



Comparative study of Specific Refraction of Potassium salts solutions in Binary (Ethanol+Water) mixtures

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Abstract

Refractive indices and Densities of different concentrations of Potassium salts like KCl, KBr, and KI in Percentage of 10, 20, 40 and 60 (v/v) ethanol-water were measured at 303.15 K. Specific Refraction (R) were calculated by using Lorentz and Lorenz (L-L), Andher Desai and Joshi (ADJ), Chavda Desai and Joshi (CDJ), Damor Desai and Joshi (DDJ), Gadhawala Desai and Joshi (GDJ), Patel Desai and Joshi (PDJ). It is observed that the refractive indices increased with an increase of percentage of ethanol as well as with the concentrations of potassium salts for given compositions of binary solvent mixtures. It is also observed that the calculated specific refraction values of the all formulae give in increasing of the binary (Ethanol+Water) mixtures.

Keywords: Refractive indices and densities, binary (Ethanol+Water) Specific Refraction, Lorentz and Lorenz (L-L), Andher Desai and Joshi (ADJ), Chavda Desai and Joshi (CDJ), Damor Desai and Joshi (DDJ), Gadhawala Desai and Joshi (GDJ), Patel Desai and Joshi (PDJ).

Introduction

The measurement of refractive index of organic liquids and solutions is of great importance because it furnishes information about the molecular structure, purity of organic compounds and of the composition of binary Mixtures¹. Refractive indices of binary, ternary liquid solutions and the solutions of biologically important compounds have been studied²⁻⁸. Apparent specific refraction of poly (oxyethylene) glycol in⁹ and 1, 4-dioxane with benzene solutions attached to one two three and four (oxyethylene) glycol in aqueous were studied by Rudan- Tasic and Klofutar¹⁰. Specific refraction of aqueous lithium iodate solutions were studied by Szweczyk, Sangwa¹¹. Densities and Refractive Indices of potassium Salts in Binary (Methanol+Water). Mixture of Different Compositions studied by S.D. Deosarkar, V.V. Pandhare and P.S. Kattakar¹². Present paper investigated the specific refraction of binary (ethanol+Water) mixtures with suggested formula Andher Desai and Joshi (ADJ)¹³ Chavda Desai and Joshi (CDJ)¹⁴, Damor Desai and Joshi (DDJ)¹⁵, Gadhawala Desai and Joshi (GDJ)¹⁶ and Patel Desai and Joshi (PDJ)¹⁷ at 300.15K.

Material and Methods

Binary (Ethanol+Water) eight mixtures of different percentage solutions were prepared by respective volume. Density measurement performed by using by specific gravity bottle with thermometer volume of 25 ml. it was calibrated by distilled water at 300.15 K. Weighing was done by the electronic balance (Repech, Ahmedabad). Percentage Solutions of 10,20,40, and 60 v/v ethanol were prepared by dissolving 10,20,40,and 60 ml ethanol in 90,80,60 and 40 ml. of distilled water in volumetric

flask containing 100ml, and then total volume of the solution was bring to 100 ml. by adding distilled water. For different percentage solutions containing 10, 20, 40, and 60 (v/v) ethanol +water mixture's densities and refractive indices were measured. Refractive indices of the percentage solutions were measured by using the Abbe's Refractometer at constant temperatures at 300.15 K Refractometer was calibrated with the glass piece provided with instrument. Four percentage solutions were taken the readings independently. Calculated the specific refractions by the personal computer in excel sheet.

Table-1

Experimental refractive indices (n) and densities (d) of pure solvents and various percentage containing 10, 20, 40, and 60 (v/v) ethanol +water mixture were measured at 300.15K

Pure solvents and the percentage mixtures	300.15 K	
	Densities	Refractive indices
Ethanol	0.7013	1.361
Water	0.9956	1.332
10% (v/v)E-W	0.9735	1.337
20% (v/v)E-W	0.9689	1.342
40% (v/v)E-W	0.9384	1.353
60% (v/v)E-W	0.9028	1.359

Table-2

Specific Refraction (R) of various percentages containing 10, 20, 40 and 60 (v/v) ethanol +water mixture were measured at 300.15 K

