+00
3	-.4523432182+00	.532-01	-.3152714522+02	.357+01		
4			.1471324779+02	.220+01		

σ(eqs 1) = .114-02
σ(eqs 2) = .242-02
σ(eqs 3) = .566-02

Experimental Data Employed in Generation of Correlating Equations

Berka and Masterton [12]. Vapor pressure osmometry measurements performed at 37°C. Φ_L and Φ_c data for $CoCl_2$ were used to adjust this data to 25°C. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
.030000	.8340
.040000	.8180
.050000	.8060
.070000	.7870
.100000	.7670
.200000	.7260
.300000	.6990
.400000	.6740
.500000	.6500



Deviation Plot For $[Co(NH_3)_5CH_3CH_2COO]I_2$: $\Delta\phi$ vs molality

Δ Berka and Masterton [12] - vapor pressure osmometry

$[Co(NH_3)_5CH_3CH_2COO]Br_2$

Recommended Values for the mean activity and osmotic coefficient of $[Co(NH_3)_5CH_3CH_2COO]Br_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ϕ	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8848	.9603	.999948	-1.
.002	.8441	.9455	.999898	-2.
.003	.8151	.9348	.999848	-3.
.004	.7921	.9262	.999800	-5.
.005	.7728	.9188	.999752	-7.
.006	.7562	.9124	.999704	-9.
.007	.7414	.9067	.999657	-11.
.008	.7282	.9015	.999610	-13.
.009	.7162	.8967	.999564	-15.
.010	.7051	.8923	.999518	-18.
.020	.6268	.8601	.999071	-49.
.030	.5773	.8388	.998641	-87.
.040	.5412	.8228	.998223	-130.
.050	.5129	.8100	.997813	-178.
.060	.4897	.7993	.997411	-229.
.070	.4701	.7902	.997015	-284.
.080	.4532	.7821	.996624	-341.
.090	.4384	.7750	.996237	-401.
.100	.4253	.7687	.995854	-464.
.200	.3423	.7265	.992178	-1168.
.300	.2974	.7020	.988683	-2040.
.400	.2677	.6848	.985305	-2983.
.500	.2459	.6718	.982011	-3996.
.600	.2290	.6615	.978779	-5066.
.700	.2155	.6532	.975590	-6185.
.800	.2043	.6466	.972428	-7347.
.900	.1949	.6415	.969278	-8546.
1.000	.1869	.6377	.966124	-9778.
1.200	.1741	.6334	.959750	-12327.

m/mol·kg^{-1}	$\sigma(\phi)$	$\sigma(\ln\gamma)$	$\sigma(\gamma)$
.001	.0001	.0002	.0001
.010	.0006	.0012	.0009
.100	.0019	.0054	.0023
1.000	.0023	.0063	.0012
1.200	.0038	.0076	.0013

Coefficients of Correlating Equations

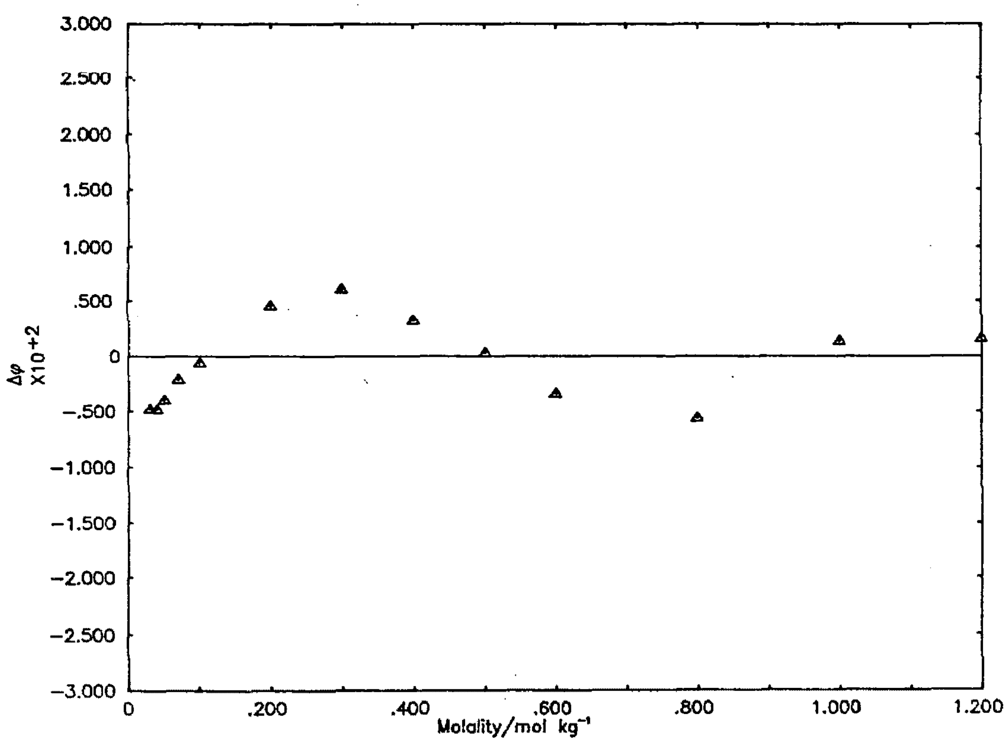
	Eqs 1		Eqs 2		Eqs 3	
Par	coefficient	σ(coeff)	coefficient	σ(coeff)	coefficient	σ(coeff)
1	.1012607877+01	.338-01	-.5267259149+01	.214+00	.5907520192+01	.103+00
2	-.2689611250+00	.513-01	.2989601315+02	.115+01	-.6305848230+01	.353+00
3	.7139830888-01	.243-01	-.3971298376+02	.233+01	.3515590473+01	.424+00
4			.2851164026+02	.206+01	-.7291162271+00	.170+00
5			-.7978924105+01	.666+00		

σ(eqs 1) = .428-02
σ(eqs 2) = .204-02
σ(eqs 3) = .219-02

Experimental Data Employed in Generation of Correlating Equations

Berka and Masterton [12]. Vapor pressure osmometry measurements performed at 37°C. Φ_L and Φ_C data for $CoCl_2$ were used to adjust this data to 25°C. Assigned weight is 1.0.

$m/mol \cdot kg^{-1}$	$\phi_{298.15}$
.030000	.8340
.040000	.8180
.050000	.8060
.070000	.7880
.100000	.7660
.200000	.7310
.300000	.7080
.400000	.6880
.500000	.6720
.600000	.6580
.800000	.6410
1.000000	.6390
1.200000	.6350



Deviation Plot For $[Co(NH_3)_5CH_3CH_2COO]Br_2$: $\Delta\phi$ vs molality

▲ Berka and Masterton [12] - vapor pressure osmometry

$[Co(NH_3)_5CH_3CH_2COO]Cl_2$

Recommended Values for the mean activity and osmotic coefficient of $[Co(NH_3)_5CH_3CH_2COO]Cl_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ϕ	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8844	.9600	.999948	-1.
.002	.8433	.9451	.999898	-2.
.003	.8141	.9342	.999849	-3.
.004	.7908	.9254	.999800	-5.
.005	.7713	.9179	.999752	-7.
.006	.7544	.9113	.999705	-9.
.007	.7395	.9055	.999657	-11.
.008	.7261	.9002	.999611	-13.
.009	.7139	.8953	.999565	-16.
.010	.7028	.8908	.999519	-18.
.020	.6234	.8578	.999073	-49.
.030	.5734	.8361	.998645	-88.
.040	.5370	.8200	.998229	-131.
.050	.5085	.8072	.997821	-180.
.060	.4853	.7966	.997420	-232.
.070	.4658	.7876	.997025	-287.
.080	.4491	.7799	.996633	-345.
.090	.4345	.7732	.996246	-406.
.100	.4216	.7673	.995862	-469.
.200	.3417	.7313	.992126	-1198.
.300	.3003	.7145	.988482	-2047.
.400	.2737	.7053	.984867	-2978.
.500	.2548	.7001	.981260	-3969.
.600	.2404	.6971	.977648	-5009.
.700	.2291	.6956	.974026	-6087.
.800	.2198	.6951	.970393	-7199.
.900	.2121	.6953	.966747	-8339.
1.000	.2056	.6959	.963088	-9604.
1.250	.1927	.6989	.953881	-12508.
1.500	.1832	.7030	.944598	-15618.
1.750	.1759	.7078	.935249	-18812.
2.000	.1701	.7128	.925845	-22075.
2.250	.1653	.7180	.916394	-25396.
2.400	.1629	.7211	.910706	-27412.

m/mol·kg^{-1}	$\sigma(\phi)$	$\sigma(\ln\gamma)$	$\sigma(\gamma)$
.001	.0000	.0001	.0001
.010	.0003	.0006	.0005
.100	.0015	.0036	.0015
1.000	.0022	.0087	.0018
2.000	.0038	.0089	.0015
2.400	.0050	.0093	.0015

Coefficients of Correlating Equations

	Eqs 1		Eqs 2		Eqs 3	
Par	coefficients	σ(coeff)	coefficients	σ(coeff)	coefficients	σ(coeff)
1	.8921256715+00	.135-01	-.8819392558+01	.108+01	.5707831492+01	.143+00
2	.1886247581-01	.753-02	.5699791392+02	.771+01	-.5526550862+01	.348+00
3			-.1220204006+03	.224+02	.2910569975+01	.294+00
4			.1561070231+03	.334+02	-.6069771021+00	.832-01
5			-.1131260227+03	.269+02		
6			.4312119692+02	.112+02		
7			-.6719160104+01	.187+01		

σ(eqs 1) = .775-02
σ(eqs 2) = .732-02
σ(eqs 3) = .711-02

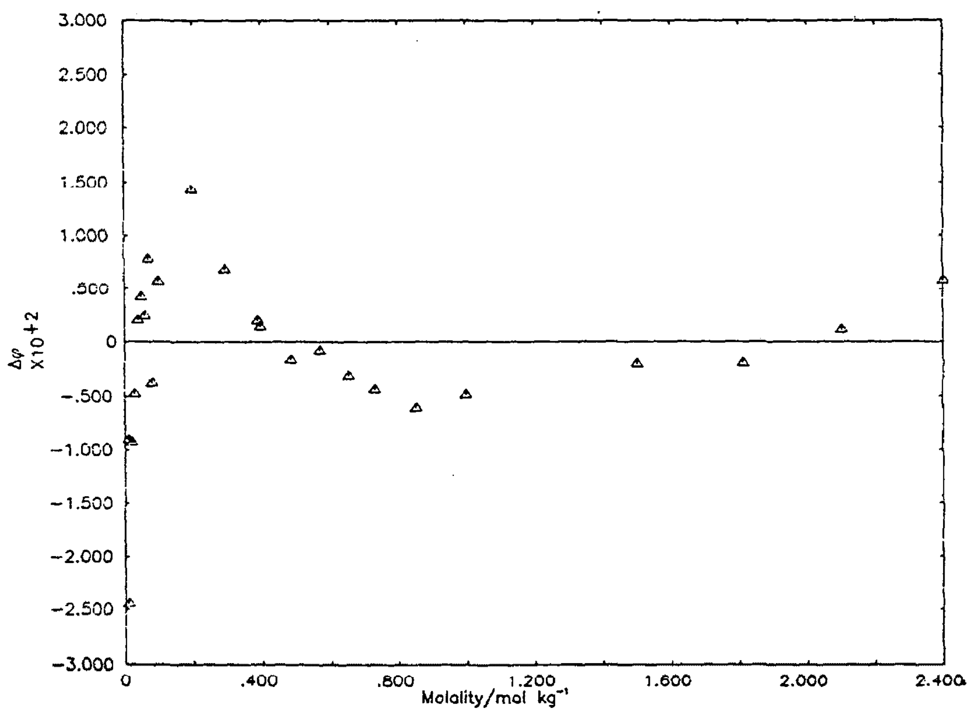
Experimental Data Employed in Generation of Correlating Equations

Berka and Masterton [12]. Vapor pressure osmometry measurements performed at 37°C. Φ_L and Φ_C data for $CoCl_2$ were used to adjust this data to 25°C. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
.010300	.8650
.010400	.8800
.020200	.8480
.030200	.8310
.040000	.8220
.050300	.8110
.060000	.7990
.070600	.7950
.080200	.7760
.100000	.7730
.198000	.7460
.295000	.7220
.390000	.7080
.396000	.7070
.485000	.6990
.570000	.6970
.653000	.6930
.732000	.6910
.852000	.6890
.999000	.6910
1.500000	.7010
1.810000	.7070
2.100000	.7160
2.400000	.7270

Comments

The fit using equations 2 is difficult for this system.



