consistent with weaker interactions between the O atom and the H atoms, where the latter are placed far from the three Cl atoms.

Glossary

a_k	coefficients in eq 2
H^E	molar excess enthalpy, J mol^{-1}
R	correlation coefficient
T	absolute temperature
x_i	mole fraction of component i (i = 1, 1,3-dioxolane; i = 2, trichloroethylene)

Greek Letters

ρ	density, kg m^{-3}
σ	standard deviation, ref 1

Registry No. 1,3-Dioxolane, 646-06-0; trichloroethylene, 79-01-6.

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Conductivity and Viscosity of Molten Mixtures of Ferric Nitrate Nonahydrate with Hydrates of Calcium, Cadmium, Magnesium, and Zinc Nitrates

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The conductivity and viscosity of molten mixtures of ferric nitrate nonahydrate with hydrates of calcium, cadmium, magnesium, and zinc nitrates have been measured as a function of temperature and composition. Both conductivity and fluidity exhibit a non-Arrhenius temperature dependence for all the compositions and have been described in terms of three-parameter equations $\Lambda = A_\Lambda \exp[-B_\Lambda/(T - T_{0,\Lambda})]$ and $\phi = A_\phi \times \exp[-B_\phi/(T - T_{0,\phi})]$. A_Λ, B_Λ, $T_{0,\Lambda}$, A_ϕ, B_ϕ, and $T_{0,\phi}$ are empirical parameters characteristic of the medium. The deviations from ideal behavior in transport properties have been interpreted considering ion-ion, ion-water, and water-water interactions. The results suggest the existence of a hydration-dehydration phenomenon in these mixed hydrated melts.

Introduction

The behavior of molten hydrated salts has been discussed considering the existence of large weak field cations of the type $M(H_2O)_n^{z+}$ and anions; this has been evidenced by spectral (*1*, *2*) volumetric and transport studies (*3*-*8*). In binary molten mixtures of hydrated salts, as divalent metal nitrates are added to trivalent metal nitrates, the differences in charge, radius, and polarizability of the cations result in a competition for preferential orientation of water dipoles and anions toward the cation having high cationic potential (z/r), leading to ion association and a hydration-dehydration phenomenon (*9*, *10*). In order to investigate these interactions in hydrated salt mixtures, the conductivity and viscosity of molten mixtures of divalent and trivalent nitrates have been studied. This communication reports the observations made on molten mixtures of ferric nitrate nonahydrate with hydrates of calcium, cadmium, magnesium, and zinc nitrates.

Experimental Section

AnalaR (BDH) grade chemicals were used. The water of hydration was determined by volumetric titration by using EDTA with an accuracy of ±0.02 mol/mol of cation. The average number of moles of water of hydration per mole of the salt (R) was 9.08 for ferric nitrate, 4.12 for calcium nitrate, 4.15 for cadmium nitrate, 6.02 for magnesium nitrate, and 6.22 for zinc nitrate. Mixtures were prepared by adding calculated amounts of the salts, melted and matured for 3 h.

A Beckman conductivity bridge (Model RC 18A, precision 0.03%) based on Wien's bridge principle, provided with a CRT null detector and Wagner ground, operating at an ac frequency of 1 kHz, was employed to measure the solution resistance. A single capillary dip-type conductivity cell with plantinized platinum electrodes was employed. The cell constant was determined with 0.1 and 1.0 mol dm^{-3} KCl solutions at 25 °C from the data of Jones and Prendergest (*11*). Redetermination of the cell constant after five to six runs showed no appreciable change. The expected accuracy of the conductivity data is ±0.3%.

A three-limb UCF-viscometer was employed for viscosity measurements. It essentially consists of receiving, measuring, and auxiliary tubes arranged parallel to one another to form the suspended level arrangement in a triangular fashion, which reduced the effect of back-pressure. The measuring arm had two small bulbs with fiducial marks between them. The size of the bulb and the length and diameter of the capillary were such that the efflux time for the flow of ca. 2 mL of solution ranges between 120 and 300 s. Viscometers were calibrated in the temperature range 278-363 K with use of triple-distilled water, 20% and 40% sucrose solutions, and 98% glycerol solution. Typical values of viscometer constants ranged between 0.003 and 0.0075 cP. Accuracy of the viscosity data is estimated to be better than ±0.5%.

