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"Thermodynamic And Transport Properties Of Aluminium Ammonium Sulphate In Aqueous *N*, *N*-Dimethyl Formamide And Aqueous Dimethyl Suphoxide At Various Temperatures A Comparative Study."

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Abstract: ***In this investigations, conductance measurements of aluminium ammonium sulphate in various proportions of aqueous DMF and aqueous DMSO mixtures containing 10, 20, 30, 40, 50, 60, 70, 80, 90 % of aqueous DMSO have been carried out at different temperatures to evaluate limiting ionic association constant, conductance's, Walden products and solvated radii of the ions. Viscosity measurement of the aluminium ammonium sulphate solutions in aqueous DMF and aqueous DMSO mixtures were carried out at different temperatures to evaluate viscosity A and B-coefficients values. The density data for all the solutions were analyzed in limiting apparent molar volume (ϕv^o) and experimental slopes (S_v) obtained from Masson equation. The viscosity data of solution were analyzed in term of A and B coefficient obtained from Jone-Dole equation.***

Keywords: Aluminium ammonium sulphate; Conductance; Constant; Aqueous; N,N-dimethylformamide; dimethyl sulphoxides.

1. INTRODUCTION

Properties of solutions like viscosity and conductance is in uncoupled nature. Such types of this study of solutions find its immense importance due to the fact that solute-solvent and solute-solute interactions can be conveniently understood with the help of such properties. The study in aqueous mixture of solutions with 1:1 ratio viz. DMF and DMSO using aluminium ammonium sulphate as electrolyte is an important for better understanding of some physiological or biological processes.

Precedent literature data on viscosity and conductance studies at higher concentration of 1:1 electrolytes in different solvent systems[1,2] has been subject of chemist interest for the last few years. The conductance studies[3,4,5,6] are mainly involving on evaluation of dissociation or association constants and limiting equivalent conductance and in light of different theories used. Most recently Behera et. al.[7] have reported conductivity behavior of magnesium and copper sulphate in aqueous sucrose solution and they have found decrease in Λ_o (limiting equivalent conductance) with increase in concentration sucrose solution to be due to frictional resistance of solvent. The various researcher also studied viscosity[8,9,10,11,12] has been carried out in high concentration range of different relationships developed from time to time for understanding the viscous behavior of different solutions at higher concentration.

During some past years a great attention is being paid to interpret interactions between solute-solvent in mixed solvents because water does not conform to some or all the solution

theories based on experiments performed with simple solvents. The incapability of solution theories used to describe the various phenomena in aqueous solutions, suggests the application of the results of various theoretical investigations to mixed solvent systems. However, binary mixed aqueous solvent mediums behave in an unexpected manner as compared with aqueous and mixed no aqueous solvent systems[13,14]. In recent years an increasing interest has been shown in study of electrolytes and mixed solvents[15,16,17] with a view to investigate solute-solvent and solute-solute interactions under different conditions.

The study of transport and thermodynamic properties in mixed solvents provides a big opportunity of extending the phenomenology of various theories of electrolytic solutions and structural aspects of solvent systems[18,19,20]. Electrolytic behavior in solutions[21,22,23,24] can be revealed through studies of transport processes such as electrical conduction, viscous flow and diffusion etc. Apart from the importance of transport processes in understanding the solute-solvent, solute-solute interactions and structural aspects of solvent in solutions, the atomic transport processes also play a major role in properties of solids such as precipitation of separate phases, sintering, electrolysis, tarnishing reactions, fuel cells, photographic process and dielectric loss [25].

Along with these the thermodynamic or transport properties of different liquids is a most important subject in chemical engineering as well as in physical chemistry. A property of liquid mixtures generally depends on the structure and internal bonding in it and expressed in terms of volume and packing density. It is also changes with temperature as well as composition of the particular solvent systems[26].

The most important aim of the present study is to understand molecular interactions and solvation behavior of Aluminium ammonium sulphate in binary mixture of aqueous DMF and aqueous DMSO solutions at different temperature.

2. MATERIALS AND METHODS

The chemicals DMSO and DMF used were of analytical grade and purchased from Merck, Germany and used without further purification. Demineralised water were double distilled and used. The electrolyte component Aluminium ammonium sulphate was purified by crystallization dried in oven drier and then used to prepare solutions of various concentrations / proportion.

