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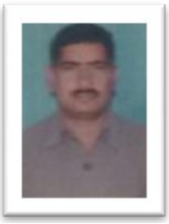
Innovation The Research Concept

Conductivity of Thorium Soaps

Abstract

The critical micellar concentration (CMC) of thorium soaps in a mixture of benzene methanol were determined by using conductometric measurements.The molar conductance at infinite dilution, degree of ionization and ionization constant have been evaluated. The result show that thorium soaps behave as simple electrolytes in dilute solution and CMC was found to decrease with increasing chain length of the fatty acid constituent of the soap.

Keywords: Thorium Soaps, Specific Conductance, Molar Conductance, Degree of Ionization Critical Micellar Concentration.



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Introduction

In recent past, metal soap has been a subject of intense investigation on account of its role in such diversified field as an emulsifiers, plasticizers, stabilizers, softeners catalysts, antioxidants, lubricants, germicides, medicines, preservatives. Cosmetics, thickners, insecticides, water proofing and wetting agents. The physico chemical charecteristics and structure of metal soaps can be controlled up to an extent by the methods and conditions of their preparations and so detailed studies of metal soaps are of great importance for their uses in various industries under different conditions.

Several workers [1-4] prepared the heavy metal soaps by double decomposition, metathesis, and fusion or by direct reaction of metal oxide with an organic acid. Mehrotra et al[5] reported the IR-spectra and X-ray diffraction pattern and magnetic moment of some Lanthanide soaps and also suggested a probable mechanism for thermal decomposition of these metal soaps. Da-Guang et al.[6] determined the structure of neodymium soaps by IR-spectra and X-ray diffraction pattern. Casellato et al.[7] correlated The available structural information of actinide soaps with their spectral and thermal characteristics. The Solubility of Different lanthanide soaps was determined by brzyska and Hubicki[8] . Kapoor et al.[9] measured the viscosity and conductivity of the uranyl soaps. Shukla et al.[10] investigated various physico-chemical properties of Dysprosium soaps in solid state as well as in solutions. Mehrotra et al.[11] carried out the coductometric, viscometric and ultra sonic studies on soaps of Ce, Sm, and Nd in pure and mixed organic solvents and determined the micellar and acoustic behavior of these soap solution. Now a days metal soap are being used[12-14] as eco-friendly thermal stabilizer in PVC products, as lubricant in medicines and for making soft and water proofing leather.

The present work has been initiated with a view to determine the CMC, molar conductance, degree of ionization and inonization constant of thorium soaps (laurate and myristate) in a mixture of benzene and methanol.

Aim of the Study

The studies on the utilization of metallic soaps in various industries are still being carried out as the problem is of immense importance from pharmaceutical and technical point of view. the practical utility of these metal soaps has attracted the attention of several workers as their physio-chemical characteristics and sturacture largely depend on the conditions and methed of prepration.

Experimental

All chemicals used were of BDH/AR grade. Solvents Benzne and Methanol were purified by distillation under reduced pressure. thorium soaps (laurate and myristate) were synthesized by direct metathesis Of corresponding their potassium soap with slight excess of the solution of thorium acetate at 50-55^{o}C under vigorous stirring. The precipitated soaps were washed several times with water and then acetone. The metal soaps thus obtained were first dried in an air oven at 50-60^{o}C and final drying of the soaps was carried out under reduced pressure. The soaps were purified by recrystallization with Benzene – Methanol mixture. The purity was checked by their melting points and absence of hydroxylic group was confirmed by IR spectra. The reproducibility of the result was checked by preparing two samples of the same soaps under similar conditions.

The solutions of soaps were prepared by dissolving a known amount of soap in a 40%benzene 60% methanol mixture (v/v) and were kept for 2 hr in a thermostat at a constant temperature of 40±0.05 ^{0}C.The soap do not possess high solubility in pure solvents thus measurements were conducted in benzene – methanol mixture. A digital conductivity meter (Toshniwal CL 01.10A) and a dipping type conductivity cell with platinized electrodes (cell constant 0.895) were used for measuring the conductance of soap solutions at 40±0.05 ^{0}C.

Results and Discussion

Thorium Soaps

The specific conductance, k of the dilute solutions of thorium soaps (laurate and myristate) in a mixture of Benzene and Methanol (4:6v/v) increases with increasing soap concentration, C (g mol l^{-1}) and decreasing chain length of fatty acid constituent of soap.(Table:I&II). The increase in the specific conductance with the increase in soap concentration may be due to the ionization of thorium soap into simple metal cations, Ce^{3+} and fatty acids anions, $RCOO^-$ (where R is $C_{11}H_{23}$and $C_{13}H_{27}$ for laurate and myristate respectively) in dilute solutions due to the formation of micelles at higher soap concentrations. The decrease in specific conductance with increasing chain length of soap may be due to the increasing size and deceasing mobility of anions with increasing chain length of the soap. The plots of specific conductance, k. vs Soap concentrations, C (fig) are characterized by intersection of two straight lines at definite soap concentration which corresponds to the CMC of soaps. The CMC is defined as the concentrations of the soap in the bulk at which micelles starts forming and above which micelles are spontaneously formed .It is suggested that the soap is considerably ionized in dilute solutions and the anions begin to aggregate to from micelles. The results show that the values of CMC decreases with increasing chain length of fatty acids constituent of soap molecule Table (III).