A liquid paraffin thermostat of 20-L capacity was used. Temperature was controlled and known with a precision of ±0.05 °C. Data were recorded both in heating and cooling cycles at ca. 5-10-deg intervals.

Results and Discussion

Conductivity (κ) and viscosity (η) of molten mixtures of $Fe(NO_3)_3 \cdot 9H_2O$ with $M(NO_3)_2 \cdot RH_2O$ (M = Ca, Cd, Mg, Zn) have been measured over available composition and temperature

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Table I. Conductivity (κ) and Viscosity (η) Data of $Fe(NO_3)_3 \cdot 9.08H_2O$ + $M(NO_3)_2 \cdot RH_2O$ Systems

mole fraction of $M(NO_3)_2 \cdot RH_2O$	temp, K	$10^2\kappa$, S cm^{-1}	η, cP	mole fraction of $M(NO_3)_2 \cdot RH_2O$	temp, K	$10^2\kappa$, S cm^{-1}	η, cP
			$M(NO_3)_2 \cdot RH_2O = Ca(NO_3)_2 \cdot 4.12H_2O$				
0.0000	293.2	1.2619	114.3	0.5987	293.2	0.6055	
	298.7	1.6505	81.70		303.2	1.1140	113.8
	303.2	2.0640	62.21		313.2	1.8172	62.58
	313.2	3.1980	36.07		323.2	2.7700	40.65
	323.2	4.5725	18.33		333.2	3.8866	25.18
	333.2	6.1223	15.27		343.2	5.1897	17.55
	343.2	7.8751	10.86		353.2	6.5999	13.04
	353.2	9.6639	8.14	0.7987	293.2	0.4773	
0.0995	293.7	1.1045	132.3		303.2	0.8195	145.5
	303.2	1.8399	72.31		313.2	1.4887	80.73
	313.2	2.8862	40.52		323.2	2.2812	46.50
	323.2	4.1443	25.29		333.2	3.2580	30.17
	333.2	5.6242	17.28		343.2	4.3936	21.12
	343.2	7.2829	12.16		353.2	5.6383	15.47
	353.2	8.9510	8.87	0.8988	303.2	0.7402	173.4
0.1991	303.2	1.7546	75.26		313.2	1.3651	90.64
	313.2	2.7333	42.10		323.2	2.0920	57.09
	323.2	3.9355	26.63		333.2	3.0194	33.45
	333.2	5.3738	17.62		343.2	4.0608	23.77
	343.2	7.0708	12.60		353.2	5.2215	17.39
	353.2	8.6925	9.41	1.0000	303.2	0.7077	180.1
0.3988	293.2	0.7838	180.6		313.2	1.1889	97.62
	303.2	1.3915	90.73		323.2	1.8237	59.50
	313.2	2.2203	51.29		333.2	2.6405	38.29
	323.2	3.3098	32.75		343.2	3.5425	27.19
	333.2	4.5851	21.19		353.2	4.6022	19.90
	343.2	5.9891	14.78				
	353.2	7.5662	10.92				
			$M(NO_3)_2 \cdot RH_2O = Cd(NO_3)_2 \cdot 4.15H_2O$				
0.0995	298.2	1.4505	102.4	0.7979	303.2	1.7268	62.42
	303.2	1.8795	81.96		313.2	2.6361	37.64
	313.2	2.8876	43.07		323.2	3.7703	24.84
	323.2	4.1819	26.59		333.2	5.0926	17.35
	333.2	5.6509	17.68		343.2	6.5422	12.74
	343.2	7.2456	12.71		353.2	8.0890	9.87
	353.2	9.0661	9.41	0.8991	303.2	1.5857	69.27
0.1994	298.2	1.3979	101.6		313.2	2.4376	41.80
	303.2	1.8315	70.59		323.2	3.5052	27.54
	313.2	2.8136	40.93		333.2	4.7458	19.27
	323.2	4.0524	25.77		343.2	6.1743	14.03
	333.2	5.5149	17.19		353.2	7.6221	10.77
	343.2	7.0653	12.27	1.0000	303.2	1.4917	69.41
	353.2	8.7667	9.11		313.2	2.2986	42.29
0.3970	303.2	1.7232	70.76		323.2	3.2879	27.97
	313.2	2.6651	41.05		333.2	4.4499	19.82
	323.2	3.8413	26.02		343.2	5.8317	14.53
	333.2	5.2149	17.41		353.2	7.2514	11.31
	343.2	6.7561	12.53				
	353.2	8.3715	9.32				
0.5962	303.2	1.6782	70.24				
	313.2	2.5845	41.64				
	323.2	3.7243	26.00				
	333.2	5.0412	17.89				
	343.2	6.5379	13.07				
	353.2	8.0629	9.79				
			$M(NO_3)_2 \cdot RH_2O = Mg(NO_3)_2 \cdot 6.02H_2O$				
0.1060	298.2	1.3961	101.4	0.1964	333.2	5.2303	17.29
	303.2	1.8089	72.82		343.2	6.7348	13.09
	313.2	2.7845	42.48		353.2	8.3380	9.91
	323.2	3.9981	26.35	0.4015	333.2	4.9010	20.04
	333.2	5.4274	17.54		338.2	5.5872	15.93
	343.2	7.0187	12.37		343.2	6.2975	14.63
	353.2	8.6618	9.25		348.2	7.0485	11.66
0.1964	308.2	2.2012	51.89		353.2	7.8026	10.59
	313.2	2.6751	41.34				
	323.2	3.8487	25.88				
			$M(NO_3)_2 \cdot RH_2O = Zn(NO_3)_2 \cdot 6.22H_2O$				
0.0985	303.2	1.7246	78.67	0.1994	308.2	2.3319	52.05
	308.2	2.1765	58.35		313.2	2.8712	40.08
	313.2	2.7122	44.27		323.2	4.1264	25.07
	322.2	3.9038	27.50		333.2	5.5914	16.45
	333.2	5.3271	18.19		343.2	7.2165	11.97
	343.2	6.8880	12.82		353.2	8.9516	8.96
	353.2	8.5555	9.46				