Deviation Plot For $[Co(NH_3)_5CH_3CH_2COO]Cl_2$: $\Delta\phi$ vs molality

▲ Berka and Masterton [12] - vapor pressure osmometry

$[Co(NH_3)_5CH_3COO](NO_3)_2$

Recommended Values for the mean activity and osmotic coefficient of $[Co(NH_3)_5CH_3COO](NO_3)_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ϕ	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8837	.9596	.999948	-1.
.002	.8420	.9444	.999898	-2.
.003	.8123	.9332	.999849	-3.
.004	.7887	.9242	.999800	-5.
.005	.7689	.9165	.999752	-7.
.006	.7517	.9097	.999705	-9.
.007	.7365	.9037	.999658	-11.
.008	.7229	.8982	.999612	-13.
.009	.7105	.8932	.999566	-16.
.010	.6991	.8886	.999520	-18.
.020	.6188	.8551	.999076	-50.
.030	.5685	.8335	.998649	-89.
.040	.5323	.8178	.998234	-133.
.050	.5043	.8057	.997825	-182.

m/mol·kg^{-1}	$\sigma(\phi)$	$\sigma(\ln\gamma)$	$\sigma(\gamma)$
.001	.0001	.0003	.0002
.010	.0008	.0019	.0013
.100	.0083	.0090	.0038

Coefficients of Correlating Equations

Par	Eqs 2 coefficient	Eqs 2 σ(coeff)	Eqs 3 coefficient	Eqs 3 σ(coeff)
1	-.4765183294+01	.915-01	.5300274697+01	.312+00
2	.1969020635+02	.367+00	-.3449700277+01	.125+01

σ(eqs 2) = .295-03
σ(eqs 3) = .101-02

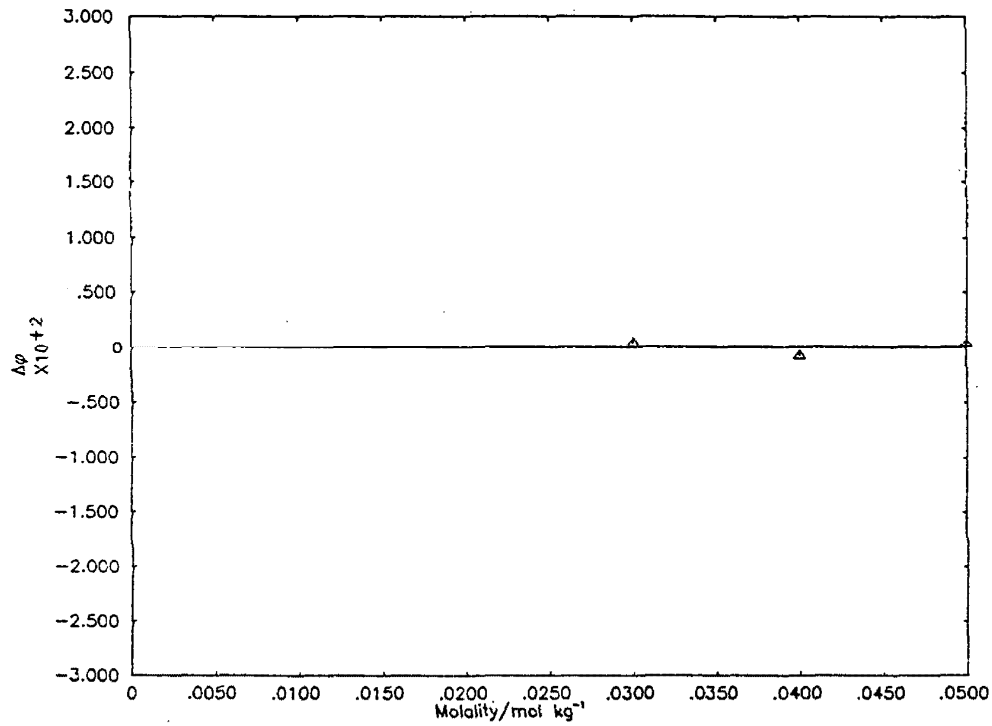
Experimental Data Employed in Generation of Correlating Equations

Berka and Masterton [12]. Vapor pressure osmometry measurements performed at 37°C. Φ_L and Φ_C data for $CoCl_2$ were used to adjust this data to 25°C. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
.030000	.8340
.040000	.8170
.050000	.8060

Comments

It was not possible to obtain a fit for this system using eqs 1. The table of recommended values and the deviation plot are based on eqs 3.



Deviation Plot For $[Co(NH_3)_5CH_3COO](NO_3)_2$: Δφ vs molality

▲ Berka and Masterton [12] - vapor pressure osmometry

$[Co(NH_3)_5CH_3COO]I_2$

Recommended Values for the mean activity and osmotic coefficient of $[Co(NH_3)_5CH_3COO]I_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ϕ	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8846	.9601	.999948	-1.
.002	.8437	.9453	.999898	-2.
.003	.8145	.9345	.999849	-3.
.004	.7914	.9257	.999800	-5.
.005	.7720	.9183	.999752	-7.
.006	.7552	.9118	.999704	-9.
.007	.7403	.9059	.999657	-11.
.008	.7269	.9007	.999611	-13.
.009	.7148	.8958	.999564	-15.
.010	.7037	.8913	.999518	-18.
.020	.6248	.8588	.999072	-49.
.030	.5753	.8377	.998643	-87.
.040	.5396	.8225	.998224	-131.
.050	.5120	.8109	.997811	-179.
.060	.4898	.8019	.997403	-230.
.070	.4715	.7949	.996997	-285.
.080	.4562	.7896	.996592	-342.
.090	.4432	.7857	.996185	-401.
.100	.4321	.7830	.995777	-463.

m/mol·kg^{-1}	$\sigma(\phi)$	$\sigma(\ln\gamma)$	$\sigma(\gamma)$
.001	.0001	.0002	.0002
.010	.0004	.0011	.0008
.100	.0004	.0013	.0006

Coefficients of Correlating Equations

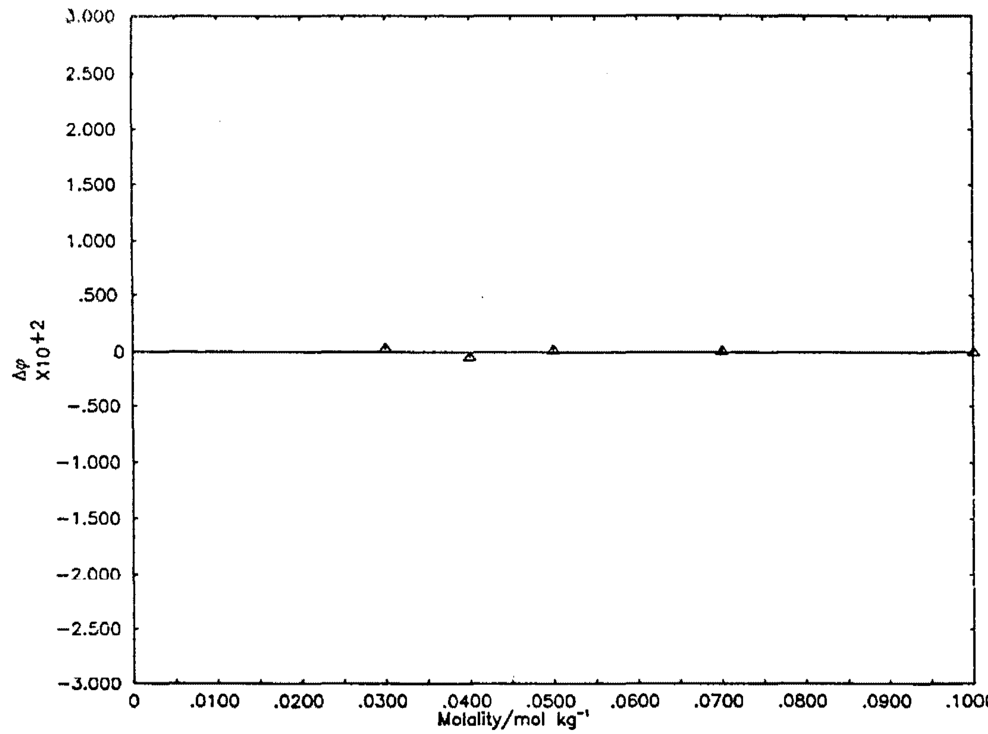
	Eqs 1		Eqs 2		Eqs 3	
Par	coefficient	σ(coeff)	coefficient	σ(coeff)	coefficient	σ(coeff)
1	.9950357293+00	.913-01	-.3331776014+01	.203+00	.5465733752+01	.895-01
2	-.4202846401+00	.370+00	.1491412062+02	.603+00	-.3231087553+01	.266+00
3	.3682235684+01	.113+01				

σ(eqs 1) = .393-03
σ(eqs 2) = .236-02
σ(eqs 3) = .104-02

Experimental Data Employed in Generation of Correlating Equations

Berka and Masterton [12]. Vapor pressure osmometry measurements performed at 37°C. Φ_L and Φ_C data for $CoCl_2$ were used to adjust this data to 25°C. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
.030000	.8380
.040000	.8220
.050000	.8110
.070000	.7950
.100000	.7830



Deviation Plot For $[Co(NH_3)_5CH_3COO]I_2$: $\Delta\phi$ vs molality

▲ Berka and Masterton [12] - vapor pressure osmometry

$[Co(NH_3)_5CH_3COO]Br_2$

Recommend Values for the mean activity and osmotic coefficient of $[Co(NH_3)_5CH_3COO]Br_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	∅	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8848	.9602	.999948	-1.
.002	.8440	.9454	.999898	-2.
.003	.8149	.9347	.999848	-3.
.004	.7919	.9260	.999800	-5.
.005	.7726	.9187	.999752	-7.
.006	.7559	.9122	.999704	-9.
.007	.7411	.9065	.999657	-11.
.008	.7279	.9013	.999610	-13.
.009	.7158	.8965	.999564	-15.
.010	.7048	.8921	.999518	-18.
.020	.6263	.8598	.999071	-49.
.030	.5768	.8385	.998641	-87.
.040	.5407	.8226	.998223	-130.
.050	.5124	.8098	.997814	-178.
.060	.4892	.7992	.997412	-229.
.070	.4697	.7901	.997015	-284.
.080	.4529	.7822	.996624	-342.
.090	.4381	.7752	.996237	-402.
.100	.4250	.7689	.995853	-464.
.200	.3426	.7276	.992166	-1188.
.300	.2980	.7035	.988659	-2040.
.400	.2681	.6859	.985282	-2981.
.500	.2460	.6715	.982018	-3993.
.600	.2286	.6589	.978860	-5064.

m/mol·kg^{-1}	σ(∅)	σ(ℓnγ)	σ(γ)
.001	.0000	.0001	.0001
.010	.0002	.0005	.0004
.100	.0006	.0019	.0008
.600	.0011	.0022	.0005

Coefficients of Correlating Equations

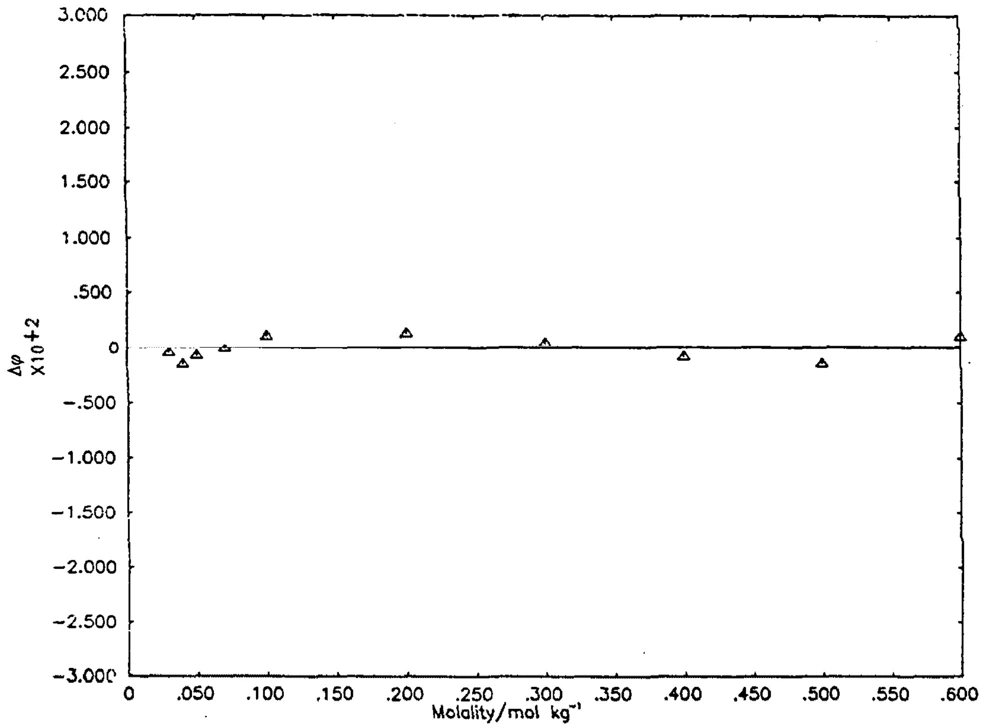
	Eqs 1		Eqs 2		Eqs 3	
Par	coefficients	σ(coeff)	coefficients	σ(coeff)	coefficients	σ(coeff)
1	.9878033191+00	.179-01	-.4217930037+01	.259+00	.5966862035+01	.316-01
2	-.1935269567+00	.410-01	.2351029944+02	.131+01	-.6144418679+01	.893-01
3	-.6819375294-02	.350-01	-.2400114309+02	.225+01	.2649536945+01	.668-01
4			.1047111653+02	.127+01		

σ(eqs 1) = .125-02
σ(eqs 2) = .245-02
σ(eqs 3) = .786-03

Experimental Data Employed in Generation of Correlating Equations

Berka and Masterton [12]. Vapor pressure osmometry measurements performed at 37°C. Φ_L and Φ_C data for $CoCl_2$ were used to adjust this data to 25°C. Assigned weight is 1.0.

m/mol·kg^{-1}	$\emptyset_{298.15}$
.030000	.8380
.040000	.8210
.050000	.8090
.070000	.7900
.100000	.7700
.200000	.7290
.300000	.7040
.400000	.6850
.500000	.6700
.600000	.6600



Deviation Plot For $[Co(NH_3)_5CH_3COO]Br_2$: $\Delta\phi$ vs molality

▲ Berka and Masterton [12] - vapor pressure osmometry

$[Co(NH_3)_5CH_3COO]Cl_2$

Recommended Values for the mean activity and osmotic coefficient of $[Co(NH_3)_5CH_3COO]Cl_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ϕ	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8830	.9593	.999948	-1.
.002	.8409	.9437	.999898	-2.
.003	.8107	.9323	.999849	-3.
.004	.7867	.9230	.999800	-5.
.005	.7665	.9150	.999753	-7.
.006	.7490	.9080	.999706	-9.
.007	.7335	.9018	.999659	-11.
.008	.7196	.8961	.999613	-13.
.009	.7069	.8909	.999567	-16.
.010	.6953	.8861	.999521	-19.
.020	.6132	.8512	.999080	-51.
.030	.5619	.8287	.998657	-90.
.040	.5250	.8124	.998245	-136.
.050	.4966	.7999	.997841	-186.
.060	.4736	.7900	.997442	-240.
.070	.4545	.7818	.997047	-297.
.080	.4382	.7749	.996655	-357.
.090	.4241	.7691	.996266	-420.
.100	.4117	.7640	.995879	-484.
.200	.3349	.7320	.992118	-1229.
.300	.2919	.7079	.988588	-2096.
.400	.2615	.6852	.985296	-3054.
.500	.2396	.6699	.982059	-4085.
.600	.2260	.6716	.978456	-5171.

