VAPOUR PRESSURES OF AQUEOUS MELTS
AT 130° CONTAINING LiNO₃-KNO₃

Terrance B. Tripp
Chemistry Department
University of Maine at Presque Isle
Presque Isle, Maine
04769

ABSTRACT

Transpiration vapor pressure measurements were made on LiNO₃-KNO₃-H₂O aqueous melts at 129.51°C. The water mole ratio, R_H₂O, was varied from approximately 0.2 to 1.0 mol H₂O/mol NO₃⁻. The salt mole fraction, R_Li⁺, was varied from 0.4493 to 0.7000 mol Li⁺/mol NO₃⁻. The vapor pressures show within experimental error a linear dependence on R_H₂O at all values of R_Li⁺. This behavior is consistent with earlier results on LiNO₃-KNO₃ melts containing water and heavy water with R_Li⁺ = 0.500 mol Li⁺/mol NO₃⁻. The vapor pressures are also a function of R_Li⁺ and computation of the water concentration dependence of the activity coefficients of LiNO₃ and KNO₃ indicates preferential interaction of water with lithium ion over potassium ion. The results are discussed in light of models which have been proposed for aqueous melts.

Introduction

The aqueous melt system LiNO₃-KNO₃-H₂O has been the subject of several thermodynamic studies during the past 10 years (1-8). This system is attractive because of its ability to form melts with small water concentrations at temperatures as low as 100°C. Further examination of this and other salt water systems over an extensive range of compositions and temperatures will supplement the limited data on electrolyte water systems at low water concentrations, and add to our understanding of the properties of aqueous melts. This information is necessary before a general model of electrolyte water systems can be developed. The present investigation measured vapor pressures of LiNO₃-KNO₃-H₂O over a broad range of water and salt compositions at 129.51°C. The results are consistent with less extensive measurements reported earlier at 119.0°C (1,2) and confirm trends suspected in those data.
Experimental

The potassium nitrate and lithium nitrate, Mallinckrodt AR grade, were finely ground, dried at 150°C for 24 hours, and stored over anhydrous magnesium perchlorate. Melts were prepared by difference weighing of the salts into the transpiration cell. This operation was carried out in a dry glove bag. Water was introduced from a weighed syringe fitted with a stainless steel stopcock and long needle. The vapor pressures were measured by a differential transpiration method previously described (1,2). Two or more salt mixtures were examined as a function of water concentration at each salt composition. No differences between the results for different salt mixtures were detected. The water mole ratio, $R_H = (\text{mol H}_2\text{O/mol NO}_3)$, was varied from approximately 0.2 to 1.0 mol H$_2$O/mol NO$_3$. The salt mole fraction, $R_L = (\text{mol Li+/mol NO}_3)$, was varied from 0.1+493 to 0.7000 mol Li+/mol NO$_3$. At each salt composition, the data were taken down to near the solubility limit.

Results

The differential transpiration method does not measure vapor pressures directly, but yields drying tubes mass gain $W_r$, $W$ and system pressures $P_r$, $P$ for the reference system (water at 64.87°C) and the melt respectively. These data are reported in Table I. The vapor pressures listed in Table I and plotted in Figure 1 were calculated from the equation

$$p = \frac{(PWQ)}{[(P_rQ_r-P_r)W_r/P_r] + W}$$  \hspace{1cm} (1)

where $p$ is the orthobaric vapor pressure of the melt and $p_r$ is the vapor pressure of water in the reference cell. $Q_r$ and $Q$ are terms which correct for deviations from Dalton's law of the gaseous mixtures in the reference cell and sample cell respectively. Equation 1 is derived in detail elsewhere (1,9) and reflects the fact that the Poynting effect and the dissolution of the carrier gas (nitrogen) in the melt have a negligible effect on the vapor pressure of the melt. The estimated uncertainty in the vapor pressures due to the measurement of pressures, temperatures and drying tube mass gains is ± 1 torr. The observed reproducibility for this and earlier work was ± 1 torr.