Table I (Continued)

mole fraction of $M(NO_3)_2 \cdot RH_2O$	temp, K	$10^2\kappa$, S cm^{-1}	η, cP	mole fraction of $M(NO_3)_2 \cdot RH_2O$	temp, K	$10^2\kappa$, S cm^{-1}	η, cP
0.2971	308.2	2.3832	48.07	0.7985	308.2	3.5780	25.17
	313.2	2.9991	36.56		313.2	4.3005	20.58
	323.2	4.3033	23.20		318.2	5.0506	16.99
	333.2	5.8126	15.82		323.2	5.8973	14.22
	343.2	7.4813	11.28		333.2	7.6630	10.25
	353.2	9.2443	8.41		343.2	9.6771	7.73
0.4006	303.2	2.1832	53.05		353.2	11.8505	6.10
	313.2	3.3072	31.62	0.8971	308.2	3.8784	22.39
	323.2	4.6820	20.48		313.2	4.6243	18.56
	333.2	6.3002	14.10		323.2	6.3001	12.86
	343.2	8.0586	10.27		333.2	8.1264	9.29
	353.2	9.9042	7.83		343.2	10.2602	7.10
0.5949	303.2	2.4752	42.87		353.2	12.3182	5.65
	308.2	3.0625	32.90	1.0000	308.2	4.1077	19.67
	313.2	3.7023	26.07		313.2	4.8527	16.19
	323.2	5.1548	17.37		318.2	5.6793	13.56
	333.2	6.8347	12.15		323.2	6.5429	11.57
	343.2	8.7172	9.05		333.2	8.4949	8.56
	353.2	10.6276	7.02		343.2	10.5379	6.68
					353.2	12.7641	5.41

Table II. Constants of the Polynomial Equation κ (S cm^{-1}) = $A + B(T - 300) - C(T - 300)^2$ for Conductivity Data of $Fe(NO_3)_3 \cdot 9.08H_2O + M(NO_3)_2 \cdot RH_2O$ Systems

