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THERMODYNAMIC STUDIES ON MICELLAR SOLUBILIZATION OF FORMIC ACID IN TRITON X 100 AQUEOUS MEDIUM

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ABSTRACT

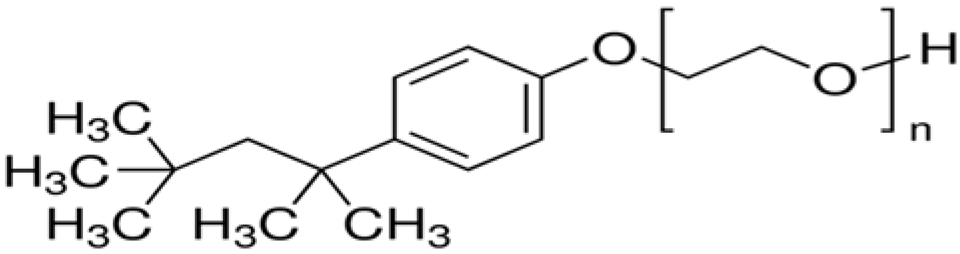
The CMC Value of Triton X 100 first increase with the increasing concentration of formic acid .But at a higher temperature of 320 K , the CMC value of Triton X 100 remains constant with increasing concentration of formic acid from 2×10^{-3} m to 6×10^{-3} m at lower temperature, lower concentration of formic acid is suitable for micellisation and solubilisation . But at higher Temperature, lower and higher both concentrations of formic acids are favorable for micellisation and solubilisation.

Key words : - CMC, Micellisation , Solubilization , formic acid .

INTRODUCTION

Surfactants (tensides) are organic substances, which signifícantly decrease the surface tension of water at relatively low concentrations, are at least partially water soluble. Because surfactants are adsorbed mainly on the surface of the solution, creating a thin monolayer, they are called surface active substances. When dissolving them, after they reach a certain value of concentration, molecules or ions of surfactants begin to associate and to organize themselves into more complex units, also called micelles. The characteristic concentration value, where the association process begins, is called the *critical micelle concentration* and it is labeled with symbol cc or abbreviation CMC. The CMC is one of the most useful physicochemical characteristics of many biologically active substances . From the chemical point of view, surfactants are mostly low-molecular compounds, so when dissolved, they form the true solutions in concentration ranges below the CMC. Micelles are aggregates of a larger number of simple molecules or ions of surfactants (e.g. several dozens), so the resulting size of such structures is in the colloidal range. For this reason the micelle solutions of surfactants are regarded as association colloids.The effect of formic acid on the self association processes of non-ionic surfactant and hence on the properties of the micelles formed has been investigated for several systems using a variety of techniques . The behavior of Triton X 100 micelles in the presence of Formic acid has been extensively investigated .

T riton X 100 is a type of nonionic surfactant, molecular formula $C_{34}H_{62}O_{11}$, molecular weight -646.86, CAS No:9002-93-1 exists as a liquid in normal physical state.



METHODOLOGY

A. Principles of Determination of CMC

The determination of CMC is generally based on the localization of the position of a breaking point in the concentration dependencies of equivalent conductance of surfactant solutions. The conductivity of any solution is directly proportional to the concentration of its ions. The dependence of equivalent conductance on the square root of concentration is used to determine CMC of ionic surfactants. The graph is plotted between $\sqrt{C}.10^2$ and $.\sqrt{C}$.

Where C is the concentration of the solution and is the equivalent conductance.

The breaking point in the graph represents the CMC.

This concentration dependence of equivalent conductivity is thus described by Onsager equation.

$$= {}_{0} - a.\sqrt{C}$$

Where, ${}_{0}$ is the corresponding equivalent conductance at the infinite dilution and 'a' is a constant.

Values of equivalent conductance are calculated from the experimental values of specific conductance .

Units: Equivalent conductance: ohm^{-1}

Concentration: $mol.dm^{-3}$

B. Materials, Chemicals and Equipments

1) Conductometer, conductivity electrode, thermometer, thermostat, stirrer, 25 ml analytical flask

2) Non ionic surfactant

(Triton X 100)

KCl solution

3) Redistilled water

C. Procedure

1) Preparation of stock solution of the surfactants with concentration $c=2X10^{-3}$ m to $14X10^{-3}$m in 25 ml analytical flask:

The weighed amount of surfactant is dissolved in calculated amount of distilled water.