m/mol·kg^{-1}	$\sigma(\phi)$	$\sigma(\ell n\gamma)$	$\sigma(\gamma)$
.001	.0001	.0002	.0002
.010	.0007	.0015	.0011
.100	.0020	.0059	.0024
.600	.0162	.0304	.0069

Coefficients of Correlating Equations

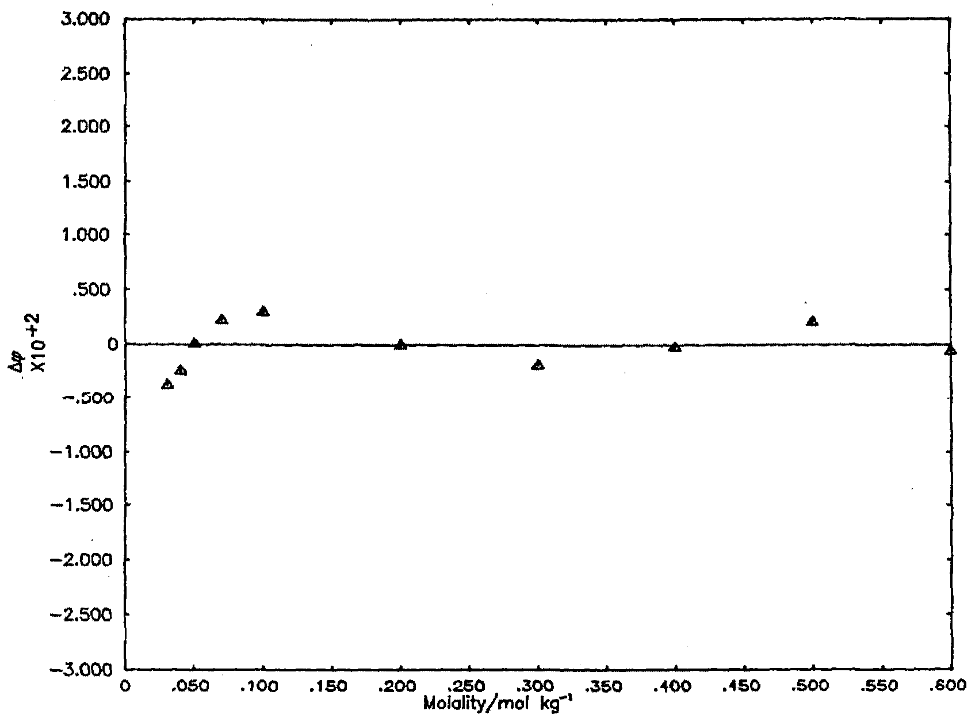
	Eqs 1		Eqs 2		Eqs 3	
Par	coefficient	σ(coeff)	coefficient	σ(coeff)	coefficient	σ(coeff)
1	.9220308995-01	.423+00	-.9298519237+01	.589+00	.2749348039+01	.348+00
2	.3809046170+01	.276+01	.5635548423+02	.434+01	.1287122212+02	.256+01
3	-.4474150070+01	.109+01	-.1059265592+03	.121+02	-.4104642937+02	.713+01
4	.2993927293+01	.595+00	.1010399493+03	.147+02	.4469339082+02	.868+01
5			-.3705374752+02	.657+01	-.1692672194+02	.388+01

σ(eqs 1) = .263-02
σ(eqs 2) = .194-02
σ(eqs 3) = .115-02

Experimental Data Employed in Generation of Correlating Equations

Berka and Masterton [12]. Vapor pressure osmometry measurements performed at 37°C. Φ_L and Φ_C data for $CoCl_2$ were used to adjust this data to 25°C. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
.030000	.8250
.040000	.8100
.050000	.8000
.070000	.7840
.100000	.7670
.200000	.7320
.300000	.7060
.400000	.6850
.500000	.6720
.600000	.6710



--.iation Plot For $[Co(NH_3)_5CH_3COO]Cl_2$: Δφ vs molality

▲ Berka and Masterton [12] - vapor pressure osmometry

$[Co(NH_3)_5(CH_3)_2CHCOO](NO_3)_2$

Recommended Values for the mean activity and osmotic coefficient of $[Co(NH_3)_5(CH_3)_2CHCOO](NO_3)_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ϕ	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8841	.9559	.999948	-1.
.002	.8427	.9447	.999898	-2.
.003	.8132	.9337	.999849	-3.
.004	.7897	.9247	.999800	-5.
.005	.7700	.9170	.999752	-7.
.006	.7529	.9103	.999705	-9.
.007	.7377	.9043	.999658	-11.
.008	.7241	.8988	.999611	-13.
.009	.7117	.8937	.999565	-16.
.010	.7003	.8890	.999520	-18.
.020	.6191	.8543	.999077	-50.
.030	.5675	.8310	.998654	-89.
.040	.5296	.8131	.998244	-133.
.050	.4998	.7986	.997844	-183.
.060	.4754	.7863	.997453	-236.
.070	.4548	.7757	.997070	-293.
.080	.4369	.7663	.996692	-354.
.090	.4213	.7579	.996320	-416.
.100	.4074	.7502	.995953	-482.
.200	.3194	.6979	.992484	-1248.
.300	.2718	.6654	.989269	-2160.
.400	.2401	.6411	.986237	-3177.
.500	.2168	.6213	.983352	-4277.
.600	.1986	.6044	.980593	-5447.
.700	.1839	.5895	.977945	-6679.
.800	.1716	.5762	.975394	-7964.
.900	.1612	.5642	.972929	-9298.
1.000	.1522	.5533	.970540	-10677.
1.250	.1342	.5299	.964831	-14297.
1.500	.1208	.5115	.959384	-18132.
1.750	.1103	.4973	.954056	-22149.
2.000	.1020	.4871	.948711	-26322.
2.250	.0954	.4807	.943215	-30629.
2.500	.0901	.4782	.937436	-35053.

m/mol·kg^{-1}	$\sigma(\phi)$	$\sigma(\ell n\gamma)$	$\sigma(\gamma)$
.001	.0000	.0001	.0001
.010	.0004	.0008	.0006
.100	.0015	.0040	.0016
1.000	.0022	.0063	.0010
2.000	.0025	.0063	.0006
2.500	.0041	.0078	.0007

Coefficients of Correlating Equations

	Eqs 1		Eqs 2		Eqs 3	
Par	coefficient	σ(coeff)	coefficient	σ(coeff)	coefficient	σ(coeff)
1	.8912538286+00	.190-01	-.5464119350+01	.410+00	.5258751480+01	.105+00
2	-.3250277045+00	.230-01	.2942187474+02	.215+01	-.5345480272+01	.253+00
3	.4444344419-01	.569-02	-.4063296042+02	.456+01	.2865204740+01	.211+00
4			.3433603266+02	.470+01	-.5967808584+00	.582-01
5			-.1506417406+02	.234+01		
6			.2646021998+01	.451+00		

σ(eqs 1) = .452-02
σ(eqs 2) = .452-02
σ(eqs 3) = .454-02

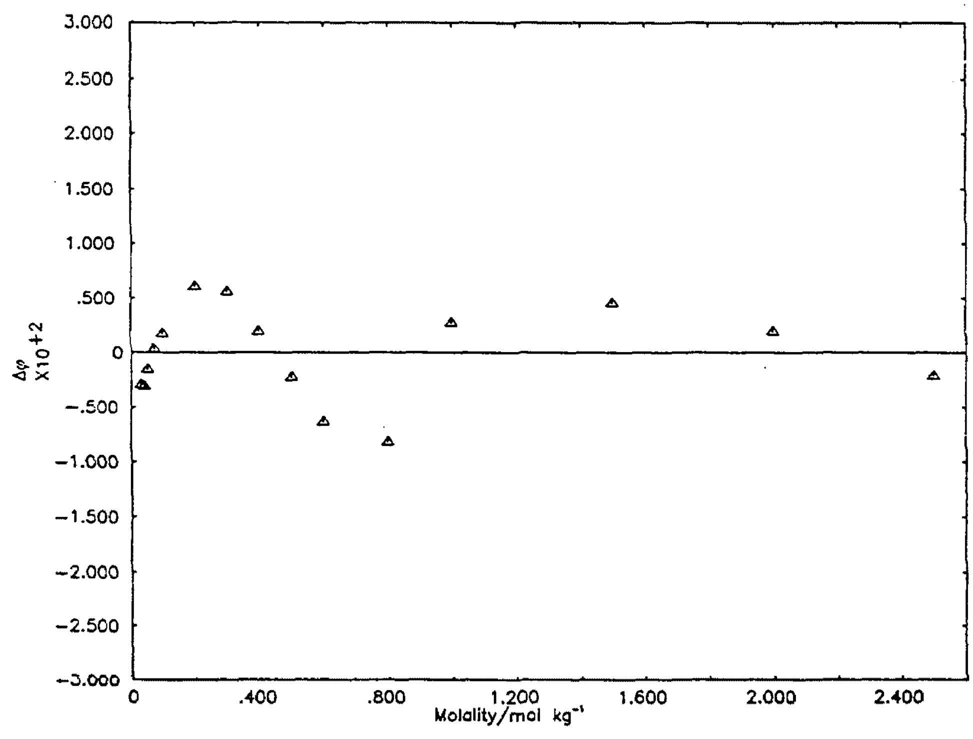
Experimental Data Employed in Generation of Correlating Equations

Berka and Masterton [12]. Vapor pressure osmometry measurements performed at 37°C. Φ_L and Φ_c data for $CoCl_3$ were used to adjust this data to 25°C. Assigned weight is 1.0

m/mol·kg^{-1}	$\phi_{298.15}$
.030000	.8280
.040000	.8100
.050000	.7970
.070000	.7760
.100000	.7520
.200000	.7040
.300000	.6710
.400000	.6430
.500000	.6190
.600000	.5980
.800000	.5680
1.000000	.5560
1.500000	.5160
2.000000	.4890
2.500000	.4760

Comments

The fit using equations 2 is difficult for this system.



Deviation Plot For $[Co(NH_3)_5(CH_3)_2CHCOO](NO_3)_2$: $\Delta\phi$ vs molality

▲ Berka and Masterton [12] - vapor pressure osmometry

$[Co(NH_3)_5(CH_3)_2CHCOO]I_2$

Recommended Values for the mean activity and osmotic coefficient of $[Co(NH_3)_5(CH_3)_2CHCOO]I_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ϕ	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8844	.9600	.999948	-1.
.002	.8432	.9450	.999898	-2.
.003	.8140	.9341	.999849	-3.
.004	.7907	.9253	.999800	-5.
.005	.7712	.9178	.999752	-7.
.006	.7543	.9113	.999705	-9.
.007	.7394	.9054	.999658	-11.
.008	.7259	.9001	.999611	-13.
.009	.7138	.8952	.999565	-16.
.010	.7026	.8907	.999519	-18.
.020	.6232	.8577	.999073	-49.
.030	.5732	.8361	.998645	-88.
.040	.5368	.8199	.998229	-131.
.050	.5083	.8070	.997822	-180.
.060	.4850	.7963	.997421	-232.
.070	.4654	.7871	.997027	-287.
.080	.4485	.7791	.996637	-346.
.090	.4337	.7720	.996252	-407.
.100	.4206	.7656	.995871	-470.
.200	.3369	.7213	.992233	-1204.
.300	.2901	.6906	.988865	-2071.
.400	.2575	.6643	.985742	-3037.
.500	.2329	.6414	.982816	-4084.
.600	.2139	.6232	.979993	-5200.
.700	.1993	.6117	.977124	-6374.
.800	.1887	.6092	.974005	-7595.

m/mol·kg^{-1}	$\sigma(\phi)$	$\sigma(\ln\gamma)$	$\sigma(\gamma)$
.001	.0000	.0001	.0001
.010	.0002	.0004	.0003
.100	.0004	.0013	.0005
.800	.0008	.0015	.0003