Density Measurements:

Density (ρ) of the solutions were determined by using bicapillary pycnometer with 10 ml bulb capacity.

Viscosity measurements:

Ubbelohde suspended-level viscometer were used for the measuring of viscosity, calibrated with double distilled water. Viscosity values of solution were determined using the given relation[27,28].

$\eta_1/\eta_2 = \rho_1 t_1/\rho_2 t_2$ … (1)

Preparation of solution of binary Mixtures:

Solution of the binary mixtures was prepared by mixing the appropriate volume of the liquid in air tight stopper amber color glass bottles. The aqueous solvents were prepared are used on the same day they were prepared. The required quantity of binary mixture like water - N,N-Dimethylformamide and water - dimethylsulphoxide was prepared.

Calibration of Glass Wares:

Standards reported procedures were applied for calibration of glass wares[29].

Determination of the Cell constant of the conductivity Cell:

The used cell for conductivity measurement was not known dimensions and consequently it needed the calibration before the finding of specific conductance. Cell constant of cell were determined using following equation.

Cell constant = K R. ..... (2)

K is specific conductance and R is resistance of solution. The cell constant of cell used was 4.153 ± 0.001 cm^{-1}.

Experimental Procedure

The conductivity cell before and after each reading was washed properly using conductivity water and rinsed two to three times with 10 ml of the solution under investigation.

For filling the solution under study the central tube of the cell was used and after filling the solution it was stopper immediately. The other two side tubes were kept stopper during addition of solution. The side tubes help in proper cleaning and evacuation of the cell. The cell was suitably placed in an electrically controlled water bath.

Conductance was noted with a calibrated Toshniwal Conductivity Bridge No. 44l at 50 cycles per second. The reading was taken after half an hour of the addition of solution. The conductance noted did not change with passage of time indicating the absence of adsorption effects.

3. RESULTS AND DISCUSSION

Conductance as well as thermodynamic studies is most important tools to study the interactions between solute - solvent and the effects of solute on the structure of solvent. The best understanding of these effects can be attained from the knowledge of transport number of ions, limiting equivalent conductance, dissociation constants and degree of dissociation as well as association, activity coefficients and Walden products of the electrolyte solutions.

Solutions apparent molar volume (Φ_v) was calculated from density data using the following equation 3.

$$\Phi_v = [1000(\rho_0 - \rho)/C\rho_0] + [M/\rho_0] \quad \ldots (3)$$

In the above equation M is the molar mass, C is the concentration of salts in aqueous DMF or DMSO (mol L^{-1}), ρ_0 is the density of solvent and ρ is the density of solution of the aluminium ammonium sulphate solution.

The solute – solvent interactions were determined using apparent molar volume (Φ_v) of the solution. Limiting partial molar volumes were calculated by Masson equation[30] and experimental slope by least square method[31].

$$\Phi_v = \Phi_v^0 + S_v\sqrt{C} \quad \ldots (4)$$

Where the limiting apparent molar volume is ϕ_v^0 and semi empirical parameter which depends on the temperature, nature of solvent and solute is S_v.

Relative viscosities of the solutions have been analyzed by Jones - Dole equation[32] given as.

$$(\eta_r - 1)/\sqrt{C} = A + B\sqrt{C} \quad \ldots (5)$$

Where $\eta_r = (\eta/\eta_o)$ and η, η_o are viscosities of the solution and solvent respectively, C is molar concentration, A is the Falkenhagen coefficient[33] and B is the Jones - Dole coefficient.

Finally the Roots and Moulik parameters were evaluated by the given equations[34,35].

$$\eta_r^2 = M + KC^2 \quad \ldots (6)$$

$$(\rho - \rho_0)/C = R - SC^{1/2} \quad \ldots (7)$$

The values of the viscosities (η), densities (ρ) and apparent molar volumes (ϕ_v) of aluminium ammonium sulphate solution in binary liquid mixture of aqueous DMF and aqueous DMSO at 308.15, 313.15, 318.15 and 323.15 K temperature are shown in Table 1 to Table 7.