For use in thermodynamic calculations, it is necessary to have the fugacity, $f$, which can be evaluated from $f = p \exp(Bp/RT + Cp^2/2RT)$ where $B = 322$ cm$^3$/mol and $C = -0.0207$ (cm$^3$/mol torr) are the second and third virial coefficients of water at 130°C (9). The calculated fugacities for LiNO$_3$-KNO$_3$-H$_2$O melts at 129.51°C are listed in Table I along with activities, $a = f/f^*$, where $f^*$ = 1942.8 torr is the fugacity of pure water under its vapor pressure at 129.51°C (10).
### TABLE I

Summary of Experimental Data for LiNO$_3$-KNO$_3$-H$_2$O System

\[ T = 129.51^\circ \text{C} \]

Pressures in torr

\[ R_L = .4493 \text{ mol Li}^+/\text{mol NO}_3^- \]

| \( R_H \) | \( P_H \) | \( P \) | \( W_H \) | \( W \) | Vapor Pressure | Fugacity | Activity |
|---|---|---|---|---|---|---|---|
| .2972 | 742.4 | 737.5 | .1261 | .1034 | 160.3 | 159.9 | .0823 |
| .2972 | 742.4 | 738.2 | .0838 | .0677 | 158.4 | 158.1 | .0814 |
| .3604 | 752.4 | 747.6 | .0966 | .1025 | 194.9 | 194.4 | .1001 |
| .3604 | 752.0 | 747.2 | .1233 | .1286 | 192.4 | 191.9 | .0988 |
| .4303 | 749.3 | 744.4 | .1173 | .1528 | 225.7 | 225.1 | .1158 |
| .4303 | 748.9 | 744.3 | .0991 | .1264 | 222.4 | 221.8 | .1142 |
| .4659 | 750.7 | 746.1 | .0941 | .1387 | 245.7 | 244.9 | .1260 |
| .4659 | 750.1 | 745.4 | .1096 | .1648 | 248.9 | 248.1 | .1277 |
| .4850 | 754.2 | 749.8 | .0879 | .1391 | 257.6 | 256.8 | .1322 |
| .4850 | 753.6 | 749.2 | .1165 | .1808 | 254.3 | 253.5 | .1305 |
| .5236 | 747.1 | 742.3 | .1015 | .1831 | 279.7 | 278.7 | .1434 |
| .5236 | 745.3 | 740.7 | .0992 | .1809 | 281.5 | 280.4 | .1443 |
| .5820 | 748.6 | 744.3 | .1026 | .2156 | 306.9 | 305.6 | .1573 |
| .5820 | 748.3 | 744.1 | .1016 | .2154 | 308.5 | 307.2 | .1581 |
| .6490 | 758.0 | 753.0 | .0856 | .2187 | 343.7 | 342.1 | .1761 |
| .6490 | 752.2 | 747.3 | .1558 | .3989 | 343.3 | 341.8 | .1759 |

\[ R_L = .5000 \text{ mol Li}^+/\text{mol NO}_3^- \]

