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COMPARISON OF ALTERATION OF REFRACTIVE INDEX OF LIQUID WITH TEMPERATURE AND CONCENTRATION

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A simple reliable and common method of measuring refractive index of liquid is by the measurement of angle of minimum deviation produced by a light beam that passes through the liquid contained in a hollow prism made of transparent glass. This technique was used to study the refractive index of aqueous acetate of zinc and lead. The variation of refractive index with temperature and concentration also studied. The result is verified with Abbe refractometer which suits best for assessment refractive index of transparent liquids. Similar refractive index variation as a function of temperature and concentration is obtained. The value of refractive index boosts, both concentration and temperature rises.

Keywords:*Abee Refractometer,Concentration,Hollow prism, Refractive index*

Introduction

The optical properties of a medium often control the interaction of electromagnetic wave incident on it.If the light enter a non homogenous material reflection and refractionoccur at the boundary surface.The refractive index n is given by the ratio of velocity of light in vacuum to that the medium.The refractive index is a measure for power of deflection occurring at the boundary surface due to refraction of the light beam.The amount of deflection is given by Snells law. The refractive index is measured relative to the refractive index measured in air. The refractive index of air is very close to unity. The absolute refractive index of a medium is the ratio of the speed of light in free space to the speed of light in that medium. The relative refractive index is the ratio of the velocity of light in one medium to that in the adjacent medium. The refractive index of a material strongly depends on wavelength of light which passing through it, the wavelength dependence is well-known, dispersion. For a specified wavelength the refractive index of a medium dependence on additional parameters similar to density of the medium, which is a function of temperature. The relationship of refractive index changes to temperature changes, is called the temperature coefficient of the refractive index ($\frac{dn}{dT}$), be positive or negative. This $\frac{dn}{dT}$ can be probabily diterminal to optical system performance so spatial knowledge of $\frac{dn}{dT}$ is also significant. High quality refractive optical design intimately can accuracy of refractive index data of constituent optical material are required. In several areas of material science, thin film technology and fiber optics refractive index acting a

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crucialresponsibility, by measuring refractive index of solution,we can establish the concentration of the solution.Several techniques and discussionwere reported for the measurement of concentration and temperature dependence of refractive index of liquids [1][8][9]. The ordinary method for the measurement of refractive index of a liquid is the measurement of minimum deviation produced by a light beam that pass through the liquid contained in a hollow prism made of glass[2][5].The glass is opaque for infrared and ultraviolet radiation whichis using we limited with source as visible light .The Abee reftactometer suits best for assessment of refractive index of transparent liquidis another generally used instruments for the determination of refractive index of the liquid[6][10]. This paper reports the variations of refractive index of aqueous zinc and lead acetate of different concentration at different temperature below the boiling point of water. Relatively simple and effective techniques, minimum deviation produced by prism is employed to measuring refractive index of solutions. The results were compared with the results obtained from Abee refractometer.

Materials and method

The materials selected for solution contained acetate of zinc and lead.To maintain the homogeneity of liquid samples a standard solutions preparations method were adopted. The standard solutions of zinc acetate and lead acetate having solute concentration of 2%,4%,6%,8%, and 10% were prepared.The accurate amount of solute was dissolved in 100 ml of distilled water.Solution with 10% solution was prepared by 10 gm solute dissolved in distilled water (10%=10gm/100ml). Distilled water was used as solvent for avoiding any type of contamination error. The method of minimum deviation provide desirable features of high accuracy and effortlessness of calculation as compared to various techniques reported in literatures[3].A convenient formula for refractive index, can be obtained in the minimum deviation case when a ray of light suffer deviation while passing through the prism[6].The angle of incidence is responsible for deviation produced in the path of light beam. The angle of deviation is minimum(δ) for particular value of angle of incidence for a prism with refracting angle(α), refractive index $n = \frac{Sin\frac{(\alpha+\delta)}{2}}{Sin\frac{\alpha}{2}}$ ……………………..(1)

Equation (1) is used to calculation of refractive index of solution filled in the hollow prism. With the aid of an optical spectrometer, liquid contained hollow prism is used to measure the refractive index. Yellow light beam collimated from sodium vapour lamp,monochromatic source was used to determine angle of prism and angle of minimum deviation. The refractive index at different temperature was measured by cooling, the liquid heated up to 70°C and poured it in to hollow prism. Without obstructing the path of light beam in hollow prism a thermometer was carefully dipped in the solution for measuring temperature of the liquid. The concentration dependence were investigated by preparing solution of accurate amount of solute dissolved in 100ml of distilled water. Before pouringinto the hollow prism prepared solution are

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filtred.The hollow prism was cleaned carefully for every measurements.Abee refractometer provides maximum precession with quick operation.With an Abberefractometer therefractive index of liquid or solid samples was determined by using the effect of total internal refelection[7]. The refractomer consist of two prisms having highly retracting glass with angles 30°,60°,and 90°.The substances to be investigated is placed betweenthese two prisms. The light refelected from the ground surface was made to fall on the bottom prism. The telescope receives the emergent light from the top prism.The light beam were incident on the hypotenuse face of prism at different angle of incidence.When the angle of incident rays will equal to the critical angle, the ray passed along the plane of liquid and then it passed into the second prism.The telescope is adjusted to a position where the cross wires lies on the dark edge of the field of view. The refractive index of liquid is directly obtained from the calibrated scale attached to the telescope. To investigate the effect of concentration,the liquid with different concentration is placed in between prisms and readings are tabulated.Temperature variation is obtained an external hot water circulator with temperatures 50°C,55°C, and 60°Cwas connected through the hose provided in Abbe refractometer and allowed time prisms to stabilize the water temperature.