Coefficients of Correlating Equations

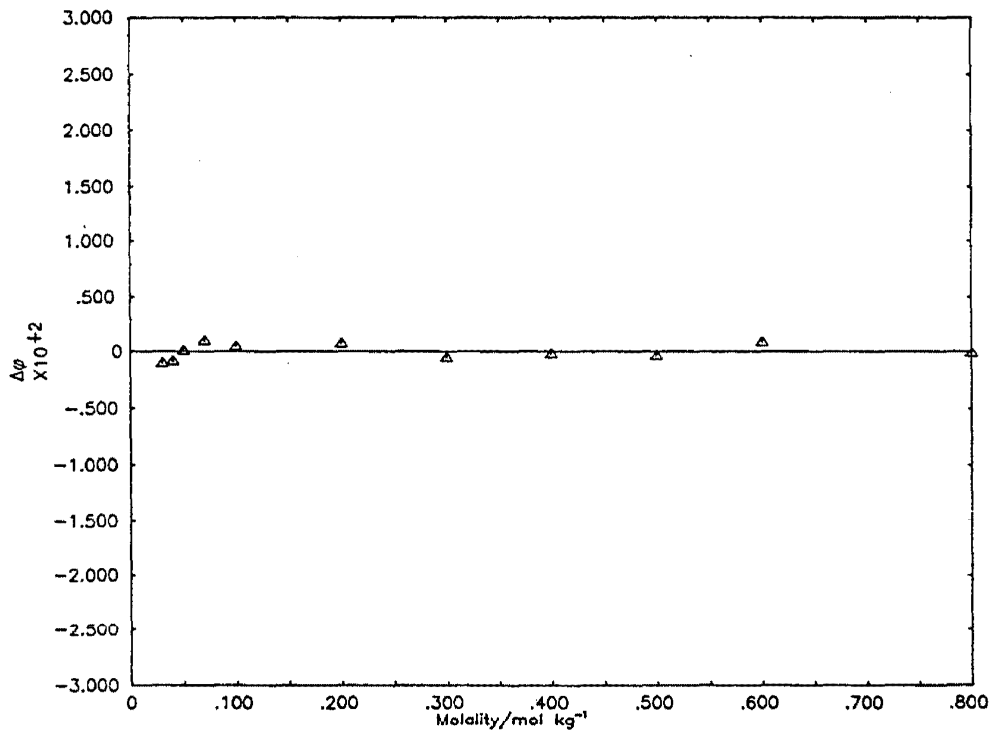
	Eqs 1		Eqs 2		Eqs 3	
Par	coefficient	σ(coeff)	coefficient	σ(coeff)	coefficient	σ(coeff)
1	.8548590270+00	.188-01	-.5735326414+01	.309+00	.5905619652+01	.141-01
2	.2002751341+00	.600-01	.3391495217+02	.206+01	-.6160048487+01	.340-01
3	-.9187716168+00	.855-01	-.5182782126+02	.514+01	.2592563302+01	.218-01
4	.6412327723+00	.507-01	.4264462977+02	.558+01		
5			-.1365531608+02	.221+01		

σ(eqs 1) = .810-03
σ(eqs 2) = .151-02
σ(eqs 3) = .467-03

Experimental Data Employed in Generation of Correlating Equations

Berka and Masterton [12]. Vapor pressure osmometry measurements performed at 37°C. Φ_L and Φ_c data for $CoCl_2$ were used to adjust this data to 25°C. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
.030000	.8350
.040000	.8190
.050000	.8070
.070000	.7880
.100000	.7660
.200000	.7220
.300000	.6900
.400000	.6640
.500000	.6410
.600000	.6240
.800000	.6090



Deviation Plot For $[Co(NH_3)_5(CH_3)_2CHCOO]I_2$: $\Delta\phi$ vs molality

△ Berka and Masterton [12] - vapor pressure osmometry

$[Co(NH_3)_5(CH_3)_2CHCOO]Br_2$

Recommended Values for the mean activity and osmotic coefficient of $[Co(NH_3)_5(CH_3)_2CHCOO]Br_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ϕ	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8835	.9595	.999948	-1.
.002	.8416	.9441	.999898	-2.
.003	.8117	.9329	.999849	-3.
.004	.7879	.9237	.999800	-5.
.005	.7679	.9159	.999753	-7.
.006	.7506	.9090	.999705	-9.
.007	.7352	.9028	.999658	-11.
.008	.7214	.8972	.999612	-13.
.009	.7089	.8921	.999566	-16.
.010	.6974	.8873	.999521	-18.
.020	.6157	.8525	.999079	-50.
.030	.5642	.8297	.998656	-90.
.040	.5270	.8128	.998244	-135.
.050	.4980	.7995	.997842	-185.
.060	.4745	.7886	.997446	-238.
.070	.4548	.7795	.997055	-295.
.080	.4379	.7717	.996669	-355.
.090	.4233	.7650	.996286	-418.
.100	.4103	.7590	.995906	-483.
.200	.3302	.7219	.992227	-1234.
.300	.2870	.6990	.988731	-2113.
.400	.2574	.6794	.985421	-3083.
.500	.2351	.6620	.982269	-4127.
.600	.2178	.6487	.979183	-5233.
.700	.2049	.6424	.975991	-6390.
.800	.1962	.6463	.972442	-7587.

m/mol·kg^{-1}	$\sigma(\phi)$	$\sigma(\ln\gamma)$	$\sigma(\gamma)$
.001	.0001	.0001	.0001
.010	.0004	.0009	.0006
.100	.0008	.0027	.0011
.800	.0018	.0032	.0006

Coefficients of Correlating Equations

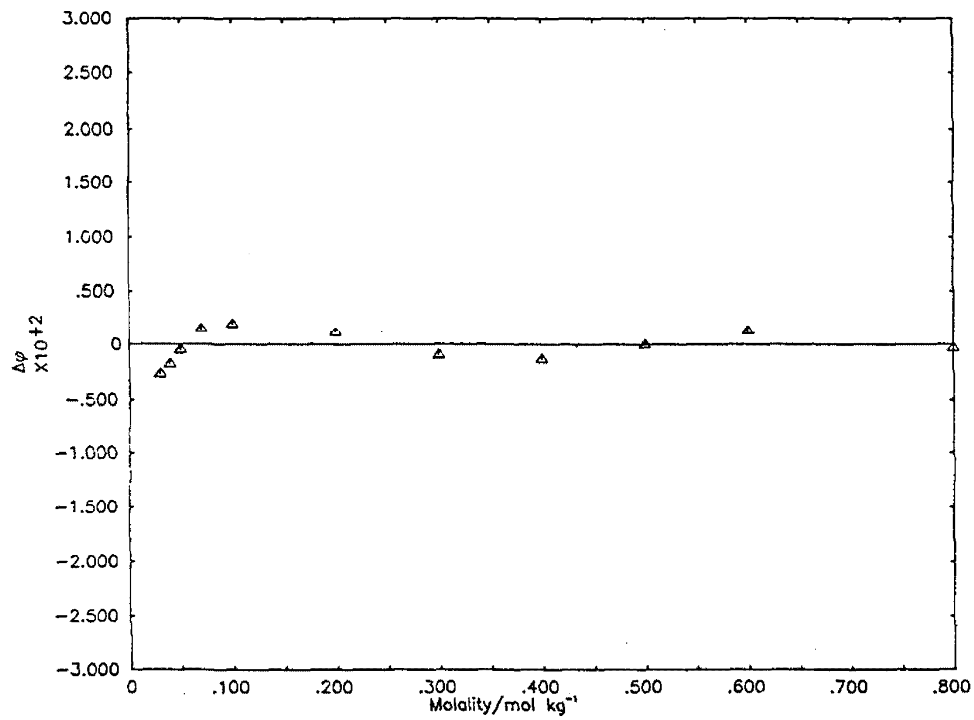
	Eqs 1		Eqs 2		Eqs 3	
Par	coefficient	σ(coeff)	coefficient	σ(coeff)	coefficient	σ(coeff)
1	.5675899742+00	.465-01	-.7259326751+01	.429+00	.4884191854+01	.111+00
2	.1073639410+01	.191+00	.4113308788+02	.286+01	-.2507992432+01	.482+00
3	-.1612047846+01	.224+00	-.6543484359+02	.714+01	-.1772302768+01	.718+00
4	.9438071158+00	.124+00	.5471241288+02	.775+01	.1810648513+01	.353+00
			-.1777257511+02	.307+01		

σ(eqs 1) = .179-02
σ(eqs 2) = .210-02
σ(eqs 3) = .148-02

Experimental Data Employed in Generation of Correlating Equations

Berka and Masterton [12]. Vapor pressure osmometry measurements performed at 37°C. Φ_L and Φ_c data for $CoCl_2$ were used to adjust this data to 25°C. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
.030000	.8270
.040000	.8110
.050000	.7990
.070000	.7810
.100000	.7610
.200000	.7230
.300000	.6980
.400000	.6780
.500000	.6620
.600000	.6500
.800000	.6460



Deviation Plot For $[Co(NH_3)_5(CH_3)_2CHCOO]Br_2$: Δϕ vs molality

▲ Berka and Masterton [12] - vapor pressure osmometry

$[Co(NH_3)_5(CH_3)_2CHCOO]Cl_2$

Recommended Values for the mean activity and osmotic coefficient of $[Co(NH_3)_5(CH_3)_2CHCOO]Cl_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ϕ	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8844	.9600	.999948	-1.
.002	.8433	.9451	.999898	-2.
.003	.8141	.9342	.999849	-3.
.004	.7908	.9254	.999800	-5.
.005	.7713	.9179	.999752	-7.
.006	.7544	.9113	.999705	-9.
.007	.7395	.9055	.999658	-11.
.008	.7261	.9001	.999611	-13.
.009	.7139	.8952	.999565	-16.
.010	.7027	.8907	.999519	-18.
.020	.6233	.8577	.999073	-49.
.030	.5733	.8360	.998645	-88.
.040	.5368	.8199	.998229	-131.
.050	.5084	.8070	.997822	-180.
.060	.4852	.7964	.997421	-232.
.070	.4656	.7874	.997025	-287.
.080	.4489	.7797	.996634	-345.
.090	.4343	.7730	.996247	-406.
.100	.4214	.7670	.995863	-469.
.200	.3414	.7308	.992131	-1198.
.300	.2998	.7139	.988492	-2049.
.400	.2732	.7045	.984884	-2981.
.500	.2542	.6991	.981285	-3974.
.600	.2398	.6960	.977683	-5015.
.700	.2284	.6944	.974073	-6095.
.800	.2191	.6937	.970452	-7209.
.900	.2114	.6937	.966820	-8352.
1.000	.2048	.6942	.963175	-9519.
1.250	.1918	.6969	.954012	-12531.
1.500	.1823	.7007	.944781	-15650.
1.750	.1749	.7050	.935491	-18855.
2.000	.1690	.7097	.926152	-22130.
2.250	.1641	.7146	.916774	-25463.
2.500	.1601	.7194	.907367	-28847.

m/mol·kg^{-1}	σ(ϕ)	σ(lnγ)	σ(γ)
.001	.0000	.0001	.0001
.010	.0002	.0005	.0003
.100	.0011	.0027	.0011
1.000	.0017	.0067	.0014
2.000	.0027	.0068	.0011
2.500	.0037	.0071	.0011

Coefficients of Correlating Equations

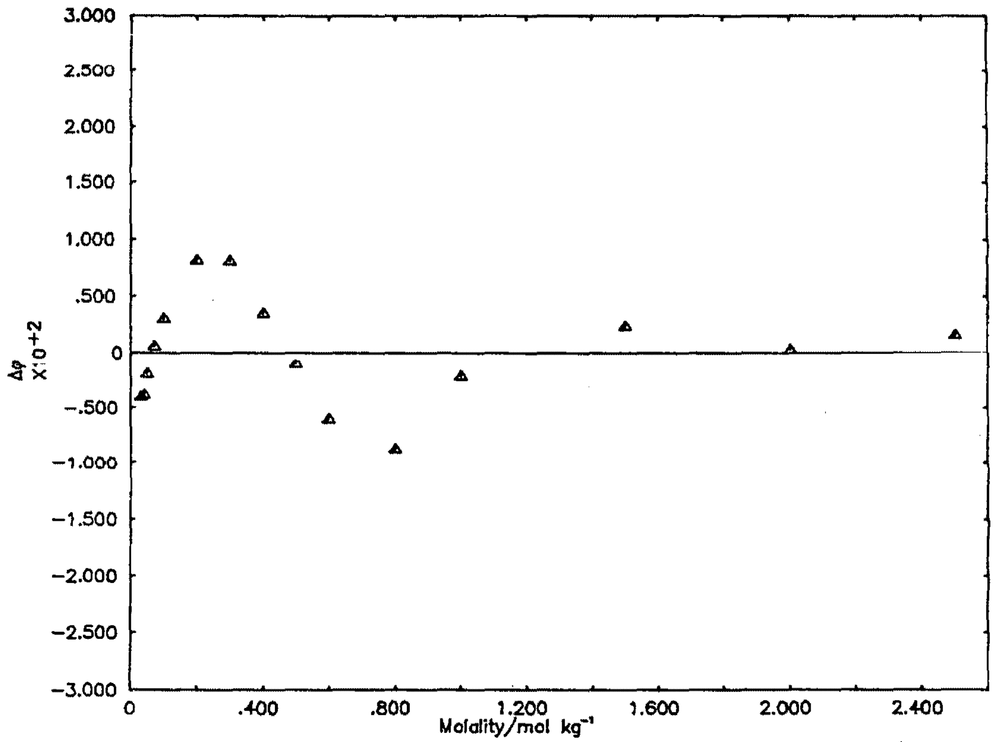
Par	Eqs 1 coefficient	Eqs 1 σ(coeff)	Eqs 2 coefficient	Eqs 2 σ(coeff)	Eqs 3 coefficient	Eqs 3 σ(coeff)
1	.8911348290+00	.100-01	-.5354876648+01	.385+00	.5141661184+01	.179+00
2	.1618118279-01	.535-02	.3079356425+02	.202+01	-.1954961021+01	.940+00
3			-.4357612886+02	.427+01	-.5737694200+01	.199+01
4			.3718596848+02	.441+01	.9216594472+01	.205+01
5			-.1640013614+02	.220+01	-.5250304976+01	.102+01
6			.2888405746+01	.423+00	.1064547987+01	.197+00

σ(eqs 1) = .492-02
σ(eqs 2) = .424-02
σ(eqs 3) = .197-02

Experimental Data Employed in Generation of Correlating Equations

Berka and Masterton [12]. Vapor pressure osmometry measurements performed at 37°C. Φ_L and Φ_c data for $CoCl_2$ were used to adjust this data to 25°C. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
.030000	.8320
.040000	.8160
.050000	.8050
.070000	.7880
.100000	.7700
.200000	.7390
.300000	.7220
.400000	.7080
.500000	.6980
.600000	.6900
.800000	.6850
1.000000	.6920
1.500000	.7030
2.000000	.7100
2.500000	.7210