| .2059 | 757.3 | 752.0 | .1249 | .0585 | 100.7 | 100.6 | .0518 |
| \( R_H \) | \( P_r \) | \( \rho \) | \( W_p \) | \( W \) | Vapor Pressure | Fugacity | Activity |
|---|---|---|---|---|---|---|---|
| .2059 | 756.2 | 750.8 | .1270 | .0600 | 101.5 | 101.3 | .0522 |
| .2553 | 754.2 | 749.1 | .1148 | .0692 | 124.8 | 124.6 | .0641 |
| .3038 | 758.0 | 753.1 | .1456 | .1081 | 148.0 | 147.7 | .0760 |
| .3038 | 758.2 | 753.5 | .1777 | .1327 | 148.6 | 148.3 | .0764 |
| .3542 | 751.9 | 747.3 | .1216 | .1095 | 172.2 | 171.8 | .0885 |
| .3542 | 752.3 | 747.9 | .1125 | .1010 | 171.8 | 171.4 | .0882 |
| .4063 | 745.4 | 740.4 | .1197 | .1301 | 198.3 | 197.8 | .1018 |
| .4063 | 745.8 | 741.2 | .1469 | .1575 | 196.4 | 195.9 | .1008 |
| .4206 | 762.5 | 757.5 | .1094 | .1237 | 204.3 | 203.7 | .1049 |
| .4206 | 761.8 | 757.2 | .1351 | .1536 | 205.1 | 204.5 | .1053 |
| .4880 | 753.9 | 749.3 | .1524 | .2113 | 235.8 | 235.1 | .1210 |
| .4880 | 753.4 | 748.2 | .1272 | .1806 | 239.6 | 238.8 | .1229 |
| .5513 | 740.1 | 735.5 | .1229 | .2095 | 269.6 | 268.6 | .1382 |
| .5513 | 739.0 | 734.0 | .1248 | .2136 | 269.4 | 268.4 | .1381 |
| .6050 | 756.7 | 752.4 | .1012 | .2001 | 296.6 | 295.4 | .1521 |
| .6050 | 756.3 | 752.0 | .1099 | .2196 | 298.5 | 297.3 | .1530 |
| .6679 | 752.0 | 747.3 | .1344 | .3157 | 327.6 | 326.1 | .1679 |
| .6679 | 753.2 | 748.4 | .1304 | .3051 | 326.7 | 325.3 | .1674 |

\[ R_L = .5500 \text{ mol Li}^+/\text{mol NO}_3^- \]

| \( R_L \) | \( P \) | \( W \) | Vapor Pressure | Fugacity | Activity |
|---|---|---|---|---|---|
| .3000 | 761.1 | 755.6 | .1190 | .0754 | 130.0 | 129.8 | .0668 |
| .3000 | 759.7 | 754.6 | .1213 | .0784 | 132.2 | 131.9 | .0679 |
| .3914 | 747.9 | 742.5 | .1267 | .1144 | 172.6 | 172.2 | .0886 |
| .3914 | 747.4 | 742.3 | .1090 | .0998 | 174.5 | 174.1 | .0896 |
| .4332 | 747.4 | 749.4 | .1215 | .1251 | 190.6 | 190.1 | .0979 |
| .4332 | 752.8 | 747.5 | .1107 | .1168 | 194.1 | 193.6 | .0996 |
| .4812 | 757.4 | 752.3 | .1294 | .1530 | 210.9 | 210.3 | .1083 |
| .4812 | 757.7 | 752.2 | .1302 | .1564 | 213.3 | 212.7 | .1095 |
| R\_H | P\_R | P | W\_R | W | Vapor Pressure | Fugacity | Activity |
|------|------|---|------|---|----------------|----------|----------|
| .5320 | 759.4 | 754.2 | .1032 | .1412 | 233.8 | 233.1 | .1200 |
| .5320 | 757.4 | 752.0 | .1349 | .1877 | 236.4 | 235.7 | .1213 |
| .5866 | 751.4 | 747.1 | .1127 | .1829 | 261.8 | 260.9 | .1343 |
| .5866 | 750.4 | 745.3 | .1211 | .1979 | 262.9 | 262.0 | .1348 |
| .6429 | 759.4 | 754.7 | .1531 | .2871 | 287.3 | 286.2 | .1473 |
| .6429 | 758.0 | 753.7 | .1090 | .2049 | 287.7 | 286.6 | .1475 |
| .6902 | 753.9 | 748.8 | .1362 | .2871 | 307.8 | 306.6 | .1578 |