By plotting the graph of apparent molar volumes (ϕ_v) vs. percent of solvent was found to be positive slopes in various compositions of binary liquid mixture of aqueous DMF and aqueous DMSO and is shown in figure 1 at 308.15 K. The limiting apparent molar volumes (ϕ_v^o) of the solutions were calculated using equation (4) from the intercept of linear plots, it is listed in table 7. The values of (ϕ_v^o) provide us valuable solute-solvent interactions information regarding with particular solution, this shows the positive values of limiting apparent molar volume (ϕ_v^o). Such positive values of (ϕ_v^o) show strong solute-solvent interactions[36,37]. The positive values of S_v show strong solute - solute interactions. With rise in temperature S_v values increase it indicates an increased solute-solute interaction in solution.

The viscosity 'B' coefficients are positive for all the composition of Aluminium ammonium sulphate in binary liquid mixture of aqueous DMF + aqueous DMSO solutions. The value of 'B' coefficient increases with increase in concentration of salts in aqueous DMF + aqueous DMSO solutions.

Values of 'S' and 'R' coefficients of Root's equation are calculated and recorded in table 8. We were found positive values of 'R' coefficients of Root's equation for all compositions. This positive values indicating strong solute-solute interactions.

The 'S' coefficients of Root's equation for all compositions are negative. The values of 'M' and 'k' coefficients of Moulik equation were tabulated in table 8. 'M' and 'K' coefficients are positive in all solvent systems and temperatures. 'M' values are of low magnitudes and 'K' values are of higher magnitudes.

Table 1: Concentration (C), Density (ρ), Viscosity (η), apparent molar volume (ϕ_v) of aluminium ammonium sulphate in DMF and 10% DMSO.

C/ mol/ dm^3	ρ/ g.cm^3	η/ Nm^{-3} s.	ϕ_v/ cm^3 mol^{-1}	ρ/ g.cm^3	η/ Nm^{-3} s.	ϕ_v/ cm^3 mol^{-1}	ρ/ g.cm^3	η/ Nm^{-3} s.	ϕ_v/ cm^3 mol^{-1}	ρ/ g.cm^3	η/ Nm^{-3} s.	ϕ_v/ cm^3 mol^{-1}
DMF												
	308.15K			313.15K			318.15K			323.15K		
0.0150	0.89526	0.7923	42.75	0.85458	0.6826	51.44	0.89522	0.7059	54.56	0.90524	0.6759	62.25
0.0329	0.90224	0.8159	46.28	0.89569	0.6921	53.58	0.90592	0.7215	59.94	0.91565	0.7045	68.23
0.0577	0.91337	0.8349	52.35	0.91259	0.7259	59.58	0.92584	0.7359	64.25	0.93564	0.7526	70.54
0.0894	0.92459	0.8659	58.64	0.92547	0.7604	61.35	0.95872	0.7521	71.51	0.96356	0.7654	82.25
0.1281	0.94568	0.8892	61.56	0.95569	0.7925	64.51	0.95945	0.7825	80.55	0.98525	0.7952	88.25
10 % DMSO												
	308.15K			313.15K			318.15K			323.15K		
0.0150	0.90528	0.8054	45.25	0.98585	0.8065	54.52	0.89202	0.7952	62.18	0.90258	0.7026	68.16
0.0329	0.92552	0.8285	49.52	0.97422	0.8255	59.25	0.91528	0.8125	72.52	0.91256	0.7632	72.52
0.0577	0.93852	0.8812	52.52	0.98762	0.8599	64.52	0.94252	0.8356	79.30	0.93658	0.8256	86.51
0.0894	0.95662	0.9152	60.85	0.97 97	0.8685	71.62	0.96595	0.8562	83.56	0.95648	0.8625	91.92
0.1281	0.97562	0.9382	68.85	0.99714	0.9035	78.89	0.98255	0.8959	89.55	0.98659	0.8895	93.65

Table 2: Concentration (C), Density (ρ), Viscosity (η), apparent molar volume (ϕ_v) of aluminium ammonium sulphate in DMF and 20% and 30% DMSO.