Deviation Plot For $(Co(NH_3)_5(CH_3)_2CHCOO]Cl_2$: $\Delta\phi$ vs molality

△ Berka and Masterton [12] - vapor pressure osmometry

trans-$[Co(C_2H_8N_2)NH_3NO_2](NO_3)_2$

Recommended Values for the mean activity and osmotic coefficient of trans-$[Co(C_2H_8N_2)NH_3NO_2](NO_3)_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ϕ	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8842	.9599	.999948	-1.
.002	.8429	.9449	.999898	-2.
.003	.8139	.9338	.999849	-3.
.004	.7901	.9249	.999800	-5.
.005	.7704	.9173	.999752	-7.
.006	.7533	.9106	.999705	-9.
.007	.7382	.9045	.999658	-11.
.008	.7246	.8991	.999611	-13.
.009	.7122	.8940	.999565	-16.
.010	.7009	.8894	.999519	-18.
.020	.6197	.8547	.999077	-50.
.030	.5680	.8311	.998653	-89.
.040	.5300	.8130	.998244	-133.
.050	.5000	.7981	.997846	-183.
.060	.4753	.7854	.997457	-236.
.070	.4543	.7742	.997075	-293.
.080	.4362	.7643	.996701	-353.
.090	.4202	.7553	.996333	-417.
.100	.4060	.7471	.995971	-482.
.200	.3145	.6871	.992601	-1255.
.300	.2636	.6456	.989587	-2184.
.400	.2291	.6122	.986853	-3230.
.500	.2036	.5840	.984343	-4371.
.600	.1839	.5601	.982002	-5593.
.700	.1682	.5403	.979765	-6886.
.800	.1556	.5250	.977557	-8241.

m/mol·kg^{-1}	$\sigma(\phi)$	$\sigma(\ln\gamma)$	$\sigma(\gamma)$
.001	.0000	.0000	.0000
.010	.0001	.0002	.0001
.100	.0002	.0006	.0002
.800	.0004	.0007	.0001

Coefficients of Correlating Equations

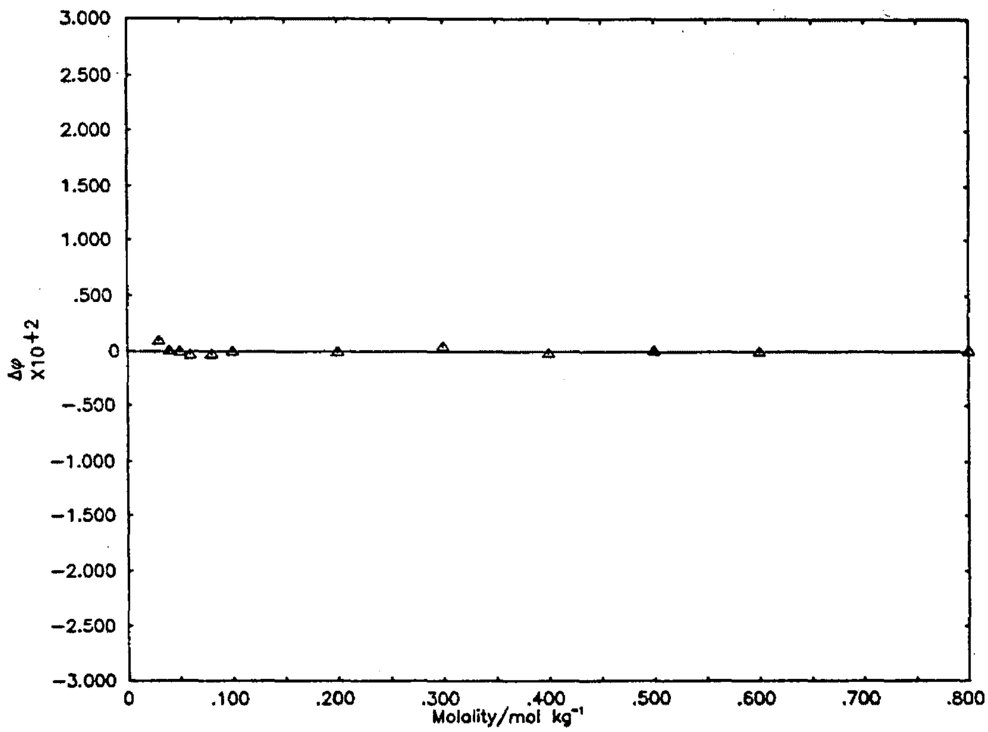
	Eqs 1		Eqs 2		Eqs 3	
Par	coefficients	σ(coeff)	coefficient	σ(coeff)	coefficient	(coeff)
1	.9410941796+00	.861-02	-.5469081010+01	.167+00	.6056465915+01	.893-01
2	-.5064808420+00	.260-01	.2973169058+02	.111+01	-.9687454751+01	.595+00
3	-.6893857214-01	.391-01	-.4205139785+02	.278+01	.1094825514+02	.149+01
4	.1402876903+00	.236-01	.3359673389+02	.302+01	-.7692814214+01	.162+01
5			-.1070282166+02	.120+01	.2475347024+01	.640+00

σ(eqs 1) = .392-03
σ(eqs 2) = .830-03
σ(eqs 3) = .444-03

Experimental Data Employed in Generation of Correlating Equations

Masterton et al [21]. Vapor pressure osmometry measurements performed at 37°C. Φ_L and Φ_c data for $CoCl_2$ were used to adjust this data to 25°C. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
.030000	.8320
.040000	.8130
.050000	.7980
.060000	.7850
.080000	.7640
.100000	.7470
.200000	.6870
.300000	.6460
.400000	.6120
.500000	.5840
.600000	.5600
.800000	.5250



Deviation Plot For trans-$[Co(C_2H_8N_2)_2NH_3NO_2](NO_3)_2$: Δφ vs molality

▲ Masterton et al [21] - vapor pressure osmometry

trans-$[Co(C_2H_8N_2)NH_3NO_2]I_2$

Recommended Values for the mean activity and osmotic coefficient of trans-$[Co(C_2H_8N_2)NH_3NO_2]I_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ϕ	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8841	.9599	.999948	-1.
.002	.8429	.9449	.999898	-2.
.003	.8136	.9340	.999849	-3.
.004	.7903	.9252	.999800	-5.
.005	.7708	.9177	.999752	-7.
.006	.7539	.9112	.999705	-9.
.007	.7390	.9054	.999658	-11.
.008	.7257	.9001	.999611	-13.
.009	.7136	.8953	.999565	-16.
.010	.7025	.8909	.999519	-18.
.020	.6241	.8590	.999072	-49.
.030	.5750	.8384	.998642	-87.
.040	.5393	.8230	.998222	-131.
.050	.5113	.8106	.997812	-179.
.060	.4883	.7999	.997409	-231.
.070	.4686	.7904	.997014	-285.
.080	.4515	.7817	.996626	-343.
.090	.4362	.7734	.996245	-404.
.100	.4224	.7655	.995871	-467.
.200	.3267	.6939	.992527	-1209.
.300	.2719	.6450	.989596	-2113.

m/mol·kg^{-1}	$\sigma(\phi)$	$\sigma(\ln\gamma)$	$\sigma(\gamma)$
.001	.0001	.0001	.0001
.010	.0003	.0006	.0004
.100	.0003	.0008	.0003
.300	.0004	.0011	.0003

Coefficients of Correlating Equations

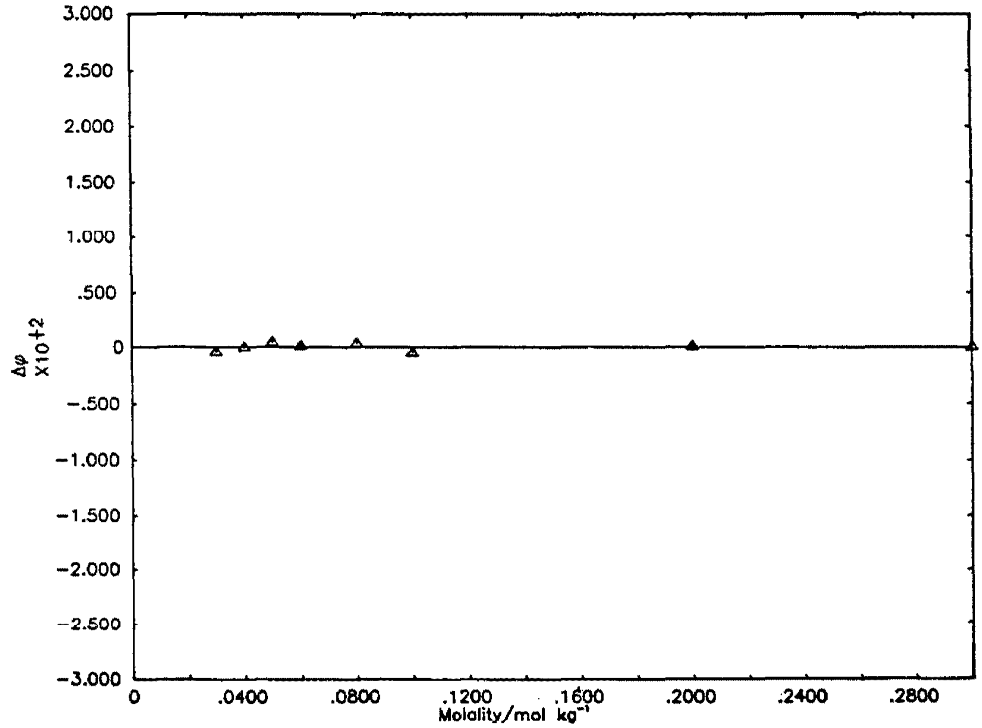
	Eqs 1		Eqs 2		Eqs 3	
Par	coefficient	σ(coeff)	coefficient	σ(coeff)	coefficient	σ(coeff)
1	.5030807927+00	.702-01	-.6485233624+01	.281+00	.5518860419+01	.120+00
2	.2253042069+01	.365+00	.4175710165+02	.195+01	-.1268600177+00	.831+00
3	-.8961814962+01	.760+00	-.7230488756+02	.459+01	-.1818881629+02	.196+01
4	.1256280010+02	.974+00	.4961577283+02	.358+01	.1888478621+02	.153+01

σ(eqs 1) = .432-03
σ(eqs 2) = .850-03
σ(eqs 3) = .363-03

Experimental Data Employed in Generation of Correlating Equations

Masterton et al [21]. Vapor pressure osmometry measurements performed at 37°C. Φ_L and Φ_c data for $CoCl_2$ were used to adjust this data to 25°C. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
.030000	.8380
.040000	.8230
.050000	.8110
.060000	.8000
.080000	.7820
.100000	.7650
.200000	.6940
.300000	.6450



Deviation Plot For trans-$[Co(C_2H_8N_2)_2NH_3NO_2]I_2$: Δø vs molality.

▲ Masterton et al [21] - vapor pressure osmometry

trans-$[Co(C_2H_8N_2)NH_3NO_2]Br_2$

Recommended Values for the mean activity and osmotic coefficient of trans-$[Co(C_2H_8N_2)NH_3NO_2]Br_2$ in H_2O at 298.15 K

$m/mol\cdot kg^{-1}$	γ	ϕ	a_w	$\Delta G^{ex}/J\cdot kg^{-1}$
.001	.8844	.9600	.999948	-1.
.002	.8433	.9451	.999898	-2.
.003	.8141	.9342	.999849	-3.
.004	.7908	.9253	.999800	-5.
.005	.7712	.9178	.999752	-7.
.006	.7542	.9111	.999705	-9.
.007	.7392	.9052	.999658	-11.
.008	.7257	.8998	.999611	-13.
.009	.7135	.8948	.999565	-16.
.010	.7022	.8902	.999519	-18.
.020	.6218	.8561	.999075	-49.
.030	.5705	.8330	.998650	-88.
.040	.5328	.8152	.998239	-132.
.050	.5031	.8006	.997839	-181.
.060	.4786	.7882	.997447	-234.
.070	.4578	.7774	.997063	-291.
.080	.4399	.7677	.996686	-350.
.090	.4240	.7589	.996315	-413.
.100	.4099	.7509	.995950	-478.
.200	.3195	.6936	.992531	-1242.
.300	.2695	.6554	.989430	-2156.
.400	.2359	.6257	.986563	-3183.
.500	.2112	.6012	.983884	-4299.
.600	.1920	.5804	.981356	-5492.
.700	.1765	.5624	.978949	-6751.
.800	.1637	.5467	.976640	-8069.
.900	.1530	.5330	.974405	-9440.
1.000	.1438	.5212	.972226	-10860.
1.250	.1260	.4980	.966915	-14593.
1.500	.1130	.4825	.961643	-18549.
1.750	.1032	.4726	.956281	-22689.
2.000	.0956	.4670	.950777	-26984.
2.250	.0895	.4639	.945147	-31410.
2.400	.0864	.4627	.941744	-34123.