R\_L = .6000 mol Li\(^+\)/mol NO\(_3\)^\(-\)
| RH     | PM | P   | Wm  | W   | Vapor Pressure | Fugacity | Activity |
|--------|----|-----|-----|-----|---------------|----------|----------|
| .7628  | 747.3 | 740.6 | .1091 | .2337 | 310.0          | 308.7    | .1589    |
| .7628  | 745.3 | 738.6 | .1207 | .2565 | 308.4          | 307.1    | .1581    |

\[ R_L = .6500 \text{ mol Li}^+/\text{mol NO}_3^- \]

| .5075  | 740.8 | 734.5 | .1271 | .1277 | 187.2          | 186.7    | .0961    |
| .5075  | 742.6 | 736.3 | .1087 | .1089 | 186.8          | 186.3    | .0959    |
| .5107  | 747.6 | 742.1 | .1172 | .1187 | 188.3          | 187.8    | .0967    |
| .5107  | 751.4 | 746.4 | .1247 | .1242 | 185.9          | 185.5    | .0955    |
| .5107  | 750.9 | 745.7 | .1694 | .1703 | 187.2          | 186.8    | .0961    |
| .5593  | 755.8 | 748.7 | .1226 | .1415 | 207.3          | 206.7    | .1064    |
| .5593  | 756.6 | 749.8 | .1006 | .1161 | 207.3          | 206.7    | .1064    |
| .5864  | 758.7 | 752.4 | .1198 | .1480 | 217.6          | 217.0    | .1177    |
| .5864  | 758.6 | 752.3 | .1265 | .1554 | 216.8          | 216.1    | .1113    |
| .6432  | 740.4 | 733.0 | .1070 | .1554 | 242.8          | 242.0    | .1246    |
| .6432  | 738.6 | 731.6 | .1001 | .1437 | 240.9          | 240.1    | .1236    |
| .6664  | 730.5 | 724.5 | .1189 | .1815 | 250.6          | 249.8    | .1286    |
| .6664  | 735.3 | 729.7 | .1188 | .1820 | 251.4          | 250.5    | .1290    |
| .7383  | 748.0 | 741.6 | .1192 | .2149 | 279.6          | 278.5    | .1434    |
| .7383  | 748.8 | 742.3 | .1380 | .2462 | 277.8          | 276.8    | .1425    |
| .7610  | 747.3 | 741.5 | .1272 | .2383 | 286.3          | 285.2    | .1468    |
| .7610  | 764.7 | 759.2 | .1263 | .2344 | 285.8          | 284.7    | .1465    |
| .8285  | 749.4 | 742.6 | .1177 | .2589 | 315.0          | 313.7    | .1614    |
| .8285  | 748.3 | 742.0 | .1122 | .2449 | 313.5          | 312.2    | .1607    |
| .8498  | 752.2 | 745.9 | .1130 | .2544 | 319.5          | 318.2    | .1638    |
| .8498  | 747.8 | 741.7 | .1164 | .2604 | 317.9          | 316.6    | .1630    |
| .9152  | 750.0 | 742.7 | .1128 | .2969 | 347.8          | 346.2    | .1782    |
| .9152  | 747.8 | 741.8 | .1221 | .3161 | 344.7          | 343.1    | .1766    |

TABLE I (cont.)
\[ R_L = 0.700 \text{ mol Li}^+/\text{mol NO}_3^- \]