mole fraction of $M(NO_3)_2 \cdot RH_2O$	temp range, K	$10A$	10^3B	10^5C	std error $\times 10^3$
$M(NO_3)_2 \cdot RH_2O = Ca(NO_3)_2 \cdot 4.12H_2O$					
0.0000	293–353	0.1803	0.9628	0.9911	0.635
0.0995	293–353	0.1616	0.8625	0.9989	0.668
0.1991	303–353	0.1439	0.8804	0.9291	0.736
0.3988	293–353	0.1184	0.6921	0.9658	0.445
0.5987	293–353	0.0934	0.5744	0.9344	0.377
0.7987	293–353	0.0721	0.4754	0.8549	0.427
0.8988	303–353	0.0572	0.5032	0.7010	0.197
1.0000	303–353	0.0571	0.3830	0.7073	0.165
$M(NO_3)_2 \cdot RH_2O = Cd(NO_3)_2 \cdot 4.15H_2O$					
0.0995	298–353	0.1591	0.8911	0.9722	0.308
0.1994	298–353	0.1537	0.8873	0.8984	0.409
0.3970	303–353	0.1421	0.8542	0.8619	0.338
0.5962	303–353	0.1872	0.8391	0.8001	0.442
0.7979	303–353	0.1470	0.8060	0.8363	0.371
0.8991	303–353	0.1342	0.7497	0.8250	0.416
1.0000	303–353	0.1253	0.6928	0.8274	0.330
$M(NO_3)_2 \cdot RH_2O = Mg(NO_3)_2 \cdot 6.02H_2O$					
0.1060	298–353	0.1527	0.8675	0.9071	0.464
0.1964	308–353	0.1403	0.8753	0.8160	0.331
0.4015	333–353	0.0962	1.0214	0.4998	0.065
$M(NO_3)_2 \cdot RH_2O = Zn(NO_3)_2 \cdot 6.22H_2O$					
0.0985	303–353	0.1408	0.0888	0.8665	0.310
0.1994	308–353	0.1478	0.0955	0.8518	0.251
0.2971	308–353	0.1465	0.1055	0.7706	0.253
0.4006	303–353	0.1816	0.1039	0.9182	0.490
0.5949	303–353	0.2084	0.1126	0.9164	0.431
0.7985	308–353	0.2510	0.1224	1.0030	0.132
0.8971	308–353	0.2676	0.1380	0.8283	0.595
1.0000	308–353	0.2896	0.1378	0.9034	0.287

ranges limited by solubility and thermal stability (Table I). The constants of polynomial equations of the type

$$\kappa = A + B(T - 300) + C(T - 300)^2 \quad (1)$$

$$\ln \eta = A' + B'/(T - 273.2) + C'/(T - 273.2)^2 \quad (2)$$

were obtained by a least-squares method and are presented in Tables II and III. Both equivalent conductivity (Λ) and fluidity (ϕ) exhibit a non-Arrhenius temperature dependence for

Table III. Constants of the Polynomial Equation $\ln \eta = A + B(T - 273.2) - C/(T - 273.2)^2$ for Viscosity Data of $Fe(NO_3)_3 \cdot 9.08H_2O + M(NO_3)_2 \cdot RH_2O$ Systems

mole fraction of $M(NO_3)_2 \cdot RH_2O$	temp range, K	A	$10^{-3}B$	$10^{-4}C$	std error $\times 10$
$M(NO_3)_2 \cdot RH_2O = Ca(NO_3)_2 \cdot 4.12H_2O$					
0.0000	293–353	0.2569	0.1728	0.1674	0.590
0.0995	293–353	0.6597	0.1475	0.1183	0.173
0.1991	303–353	0.1266	0.1995	0.2185	0.331
0.3988	293–353	0.4358	0.1842	0.1788	0.726
0.5987	303–353	0.2240	0.2428	0.3053	0.403
0.7987	293–353	0.6215	0.1978	0.1936	0.558
0.8988	303–353	0.4047	0.2298	0.2622	0.119
1.0000	303–353	0.5452	0.2318	0.2776	0.216
$M(NO_3)_2 \cdot RH_2O = Cd(NO_3)_2 \cdot 4.15H_2O$					
0.0995	298–353	0.0020	0.2109	0.2383	0.241
0.1994	298–353	0.1240	0.1969	0.2132	0.482
0.3970	303–353	0.0975	0.2222	0.2752	0.221
0.5962	303–353	0.0812	0.2094	0.2533	0.205
0.7979	298–353	0.3751	0.1804	0.1997	0.318
0.8991	298–353	0.4487	0.1822	0.2020	0.371
1.0000	303–353	0.3680	0.1956	0.2389	0.198
$M(NO_3)_2 \cdot RH_2O = Mg(NO_3)_2 \cdot 6.02H_2O$					
0.1060	298–353	0.0518	0.2052	0.2294	0.420
0.1964	308–353	−0.0234	0.2214	0.2879	0.143
0.4015	333–353	−0.1346	0.2332	0.2751	0.488
$M(NO_3)_2 \cdot RH_2O = Zn(NO_3)_2 \cdot 6.22H_2O$					
0.0985	303–353	0.1400	0.2276	0.2788	0.243
0.1994	308–353	0.2704	0.2363	0.3104	0.096
0.2971	303–353	0.5004	0.2947	0.4657	0.680
0.4006	303–353	0.0988	0.2055	0.2514	0.204
0.5949	303–353	0.0617	0.1911	0.2309	0.203
0.7985	308–353	0.2787	0.2025	0.2804	0.082
0.8971	308–353	0.1763	0.1831	0.2362	0.152
1.0000	308–353	0.1402	0.1760	0.2347	0.081

