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THE VOLUMETRIC PROPERTIES OF VAPOR SATURATED AQUEOUS POTASSIUM CHLORIDE SOLUTIONS
FROM 0° TO 400°C BASED ON A REGRESSION OF THE AVAILABLE LITERATURE DATA

by

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Pressure (P) - volume (V) - temperature (T) - composition (X) data for brines are required to establish optimum operating temperatures, pressures, and flow rates for the production of geothermal brine fields; to minimize scaling and corrosion; and to intelligently design turbines for production of electricity. One of the prerequisites for chemical modeling of geothermal brine systems, as well as reservoir modeling, is thermodynamic data derived from the volumetric properties of brines, e.g. partial and apparent molal volumes. The available data for the volumetric properties of brines have been summarized by Potter et al. (1975).

Prior to this, the only fairly extensive tabulation of volumetric data for aqueous, vapor-saturated potassium chloride solutions was that of Fabuss and Korosi (1968b) for 0.1 molal to 3.5 molal solutions from 20° to 150°C. These were derived from their own experimental numbers published elsewhere (Fabuss et al., 1966 and Fabuss and Korosi, 1968a). There are no compilations available for solutions at pressures greater than the saturation vapor pressure (Potter, 1976). The purpose of the present report is to supply a compilation of an internally consistent set of density values for vapor-saturated, aqueous potassium chloride solutions from 0° to 400°C based on currently available experimental data as summarized by Potter et al. (1975).

The density data presented in Tables 1 and 2 were obtained from a computer regression of the P-V-T-X data from the 100 references cited by Potter et al. (1975). The computer regression of the data was accomplished by using a least squares method in which the individual data points were

weighted with respect to the relative uncertainty of the datum. The uncertainties used in the majority of cases were those assigned by the experimentalist; however, in those cases where uncertainties were not stated, an estimate was supplied on the basis of the experimental method employed in the study.

The data summarized in Tables 1 and 2 are for vapor-saturated solutions from 0° to 400°C. These were obtained by regressing the experimental densities at constant composition as a function of temperature and then regressing the resulting smoothed densities at constant temperature as a function of composition. Discordant data were evaluated via Chauvenet's criterion. The appropriate data were then rejected and the densities were refitted.

Attempts to obtain internally consistent density data at pressures greater than the saturation pressure were unsuccessful. Due to the lack of consistency of the data, the only method of obtaining a realistic set of internally consistent densities will be by experimental measurement.

Table 1. Densities of vapor saturated KCl solutions, g/cm³. Concentration in molality.

Temp °C	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	Estimated Error
0	1.02415	1.04698	1.06859	1.08912	1.10863	1.12718	1.14482	1.16160	--	--	±.00005
25	1.01989	1.04150	1.06209	1.08178	1.10061	1.11866	1.13595	1.15253	1.16814	1.18370	±.00002
50	1.01034	1.03145	1.05159	1.07086	1.08935	1.10709	1.12415	1.14054	1.15632	1.17152	±.00005
75	0.9971	1.0180	1.0380	1.0572	1.0756	1.0932	1.1102	1.1265	1.1423	1.1574	±.0002
100	0.9810	1.0021	1.0222	1.0413	1.0597	1.0774	1.0945	1.1109	1.1268	1.1422	±.0002
125	0.963	0.984	1.004	1.024	1.044	1.063	1.082	1.10*	--	--	±.002
150	0.941	0.963	0.984	1.005	1.025	1.046	1.066	1.09*	--	--	±.002
175	0.919	0.939	0.961	0.983	1.005	1.028	1.051	1.07*	--	--	±.005
200	0.900	0.923	0.944	0.964	0.984	1.004	1.024	1.04*	--	--	±.005
225	0.867	0.891	0.913	0.935	0.957	0.978	0.999	1.02*	--	--	±.005
250	0.834	0.860	0.884	0.907	0.930	0.953	0.975	1.00*	--	--	±.005
275	0.797	0.825	0.852	0.877	0.902	0.926	0.950	0.97*	--	--	±.005
300	0.760	0.792	0.821	0.848	0.875	0.901	0.926	0.95*	--	--	±.005
325	0.715	0.752	0.786	0.817	0.848	0.877	0.906	0.93*	--	--	±.005
350	0.660	0.704	0.743	0.779	0.813	0.845	0.877	0.91*	--	--	±.007
375	0.593	0.657	0.707	0.748	0.784	0.817	0.847	0.87*	--	--	±.007
400	0.491	0.583	0.648	0.699	0.742	0.778	0.809	0.84*	--	--	±.007

* Estimated error for extrapolated values is ±.02 g/cm³.

Table 2. Densities of vapor saturated KCl solutions, g/cm³. Concentration in weight percent.

Temp °C	1	3	5	7	9	11	13	15	17	19	21	23	25	27	Estimated Error
0	1.00662	1.02013	1.03371	1.04740	1.06122	1.07518	1.08929	1.10353	1.11792	1.13243	1.14706	--	--	--	±.00005
25	1.00340	1.01610	1.02892	1.04190	1.05506	1.06840	1.08194	1.09566	1.10963	1.12379	1.13816	1.15274	1.16754	1.18253	±.00002
50	0.99424	1.00664	1.01916	1.03184	1.04470	1.05776	1.07102	1.08450	1.09821	1.11215	1.12633	1.14075	1.15543	1.17035	±.00005
75	0.9810	0.9934	1.0058	1.0184	1.0312	1.0442	1.0574	1.0709	1.0844	1.0982	1.1124	1.1267	1.1414	1.1561	±.0002
100	0.9647	0.9772	0.9898	1.0025	1.0153	1.0283	1.0415	1.0549	1.0685	1.0825	1.0966	1.1111	1.1259	1.1411	±.0002
125	0.946	0.959	0.971	0.984	0.997	1.010	1.024	1.038	1.053	1.068	1.085	--	--	--	±.002
150	0.924	0.937	0.950	0.963	0.976	0.990	1.005	1.020	1.035	1.052	1.069	--	--	--	±.002
175	0.907	0.916	0.927	0.940	0.953	0.968	0.983	0.999	1.016	1.035	1.054	--	--	--	±.005
200	0.882	0.896	0.910	0.923	0.937	0.950	0.965	0.979	0.994	1.010	1.026	--	--	--	±.005
225	0.848	0.863	0.877	0.891	0.905	0.920	0.935	0.951	0.967	0.984	1.002	--	--	--	±.005
250	0.813	0.830	0.845	0.860	0.876	0.891	0.907	0.924	0.941	0.959	0.978	--	--	--	±.005
275	0.773	0.792	0.809	0.826	0.843	0.860	0.877	0.895	0.914	0.933	0.953	--	--	--	±.005
300	0.731	0.754	0.774	0.792	0.811	0.830	0.849	0.868	0.888	0.908	0.929	--	--	--	±.005
325	0.680	0.707	0.731	0.753	0.774	0.796	0.818	0.840	0.862	0.886	0.910	--	--	--	±.005
350	0.618	0.652	0.679	0.705	0.730	0.754	0.779	0.804	0.829	0.855	0.881	--	--	--	±.007
375	0.515	0.579	0.622	0.658	0.691	0.720	0.748	0.774	0.801	0.826	0.851	--	--	--	±.007
400	0.375	0.470	0.534	0.585	0.628	0.666	0.700	0.731	0.760	0.787	0.813	--	--	--	±.007

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