| \( P_H \) | \( P_R \) | \( P \) | \( W_R \) | \( W \) | Vapor Pressure | Fugacity | Activity |
|--------|--------|--------|--------|--------|----------------|----------|----------|
| 0.6509  | 760.0  | 755.3  | 0.0656  | 0.0830  | 221.4          | 220.7    | 1.136    |
| 0.6509  | 759.2  | 754.3  | 0.0932  | 0.1175  | 220.8          | 220.2    | 1.133    |
| 0.6954  | 750.8  | 746.0  | 0.2151  | 0.3005  | 236.9          | 236.2    | 1.126    |
| 0.6954  | 750.6  | 746.3  | 0.1583  | 0.2222  | 237.7          | 236.9    | 1.120    |
| 0.7481  | 760.1  | 755.2  | 0.1146  | 0.1805  | 257.1          | 256.2    | 1.139    |
| 0.7481  | 759.6  | 754.8  | 0.0927  | 0.1443  | 255.1          | 254.2    | 1.108    |
| 0.7963  | 751.4  | 745.9  | 0.1111  | 0.1933  | 273.7          | 272.7    | 1.140    |
| 0.7963  | 750.0  | 744.3  | 0.1158  | 0.2022  | 274.2          | 273.2    | 1.146    |
| 0.8424  | 757.7  | 753.0  | 0.0920  | 0.1766  | 291.4          | 290.2    | 1.149    |
| 0.8424  | 757.5  | 752.1  | 0.1098  | 0.2096  | 290.3          | 298.2    | 1.149    |
| 0.8895  | 754.7  | 749.1  | 0.1239  | 0.2591  | 306.4          | 305.2    | 1.157    |
| 0.8895  | 753.5  | 748.1  | 0.1467  | 0.3062  | 306.0          | 304.8    | 1.156    |
| 0.9448  | 745.7  | 740.8  | 0.1095  | 0.2573  | 326.8          | 325.4    | 1.175    |
| 0.9448  | 744.3  | 739.3  | 0.1405  | 0.3302  | 326.6          | 325.2    | 1.167    |
| 1.003   | 734.8  | 730.2  | 0.0961  | 0.2500  | 344.0          | 342.4    | 1.176    |
| 1.003   | 735.7  | 731.4  | 0.1331  | 0.3440  | 343.0          | 341.4    | 1.175    |
Discussion

The two salient features of the results as revealed in Figure 1 are the dependence of the vapor pressure on the Li+/K+ ratio and the apparent linear dependence of vapor pressure on the water mole ratio, RH, at fixed salt mole fraction, RL.

It has been suggested that the dependence of vapor pressure on salt mole fraction, RL, is due to the preferential hydration of Li+ over K+ (1). Further evidence for this proposition can be gleaned from the present results by evaluating the water concentration dependence of the chemical potential or activity of lithium nitrate and the potassium nitrate. The LiNO3-KNO3-H2O system is a ternary system, and since the results yield water activities as a function of water concentration and salt mole fraction, it is possible to evaluate activities of LiNO3 and of KNO3 as a function of RH (11). The details of the evaluation process have been fully developed by Darken (12) and Gokcen (13). The necessary equations are obtained by applying the relationships of exact differential equations to the total differential of the Gibbs free energy at constant temperature and pressure

\[ \frac{dG}{dH} = \mu_L dL + \mu_K dK + \mu_H dH \] (2)

where, for example, \( \mu_L \) and \( n_L \) are the chemical potential and number of moles of Li+. Equation 2 is an exact differential equation and yields

\[ \frac{\partial \mu_L}{\partial n_L} n_L n_K = \frac{\partial \mu_K}{\partial n_K} n_L n_K \] (3)

and

\[ \frac{\partial \mu_K}{\partial n_K} n_L n_K = \frac{\partial \mu_L}{\partial n_L} n_L n_K \] (4)

Thus, the chemical potentials \( \mu_L \) and \( \mu_K \) can be evaluated from a knowledge of \( \mu_H \) as a function of \( n_L, n_K \) and \( n_H \) by integration of equations 3 and 4. The direct evaluation of chemical potentials is awkward because \( \mu_H \) approaches negative infinity as \( R_H \rightarrow 0 \) and, in practice, the concentration dependence of \( \log \gamma_L \) and \( \log \gamma_K \) is evaluated. Here \( \gamma_L \) and \( \gamma_K \), the activity coefficients of LiNO3 and KNO3 are computed from \( \gamma_i = a_i / x_i \) where \( x_i \) is the mole fraction of component i in the melt. The activity coefficients, relative to values in the standard state, computed for Li+ and K+ are shown as a function of water mole ratio in Figure 2. We see that the activity coefficient of LiNO3 is more strongly effected by the addition of water to the melt than is the activity coefficient of KNO3, indicating a preferential
interaction of water with Li$^+$ relative to K$^+$.