Pure solvents and the percentage mixtures	L-L (R1)	ADJ (R2)	CDJ (R3)	DDJ (R4)	GDJ (R5)	PDJ (R6)
Ethanol	0.3155	0.3174	0.3165	0.3025	0.3054	0.3122
Water	0.2060	0.2322	0.2087	0.1997	0.2155	0.2058
10% (v/v)E-W	0.2136	0.2378	0.2159	0.2066	0.2216	0.2129
20%(v/v)E-W	0.2175	0.2403	0.2195	0.2099	0.2247	0.2165
40%(v/v)E-W	0.2311	0.2500	0.2323	0.2221	0.2357	0.2292
60%(v/v)E-W	0.2439	0.2597	0.2448	0.2339	0.2462	0.2414

Table-3

Specific Refraction (R) of various percentages containing in Potassium Iodide 10, 20, 40, and 60 (v/v) ethanol +water mixture were measured at 300.15 K

KI	L-L (R1)	ADJ (R2)	CDJ (R3)	DDJ (R4)	GDJ (R5)	PDJ (R6)
10% (v/v)E-W	0.2113	0.2355	0.2134	0.2041	0.2197	0.2104
20%(v/v)E-W	0.2145	0.2377	0.2164	0.2069	0.2222	0.2134
40%(v/v)E-W	0.2244	0.2452	0.226	0.2161	0.2304	0.2229
60%(v/v)E-W	0.2426	0.2583	0.2433	0.2325	0.2451	0.2400

Table-4

Specific refraction (R) of various percentages containing in Potassium Bromide 10, 20, 40, and 60 (v/v) ethanol +water mixture were measured at 300.15 K

KBr	L-L (R1)	ADJ (R2)	CDJ (R3)	DDJ (R4)	GDJ (R5)	PDJ (R6)
10% (v/v)E-W	0.2120	0.2362	0.2141	0.2048	0.2202	0.2111
20%(v/v)E-W	0.2163	0.2392	0.2182	0.2086	0.2237	0.2152
40%(v/v)E-W	0.2278	0.2475	0.2292	0.2191	0.2331	0.226
60%(v/v)E-W	0.2423	0.2584	0.2432	0.2325	0.2449	0.2399

Table-5

Specific refraction (R) of various percentages containing in Potassium chloride 10, 20, 40, and 60 (v/v) ethanol +water mixture were measured at 300.15 K

KCl	L-L (R1)	ADJ (R2)	CDJ (R3)	DDJ (R4)	GDJ (R5)	PDJ (R6)
10% (v/v)E-W	0.2115	0.2360	0.2138	0.2045	0.2199	0.2108
20%(v/v)E-W	0.2179	0.2404	0.2198	0.2101	0.2250	0.2167
40%(v/v)E-W	0.2304	0.2496	0.2317	0.2215	0.2352	0.2285
60%(v/v)E-W	0.2482	0.2625	0.2487	0.2377	0.2497	0.2454

Table-6
Specific Refraction(R) of pure solvents and the various percentage containing 10, 20, 40, and 60 (v/v) ethanol +water mixtures in different potassium salts were measured at 300.15 K

