[CONTRIBUTION FROM THE CHEMICAL LABORATORY OF THE UNIVERSITY OF CALIFORNIA]

THE SOLUBILITY OF THALLOUS CHLORIDE IN WATER AND AQUEOUS SOLUTIONS OF MAGNESIUM SULFATE AND LANTHANUM NITRATE AT 25°

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The solubility of thallous chloride has been determined in water and aqueous solutions of magnesium sulfate and lanthanum nitrate at 25°, using the same apparatus as that used in the previous investigation.[1]

The thallous chloride was prepared by metathesis, washed with dilute hydrochloric acid and rotated with water to a constant solubility. An older sample from a previous investigation gave the same solubility. The salts were recrystallized from high grade materials and the purity was checked by analysis.

All concentrations are expressed in moles per 1000 g. of water in vacuum. Weighed samples of the saturated solution were titrated with standardized silver nitrate solution (weight buret). The end-point was determined without indicator, using Tyndall's optical test.

Equilibrium was approached from undersaturation and supersaturation in each case. The solid phase was analyzed after the experiments with the most concentrated solutions of added salts and found to be thallous chloride in both cases.

The results are given in Table I. The first column gives the molality of the added salt, the second the molality of the thallous chloride, the third the square root of the ionic strength, the fourth the logarithm of the

TABLE I

SOLUBILITY OF THALLOUS CHLORIDE IN AQUEOUS SOLUTIONS OF MAGNESIUM SULFATE AND LANTHANUM NITRATE AT 25°

Added salt	m	Soly.	$\mu^{1/2}$	Log $(1/m_{Cl})$	Log γ
None	0.00000	0.01611	0.1269	1.7929	−0.070
$MgSO_4$	.01708	.01920	.2958	1.7127	− .150
	.03364	.02042	.3937	1.6899	− .173
	.04384	.02106	.4454	1.6765	− .187
	.06259	.02214	.5220	1.6548	− .208
	.1291	.02504	.7358	1.6014	− .262
	.1994	.02641	.9078	1.5782	− .285
	.3529	.02878	1.2002	1.5409	− .322
$La(NO_3)_3$	.005215	.01740	0.2224	1.7594	− .104
	.008808	.01778	.2657	1.7500	− .113
	.02024	.01946	.3754	1.7109	− .152
	.04180	.02129	.5216	1.6718	− .192
	.08166	.02433	.7171	1.6138	− .249
	.1970	.02697	1.1000	1.5692	− .294

[1] Randall and Vietti, THIS JOURNAL, **50**, 1526 (1928).

reciprocal of the mean molality of the thallous and chloride ions and the last the activity coefficient of the thallous chloride in the mixture.

These results have been reviewed in the previous paper. The specific gravity of the saturated solution was found to be 1.0034 and its density 1.0004. Bray and Winninghoff[2] give 0.9994 as the density of the saturated solution, which corresponds to a solubility of 0.01615 mole per 1000 g. of water. Butler and Hiscocks[3] found the same solubility, 0.01607 mole per liter, as that found by Bray and Winninghoff, but found the density to be 1.0004, from which the solubility is 0.01612 mole per 1000 g., in agreement with our value.

Summary

The solubility of thallous chloride in water and aqueous magnesium sulfate and lanthanum nitrate solutions and the density of the saturated aqueous solution at 25° have been determined.

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[CONTRIBUTION FROM THE DEPARTMENTS OF CHEMISTRY AND PHYSICS OF PRINCETON UNIVERSITY]

THE DIELECTRIC POLARIZATION OF LIQUIDS. I. THE DIELECTRIC CONSTANTS AND DENSITIES OF SOLUTIONS OF THE CHLOROBENZENES IN BENZENE AND IN HEXANE[1]

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Some years ago it was recognized that the calculation of the electric moments of molecules from dielectric constants might provide valuable aid in solving the complex problems of molecular structure. An approximate method of calculation was devised and applied to data on pure substances already existing in the literature to obtain the moments of a large number of molecules.[3]

It was evident, however, that many molecules which were surrounded by strong fields of force did not lend themselves to this calculation. The experimental work, which was then being initiated in the Palmer Physical

[2] Bray and Winninghoff, THIS JOURNAL, **33**, 1663 (1911).

[3] Butler and Hiscocks, *J. Chem. Soc.*, **129**, 2554 (1926).

[1] Papers based upon the data of the present contribution were presented before the Physical and Inorganic Division and before the Organic Division of the American Chemical Society in Philadelphia, September, 1926. The results of the measurements upon the substituted benzene compounds have been applied in a study of the structure of the benzene ring, Smyth and Morgan, THIS JOURNAL, **49**, 1030 (1927).

[2] DuPont Fellow in Chemistry, 1926–27.

[3] (a) Smyth, *Phil. Mag.*, **45**, 849 (1923); (b) **47**, 530 (1924); (c) THIS JOURNAL, **46**, 2151 (1924); (d) **47**, 1894 (1925).