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Research Paper

Study of Effect of KCl Concentration on Density and Viscosity of Ethanol-Water Mixed Solvent Systems at 298.5 K

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Abstract: *The effect of KCl concentration ranging from 2 % to 10 % on density and viscosity ethanol-water mixed solvent systems ranging from 5 % to 40 % has been studied. The data which obtained has been used to calculate the excess viscosity* η^E *and B coefficient. The result indicates that as the concentration of KCl increases the density and viscosity also increases it is due to the solute-solvent interaction. The KCl solute breaks the solvent-solvent molecules i.e. ethanol-water molecule due to which there is increase in density and viscosity of mixed solvent systems. The increase in excess viscosity which also gives idea about the dispersion types of forces exerts predominant behavior in these mixed solvent systems due to addition of KCl electrolyte.*

Keywords: Ethanol-water mixture, KCl, Density, Viscosity, Excess Viscosity.

Introduction

Calcareous soils have resulted in precipitation of the viscosity of solution is the resistance to flow. In general, the viscosity of solution is due to internal friction of layers which decreases the velocity to flow. The solution which is free from impurity has the less viscosity as compare to the solution with impurity. The impurity is responsible for the existence of any solution[1].The aqueous solution of electrolyte plays an important role in biochemical and natural processes. The viscosity is one of the important thermo-physical property which is the function of temperature and electrolyte concentration[2].The literature survey shows that the viscosity of pure ethanol and water depends upon the temperature which is inversely proportional to temperature[3]. But when these mixed solvents are taken in particular proportion and viscosity is determined[4] the viscosity values indicate that as the concentration of ethanol increases the viscosity values also increases due to solvent-solvent interaction and hydrogen bonding.

Ummul Khair Asema *et.al.* reported the effect of sodium chloride electrolyte in ethanol-water mixed solvent system and conclude the increase in viscosity of these solvent systems is due to solute-solvent interaction[5]. In our research work we have taken the potassium chloride electrolyte and determined the viscosity of mixed solvent systems at 298.5 K because potassium chloride is very important inorganic salt which plays an important role in cellular functions. In KCl the K^+ is the primary cation which is found to be 4-5mg/ 100 ml of blood serum[6]. The literature survey shows that the intake of alcohol causes the loss of potassium from body and finally the blood potassium decreases. This fact we have studied in terms of viscosity by increasing concentration of ethanol in each experiment[7].

Material and Methods

AR grade chemicals of SD-fine brand were used. The doubly distilled and deionised water was used. The ethanol was refluxed to get purity. The standardized pyknometer and single pan balance was used to determine the density. The Ostwald's Viscometer was used to determine the viscosity by flow time method.

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 determine and resultant values are tabulated in table no.1 In the second part to each mixture the 2,4,6,8 and 10 grams of KCI was added and kept in thermostat and then density and viscosity were determined. The results so obtained are tabulated in table 2.

Results and Discussion

It is revealed from the data in the table that chlorophyll 'a' and 'b' contents at 45 DAS significantly increased over control with the rise in pyrite application and rhizobium inoculation but decreased with increasing RSC levels. Highest value of chlorophyll 'a' was recorded at $R_1S_2I_1$ which was 3.63% and 3.03% higher over the control respectively for the years '07 and '08 whereas the lowest chlorophyll 'a' content recorded at $R_3S_0I_1$ was 20.45% and 21.81% lower than the control respectively for both the years. And chlorophyll 'b' was recorded a highest at $R_1S_2I_1$ with values of 15.2% and 25% over the control and lowest values recorded at $R_3S_0I_1$ were 28.4% and 25.4% respectively for both the years. Comparing the treatments, it is obvious that the application of pyrites increased the leaf chlorophyll due to sulphur availability. Similar results were reported by Sinha and Sakal[11].

Calculations

The density and viscosity parameters for each mixture were determined by using following formulae.

$$\text{Density} = \frac{\text{Weight of definite volume of solvent mixture}}{\text{Weight of same volume of solvent mixture with KCl}}$$

Viscosity

$$\eta_2 = \frac{t_2}{t_1} \cdot \frac{\varsigma_2}{\varsigma_1} \cdot \eta_1$$

Where

t_1 = flow time for solvent mixture

t_2 = flow time for solvent mixture with KCl

ς_1 = Density of solvent mixture

ς_2 = Density of solvent mixture with KCl

η_1 = Viscosity of solvent mixture

η_2 = Viscosity of solvent mixture with KCl

From the values of viscosity, the excess viscosity of each mixture has been determined by following equation.

$$\eta^E = \eta_{mix}(x_1\eta_1 - x_2\eta_2)$$

Where

η_{mix} = Viscosity of solvent mixture with KCl

$\eta_1 \& \eta_2$ = Viscosity of solvent mixture

$x_1 \& x_2$ = Mole fraction of individual solvents i.e. ethanol and water

η^E = Excess Viscosity of solvent mixture with KCl

Result and Discussion

Table 1: Density of solvent mixture with KCl in gm/cm^3

↓ EtOH	KCl →	2 %	4%	6%	8%	10%
5 %		0.8531	0.8873	0.8987	0.9051	0.9165
10 %		0.8495	0.8697	0.8758	0.8668	0.8939
20 %		0.8322	0.8631	0.8630	0.8657	0.8720
40 %		0.8201	0.8434	0.8551	0.8630	0.8713

Table 2: Viscosity of solvent mixture without KCl(η) in Poise (P)

S. No.	Mixture (Ethanol + Water, v/v)	Viscosity in Poise
1	5% Ethanol	0.0096
2	10% Ethanol	0.0109
3	20% Ethanol	0.0140
4	40% Ethanol	0.0185

Table 3: Viscosity of mixture with KCl (η) in Poise (P)

EtOH ↓ / KCl →	2 %	4%	6%	8%	10%
5 %	0.0073	0.0082	0.0085	0.0087	0.0091
10 %	0.0082	0.0083	0.0094	0.0096	0.0099
20 %	0.0080	0.0106	0.0109	0.0111	0.0115
40 %	0.0147	0.0148	0.0152	0.0157	0.0159

Table 4: Excess Viscosity(η^E)of mixture with KCl in Poise (P)

EtOH ↓ / KCl →	2 %	4%	6%	8%	10%
5 %	0.95318	0.95281	0.96135	0.96158	0.96197
10 %	0.90321	0.90331	0.90441	0.90461	0.90491
20 %	0.80733	0.80993	0.81023	0.81043	0.81083
40 %	0.61950	0.61960	0.62000	0.62050	0.62070

Conclusion

From the table 1 it has been revealed that the density of solvent mixtures increases when we proceed from 2% to 10%, it is due to increase in the concentration of KCl in the solvent mixtures. In a similar way when we observed the viscosity values from table no.02 we came to conclusion 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 KCI, increases as the concentration of KCl increases it is due to solute-solvent interaction between water-KCl and ethanol- KCl molecules. Finally, the table no. 04 shows the excess viscosity which also increases with increase in concentration of KCl. The KCI electrolyte breaks the solvent-solvent molecule and enhances the viscosity of solvent mixture.

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