C/ mol/ dm^3	ρ/ $g.cm^3$	η/ Nm^{-3} s.	ϕ_v/ cm^3 mol^{-1}	ρ/ $g.cm^3$	η/ Nm^{-3} s.	ϕ_v/ cm^3 mol^{-1}	ρ/ $g.cm^3$	η/ Nm^{-3} s.	ϕ_v/ cm^3 mol^{-1}	ρ/ $g.cm^3$	η/ Nm^{-3} s.	ϕ_v/ cm^3 mol^{-1}
20 % DMSO												
	308.15K			313.15K			318.15K			323.15K		
0.0150	0.93256	0.8457	49.81	0.92056	0.8264	62.36	0.90231	0.8059	62.42	0.92356	0.6954	72.77
0.0329	0.94165	0.8658	53.10	0.93654	0.8624	63.54	0.93520	0.8264	70.52	0.95531	0.7265	79.75
0.0577	0.96594	0.9025	62.86	0.95348	0.8895	72.45	0.94265	0.8307	79.42	0.95982	0.7895	84.25
0.0894	0.97264	0.9234	70.12	0.96325	0.9025	80.41	0.96524	0.8652	82.64	0.97856	0.84936	90.53
0.1281	0.99264	0.9834	76.67	0.99326	0.9634	90.42	0.98654	0.8825	92.44	0.98366	0.8825	94.44
30 % DMSO												
	308.15K			313.15K			318.15K			323.15K		
0.0150	0.96524	0.8524	50.81	0.96085	0.8452	60.50	0.9558	0.7974	70.00	0.94164	0.7886	76.03
0.0329	0.96942	0.8996	53.09	0.96422	0.8558	61.52	0.95784	0.8185	74.65	0.96531	0.8081	84.68
0.0577	0.974778	0.9185	60.65	0.96862	0.8694	72.42	0.96438	0.8345	79.64	0.97982	0.8257	89.21
0.0894	0.98058	0.9374	72.21	0.97397	0.8878	76.92	0.96784	0.8577	82.67	0.98534	0.8495	91.34
0.1281	0.98775	0.9574	77.66	0.98348	0.9203	89.45	0.97744	0.8777	90.64	0.99150	0.8855	99.23

Table 3: Concentration (C), Density (ρ), Viscosity (η), apparent molar volume (ϕ_v) of aluminium ammonium sulphate in DMF and 40% and 50% DMSO.

C/ mol/ dm^3	ρ/ $g.cm^3$	η/ Nm^{-3} s.	ϕ_v/ cm^3 mol^{-1}	ρ/ $g.cm^3$	η/ Nm^{-3} s.	ϕ_v/ cm^3 mol^{-1}	ρ/ $g.cm^3$	η/ Nm^{-3} s.	ϕ_v/ cm^3 mol^{-1}	ρ/ $g.cm^3$	η/ Nm^{-3} s.	ϕ_v/ cm^3 mol^{-1}
40% DMSO												
	308.15K			313.15K			318.15K			323.15K		
0.0150	0.94524	0.8274	65.75	0.94585	0.8452	53.76	0.9458	0.7464	72.25	0.94564	0.7856	77.45
0.0329	0.97542	0.8994	65.85	0.95222	0.8458	64.45	0.97684	0.8585	74.46	0.97431	0.8075	86.75
0.0577	0.975778	0.9555	67.46	0.98262	0.8524	75.86	0.98538	0.8525	78.25	0.97482	0.8285	90.45
0.0894	0.98558	0.9754	76.75	0.98497	0.8468	78.25	0.98584	0.8527	83.47	0.98634	0.8475	92.34
0.1281	0.98575	0.9754	79.46	0.98248	0.9793	90.49	0.97454	0.8467	91.62	0.99530	0.8875	99.46

50 % DMSO												
	308.15K			313.15K			318.15K			323.15K		
0.0150	0.93520	0.9561	54.45	0.94525	1.0445	63.46	0.97652	0.9366	70.86	0.94542	0.8563	80.46
0.0329	0.95665	0.9754	57.57	0.98552	1.0486	69.18	0.98523	0.9565	75.45	0.95656	0.8672	86.75
0.0577	0.97956	0.9998	60.46	1.04567	1.0454	75.46	0.98887	0.9635	81.85	0.97965	0.8729	92.45
0.0894	0.99465	1.0655	71.75	1.05628	1.0485	83.49	0.99996	0.9862	87.75	0.99998	0.8852	94.37
0.1281	1.04652	1.0442	79.45	1.05829	1.0748	89.46	1.00465	0.9994	98.95	1.00992	0.9845	104.86

Table 4: Concentration (C), Density (ρ), Viscosity (η), apparent molar volume (ϕ_v) of Aluminium ammonium sulphate in DMF and 60% and 70% DMSO.

