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# Viscosity of Cetrimide in Glycerol and Water System

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**Abstract:** *Viscosity of drug cetrimide in various aqueous mixture of glycerol has been determined. The viscosity data have been analyzed .Partial molar volume, molar excess volume, excess viscosity, viscosity coefficient are determined. The results are correlated to understand the solution behaviour of drug.*

**Keywords:** *Cetrimide, Glycerol, Viscosity*

## 1. INTRODUCTION

A systematic knowledge of solution behavior of drugs can be of great importance in order to understand their physiological action [9]. The thermodynamic properties are the convenient parameter for interpreting solute-solvent interactions in the solution phase, which ultimately explain the excess properties using different interaction parameters. Most of the drugs are organic molecules with both hydrophobic and hydrophilic groups. These molecules often contain certain groups, which are responsible for their acidic, basic or amphoteric properties. Pharmacological properties of drugs are highly dependent on the solution behavior. In the present work an attempt has been made to study density and viscosity measurements of Cetrimide in aqueous glycerol to investigate various types of interactions [8, 9].

## 2. EXPERIMENTAL

### 2.1 Materials

The binary solvent selected for the study was glycerol + water. Double distilled water is used for preparation of solution mixture. The density and viscosity of water and glycerol are measured at room temperature and compared with literature values[10].

### 2.2 Apparatus and procedure

Densities of liquids and various solutions were measured at room temperature by using specific gravity bottle of 10 $cm^3$ capacity. A single pan electronic balance was used for weighing purpose. The weighing was repeated thrice to ensure the accuracy in weights with a little interval of time. The reproducibility of the result was close to hundred percent.

Viscosity measurements were carried out using Ostwald's viscometer with precision ± 0.1 %. The viscometer was clamped vertically in a thermostatically controlled water-bath, whose temperature was maintained constant at room temperature ± 0.02°C. A fixed volume (10ml) of the solution was delivered into the viscometer.
The procedure for measurement of viscosity is as follows. The viscometer is fixed vertically on the stand and 10 mL of water is pipetted into the lower bulb. The volume of water (10 mL) is chosen so that the liquid can be conveniently sucked into the upper bulb leaving some in the lower bulb. It is sucked up into the other bulb to a point about the mark above the bulb. Now it is released and stop clock is started when the meniscus crosses the mark. The clock is stopped when the mark below the bulb is passed. The time is recorded at the moment. The same procedure is repeated thrice and their average is used in calculations[10].

## 3. RESULTS AND DISCUSSION

Cetrimide is chemically Alkyl tri-methyl ammonium bromide. It is white crystalline powder, free flowing hygroscopic powder. It has faint characteristic odour and bitter soapy taste. It is soluble in water.

The densities and viscosities of glycerol- water binary mixture with cetrimide are measured and used for determination of **partial molar volume**. The partial molar volume ϕv was obtained from density results using equation 1.

$$\phi v = a*b + c \qquad 1$$

a=1000/C
b= ($d_0$* d/d)
c=M/d
Where do is the density of pure solvent & d is the density of solution, C is molar concentration, M is molar mass of drug.

Cetrimide is a salt of alkyl ammonium halide which has bulkier positive ion and negative bromine ion. It is observed that the ϕv values increases with concentration of cetrimide and increases with increase in concentration of glycerol [9](Table .1).

**Table 1: (Partial Molar Volume)**

| Sr. No. | Molar Concentration of cetrimide | 1% of Glycerol in cc | ϕv in cm3 mol-1 |
|---|---|---|---|
| 01 | 0.099 | 1.0 | 10414 |
| 02 | 0.098 | 2.0 | 10517 |
| 03 | 0.097 | 3.0 | 10625 |
| 04 | 0.096 | 4.0 | 10741 |
| 05 | 0.095 | 5.0 | 10868 |
| 06 | 0.094 | 6.0 | 10989 |

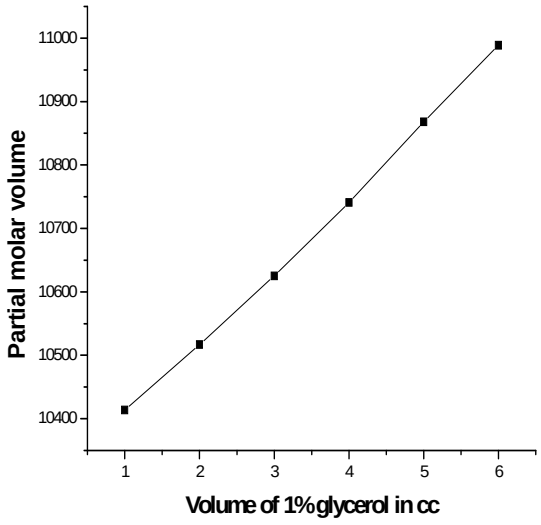


**Fig. 1: Graph of partial molar volumeVs volume of glycerol**

The density data was also used to evaluate **excess molar volumes** (Table 2) calculated by using the relation (Equation 2).