all the compositions. Three-parameter Vogel–Tammann–Fulcher (VTF) (*12–14*) equations of the type

$$\Lambda = A_\Lambda \exp\left(-\frac{B_\Lambda}{T - T_{0,\Lambda}}\right) \quad (3)$$

$$\phi = A_\phi \exp\left(-\frac{B_\phi}{T - T_{0,\phi}}\right) \quad (4)$$

based on a free volume model (*15*) and cooperative rearrangement theory (*16*) describe adequately the temperature

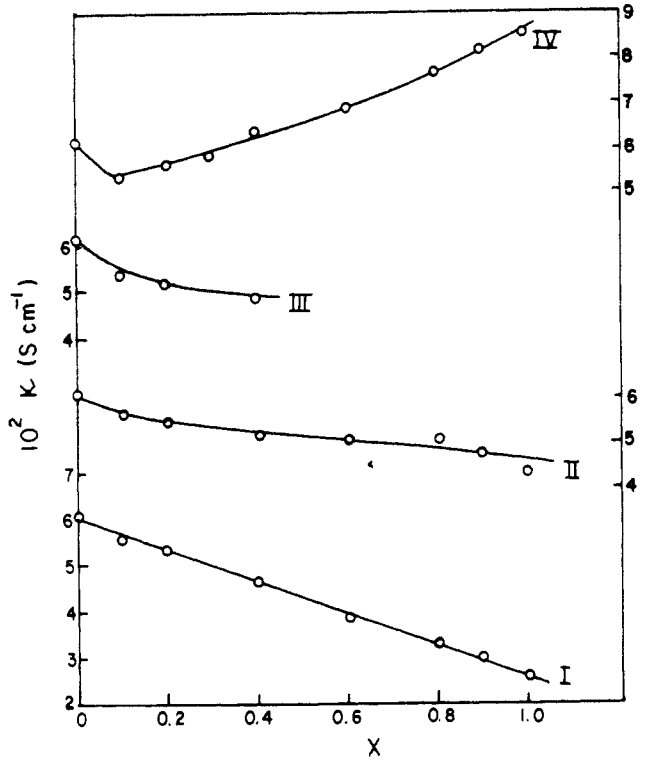

Figure 1. Conductivity (κ) vs mole fraction of $M(NO_3)_2 \cdot RH_2O$ isotherms at 333.2 K for $Fe(NO_3)_3 \cdot 9H_2O$ + $M(NO_3)_2 \cdot RH_2O$ systems for (I) Ca-, (II) Cd-, (III) Mg-, and (IV) Zn-containing mixtures.