2) From the stock solution, various other solutions are prepared of different concentrations:

c1.V1=c2.V2

c1=concentration of stock solution

V1=volume of stock solution

c2=concentration of solution to prepare

V2 volume of solution to prepare

3) Conductometer is calibrated :

For calibrating the conductometer, 0.1N KCl solution is prepared and electrode is dipped in it then its conductance value is set in the conductometer.

4) Solution is poured in conductivity vessel, stirrer is inserted and then the thermometer and conductivity electrode is immersed in it.

5) Thermostat is set to 305K.

6) The measurement:

First the reading of conductance is taken for the stock solution followed by solutions of different concentrations. The values observed are noted. The value so obtained is the observed conductance. From this value equivalent conductance is calculated. And then the graph is plotted between $\sqrt{C}.10^2$ and $.\sqrt{C}$. The break in the curve gives the CMC.

7) Now the thermostat is set to 310K then 315K, 320K and the measurements are made.

8) Similarly in presence of Formic acid, the values are determined.

D. Calculation of Equivalent Conductance

The value obtained with the help of conductivity meter is known as the observed conductance. Here the cell constant of conductivity meter was set 1. From this observed value, specific conductance is calculated.

Specific conductance = observed conductance x cell constant

Since the cell constant is 0.91 .

The product of the specific conductance and the volume gives the Equivalent conductance.

= .V

is the equivalent conductance

is the specific conductance

V is the volume

E. Calculation of Thermodynamic Parameters

Change in free energy, change in enthalpy and change in entropy is calculated by using the formula given below-

$$\Delta G^0 = RT \text{ Log CMC}$$

$$\Delta H^0 = -RT^2 \text{ d/dt Log CMC}$$

$$\Delta S^0 = \Delta H^0 - \Delta G^0/T$$

RESULT AND DISCUSSION

Effect of formic acid on the CMC value of Triton X 100

VARIATION OF CMC VALUE OF TRITON X 100 WITH INCREASING MOLAR CONCENTRATION OF FORMIC ACID AT 305 K

S.No.	Molar conc.Of formic acid	CMC value at 305 K
1	2.0×10^{-3}	2.5×10^{-4}
2	4.0×10^{-3}	3.0×10^{-4}
3	6.0×10^{-3}	3.5×10^{-4}

The CMC value of triton X 100 increasing with the increasing concentration of formic acid at 305 K

VARIATION OF CMC VALUE OF TRITON X 100 WITH INCREASING MOLAR CONCENTRATION OF FORMIC ACID AT 310 K

S.No.	Molar conc.of formic acid	CMC value
1	2.0 X 10^{-3}	2.0 X 10^{-3}
2	4.0 X 10^{-3}	2.5 X 10^{-3}
3	6.0 X 10^{-3}	3.0 X 10^{-3}

The CMC value of Triton X 100 increase with the increasing concentration of formic acid at 310 k

VARIATION OF CMC VALUE OF TRITON X 100 WITH INCREASING MOLAR CONCENTRATION OF FORMIC ACID AT 315 K

S.No.	Molar conc.of formic acid	CMC value
1	2.0X10^{-3}	1.5X10^{-4}
2	4. 0X10^{-3}	2.5X10^{-4}
3	6. 0X10^{-3}	3.0X10^{-4}

The CMC value of Triton X 100 remains constant with the increasing concentration of formic acid at 320 K

VARIATION OF CMC VALUE OF TRITON X 100 WITH INCREASING MOLAR CONCENTRATION OF FORMIC ACID AT FORMIC ACID AT DIFFERENT TEMPERATURES

Molar conc. Of formic acid X10^{-3}	CMC at 305 K	CMC at 310 K	CMC at 315 K	CMC at 320 K
2	2.5X10^{-4}	2.0X10^{-4}	1.5 X10^{-4}	1.0 X10^{-4}
4	3.0 X10^{-4}	2.5 X10^{-4}	2.5 X10^{-4}	1.0 X10^{-4}
6	3.5 X10^{-4}	3.0 X10^{-4}	3.0 X10^{-4}	1.0 X10^{-4}

It was observed that The CMC Value of Triton X 100 first increase with the increasing concentration of formic acid .But at a higher temperature of 320 K , the CMC value of Triton X 100 remains constant with increasing concentration of formic acid from 2X10^{-3} m to 6X10^{-3}m at lower temperature ,lower concentration of formic acid is suitable for micellisation and solubilisation . But at higher Temperature, lower and higher both concentrations of formic acids are favorable for micellisation and solubilisation.

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