In order to compute the results shown in Figure 2, values of $\log Y_H$ must be known as $R_H \to 0$. Solubility limitations prohibit the evaluation of $\log Y_H$ at very low water concentrations directly from experimental data. The limiting values of $\log Y_H$ were computed by extrapolations of the data into the hypothetical supercooled liquid state and the results reflect assumptions made in these extrapolations. The absolute magnitude of $\log Y_L$ and $\log Y_K$ in Figure 2 should, therefore, be viewed in light of this limitation.

That the trend of the water concentration dependence of $\log Y_L$ and $\log Y_K$ is correct is confirmed by an evaluation of $(3 \log Y_L/\partial R_L)_{R_L}$ and $(3 \log Y_K/\partial R_K)_{R_K}$ thereby eliminating the constants of integration inherent in the computation of $\log Y_L$ and $\log Y_K$. The above slopes evaluated in the region of the experimental measurements at various $R_H$ and $R_L$ are listed in Table II. In all cases, the water concentration dependence of $\log Y_L$ is found to be greater than the water concentration dependence of $\log Y_K$.

Previous results on LiNO$_3$-KNO$_3$ melts containing H$_2$O and D$_2$O at temperatures between 110 - 150°C (1,2) indicated a linear dependence of vapor pressure on $R_H$ when $R_L = 0.500$ mol Li$^+$/mol NO$_3^-$ Insufficient data were available to determine the form of the water concentration dependence of the vapor pressure when $R_L \neq 0.500$ mol Li$^+$/mol NO$_3^-$. In order to deduce the relationship between vapor pressure and $R_H$ for the present results, first and second order polynomials were fitted to the data by least squares using the polynomial regression program from the program library of the University of Maine Computer Center. The best fit at all values of $R_L$ was obtained with a first order polynomial of the form

$$P = A_1 + A_2 R_H$$

where $A_1$ and $A_2$ are constants, as indicated by the correlation factors listed in Table III. The Durbin Watson D-statistic is a measure of the randomness of residuals and becomes smaller as the fit improves.

The constants for equation 5 evaluated using the vapor pressure data at 129.5°C at values of $R_L$ between 0.493 mol Li$^+$/mol NO$_3^-$ and 0.7000 mol Li$^+$/mol NO$_3^-$ are listed in Table IV. Worthy of note is that the intercepts, $A_1$, deviate considerably from zero when $R_L \neq 0.500$ mol Li$^+$/mol NO$_3^-$. This is physically unrealistic if it is presumed that the vapor pressure results can be extrapolated to a hypothetical supercooled liquid state of limiting water concentration.

568
TABLE II
Water Concentration Dependence
of log $\gamma_L$ and log $\gamma_K$

$T = 129.51^\circ C$

\[
\begin{array}{c|c|c}
R_L & \left( \frac{\partial \log \gamma_L}{\partial R_H} \right)_{R_L} & \left( \frac{\partial \log \gamma_K}{\partial R_H} \right)_{R_L} \\
\hline
.500 & .522 & .378 \\
.550 & .680 & .120 \\
.600 & .732 & .018 \\
\end{array}
\]

569
The use of the water mole ratio for correlating LiNO₃-KNO₃-H₂O vapor pressures arose originally because of an ease in computing this concentration term from experimental data. The apparent linearity of the vapor pressures of (Li-K)NO₃ aqueous melts lead to speculation about satisfactory statistical models for this system (1). For example, at limiting water concentrations, linearity with respect to the water mole fraction, \( X_{H_2O} = n_{H_2O}/(n_{H_2O} + n_{NO_3}) \), would imply the unrealistic model in which anions, cations and water mix randomly with each other. A site model, in which the melt is envisioned to consist of sites at which water can be bound predicts proportionality of the vapor pressure to \( R_H \) and was applied to LiNO₃-KNO₃ aqueous melts when \( R_H = 0.500 \) (1). This model requires \( p \rightarrow 0 \) as \( R_H \rightarrow 0 \).