Result and Discussion

Study of variation of refractive index of Zinc acetate solution with concentration

The refractive index of Zinc acetate solution with concentration is show in fig.1-3. From this it is clear that the variations of refractive index with solute concentration is linear at temperatures 50°C, 55°C, and 60°C[4]. The refractive index of Zinc acetate solution after 8% of solute concentration abruptly increasing all the temperature taken to be observed.

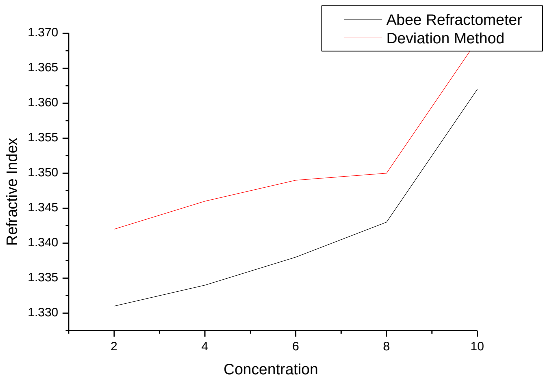

Fig.1 Refractive index of Zinc acetate at 50°C

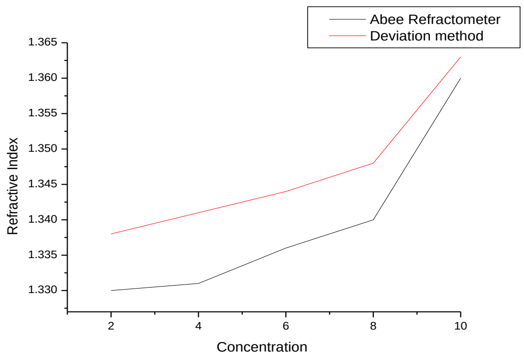

Fig.2 Refractive index of Zinc acetate at 55°C

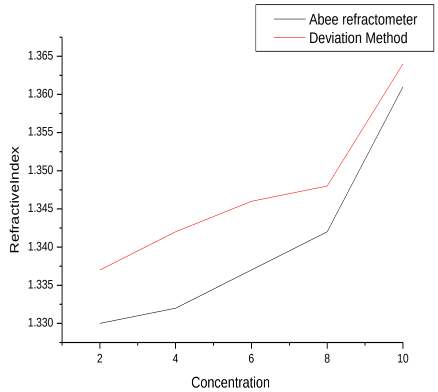

Fig.3 Refractive index of Zinc acetate at 60°C

Study of variation refractive index of Lead acetate solution with concentration

The refractive index of Lead acetate solution with concentration is show in fig.4-6. From this it is clear that the variations of refractive index with solute concentration is linear at temperatures 50°C, 55°C, and 60°C. It is clear that the refractive index of Lead acetate solution has a dependence on concentration as well as temperature.

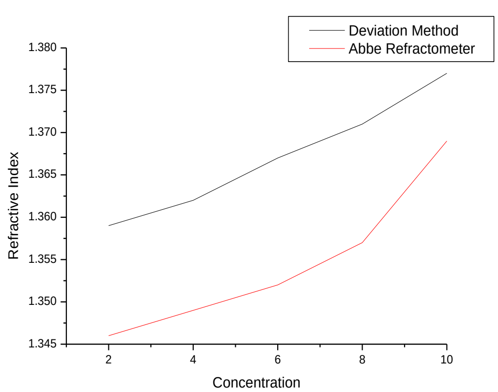

Fig.4 Refractive index of Zinc acetate at 50°C

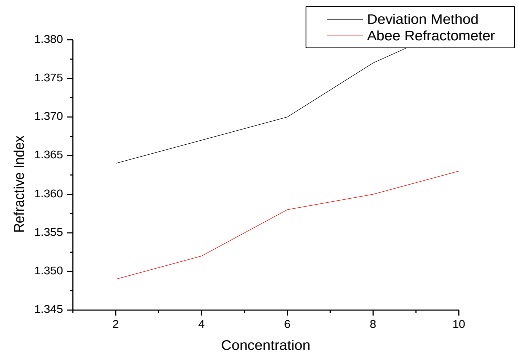

Fig.5 Refractive index of Lead acetate at 55°C

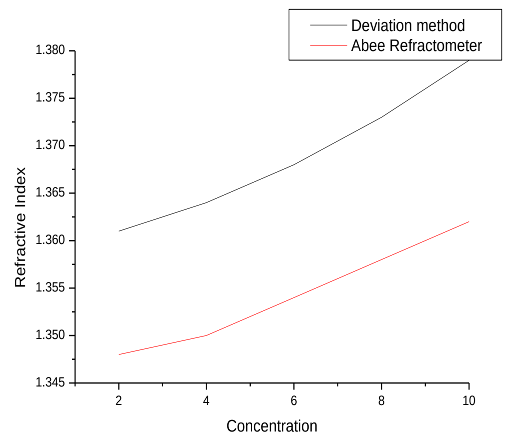

Fig.6 Refractive index of Lead acetate at 60°**C**

Conclusion

Variation of refractive index of Zinc acetate and Lead acetate were obtained using Minimum deviation produced by light ray travelled in liquid contained hollow prism. Analogous deviation was observed by measurements taken by Abbe Refractometer. Both the measurements shows refractive index has a dependence on the concentration in addition to temperature of the state at it contains.

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