$a=(X_1M_1+ X_2M_2/\rho)$
$b= X_1M_1/ \rho_1$
$c= X_2M_2/ \rho_2$
$V^E = a-b-c$ 2
Where, ρ is the density of mixture, $M_1$, $X_1$, $V_1$ and $M_2$, $X_2$ & $V_2$ are the molecular weight, mole fraction and molar volumes of glycerol & water respectively. With increase in the concentration of glycerol the **excess molar volumes increases**[9]

**Table 2: (Excess Molar Volumes)**

| Sr. No. | Molar Concentration of Cetrimide | 1% of Glycerol in cc | VE in cm3 mol-1 |
|---|---|---|---|
| 01 | 0.098 | 2.0 | 0.006 |
| 02 | 0.097 | 3.0 | 0.24267 |
| 03 | 0.096 | 4.0 | 0.7451 |
| 04 | 0.095 | 5.0 | 1.7425 |
| 05 | 0.094 | 6.0 | 2.3120 |

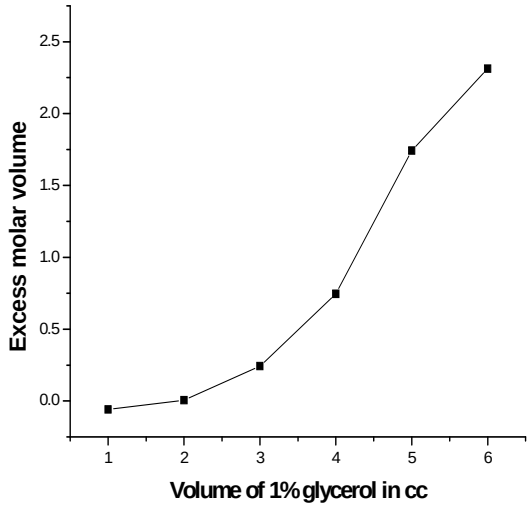


**Fig. 2: Graph of excess molar volumes Vs volume of glycerol**

**Excess viscosities** of non-electrolyte in binary system may be due to the presence of larger alkyl chain of cetrimide.

Excess Viscosity decreases in aqueous mixtures of glycerol. It seems that some kind of structural organization of water surrounding the hydrocarbon chain of glycerol is the most likely explanation of the observed dependence of viscosity on solvent composition[9].

The measured values of viscosities of liquid mixtures and those of pure components were used to calculate the excess viscosity $\eta^E$(Table.3) in the liquid mixtures using the formula (Equation 3)
$\eta^E = \eta_{mix} -( x_1 \eta_1 - x_2 \eta_2)$ (3)
Where $\eta_{mix}$ , $\eta_1$ & $\eta_2$ are the viscosities of liquid mixtures, component glycerol & water respectively and $x_1$ & $x_2$ are the mole fractions of component glycerol & water respectively[9].
The hydrocarbon residue of cetrimide in alcohol results in a considerable amount of hydrophobic hydration[9,11].
However the further decrease of excess viscosity with increase in percentage glycerol may result because these hydrophobic groups exert their effect predominantly with increase in alcohol percent (Fig 3). It appears that increase in v/v glycerol concentration a loss of hydrophobic hydration takes place which leads to decrease in excess viscosity [5,9].

**Table .3: (Excess Viscosities)**

| Sr. No. | Molar Concentration of cetrimide | 1% of Glycerol in cc | ηE in poise |
|---|---|---|---|
| 01 | 0.099 | 1.0 | 0.01355 |
| 02 | 0.098 | 2.0 | 0.01013 |
| 03 | 0.097 | 3.0 | 0.00655 |
| 04 | 0.096 | 4.0 | 0.003661 |

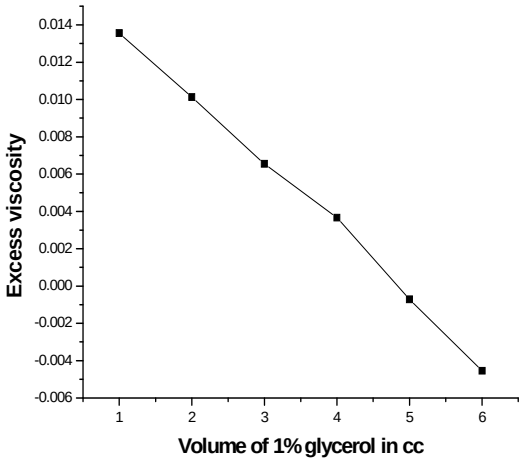


**Fig. 3: Graph of excess viscosity Vs volume of glycerol**

**Viscosity Coefficients:**

**Table 4**

| Sr No. | 0.1M soln of cetrimide in ml | 1% of Glycerol in cc | Viscosity in poise |
|---|---|---|---|
| 1 | 99 | 1.0 | 0.00855 |
| 2 | 98 | 2.0 | 0.00874 |
| 3 | 97 | 3.0 | 0.00880 |
| 4 | 96 | 4.0 | 0.00960 |

## 4. CONCLUSION

It is observed that the ϕv Partial molar volume, Excess molar volume values increases with concentration of cetrimide and glycerol.

Excess viscosity decreases with concentration of cetrimide and glycerol.

## 5. ACKNOWLEDGEMENTS:-

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