$m/mol\cdot kg^{-1}$	$\sigma(\phi)$	$\sigma(\ln\gamma)$	$\sigma(\gamma)$
.001	.0001	.0002	.0001
.010	.0005	.0012	.0008
.100	.0018	.0052	.0021
1.000	.0022	.0063	.0009
2.000	.0031	.0077	.0007
2.400	.0044	.0077	.0007

Coefficients of Correlating Equations

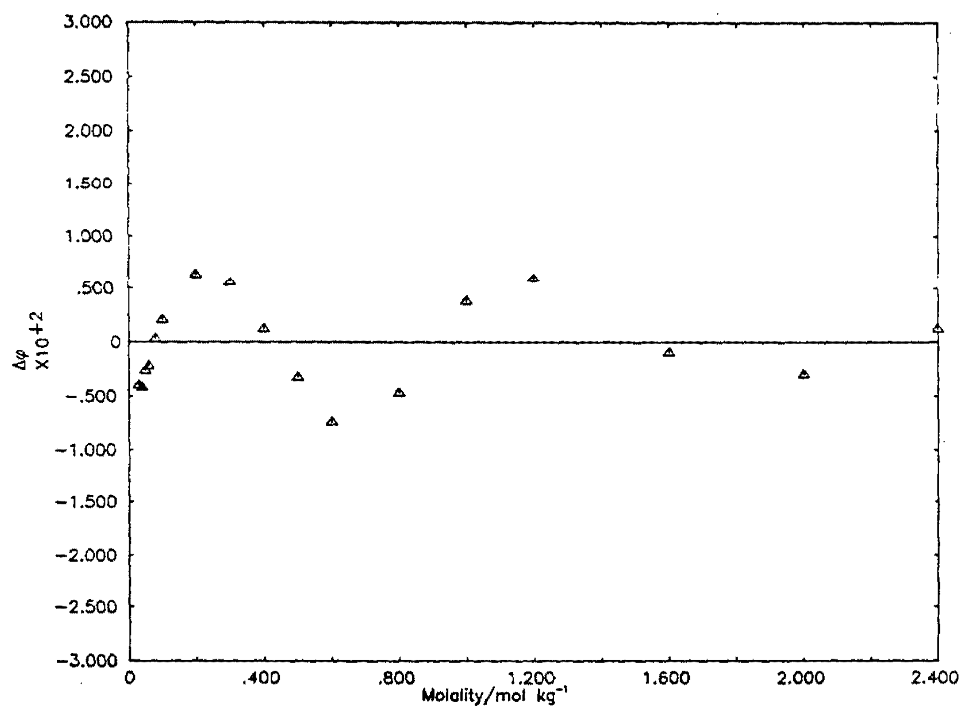
	Eqs 1		Eqs 2		Eqs 3	
Par	coefficient	σ(coeff)	coefficient	σ(coeff)	coefficient	σ(coeff)
1	.9929434566+00	.331-01	-.5205317126+01	.438+00	.5986852959+01	.172+00
2	-.5880831391+00	.535-01	.2856561422+02	.237+01	-.8333401811+01	.639+00
3	.1671993808+00	.331-01	-.4026380543+02	.511+01	.7019194039+01	.917+00
4	-.2011584158-01	.738-02	.3508871349+02	.536+01	-.3087116233+01	.578+00
5			-.1586464626+02	.271+00	.5494769115+00	.133+00
6			.2866917885+01	.529+00		

σ(eqs 1) = .458-02
σ(eqs 2) = .495-02
σ(eqs 3) = .387-02

Experimental Data Employed in Generation of Correlating Equations

Masterton et al [21]. Vapor pressure osmometry measurements performed at 37°C. Φ_L and Φ_c data for $CoCl_2$ were used to adjust this data to 25°C. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
.030000	.8290
.040000	.8110
.050000	.7980
.060000	.7860
.080000	.7680
.100000	.7530
.200000	.7000
.300000	.6610
.400000	.6270
.500000	.5980
.600000	.5730
.800000	.5420
1.000000	.5250
1.200000	.5080
1.600000	.4770
2.000000	.4640
2.400000	.4640



Deviation Plot For trans-$[Co(C_2H_8N_2)_2NH_3NO_2]Br_2$: $\Delta\phi$ vs molality

Δ Masterton et al [21] - vapor pressure osmometry

trans-$[Co(C_2H_8N_2)NH_3NO_2]Cl_2$

Recommended Values for the mean activity and osmotic coefficient of trans-$[Co(C_2H_8N_2)NH_3NO_2]Cl_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ø	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8851	.9604	.999948	-1.
.002	.8446	.9458	.999898	-2.
.003	.8158	.9352	.999848	-3.
.004	.7930	.9267	.999800	-5.
.005	.7738	.9194	.999752	-7.
.006	.7573	.9131	.999704	-9.
.007	.7427	.9074	.999657	-11.
.008	.7295	.9023	.999610	-13.
.009	.7176	.8976	.999563	-15.
.010	.7067	.8932	.999517	-18.
.020	.6290	.8615	.999069	-48.
.030	.5798	.8404	.998638	-86.
.040	.5438	.8245	.998219	-129.
.050	.5155	.8117	.997809	-176.
.060	.4923	.8009	.997406	-227.
.070	.4727	.7916	.997010	-282.
.080	.4557	.7834	.996619	-339.
.090	.4408	.7760	.996232	-398.
.100	.4275	.7693	.995851	-461.
.200	.3426	.7235	.992210	-1182.
.300	.2959	.6949	.988796	-2036.
.400	.2646	.6738	.985540	-2985.
.500	.2415	.6571	.982399	-4009.
.600	.2235	.6436	.979345	-5095.
.700	.2091	.6326	.976352	-6235.
.800	.1972	.6235	.973400	-7421.
.900	.1871	.6162	.970473	-8648.
1.000	.1786	.6103	.967553	-9912.
1.250	.1620	.6009	.960215	-13209.
1.500	.1501	.5974	.952722	-16667.
1.750	.1411	.5979	.945021	-20252.
2.000	.1341	.6006	.937138	-23941.
2.250	.1284	.6040	.929179	-27718.
2.400	.1254	.6057	.924437	-30021.

m/mol·kg^{-1}	σ(ø)	σ(ℓnγ)	σ(γ)
.001	.0001	.0001	.0001
.010	.0005	.0011	.0008
.100	.0016	.0045	.0019
1.000	.0018	.0054	.0010
2.000	.0026	.0066	.0009
2.400	.0038	.0066	.0008

Coefficients of Correlating Equations

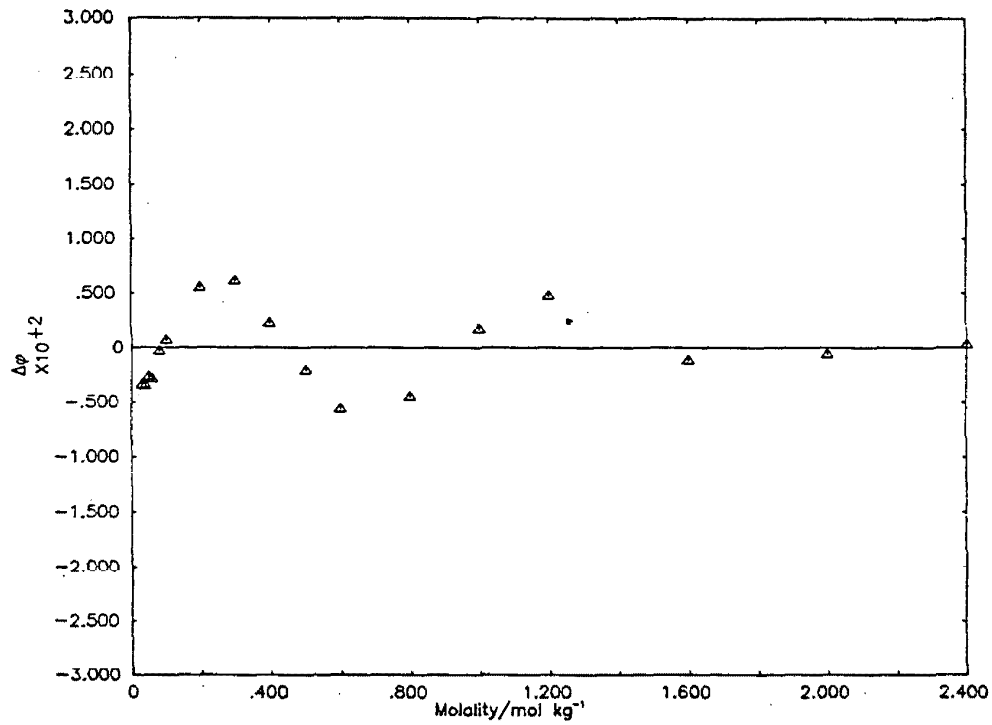
	Eqs 1		Eqs 2		Eqs 3	
Par	coefficient	σ(coeff)	coefficient	σ(coeff)	coefficient	σ(coeff)
1	.1091399364+01	.293-01	-.4461734423+01	.385+00	.6519378323+01	.135+00
2	-.4500087573+00	.424-01	.2679690338+02	.208+01	-.8866682905+01	.503+00
3	.1595421536+00	.270-01	-.3728105309+02	.449+01	.7232420854+01	.722+00
4	-.2230783721-01	.611-02	.3216931328+02	.471+01	-.3053021421+01	.455+00
5			-.1439312904+02	.238+01	.5163719665+00	.105+00
6			.2572301164+01	.465+00		

σ(eqs 1) = .389-02
σ(eqs 2) = .435-02
σ(eqs 3) = .305-02

Experimental Data Employed in Generation of Correlating Equations

Masterton et al. [21]. Vapor pressure osmometry measurements performed at 37°C. Φ_L and Φ_c data for $CoCl_2$ were used to adjust this data to 25°C. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
.030000	.8370
.040000	.8210
.050000	.8090
.060000	.7980
.080000	.7830
.100000	.7700
.200000	.7290
.300000	.7010
.400000	.6760
.500000	.6550
.600000	.6380
.800000	.6190
1.000000	.6120
1.200000	.6070
1.600000	.5960
2.000000	.6000
2.400000	.6060



Deviation Plot For trans-$[Co(C_2H_8N_2)_2NH_3NO_2]Cl_2$: $\Delta\phi$ vs molality

Δ Masterton et al [21] - vapor pressure osmometry

cis-$[Co(C_2H_8N_2)NH_3NO_2](NO_3)_2$

Recommended Values for the mean activity and osmitic coefficient of cis-$[Co(C_2H_8N_2)NH_3NO_2](NO_3)_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ϕ	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8842	.9599	.999948	-1.
.002	.8429	.9448	.999898	-2.
.003	.8134	.9338	.999849	-3.
.004	.7899	.9248	.999800	-5.
.005	.7702	.9172	.999752	-7.
.006	.7531	.9105	.999705	-9.
.007	.7380	.9044	.999658	-11.
.008	.7244	.8989	.999611	-13.
.009	.7120	.8939	.999565	-16.
.010	.7007	.8892	.999520	-18.
.020	.6195	.8545	.999077	-50.
.030	.5678	.8310	.998653	-89.
.040	.5298	.8129	.998244	-133.
.050	.4998	.7981	.997846	-183.
.060	.4752	.7855	.997456	-236.
.070	.4543	.7745	.997074	-293.
.080	.4362	.7646	.996699	-354.
.090	.4203	.7557	.996331	-417.
.100	.4061	.7476	.995968	-482.
.200	.3149	.6682	.992589	-1255.
.300	.2640	.6464	.989574	-2182.
.400	.2293	.6120	.986856	-3227.
.500	.2035	.5824	.984386	-4368.
.600	.1834	.5568	.982105	-5591.

m/mol·kg^{-1}	$\sigma(\phi)$	$\sigma(\ln\gamma)$	$\sigma(\gamma)$
.001	.0000	.0001	.0001
.010	.0002	.0004	.0003
.100	.0003	.0008	.0003
.600	.0006	.0010	.0002

Coefficients of Correlating Equations

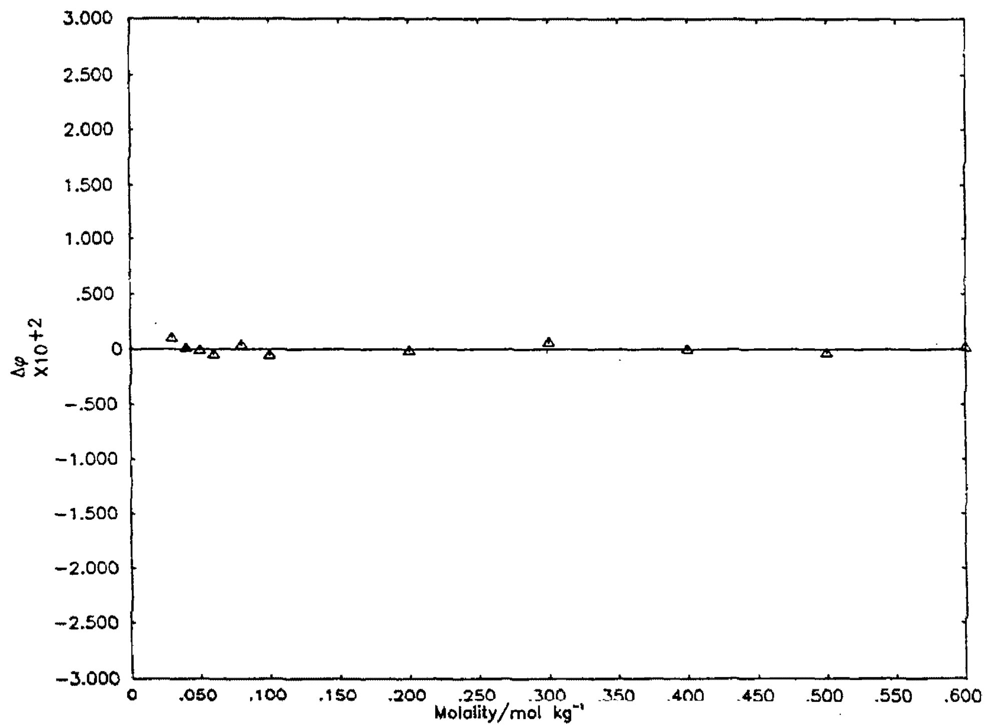
Par	Eqs 1 coefficient	Eqs 1 σ(coeff)	Eqs 2 coefficient	Eqs 2 σ(coeff)	Eqs 3 coefficient	Eqs 3 σ(coeff)
1	.9191110165+00	.187-01	-.5809298312+01	.212+00	.5758905962+01	.798-01
2	-.4209988203+00	.634-01	.3232462561+02	.156+01	-.7567906060+01	.410+00
3	-.2105690548+00	.116+00	-.4925788990+02	.434+01	.5525137661+01	.709+00
4	.2108699123+00	.906-01	.4232230189+02	.528+01	-.1679768012+01	.402+00
5			-.1461163169+02	.236+01		