C/ mol/ dm^3	ρ/ g.cm^3	η/ Nm^{-3} s.	ϕ_v/ cm^3 mol^{-1}	ρ/ g.cm^3	η/ Nm^{-3} s.	ϕ_v/ cm^3 mol^{-1}	ρ/ g.cm^3	η/ Nm^{-3} s.	ϕ_v/ cm^3 mol^{-1}	ρ/ g.cm^3	η/ Nm^{-3} s.	ϕ_v/ cm^3 mol^{-1}
60% DMSO												
	308.15K			313.15K			318.15K			323.15K		
0.0150	0.92620	0.9451	52.55	0.99525	1.0425	62.56	0.98452	0.9256	69.45	0.97242	0.8453	78.45
0.0329	0.94965	0.9954	56.45	0.99452	1.0442	68.12	0.94523	0.9375	72.63	0.98556	0.8472	84.12
0.0577	0.98956	0.9985	62.46	1.04527	1.0425	74.53	0.98227	0.9575	80.65	0.98965	0.8649	90.75
0.0894	0.99925	1.0455	69.94	1.04228	1.0474	81.42	0.99446	0.9732	86.75	0.99978	0.8852	96.35
0.1281	1.00252	1.0499	80.99	1.04529	1.0789	88.75	1.00465	0.9924	95.65	1.00092	0.9145	113.00
70 % DMSO												
	308.15K			313.15K			318.15K			323.15K		
0.0150	1.00047	1.2425	60.45	1.04557	1.1945	68.45	1.04455	1.0456	70.20	1.01454	1.0441	79.52
0.0329	1.05668	1.2852	70.42	1.05487	1.1948	73.44	1.04543	1.0457	82.35	1.01752	1.0412	83.85
0.0577	1.06589	1.2882	75.45	1.09597	1.1955	79.88	1.06434	1.0547	84.25	1.02771	1.0149	96.25
0.0894	1.07292	1.2453	90.42	1.09586	1.1945	94.44	1.04502	1.1457	95.02	1.02745	1.0444	98.42
0.1281	1.08971	1.3853	95.42	1.04653	1.2956	98.34	1.03456	1.1892	101.34	1.03578	1.1774	105.66

Table 5: Concentration (C), Density (ρ), Viscosity (η), apparent molar volume (ϕ_v) of Aluminium ammonium sulphate in DMF and 80% and 90% DMSO.

C/ mol/ dm^3	ρ/ g.cm^3	η/ Nm^{-3} s.	ϕ_v/ cm^3 mol^{-1}	ρ/ g.cm^3	η/ Nm^{-3} s.	ϕ_v/ cm^3 mol^{-1}	ρ/ g.cm^3	η/ Nm^{-3} s.	ϕ_v/ cm^3 mol^{-1}	ρ/ g.cm^3	η/ Nm^{-3} s.	ϕ_v/ cm^3 mol^{-1}
80 % DMSO												

	308.15K			313.15K			318.15K			323.15K		
0.0150	1.00917	1.8582	70.37	1.08457	1.6822	74.84	1.07821	1.5821	74.82	1.07821	1.4827	85.68
0.0329	1.08861	1.8127	75.27	1.08523	1.7981	82.82	1.07826	1.5738	82.92	1.07585	1.4984	93.52
0.0577	1.09255	1.9857	80.22	1.08522	1.7726	90.96	1.08821	1.5928	90.82	1.07828	1.5823	101.45
0.0894	1.09527	1.9653	92.97	1.09759	1.7826	98.25	1.08823	1.6725	98.86	1.08862	1.5686	109.87
0.1281	1.18502	2.0653	100.01	1.09844	1.8850	105.82	1.08925	1.6823	106.75	1.08288	1.6864	119.72
90% DMSO												
	308.15K			313.15K			318.15K			323.15K		
0.0150	1.09457	2.0853	77.78	1.09753	1.8576	79.75	1.08876	1.6875	88.45	1.08759	1.5757	95.85
0.0329	1.10459	2.0547	84.52	1.09872	1.8877	88.95	1.09781	1.6454	96.75	1.08878	1.6759	103.45
0.0577	1.10753	2.0857	92.95	1.10671	1.8743	95.22	1.09781	1.7875	104.74	1.09799	1.6753	111.86
0.0894	1.11847	2.1754	101.75	1.10875	1.9976	104.87	1.09872	1.7843	113.76	1.09784	1.7752	119.45
0.1281	1.11842	2.1486	108.93	1.11759	1.9873	114.98	1.10753	1.8766	122.75	1.09753	1.7697	130.78

Table 6: Concentration (C), Density (ρ), Viscosity (η), apparent molar volume (ϕ_v) of aluminium ammonium sulphate in DMSO.

