INTERNATIONAL JOURNAL OF RESEARCH IN PHARMACY AND CHEMISTRY

Available online at www.ijrpc.com

Research Article

VOLUMETRIC PROPERTIES OF STANNOUS CHLORIDE IN ACETONE-WATER AT 298ºK

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ABSTRACT

The density of stannous chloride is measured in binary solution of 40 %(w/v) acetone-water at 298ºK. Stannous chloride is widely used in industries. The data of $SnCl_2$ in binary solution is reported .The related parameters of density like apparent molar volume, (ϕ_v), apparent molar volume at infinite dilution, (ϕ_V^*), experimental slope, (S_V^*), and excess molar volume (V^E) are also calculated and reported. Data of density and their parameter shows interaction between solute and solvent system.

Keywords: Molar volume, Density, Stannous chloride & Apparent molar volume .

INTRODUCTION

Volumetric properties of binary mixtures are complex because they not only depend on solute-solvent ,solvent-solvent and solute-solvent interactions ,but also are the result of the structural effects arising from interstitial accommodation due to the difference in molar volume and free volume between components present in solution .Knowledge of volumetric properties of stannous chloride is widely used for industrial purpose so its study in binary solvent system is useful for engineering design new applications. Stannous chloride is used as a mordant in textile dyeing because it gives brighter colours with some dyes e.g. Cochineal(1). This mordant has also been used alone to increase the weight of silk. It is used as a catalyst in the production of the plastic polylactic acid (PLA).stannous chloride also finds wide use as a reducing agent(1). This is seen in its use for silvering mirrors .Stannous chloride is also added as a food additive with e number **e512** to some canned and bottled foods, where it serves as a colour-retention agent and antioxidant.$SnCl_2$ is used in radionuclide angiography to reduce the radioactive agent technetium-99m-pertechnetate to assist in binding to blood cells(2). Aqueous stannous chloride is used by many precious metals refining hobbyists as an indicator of gold and platinum group metals in solutions. Stannous chloride is studied in 40%(w/v)acetone-water at 298ºK.The data of densities is used to analyse of apparent molar volume (ϕ_v), limiting apparent molar volume (ϕ_V^0), experimental slope (s_V^*), molar volume (v) and excess molar volume(v^E) .

Experimentation

A stock solution of 1.00M of stannous chloride is prepared in 40 %(w/v) acetone- water solvent by direct weighing. Mass dilution technique used for preparation of other concentrations. The concentration of the solutions involved in the experiment was taken in range from 0.10M to 1.00M. Mass dilution technique was applied to prepare the solution of different concentration. Densities of solutions of stannous chloride in 40 %(w/v)acetone-water at 298°K are determined using 10 cm^3 double armed pycnometer at temperatures at 298°K. The pycnometer was calibrated at these temperatures with distilled water and benzene. The estimated accuracy of density measurement of solution was 0.00003 g cm^{-3}.

RESULTS AND DISCUSSION

Densities of stannous chloride in 40 %(w/v)acetone-water (3)

$$\rho/\rho_1 = W/W_1 \qquad [1]$$

Where,
W and W_1 are weight of stannous chloride in acetone-water respectively. ρ is density of stannous chlolride and ρ_1 is density of acetone-water solution . Densities of stannous chlolride solutions, determined as a function of their concentration a 298 °K temperature in 40 %(w/v)acetone-water solution . The densities of solute were obtained as an intercept of plot between concentration and density of solutions (using Microsoft Excel). The data is reported in Table -1.