Pure solvents and Potassium salts percentage mixtures	L-L (R1)	ADJ (R2)	CDJ (R3)	DDJ (R4)	GDJ (R5)	PDJ (R6)
Ethanol	0.3155	0.3174	0.3165	0.3025	0.3054	0.3122
Water	0.2060	0.2322	0.2087	0.1997	0.2155	0.2058
10% (v/v)E-W	0.2136	0.2378	0.2159	0.2066	0.2216	0.2129
20%(v/v)E-W	0.2175	0.2403	0.2195	0.2099	0.2247	0.2165
40%(v/v)E-W	0.2311	0.2500	0.2323	0.2221	0.2357	0.2292
60%(v/v)E-W	0.2439	0.2597	0.2448	0.2339	0.2462	0.2414
KCl						
10% (v/v)E-W	0.2115	0.2360	0.2138	0.2045	0.2199	0.2108
20%(v/v)E-W	0.2179	0.2404	0.2198	0.2101	0.2250	0.2167
40%(v/v)E-W	0.2304	0.2496	0.2317	0.2215	0.2352	0.2285
60%(v/v)E-W	0.2482	0.2625	0.2487	0.2377	0.2497	0.2454
KBr						
10% (v/v)E-W	0.2120	0.2362	0.2141	0.2048	0.2202	0.2111
20%(v/v)E-W	0.2163	0.2392	0.2182	0.2086	0.2237	0.2152
40%(v/v)E-W	0.2278	0.2475	0.2292	0.2191	0.2331	0.226
60%(v/v)E-W	0.2423	0.2584	0.2432	0.2325	0.2449	0.2399
KI						
10% (v/v)E-W	0.2113	0.2355	0.2134	0.2041	0.2197	0.2104
20%(v/v)E-W	0.2145	0.2377	0.2164	0.2069	0.2222	0.2134
40%(v/v)E-W	0.2244	0.2452	0.226	0.2161	0.2304	0.2229
60%(v/v)E-W	0.2426	0.2583	0.2433	0.2325	0.2451	0.2400

Results and Discussion

Densities and refractive indices of pure solvents and various percentage containing 10, 20, 40, and 60 (v/v) ethanol + water mixture at 303.15K are reported in table-1. Whereas table-2, gives the calculated values of Specific Refraction of pure solvents and the various percentage of binary (ethanol+water) solutions. Table-3 gives the calculated values of specific Refraction of potassium iodide. Table- 4 gives the calculated values of Specific Refraction of Potassium Bromide and table-5 gives the calculated values of Specific Refraction of Potassium Chloride. For all Potassium salts Percentage containing 10, 20, 40, and 60 (v/v) (ethanol + water) mixture at 303.15K is reported in table-6. Densities followed the order KI > KBr > KCl for given percentage of ethanol and for approximately the same concentration of salts Densities of all the salts solutions increased with increased in concentration in a given ethanol-water mixture which is because of strengthening of ion-solvent interactions and decreased in volume of the system. And densities decreased with increase in the percentage of ethanol for approximately the same concentration of salts which may be due to the weakening of ion-solvent interactions in higher

percentage of ethanol and increased in volume of system as ethanol percentage increases. Refractive indices of all salts solutions for given composition of ethanol-water mixture are higher than corresponding ethanol-water binary mixture. The refractive index of various solutions shows a linear relationship with concentration of potassium salts. For given composition of binary ethanol-water mixture, refractive indices of potassium salt increase with their concentration. Also for approximately same concentration of salts, refractive indices increased with increase in percentage of ethanol + water mixture which is due to the higher refractive index of ethanol than water. Specific refraction of a substance was calculated by Lorentz and Lorentz equation as follows:

$$\frac{n^2 - 1}{n^2 + 2} \cdot \frac{1}{d} = \text{constant}(R1) \quad (1)$$

Where R is Specific Refraction n is Refractive index and d is Density

This data can be utilized for the calculation of Specific Refraction by ADJ, CDJ, DDJ, GDJ, and PDJ respectively.

$$R2 = \frac{1}{9} \left(\frac{3n - 2.47}{d} + 0.557 \right) \text{ ADJ} \quad (2)$$

$$R3 = \frac{\sin(0.5 \times n - 0.4567)}{d} \text{ CDJ} \quad (3)$$

$$R4 = \frac{0.0843}{1.0251} \times (n^3 - 0.0045) \text{ DDJ} \quad (4)$$

$$R5 = \frac{1}{0.09} \left(\frac{3n - 2.85}{n^2 + 73} \cdot \frac{1}{d} + 0.004 \right) \text{ GDJ} \quad (5)$$

$$R6 = \frac{(n - 0.91)}{2.06} \cdot \frac{1}{d} \text{ PDJ} \quad (6)$$

Conclusion

Densities followed the order KI > KBr > KCl for given percentage of ethanol and for approximately the same concentration of salts. Refractive indices of all salt solutions for given composition of ethanol-water mixture are higher than corresponding ethanol-water binary mixture. The refractive index of various solutions shows a linear relationship with concentration of potassium salts.

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