C/ mol/ dm^3	ρ/ $g.cm^{-3}$	η/ Nm^{-3} s.	ϕ_v/ cm^3 mol^{-1}	ρ/ $g.cm^{-3}$	η/ Nm^{-3} s.	ϕ_v/ cm^3 mol^{-1}	ρ/ $g.cm^{-3}$	η/ Nm^{-3} s.	ϕ_v/ cm^3 mol^{-1}	ρ/ $g.cm^{-3}$	η/ Nm^{-3} s.	ϕ_v/ cm^3 mol^{-1}
DMSO												
	308.15K			313.15K			318.15K			323.15K		
0.0150	0.95663	1.0563	65.56	0.96585	1.0067	65.65	0.98953	0.9655	72.32	0.98532	0.8963	76.65
0.0329	1.09553	1.0657	68.96	0.98568	1.0205	71.85	0.99359	0.9428	78.56	0.97536	0.8952	82.35
0.0577	1.05638	1.0951	73.89	1.06544	1.0384	77.64	0.99651	0.9626	85.75	0.99535	0.8549	88.52
0.0894	1.06518	1.0926	79.35	1.05696	1.0602	84.95	1.00456	0.9652	93.85	0.97518	0.8765	94.53
0.1281	1.01571	1.1984	85.64	1.01552	1.0885	92.35	1.00762	1.0941	99.84	1.08239	0.9285	105.53

Figure 1: Plots of apparent molar volume ϕ_v vs. solvent percentage for aluminium ammonium sulphate in binary liquid mixture of aqueous DMF + aqueous DMSO solution at 308.15 K.

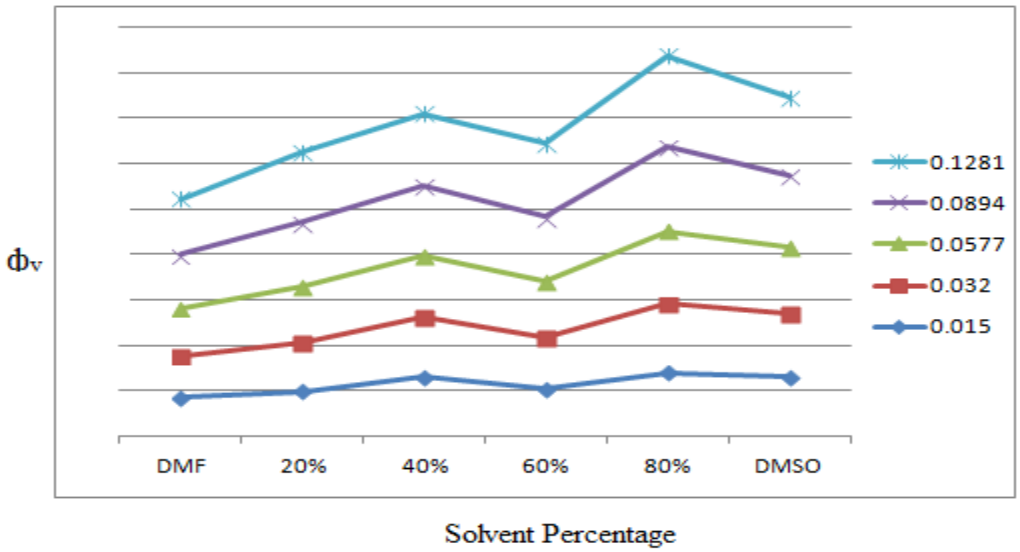

Table 7: ϕ_v^0 ($cm^3.mol^{-1}$), S_V ($cm^3.mol^{-2/3}.L^{1/2}$), A ($dm^{3/2}.mol^{-1/2}$) and B ($dm^3.\ mol^{-1}$) of aluminium ammonium sulphate in different compositions of aqueous DMF and aqueous DMSO at different temperatures.