σ(eqs 1) = .567-03
σ(eqs 2) = .716-03
σ(eqs 3) = .782-03

Experimental Data Employed in Generation of Correlating Equations

Masterton et al [21]. Vapor pressure osmometry measurements performed at 37°C. Φ_L and Φ_c data for $CoCl_2$ were used to adjust this data to 25°C. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
.030000	.8320
.040000	.8130
.050000	.7980
.060000	.7850
.080000	.7650
.100000	.7470
.200000	.6880
.300000	.6470
.400000	.6120
.500000	.5820
.600000	.5570



Deviation Plot For cis-$[Co(C_2H_8N_2)_2NH_3NO_2](NO_3)_2$: $\Delta\phi$ vs molality

Δ Masterton et al [21] - vapor pressure osmometry

cis-$[Co(C_2H_8N_2)NH_3NO_2]I_2$

Recommended Values for the mean activity and osmotic coefficient of cis-$[Co(C_2H_8N_2)NH_3NO_2]I_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ϕ	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8839	.9598	.999948	−1.
.002	.8425	.9446	.999898	−2.
.003	.8129	.9335	.999849	−3.
.004	.7894	.9245	.999800	−5.
.005	.7696	.9169	.999752	−7.
.006	.7525	.9102	.999705	−9.
.007	.7374	.9041	.999658	−11.
.008	.7237	.8987	.999612	−13.
.009	.7114	.8937	.999565	−16.
.010	.7000	.8890	.999520	−18.
.020	.6193	.8549	.999076	−50.
.030	.5682	.8321	.998652	−89.
.040	.5308	.8148	.998240	−133.
.050	.5014	.8007	.997839	−183.
.060	.4772	.7887	.997446	−236.
.070	.4567	.7782	.997060	−293.
.080	.4389	.7687	.996682	−352.
.090	.4232	.7603	.996310	−415.
.100	.4091	.7519	.995944	−480.
.200	.3159	.6864	.992608	−1248.
.300	.2607	.6319	.989807	−2179.
.400	.2224	.5858	.987417	−3239.
.500	.1949	.5502	.985241	−4408.
.600	.1749	.5259	.983089	−5666.

m/mol·kg^{-1}	$\sigma(\phi)$	$\sigma(\ln\gamma)$	$\sigma(\gamma)$
.001	.0000	.0001	.0001
.010	.0002	.0005	.0004
.100	.0003	.0007	.0003
.600	.0005	.0009	.0002

Coefficients of Correlating Equations

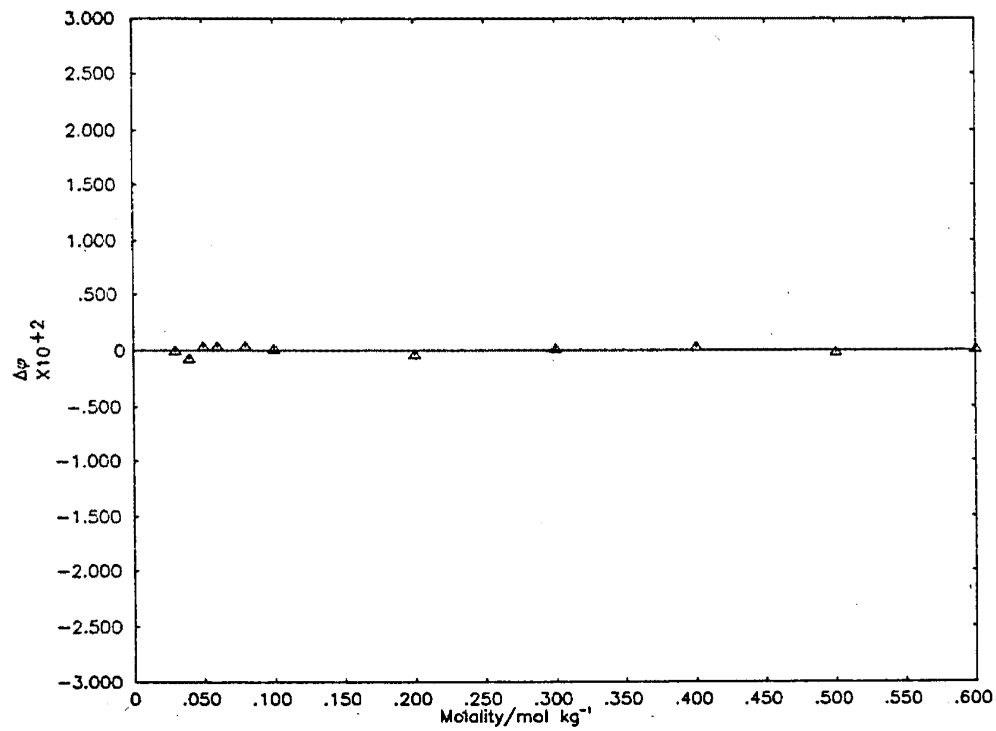
	Eqs 1		Eqs 2		Eqs 3	
Par	coefficient	σ(coeff)	coefficient	σ(coeff)	coefficient	σ(coeff)
1	.7177177567+00	.394−01	.6642253502+01	.295+00	.5738553632+01	.568−01
2	.6103399302+00	.176+00	.3984406819+02	.216+01	−.6220063257+01	.291+00
3	−.3429135930+01	.438+00	.7088013482+02	.601+01	.1378908994+01	.504+00
4	.4659847619+01	.720+00	.6675957812+02	.732+01	.1306594809+01	.286+00
5	−.2114807049+01	.469+00	.2421750363+02	.327+01		

σ(eqs 1) = .453−03
σ(eqs 2) = .933−03
σ(eqs 3) = .556−03

Experimental Data Employed in Generation of Correlating Equation

Masterton et al [21]. Vapor pressure osmometry measurements performed at 37°C. Φ_L and Φ_c data for $CoCl_2$ were used to adjust this data to 25°C. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
.030000	.8320
.040000	.8140
.050000	.8010
.060000	.7890
.080000	.7690
.100000	.7520
.200000	.6860
.300000	.6320
.400000	.5860
.500000	.5500
.600000	.5260



Deviation Plot For cis-$[Co(C_2H_8N_2)_2NH_3NO_2]I_2$: $\Delta\phi$ vs molality

△ Masterton et al [21] - vapor pressure osmometry

cis[Co($C_2H_8N_2$)NH_3NO_2]Br_2

Recommended Values for the mean activity and osmotic coefficient of cis-[Co($C_2H_8N_2$)NH_3NO_2]Br_2 in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ϕ	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8838	.9597	.999948	-1.
.002	.8421	.9444	.999898	-2.
.003	.8124	.9332	.999849	-3.
.004	.7886	.9240	.999800	-5.
.005	.7687	.9162	.999752	-7.
.006	.7514	.9094	.999705	-9.
.007	.7361	.9032	.999658	-11.
.008	.7223	.8976	.999612	-13.
.009	.7097	.8924	.999566	-16.
.010	.6982	.8876	.999520	-18.
.020	.6156	.8517	.999080	-50.
.030	.5630	.8273	.998660	-90.
.040	.5243	.8084	.998264	-136.
.050	.4938	.7930	.997859	-185.
.060	.4687	.7798	.997474	-240.
.070	.4475	.7683	.997098	-298.
.080	.4291	.7580	.996728	-359.
.090	.4130	.7488	.996365	-424.
.100	.3986	.7403	.996007	-491.
.200	.3067	.6789	.992689	-1280.
.300	.2559	.6363	.989735	-2229.
.400	.2215	.6015	.987080	-3298.
.500	.1960	.5715	.984676	-4466.
.600	.1762	.5455	.982467	-5718.
.700	.1605	.5236	.980385	-7045.
.800	.1478	.5064	.978342	-8437.
.900	.1377	.4945	.976231	-9885.
1.000	.1298	.4888	.973927	-11382.

m/mol·kg^{-1}	$\sigma(\phi)$	$\sigma(\ell n\gamma)$	$\sigma(\gamma)$
.001	.0000	.0001	.0001
.010	.0003	.0007	.0005
.100	.0007	.0022	.0009
1.000	.0016	.0028	.0004

Coefficients of Correlating Equations

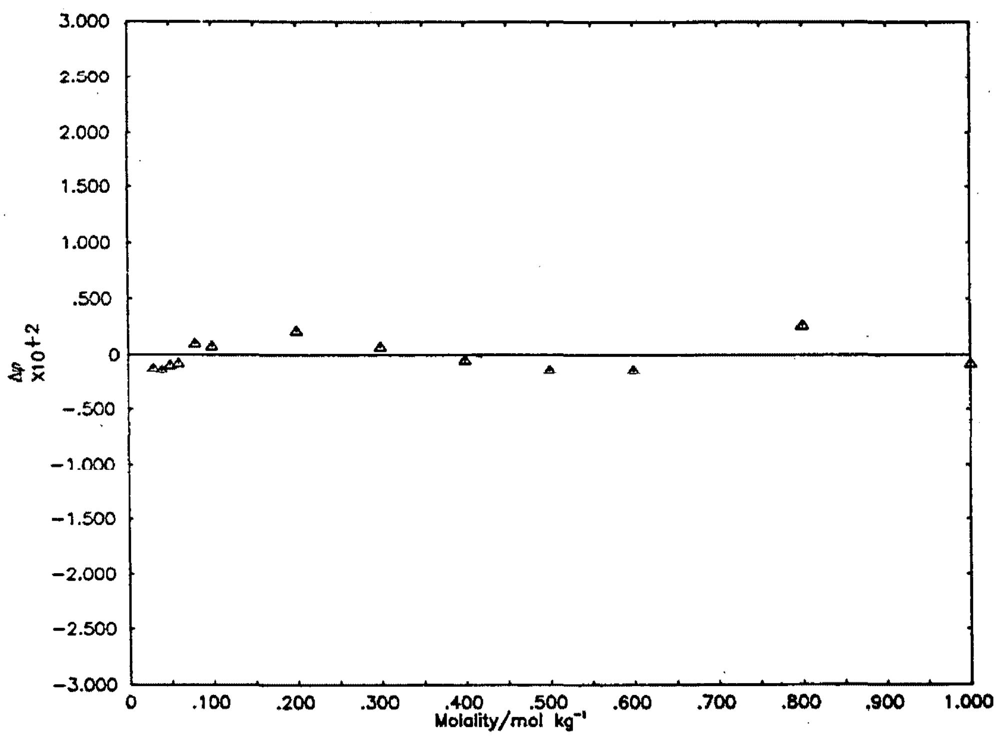
	Eqs 1		Eqs 2		Eqs 3	
Par	coefficient	σ(coeff)	coefficient	σ(coeff)	coefficient	(coeff)
1	.8350063743+00	.265-01	-.6085415820+01	.226+00	.5202880830+01	.536-01
2	-.3308338378+00	.797-01	.3164835313+02	.134+01	-.5774273868+01	.209+00
3	-.2721356446+00	.966-01	-.4390216662+02	.301+01	.3136713565+01	.282+00
4	.2269103881+00	.476-01	.3334285107+02	.292+01	-.5337852850+00	.125+00
5			-.9915690944+01	.103+01		

σ(eqs 1) = .162-02
σ(eqs 2) = .171-02
σ(eqs 3) = .100-02

Experimental Data Employed in Generation of Correlating Equations

Masterton et al [21]. Vapor pressure osmometry measurements performed at 37°C. Φ_L and Φ_c data for $CoCl_2$ were used to adjust this data to 25°C. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
.030000	.8260
.040000	.8070
.050000	.7920
.060000	.7790
.080000	.7590
.100000	.7410
.200000	.6810
.300000	.6370
.400000	.6010
.500000	.5700
.600000	.5440
.800000	.5090
1.000000	.4880



Deviation Plot For cis-$[Co(C_2H_8N_2)_2NH_3NO_2]Br_2$: $\Delta\phi$ vs molality

Δ Masterton et al [21] - vapor pressure osmometry

cis-$[Co(C_2H_8N_2)NH_3NO_2]Cl_2$

Recommended Values for the mean activity and osmotic coefficient of cis-$[Co(C_2H_8N_2)NH_3NO_2]Cl_2$ in H_2O at 298.15 K

m/mol·kg^{-1}	γ	ϕ	a_w	ΔG^{ex}/J·kg^{-1}
.001	.8850	.9604	.999948	−1.
.002	.8444	.9457	.999898	−2.
.003	.8156	.9351	.999848	−3.
.004	.7927	.9265	.999800	−5.
.005	.7735	.9192	.999752	−7.
.006	.7565	.9128	.999704	−9.
.007	.7422	.9071	.999657	−11.
.008	.7291	.9019	.999610	−13.
.009	.7171	.8972	.999564	−15.
.010	.7061	.8928	.999518	−18.
.020	.6280	.8607	.999070	−48.
.030	.5784	.8393	.998640	−86.
.040	.5421	.8230	.998222	−129.
.050	.5135	.8098	.997814	−177.
.060	.4900	.7986	.997414	−228.
.070	.4701	.7889	.997020	−283.
.080	.4529	.7803	.996632	−341.
.090	.4377	.7726	.996249	−401.
.100	.4242	.7656	.995871	−463.
.200	.3375	.7162	.992289	−1193.
.300	.2894	.6841	.988970	−2061.
.400	.2570	.6595	.985844	−3029.
.500	.2329	.6395	.982867	−4077.
.600	.2142	.6227	.980008	−5193.
.700	.1990	.6085	.977242	−6367.
.800	.1864	.5963	.974545	−7592.
.900	.1758	.5860	.971898	−8863.
1.000	.1668	.5773	.969283	−10176.
1.250	.1491	.5613	.962788	−13614.
1.500	.1363	.5522	.956218	−17239.
1.750	.1266	.5483	.949461	−21015.
2.000	.1192	.5481	.942480	−24915.
2.250	.1132	.5500	.935305	−28919.
2.500	.1083	.5528	.928035	−33011.
2.750	.1040	.5549	.920834	−37181.
2.800	.1032	.5552	.919421	−38024.