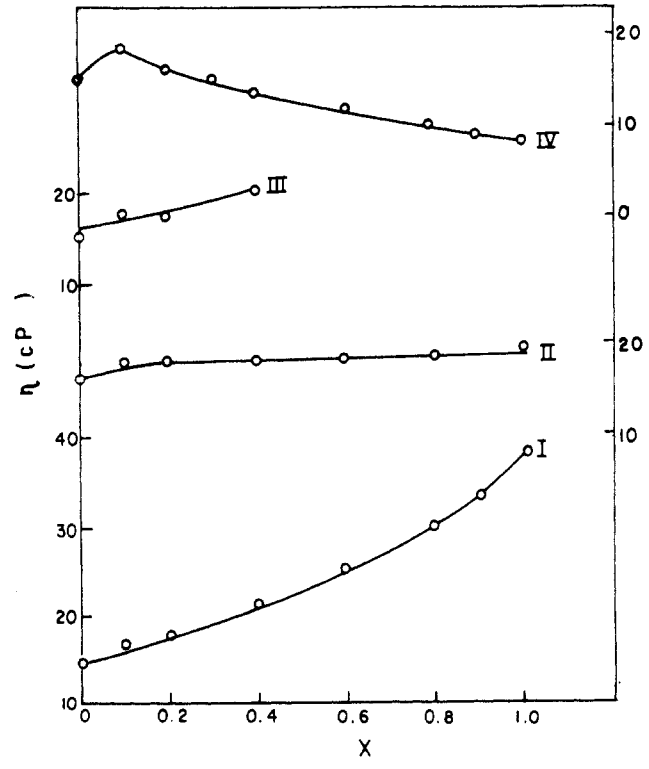

Figure 2. Viscosity (η) vs mole fraction of $M(NO_3)_2 \cdot RH_2O$ isotherms at 333.2 K for $Fe(NO_3)_3 \cdot 9H_2O$ + $M(NO_3)_2 \cdot RH_2O$ systems for (I) Ca-, (II) Cd-, (III) Mg-, and (IV) Zn-containing mixtures.

dependence of Λ and ϕ. Parameters A_Λ, A_ϕ, B_Λ, B_ϕ, $T_{0,\Lambda}$, and $T_{0,\phi}$ are constants characteristic of the system. T_0, the zero mobility temperature, is the temperature at which the molten system looses its fluid behavior. The constants of eqs 3 and 4 were found by an iterative method (Tables IV and V). The linearity of ln (Λ,ϕ) vs $(T - T_0)^{-1}$ plots (not shown) indicates

Table IV. Constants for the Equation Λ (S cm^2 equiv^{-1}) = $A_\Lambda \exp(-B_\Lambda/(T - T_{0,\Lambda}))$ for the Equivalent Conductivity–Temperature Data for $Fe(NO_3)_3 \cdot 9.08H_2O$ + $M(NO_3)_2 \cdot RH_2O$ Systems

mole fraction of $M(NO_3)_2 \cdot RH_2O$	temp range, K	ln A_Λ	B_Λ	$T_{0,\Lambda}$	std error ×10
	$M(NO_3)_2 \cdot RH_2O$ = $Ca(NO_3)_2 \cdot 4.12H_2O$				
0.0000	293–353	5.2262	469.46	203.54	0.101
0.0995	293–353	5.0830	449.04	207.67	0.060
0.1991	303–353	5.1364	463.49	207.30	0.143
0.3988	293–353	5.0675	476.72	207.92	0.045
0.5987	293–353	5.0380	493.64	208.77	0.044
0.7987	293–353	5.2566	573.72	203.02	0.290
0.8988	303–353	3.9853	316.32	234.86	0.105
1.0000	303–353	4.6595	495.11	211.18	0.040
	$M(NO_3)_2 \cdot RH_2O$ = $Cd(NO_3)_2 \cdot 4.15H_2O$				
0.0995	298–353	4.9988	431.44	209.61	0.048
0.1994	298–353	4.8303	402.38	213.35	0.057
0.3970	303–353	4.9312	440.33	208.72	0.028
0.5962	303–353	4.7816	421.80	210.96	0.028
0.7979	303–353	4.7883	437.16	207.50	0.061
0.8991	303–353	4.9740	453.77	206.45	0.042
1.0000	303–353	4.9122	501.51	200.69	0.040
	$M(NO_3)_2 \cdot RH_2O$ = $Mg(NO_3)_2 \cdot 6.02H_2O$				
0.1060	298–353	4.9499	427.46	209.98	0.049
0.1964	308–353	5.0392	458.20	205.91	0.042
0.4015	333–353	4.7030	395.62	214.08	0.037
	$M(NO_3)_2 \cdot RH_2O$ = $Zn(NO_3)_2 \cdot 6.22H_2O$				
0.0985	303–353	4.8878	411.16	213.39	0.023
0.1994	308–353	4.8850	403.65	213.65	0.024
0.2971	308–353	4.5753	326.95	224.93	0.040
0.4006	303–353	5.0784	434.29	207.11	0.031
0.5949	303–353	5.0951	429.97	205.50	0.022
0.7985	308–353	5.3213	473.79	196.67	0.022
0.8971	308–353	5.0723	406.36	204.41	0.033
1.0000	308–353	5.2961	460.19	195.34	0.018