Table 1: Densities, ρ, of stannous chloride in 40%(w/v)acetone-water at 298°K

Concentration ($Mol.L^{-1}$)C	Density($Kg.M^{-1}$) ρ
0.1000	0.9917
0.2000	1.0125
0.3000	1.0217
0.4000	1.0403
0.5000	1.0542
0.6000	1.0688
0.7000	1.0813
0.8000	1.0926
0.9000	1.1118
1.0000	1.1181

Apparent molar volume, ϕ_v, is calculated by following the equation (4)

$$\phi_v = (\rho_1-\rho)/c\rho\rho_1 + M/\rho \qquad [2]$$

Where,
c is Morality of the solution, M is Molar mass of the solute,ρ andρ_1 Density of solution and solute. The result of ϕ_v of stannous chloride are reported in Table- 2.The apparent molar volume at infinite dilution ϕ_V^0 were calculated by the method of least square and fit to plot of ϕ_v vs $c^{1/2}$ in accordance with the Masson's (5)empirical relation ,

$$\phi_v = \phi_V^0 + S_V^* c^{1/2} \qquad [3]$$

Where, S_V^* is experimental slope. The slope is calculated by the extrapolation of the plots to zero concentration (using Microsoft excel). The positive and less negative values of experimental slope are generally associated with the solutes showing an overall hydrophilic character as in the present investigation. The values of apparent molar volume are reported in Table-2.

Table 2: Apparent molar volume ϕ_v , apparent molar volume infinite dilution, ϕ_V^0 and experimental slope, S_V^* of stannous chloride in 40%(w/v)acetone-water at 298°K

Concentration ($Mol.L^{-1}$)	Apparent molar volume($M^3.Mol^{-1}$) ϕ_v	ϕ_V^0	S_V^*
0.1000	89.9771		
0.2000	50.5778		
0.3000	76.5544		
0.4000	64.9221		
0.5000	67.0032		
0.6000	67.0573		
0.7000	69.6925	71.09242	-2.09287
0.8000	72.9217		
0.9000	66.6282		
1.0000	74.0786		

The molar volumes of solutions are derived from the following expression (6),

$$V=(X_1M_1+X_2M_2)/\rho \qquad [4]$$

Where, X_1 and X_2 are Mole fraction of mixed solvent and Mole fraction of solute.M_1 and M_2 Molecular weight of solvent and Molecular weight of solute ρ is density of solution respectively. The data of molar volume of solution is reported in Table-3. The molar volume of 40%(w/v)stannous chloride in solution is 26.3516.The molar volume of stannous chloride is 230.2050 .

Table 3: Molar volume,V, of stannous chloride in 40%(w/v)acetone-water at 298°K

Concentration ($Mol.L^{-1}$)C	Molar volume ($M^3.Mol^{-1}$)V
0.1000	229.4670
0.2000	223.0034
0.3000	222.2943
0.4000	217.8107
0.5000	214.9824
0.6000	212.0165
0.7000	209.6357
0.8000	207.5593
0.9000	203.6715
1.0000	202.8107

Knowledge of the excess molar volume is of important property in design and storage and handling facilities of mixtures .The excess molar volume (V^E) for these solutions are obtained by the given expression(7),

$$V^E = V - (X_1V_1 + X_2V_2) \qquad [5]$$

Where, V, V_1 and V_2 are the molar volume of solution, mixed solvent and solute respectively. Negative excess molar volume arises due to increased interaction between the unlike molecules. At lower dilution values are positive. The data of compound is reported in Table -4.

Table 4: Excess molar volume of stannous chloride in 40%(w/v)acetone-water at 298°K

Concentration($Mol.L^{-1}$)C	Excess molar volume V^E
0.1000	6.0096
0.2000	1.2846
0.3000	-0.7111
0.4000	-4.6763
0.5000	-7.5605
0.6000	-10.4871
0.7000	-12.9496
0.8000	-15.1287
0.9000	-18.6875
1.0000	19.8560

CONCLUSION

The data of densities increases as function of concentration .The positive value of ϕ_v for indicate greater solute-solvent interactions. The values of ϕ^0_v are large and positive for stannous chloride in 40%(w/v)acetone-water solution, suggesting the presence of strong solute – solvent interaction. The experimental slope of stannous chloride is positive showing ion-ion interaction.

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