m/mol·kg^{-1}	$\sigma(\phi)$	$\sigma(\ln\gamma)$	$\sigma(\gamma)$
.001	.0001	.0002	.0002
.010	.0006	.0014	.0010
.100	.0021	.0059	.0025
1.000	.0024	.0073	.0012
2.000	.0033	.0085	.0010
2.800	.0049	.0087	.0009

Coefficients of Correlating Equations

	Eqs 1		Eqs 2		Eqs 3	
Par	coefficient	σ(coeff)	coefficient	σ(coeff)	coefficient	σ(coeff)
1	.1088759074+01	.358-01	−.4050015680+01	.394+00	.6568763321+01	.143+00
2	−.5196348468+00	.467-01	.2391831812+02	.190+01	−.9303671606+01	.486+00
3	.1602028661+00	.256-01	−.3060292713+02	.373+01	.7790660050+01	.639+00
4	−.1964073261-01	.495-02	.2471654150+02	.357+01	−.3346305727+01	.369+00
5			−.1039164063+02	.166+01	.5725151722+00	.783-01
6			.1745752336+01	.299+00		

σ (eqs 1) = .514-02
σ (eqs 2) = .519-02
σ (eqs 3) = .353-02

Experimental Data Employed in Generation of Correlating Equations

Masterton et al [21]. Vapor pressure osmometry measurements performed at 37°C. Φ_L and Φ_c data for $CoCl_2$ were used to adjust this data to 25°C. Assigned weight is 1.0.

m/mol·kg^{-1}	$\phi_{298.15}$
.030000	.8360
.040000	.8190
.060000	.7960
.080000	.7800
.100000	.7660
.200000	.7220
.300000	.6900
.400000	.6620
.500000	.6380
.600000	.6170
.800000	.5880
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1.200000	.5700
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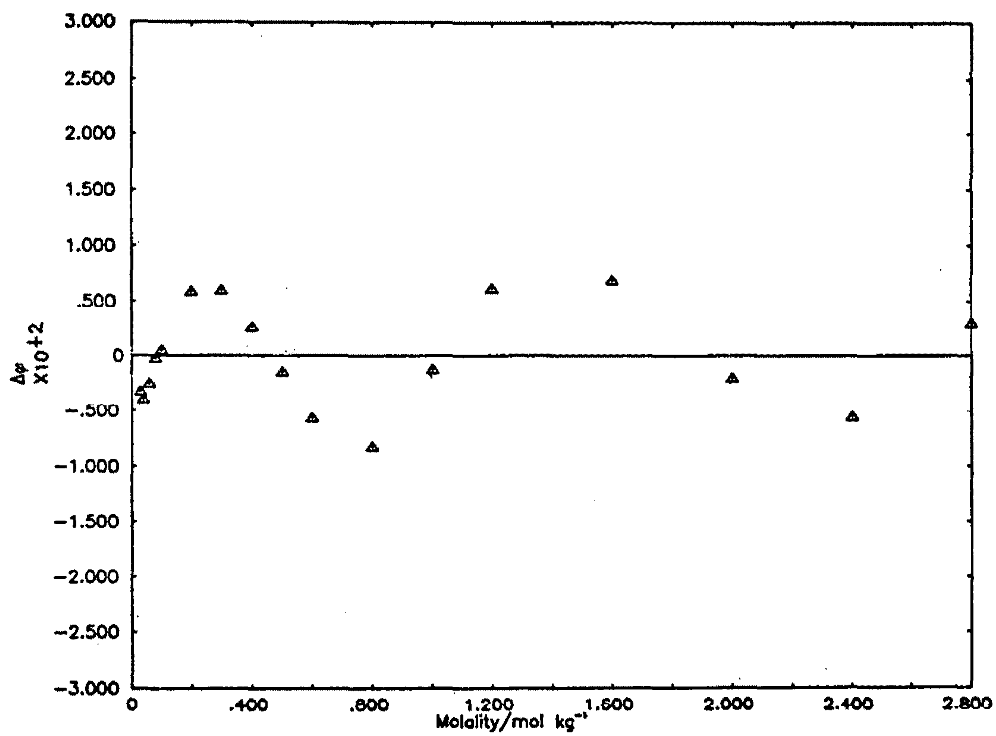
2.000000	.5460
2.400000	.5460
2.800000	.5580



Deviation Plot For cis-$[Co(C_2H_8N_2)_2NH_3NO_2]Cl_2$: $\Delta\phi$ vs molality

▲ Masterton et al [21] - vapor pressure osmometry

3.5. Systems Not Treated

King et al. [14] have reported freezing point depression measurements for aqueous solutions of $[Ni(NH_3)_6](NO_3)_2$ and $[Ni(C_6H_5N)_6](NO_3)_2$. The measurements are not very precise and do not appear to be very accurate since only a crude Beckmann type apparatus was used. Hence we have not treated the data for these systems.

3.6. Comparison with Previous Compilations and Evaluations

Earlier evaluations and compilations of the activity and osmotic coefficients for many of the systems dealt with herein may be found in the books by Harned and Owen [15] and Robinson and Stokes [16], and in the papers of Wu and Hamer [17] and Pitzer and Mayorga [18]. It should be noted that evaluated data for $Co(ClO_4)_2$, $Ni(ClO_4)_2$, and all of the cobalt complex compounds dealt with herein, with the exception of *cis*- and *trans*-$[Co(C_2H_8N_2)_2NH_3NO_2]X_2$, where X = NO_3, I, Br, or Cl, have not appeared in any of these earlier sources.

The tables given by Robinson and Stokes [16] appear to be exclusively based upon their own isopiestic measurements and Harned and Owen [15] also based their tables, which are not as extensive as those given by Robinson and Stokes [16], upon earlier calculations performed by Robinson and Stokes [19] and also based on these same isopiestic measurements. Comparison of the activity coefficients at the maximum molalities given in the tables of Robinson and Stokes [16] with our own values show an average difference of 1.8%, which appears to be random, and a maximum difference of 2.7%; this maximum difference is for $CoCl_2$ where we have included the recent experimental data of Downes [20].

Wu and Hamer [17] and Pitzer and Mayorga [18], like ourselves, have made use of modern digital computers which were not available to either Robinson and Stokes [16] or to Harned and Owen [15]. Wu and Hamer [17] used an equation that differs from our equation (1a) only in that it gives $\log_{10}\gamma$ rather than $\ln\gamma$. While the equations of Pitzer and Mayorga [18] differ from those we have used, they still include the Debye-Hückel limiting law, and insofar as the parameters they calculate are based on experimental data, their results remain essentially empirical in nature. The coefficients given by Pitzer and Mayorga [18] are based upon either the smoothed osmotic coefficients given by Robinson and Stokes [16] or, for *cis*- and *trans*-$[Co(C_2H_8N_2)NH_3NO_2]X_2$, where X = NO_3, I, Br, or Cl, upon the reported osmotic coefficients of Masterton et al. [21]. Pitzer and Mayorga [18], gave additional physical interpretation to their calculated parameters but did not give fits out to the maximum molalities for which experimental data existed for several systems. Wu and Hamer [17], while citing additional sources of data for several of the systems, do not state how these various data sets were weighted and for two systems ($NiCl_2$ and $CoBr_2$) their tables give values for the activity and osmotic coefficients at molalities greater than that for which there is experimental data. Comparison of our calculated activity coefficients with those of Pitzer and Mayorga [18] and Wu and Hamer [17] at the maximum possible molalities show an average difference of 4 and 3 percent, and a maximum difference of 10 and 7 percent, respectively. The maximum difference with the calculations of Pitzer and Mayorga [18] occurs for *cis*-$[Co(C_2H_8N_2)NH_3NO_2]Cl_2$ and is equal to 0.011 for an activity coefficient equal to 0.103 at 2.4 $mol \cdot kg^{-1}$; this difference may be attributable to either the different correlating equations we have used or to the adjustment of the osmotic coefficient data of Masterton et al. [21] from 37 to 25 °C. The maximum difference with the calculations of Wu and Hamer [17] occurs for $FeCl_2$ and is equal to 0.056 for an activity coefficient equal to 0.776 at 2.0 $mol \cdot kg^{-1}$; it may be attributable to differences in the way the various data sets were weighted.

4. Auxiliary Data

Osmotic Coefficient Data

Evaluated data for several reference systems were needed in treating the isopiestic data. These systems and the sources of the evaluated data are: KCl [1], NaCl [1], $NaClO_4$ [1], H_2SO_4 [4], $CaCl_2$ [3], NH_4Cl [1], and $CaBr_2$ [3]. For $Mg(ClO_4)_2$ we have used equation (1b) with the coefficients $B = 2.03029792$, $C = 0.634422465$, $D = 0.20312563$, $E = -0.019262859$, and $F = -0.0000902002$. These coefficients were obtained by a weighted fit of the isopiestic data of Stokes and Levien [21a] and the freezing point depression data of Nicholson and Felsing [21b].

Relative Apparent Molal Enthalpy Data

The coefficients for the equation $\Phi_L/J \cdot mol^{-1} = \Sigma_{i=1}^{N} \alpha_i m^{i/2}$ were obtained by least squares fits to enthalpies of dilution calculated from the compiled values of enthalpies of formation at various molalities as given in NBS Technical Note 270–4 [22]. They are given in table 1.

TABLE 1. Coefficients used to calculate relative apparent molal enthalpies

System	Range of validity, molality/$mol \cdot kg^{-1}$	α_1	α_2	α_3	α_4	α_5	α_6	α_7
$FeCl_2$	0.056 to 2.22	647.093	61004.0	−183886.0	243739.0	−162026.0	53250.0	−6867.75
$NiCl_2$	0 to 2.78	10263.4	−11231.10	15465.7	−13503.4	6600.57	−1215.48	
$CoCl_2$	0 to 3.70	10263.4	13829.8	−161829.0	44613.0	−478966.0	175850.0	

Apparent Molal Heat Capacity Data

For $CoCl_2$ and $NiCl_2$ we have used, depending upon molality range of interest, two different sets of coefficients in the equation $\Phi_C/J \cdot mol^{-1} \cdot k^{-1} = \Phi_C^\circ + \Sigma_{i=1}^{N} \beta_i m^{i/2}$. These are given in table 2.

TABLE 2. Coefficients used to calculate apparent molal heat capacities

System	Range of validity molality/mol·kg^{-1}	Φ°_C	β_1	β_2	Reference
$CoCl_2$	0.05 to 0.24	−278.7	150.38	−61.7	[23]
$CoCl_2$	0.10 to 4.2	−280.1	46.38	−20.18	[24]
$NiCl_2$	0.04 to 0.20	−294.0	150.38	−67.9	[23]
$NiCl_2$	0.35 to 2.04	−266.9	89.96	0.0	[25]

All of the above coefficients are those given by the respective workers, except for the coefficients of $CoCl_2$ for the molality range 0.10 to 4.2 mol·kg^{-1} which was obtained by a least squares fit to the experimental data.

Additional Auxiliary Data Follow:

ΔH°_{fus}	$= 6008\ J \cdot mol^{-1}$	[26]
ΔC°_{fus}	$= 38.1\ J \cdot mol^{-1} K^{-1}$	[26]
Δb	$= -0.197\ J \cdot K^{-2} \cdot mol^{-1}$	[26]
T_{fus}	= 273.15 K for water	[7]
R	$= 8.31441\ J \cdot K^{-1} \cdot mol^{-1}$	[27]
F	$= 96484.56\ C \cdot mol^{-1}$	[27]
A	$= 1.17625\ kg^{1/2} \cdot mol^{-1/2}$	[2]
P°	= 3168.6 Pa (23.7627 torr) for water at 25 °C	[28]
B_T	$= -992\ cm^3 \cdot mol^{-1}$ at 25 °C	[29]

5. Acknowledgment

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7. Glossary and Symbols

a_w	activity of water
Δb	$(\partial \Delta C_p / \partial T)_p$
c_B or c	concentration of solute substance B
m_B or m	molality of solute substance B
x_B or x	mole fraction of substance B
z_B	charge number of an ion B
A	constant in Debye-Hückel limiting law
A_1	$\lvert z_+ z_- \rvert A$
A_2	$\dfrac{(\Sigma_i \nu_i z_i^3)^2}{3\nu \Sigma_i (\nu_i z_i^2)} A^2$
A_i	coefficients in a specified equation
B, C, D, E...	coefficients in eqs (1)
B_i	coefficients in a specified equation
B_T	the second virial coefficient for water vapor
$\Delta C°_{fus}$	the heat capacity change accompanying the fusion of the pure solvent at the freezing temperature of the pure solvent
F	the Faraday constant
ΔG^{ex}	the excess Gibbs energy of a solution containing one kilogram of solvent
$\Delta H°_{fus}$	the enthalpy of fusion of the pure solvent at the freezing temperature of the pure solvent
I_m or I	ionic strength: ($I_m = ½ \Sigma_i m_i z_i^2$)
M_1	molecular weight of solvent
P	vapor pressure of a solution
$P°$	vapor pressure of pure solvent
R	molar gas constant
T	thermodynamic or absolute temperature
T_{fus}	absolute temperature of fusion of pure solvent
α_i	coefficients in a specified equation
β_i	coefficients in a specified equation
$\gamma_\pm$ or γ	activity coefficient, molality basis
θ	freezing point depression of a given solution
μ	chemical potential
ν_i	number of ions of species i formed from one molecule of solute assuming complete dissociation
ν	total number of ions formed from one molecule of solute assuming complete dissociation: [$\nu = \Sigma_i \nu_i$]
ρ_B or ρ	mass concentration or density of a given system
$\rho°$	mass concentration or density of pure solvent
σ	standard deviation
ϕ or φ	osmotic coefficient
Φ_C	apparent molal heat capacity
Φ_L	relative apparent molal enthalpy