Application of the site model to explain the present results is complicated by the presence of finite intercepts for the \( p \) vs \( R_H \) relationships. While adjustments to the model can be made to yield qualitative agreement with experiment, it seems best to continue to regard the linear dependence of vapor pressure on water mole ratio as an empirical correlation pending vapor pressure measurements on other aqueous melt systems and especially spectroscopic data on aqueous melts at low water concentrations.

Acknowledgements

This work was supported in part by Sigma Xi Grants-in-Aid of Research, the Coe Fund, University of Maine at Orono, and an Innovative Projects grant, University of Maine at Presque Isle. The author wishes to express his appreciation to Dr. Jerry Braunstein, Chemistry Division, Oak Ridge National Laboratory for his generous assistance in the preparation of this manuscript.

References

(1) Tripp, T. B. and Braunstein, J., J. Phys. Chem. 73, 1984 (1969).
(2) Tripp, T. B., J. Chem. Thermodynamics 7, 263 (1975).
(3) Tripp, T. B. and Braunstein, J., Chem. Communication 144 (1968).
(4) Hess, J. M. C., Braunstein, J. and Braunstein, H., J. Inorg. Nucl. Chem. 26, 811 (1964).
(5) Braunstein, H. and Braunstein, J., J. Chem. Thermodynamics 3, H19 (1971).
### TABLE III
Summary of Correlations for Polynomial Regression Fits of Vapor Pressures of LiNO$_3$-KNO$_3$-H$_2$O

\( T = 129.51^\circ \text{C} \)

| RL | First Order Regression | Second Order Regression |
|----|------------------------|-------------------------|
| .45 | 1.51                   | 1.66                    |
| .50 | 1.52                   | 2.37                    |
| .55 | 2.57                   | 2.59                    |
| .60 | 2.73                   | 2.83                    |
| .65 | 1.32                   | 1.78                    |
| .70 | 1.73                   | 2.02                    |

### TABLE IV
Slopes and Intercepts for \( p=A_1+A_2R_H \)

for the LiNO$_3$-KNO$_3$-H$_2$O System at 129.51$^\circ$ C

| RL | \( A_1 \) | \( A_2 \) |
|----|----------|----------|
| 0.45 | 2.68     | 524.8    |
| 0.50 | -1.24    | 491.3    |
| 0.55 | -4.94    | 453.9    |
| 0.60 | -10.35   | 418.9    |
| 0.65 | -11.96   | 392.1    |
| 0.70 | -12.8    | 359.5    |
(6). Braunstein, J., Orr, L. and MacDonald, W., J. Chem. Eng. Data 12, 415 (1967).

(7). Lammers, P. C. and Braunstein, J., J. Phys. Chem. 71, 2626 (1967).

(8). Braunstein, J., J. Phys. Chem. 71, 3402 (1967).

(9). Tripp, T. B., Ph.D. dissertation, University of Maine, Orono, Maine, 1967; University Microfilms 68-2124.

(10). "National Engineering Laboratory Steam Tables", Her Majesty's Stationary Office, Edinburgh, 1964.

(11). Lewis, G. N. and Randall, M., "Thermodynamics", 2nd ed., revised by Pitzer, K. S. and Brewer, L., McGraw-Hill Book Co., Inc., New York, New York, 1961, Chap. 34.

(12). Darken, L. S., J. Am. Chem. Soc. 72, 2909 (1950).

(13). Gokcen, N. A., J. Phys. Chem. 64, 401 (1960).
Figure 1. Vapor pressures at 129.51°C of LiNO$_3$-KNO$_3$-H$_2$O aqueous melts as a function of water mole ratio at various salt mole fractions.
Figure 2. Log $\gamma$ - log $\gamma^*$ at 129.51°C for water, LiNO$_3$ and KNO$_3$ in LiNO$_3$-KNO$_3$-H$_2$O aqueous melts as a function of water mole ratio and salt mole fraction.