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Comparative study of effect of temperature and concentration of lithium chloride on density and viscosity of ethanol: Water system

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Abstract
In the present work the viscosity and density parameters have been determined by taking different concentration of lithium chloride electrolyte (2% to 10%) in different sets of ethanol-water mixed solvent system (5% to 40%) at room temperature. From the viscosity and excess viscosity values the effect of temperature and electrolytic concentration has been discussed related to solute-solvent and solvent-solvent interaction. The result indicates that as concentration of lithium chloride increases the density and viscosity also increases.

Keywords: ethanol-water mixture, electrolyte, density, viscosity, excess viscosity, temperature

Introduction
This study aims to determine the effect of temperature and concentration of lithium Chloride on density and viscosity of binary mixture of ethanol and water. The molecular interactions can be evaluated using physical properties such as density and viscosity [1]. The aliphatic alcohols and water mixture has interaction with hydrogen bonding among water having OH group acting as a π donor and the alcohol having H atom which acts as a σ acceptors [2].
The associations and dissociations which are present intermolecular can be investigated by viscometer. The state of solvation of molecules and the size in the solution can be explored by using the information given by these measurements. To describe the strength and nature of interactions between the molecules in the solution, the temperature and concentration reliance of viscosity have been used efficiently [3].
Due to the different interactions of solute and solvent, the behavior of viscosity of solution depends and hence it depends on the nature of solute and solvent, concentration, the size and shape, affected by eternal factors like temperature. The industrial applications are responsive to flow behavior and are affected by the behavior of viscosity with temperature [4].
Alcohols are a very good example of polar and self-associated liquids which are industrially as well as biologically important [5].
Viscosity can also be explained as a level of resistance to flow. Like different transport properties, viscosity also provides the details regarding the solute-solute and solute- solvent interactions [6].
Generally, the viscosity is present in the solution because of internal friction of layers which decreases the speed to flow. The solution in which impurity is not present is less viscous as compared to the solution in which impurity is present [7].
Studies of transport properties of binary liquids give the useful information about the interactions among the constituents [8].
Our earlier research of effect of electrolyte on density and viscosity of ethanol water mixed solvent system [9-12], now this present study is related with the viscosity and density of ethanol-water mixed solvent system and ethanol-water-lithium chloride.

Material and methods
Deionised and doubly distilled water and refluxed ethanol was used for the preparation of binary mixture of ethanol-water. AR grade Lithium Chloride salt supplied by SD Fine Chemicals Ltd was used in the experimental work.
Density of all binary mixtures was measured by using standardized pycnometer with single

arm capillary and single pan electronic balance. Weighing was done in triplicate for the surity reproducibility of results. Ostwald's viscometric method was used to obtain the viscosity measurements. The viscometer was fixed in a thermostat maintained at a constant temperature as required. The flow time of the solution between the two points on was measured on the viscometer and was performed at least five times for each solution and the average results were produced. The ethanol-water mixtures were prepared by using 5, 10, 20 and 40 ml of ethanol in 100 ml distilled water (v/v) and kept in thermostat to attain the constant temperature. Then the density and viscosity of each mixture were determined with and without the addition of salt. The values are given in the respective tables.

Result and discussion

Table 1: Density of solvent mixture with LiCl

% Et OH ↓	LiCl →	2%	4%	6%	8%	10%
5%		1.001	1.002	1.008	1.013	1.021
10%		0.999	1.001	1.005	1.009	1.018
20%		0.996	0.999	1.001	1.006	1.015
40%		0.992	0.994	0.998	1.003	1.008

Table 2: Viscosity of solvent mixture without LiCl (η in poise)

Sr. No	Et OH%	Viscosity
1	5%	0.0065
2	10%	0.0073
3	20%	0.0081
4	40%	0.0082

Table 3: Viscosity of mixture with LiCl in poise

% Et OH ↓	LiCl →	2%	4%	6%	8%	10%
5%		0.0070	0.0078	0.0083	0.0086	0.0089
10%		0.0079	0.0082	0.0092	0.0094	0.0098
20%		0.0084	0.0091	0.0100	0.0104	0.0111
40%		0.0089	0.0101	0.0192	0.0125	0.0132

From the table 1 it has been revealed that the density of solvent mixtures increases when we proceed from 2% to 10% solution of Lithium Chloride it is due to increase in the concentration of lithium chloride in the solvent mixtures. Similarly it is observed that viscosity values from table no.02 reveals that the viscosity of ethanol-water solvent mixture increases as the concentration of ethanol in each set increases, it is because of strong hydrogen bonding between ethanol and water which increases the viscosity of mixture. The table number 03 shows that the viscosity of ethanol-water mixed solvent with Lithium Chloride increases as the concentration of Lithium Chloride increases, this increase in viscosity isdue to solute-solvent interaction between water-LiCl and ethanol-LiCl molecules.

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