Temp. (K)	**DMF**	**20% DMSO**	**40% DMSO**	**60% DMSO**	**80% DMSO**	**DMSO**
	ϕ_v^o ($cm^3.mol^{-1}$)					
308.15	30.85	33.12	45.20	49.49	50.22	56.35
313.15	36.22	45.65	49.86	59.36	58.72	59.64
318.15	42.65	95.13	58.69	60.23	69.92	60.56
323.15	54.56	58.52	63.64	68.23	70.94	68.56
	S_V ($cm^3.mol^{-2/3}.L^{1/2}$)					
308.15	98.22	101.2	112.6	111.9	122.2	124.5
313.15	104.0	115.8	115.4	114.5	125.4	138.0
318.15	108.5	118.9	119.7	122.2	132.6	134.8
323.15	109.4	119.7	116.6	121.5	134.9	144.9
	A ($dm^{3/2}.mol^{-1/2}$)					
308.15	0.015	0.016	0.022	0.026	0.038	0.028
313.15	0.024	0.029	0.028	0.032	0.034	0.034
318.15	0.065	0.059	0.062	0.036	0.069	0.069
323.15	0.079	0.095	0.086	0.065	0.089	0.088
	B ($dm^3.\ Mol^{-1}$)					
308.15	0.445	0.525	0.545	0.524	0.542	0.565
313.15	0.665	0.645	0.645	0.645	0.665	0.656
318.15	0.746	0.745	0.654	0.784	0.745	0.775
323.15	0.856	0.856	0.845	0.845	0.842	0.945

Table 8: Moulik constants (M and K) and Roots parameters (R and S) of aluminium ammonium sulphate compositions of aqueous DMF and aqueous DMSO at different temperatures.

Temp. (K)	**DMF**	**20% DMSO**	**40% DMSO**	**60% DMSO**	**80% DMSO**	**DMSO**
	M					

308.15	1.068	1.056	1.059	1.059	1.026	1.056
313.15	1.095	1.062	1.096	1.025	1.063	1.095
318.15	1.126	1.062	1.059	1.065	1.016	1.063
323.15	1.195	1.096	1.095	1.049	1.062	1.062
	K					
308.15	6.359	6.852	6.995	6.952	7.152	7.359
313.15	8.052	8.385	8.165	8.452	8.785	9.084
318.15	10.92	10.62	9.395	10.58	11.96	11.92
323.15	12.95	12.95	12.95	12.85	13.36	13.49
	R					
308.15	-0.236	-0.226	-0.259	-0.259	-0.295	-0.196
313.15	-0.263	-0.262	-0.263	-0.295	-0.126	-0.196
318.15	-0.265	-0.296	-0.295	-0.159	-0.163	-0.126
323.15	-0.296	-0.195	-0.145	-0.149	-0.163	-0.149
	S					
308.15	0.026	0.159	0.116	0.119	0.130	0.169
313.15	0.069	0.136	0.119	0.128	0.132	0.159
318.15	0.096	0.159	0.126	0.129	0.138	0.168
323.15	0.100	0.126	0.132	0.133	0.148	0.195

4. CONCLUSION

Density and viscosity of data aluminium ammonium sulphate in binary mixture of aqueous DMF and aqueous DMSO at different temperatures such as 308.15, 313.15, 318.15 and 323.15 K were studied. All the determined values of ϕ_v^0 at all temperatures are higher and positive, it suggest the strong solute solvent interactions in binary liquid mixture. The positive S_v values are showing strong solute-solute interactions in aluminium ammonium sulphate.

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5. REFERENCES

[1] Chum H. F. and Gilkerson W. R., *J. Soln. Chem*., **1983,** 12, 161.
[2] Salomon M. and Plichta E. J., *Electrochim. Acta*, **1984,** 29, 731.
[3] Gill D. S., Sharma A., Chauhan M. S., Sharma A. N. and Cheema J. S., *Electrochim Acta*, **1985,** 30, 151.
[4] Sastry V. V. and Kalidas C., *Ind. J. Chem*. **1985,** 24A, 658.
[5] Jauhar S. P., Guraya P. S. and. Narula S. P., *Ind. J. Chem*., **1984,** 23A, 680.
[6] Kodejs Z., Novak J. and Slama I., *Ind.J.Chem*., **1983,** 22A, 1029.
[7] Behera B., Sahu S., Pradhan S. and Behera K., *Ind. J. Chem*, **1983,** 22A, 20.
[8] Goldsack D. E, and Franchetto R.; *Can. J. Chem*., **1977,** 55, 1062.
[9] Kartzmark E. M., *Can. J. Chem*., **1972,** 50, 2845.
[10] Goldsack D. E. and Franchetto A.; *Electrochim Acta*, **1977,** 22, 1287.
[11] Goldsack D. E. and Franchetto R.; *Can. J. Chem*., **1977,** 56, 1442.
[12] Janz C. J., Oliver B. G., Lakhsminaryanan G. R. and Mayer G. E.; *J. Phys. Chem*., **1970,** 74, 1285.