Table V. Constants of the Equation (ϕ (cP^{-1}) = $A_\phi \exp(-B_\phi/(T - T_{0,\phi}))$ for the Fluidity–Temperature Data for $Fe(NO_3)_3 \cdot 9.08H_2O$ + $M(NO_3)_2 \cdot RH_2O$ Systems

mole fraction of $M(NO_3)_2 \cdot RH_2O$	temp range, K	ln A_ϕ	B_ϕ	$T_{0,\phi}$	std error ×10
	$M(NO_3)_2 \cdot RH_2O$ = $Ca(NO_3)_2 \cdot 4.12H_2O$				
0.0000	293–353	2.6967	801.46	185.66	0.089
0.0995	293–353	2.4980	762.43	190.42	0.101
0.1991	303–353	2.7457	732.41	165.02	0.561
0.3988	293–353	2.0616	689.61	198.26	0.024
0.5987	303–353	2.3972	812.40	189.21	0.207
0.7987	293–353	2.0642	751.12	196.35	0.152
0.8988	303–353	2.8362	480.15	223.80	0.105
1.0000	303–353	2.2115	611.52	207.63	0.063
	$M(NO_3)_2 \cdot RH_2O$ = $Cd(NO_3)_2 \cdot 4.15H_2O$				
0.0995	298–353	2.1412	682.43	197.39	0.073
0.1994	298–353	1.7877	587.55	206.35	0.117
0.3970	303–353	2.0270	659.09	198.26	0.032
0.5962	303–353	1.4714	543.64	208.44	0.107
0.7979	298–353	2.6432	399.25	152.75	0.122
0.8991	298–353	1.5271	603.82	198.48	0.025
1.0000	303–353	1.2007	540.96	203.88	0.054
	$M(NO_3)_2 \cdot RH_2O$ = $Mg(NO_3)_2 \cdot 6.02H_2O$				
0.1060	298–353	2.3129	720.32	194.21	0.064
0.1964	308–353	1.1307	467.77	216.37	0.155
0.4015	333–353	4.1556	280.99	187.83	0.227
	$M(NO_3)_2 \cdot RH_2O$ = $Zn(NO_3)_2 \cdot 6.22H_2O$				
0.0985	303–353	2.1098	664.68	220.57	0.017
0.1994	308–353	2.6198	748.54	280.19	0.100
0.2971	303–353	1.8410	587.80	205.32	0.041
0.4006	303–353	1.9105	608.87	199.67	0.023
0.5949	303–353	1.5695	517.52	206.02	0.031
0.7985	308–353	2.0932	654.97	185.16	0.039
0.8971	303–353	2.2917	705.70	177.49	0.076
1.0000	308–353	1.3893	466.69	201.40	0.035

the applicability of the VTF equation. The parameters do not show any systematic variation with composition; however these are for the most part of about the same magnitude. The reason for this apparent lack of trend has been explained by Moynihan et al. (*17*) as due to a strong interdependence of these parameters so that if the transport data do not cover a reasonably large range, the system can be described equally well by a number of $A-B-T_0$ sets.

Conductivity and viscosity composition isotherms for the binary mixtures of $Fe(NO_3)_3 \cdot 9H_2O$ with $M(NO_3)_2 \cdot RH_2O$ (M = Ca, Cd, Mg, Zn) are shown in Figures 1 and 2. Addition of $Ca(NO_3)_2 \cdot RH_2O$, $Cd(NO_3)_2 \cdot RH_2O$, or $Mg(NO_3)_2 \cdot RH_2O$ to the $Fe(NO_3)_3 \cdot 9H_2O$ melt results in preferential orientation of NO_3^- ions toward $Fe(H_2O)_n^{3+}$, because of its higher cationic potential diminishing the mobility of these ions, decreasing κ and increasing η. Addition of $Zn(NO_3)_2 \cdot 6H_2O$ to the $Fe(NO_3)_3 \cdot 9H_2O$ melt results in an increase in κ and decrease in η. Spectral studies of $Zn(NO_3)_2$ solutions (*18*) indicate that Zn^{2+} forms a variety of contact-ion pairs and complexes. Due to complexing nature of Zn^{2+} ions, its addition would not increase $Fe(H_2O)_n^{3+}-NO_3^-$ interactions, but it may slightly loosen the NO_3^- from the Fe^{3+} nearest neighbors. These interactions would result in a broadening of the hydration sphere of Fe^{3+} ions, resulting in an increase in κ and decrease in η.

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Registry No. $Fe(NO_3)_3 \cdot 9H_2O$, 7782-61-8.

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