[13] Prasad B. N. and Agarwal M. M., *Ind. J. Chem*. **1976,** 14A, 343.
[14] Prasad B. N., Singh N. P. and Singh M. M., *Ind. J. Chem*. A, **1976**, 322.; Kundu K. K. and Majumdar K., *J. Chem. Soc. Faraday Trans*, I, 71, **1975,** 1422.; Day N. C., Kumar G., Saikia B. K. and Inamul Haque, *J. Soln. Chem*., **1985**, 14, 49.
[15] Miyashi K. and Tominga J., *J. Phys. Chem*. **1973**, 77, 519.
[16] Salomon M. and Plichta E.; Electrochim. Acta, **1983,** 28, 1681.
[17] Crudden Jo, Delaney G. M., Feakins D., O'Reilly P. J., Waghorne W. E, and Lawrence K.G.; *J. Chem. Soc. Faraday Trans* I, **1986,** 82, 2195 and 2207.
[18] Desnoyers J. E, and Perron G,; *J. Soln, Chem*, **1972,** 1, 199.
[19] Das P. B. and Misra P. P.; *Electrochim. Acta*, **1978,** 23, 1233.
[20] Domenech J. and Rivera S.; *J. Chem. Soc. Faraday Trans*. I., **1984,** 80, 1249.
[21] Evans D. F., Thomson J., Nadas J. A. and Matesich S. M. A.; *J. Phys. Chem*., **1971**, 75, 1714.
[22] Stoke R. H. and Mills R., "Viscosity of Electrolytes and Related Properties", International encylopedia of physical chemistry and chemical physics, Pergamon, Oxford, **1965**.
[23] Gurney R. W., "Ionic processes in solutions," McGraw Hill, New York, **1953**.
[24] Jauhar S. P., Chawla H. S. and Palvinder Singh; *Ind, J, Chem*., **1985**, 24A, 731.
[25] Friauf R. J., "Physics of Electrolytes", Vol. I Ed. J. Hladik, Academic Press, London, P. 154, **1972**.
[26] Patil, P., Patil, S., and Borase, A D., *Hundiwale. Rasayan Jour. Chem*. **2011**. 4, 599.
[27] Nikam P. S., Jagdale B. S., Sawant A. B. and Hasan M. ,*Journal of Chemical and Engineering Data*, **2000**; 45: 559-563.
[28] Keshapolla D., Singh V. and Gardas R. L. *Journal of Molecular Liquids*, **2014**; 199: 330-338.
[29] Yanfang G, Tengfang W, Dahong Y, Changjun P, Honglai and Ying H, *Chinese Jour. of Chem. Engg*. **2008**, 16.
[30] Masson D. O., XXVIII. Solute molecular volumes in relation to solvation and ionization. *The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science* **1929**; 8: 218-235.
[31] Roy M. N., Dakua V. K. and B. Sinha. *International Journals of Thermophysics* **2007**; 28: 1275-1284.
[32] Jones G. and Dole M. *Journal of the American Chemical Society* **1929**; 51: 2950- 2964.
[33] Deosarkar S. D., Puyad A. L., Kattekar P. S. and Kalyankar T. M. *Russian Journal of Physical Chemistry A* **2013**; 87: 524-527.
[34] Moulik S. P. *The Journal of Physical Chemistry* **1968**; 72: 4682-4684.
[35] Root W. C. Journal of the American Chemical Society **1933**; 55: 850-851.
[36] Sharma S. K., Singh G., Kataria R. and Kumar H. *Thermochimica Acta* **2014**; 589: 123-130.
[37] Nikam P. S., Aher J. S. and Kharat S. J. *Journal of Chemical and Engineering Data*, **2008**; 53: 2469-2472.