The molar conductance, μ of the solutions of thorium soap decreases with increasing soap concentration as well as increases with chain length of fatty acid constituent of soap. The decreases in molar conductance may be due to combined effects of ionic atmosphere, salvation of ions, decrease of mobility and ionization and formation of micelles. The plots of molar conductance, μ vs. Square root of soap concentration, $C^{1/2}$ are concave upward with increasing slops, which indicates that these soap behave as simple electrolyte. The Debye-Huckel – Onsager's equation is not applicable to these soap solutions and the limiting molar conductance, μ_0 cannot be determined by usual extrapolation method species can be written as:

$$(RCOO)_3Ce \Leftrightarrow Ce^{+3} + 3RCOO^-$$

C(1-α) Cα 3Cα

Where R is $C_{11}H_{23}$ and $C_{13}H_{27}$ for laurate and myristate respectively.

The ionization constant, K can be expressed as:

$$K = \frac{[Ce^{3+}][\mathrm{RCOO}^-]^3}{Ce[\mathrm{RCOO}^-]_3} = \frac{C\alpha(3C\alpha)^3}{C(1-\alpha)} = \frac{27C^3\alpha^4}{(1-\alpha)} \ldots\ldots\ldots.(1)$$

Since the ionic concentration are low and interionic effects are almost negligible in dilute solutions , the Solutions of soaps will note deviate appreciably from Ideal behavior and so the activities of ions can be taken as almost equal to the concentrations. The degree of ionization,α may be. May be replaced by the conductance ratio,μ/μ_0 is the molar conductance at finite concentration and μ_0 is the limiting molar conductance at infinite dilution. On substituting the value of α and rearranging, equation (1) can be written as:

$$\mu^3C^6 = \frac{K\mu_0^4}{27\mu} - \frac{K\mu_0^3}{27} \ldots\ldots\ldots(2)$$

The value of the ionization constant, K and limiting molar conductance, μ_0 have been obtained from the slope, (K μ_0^4/27) and intercept, (-K μ_0^3/27) of the linear plots ofμ^3C^3vs.1/μ below the CMC and are recorded (Table:III) . The results show that the values of limiting molar conductance increase while of ionization constant decreases with increasing chain length of the soap. The value of the degree of ionization α at different soap concentrations have been evaluated by assuming it as equal to the conductance ratio μ/μ_0. The plots of degree of ionization vs soap concentration show that the degree of ionization decreases rapidly in dilute solutions with the increase in soap concentration.The value of K calculated by using equation(1)and assuming the degree of ionization as equal to the conductance ratio are presented in Table: 1(I&II). The values show that K decreases with increasing chain length of the soap. The values of K show approximately constancy in dilute solutions but exhibit a drift with increasing soap concentrations which shows that the soap does not behaves as a very weak electrolyte. The drift in the values of ionization constant with increasing soap concentration may be partly due to the fact that Degree Ionization is not exactly iqual to the conductance ratio, μ/μ_0 and mainly due to the fact that the activities coefficient of ions are not equal to unity. The deviations at higher soap concentration may also be due to the failure of simple Debye-Huckel activity equation.

Table- I Conductance of Thorium Laurate in 40% Benzene and 60% Methanol at 40 ± 0.05°C

S. No.	Concentration C(g mole l^{-1})	Specific Conductance K	Molecule Conductance $\mu \times 10^6$	Degree of Association α	Dissociation Constant $K \times 10^{10}$
1.	0.0012	11.01	9.174	0.360	4.8
2.	0.0013	11.21	8.623	0.338	5.1
3.	0.0014	11.41	8.149	0.319	4.9
4.	0.0015	11.63	7.753	0.304	4.8
5.	0.0016	11.89	7.431	0.291	4.5
6.	0.0017	12.08	7.105	0.278	4.7
7.	0.0018	12.22	6.788	0.266	4.6
8.	0.0019	12.50	6.578	0.258	5.1
9.	0.0020	12.69	6.345	0.249	5.2
10.	0.0022	13.11	5.959	0.233	5.3
11.	0.0024	14.09	5.612	0.220	5.6
12.	0.0026	14.43	5.392	0.211	6.1
13.	0.0028	15.19	5.153	0.202	6.6
14.	0.0033	15.68	4.603	0.180	6.9
15.	0.0036	15.68	4.355	0.170	7.3
16.	0.0040	16.29	4.072	0.159	7.9

Table - II Conductance of Thorium Myrestate in 40% Benzene and 60% Methanol at 40 ± 0.05°C

S. No.	Concentration C(g mole l^{-1})	Specific conductance K	Molecule conductance $\mu \times 10^6$	Degree of association α	Dissociation constant $K \times 10^{10}$
1.	0.0011	8.64	7.854	0.346	1.9
2.	0.00 12	8.88	7.400	0.326	2.8
3.	0.0013	9.08	6.984	0.308	3.1
4.	0.0014	9.31	6.50	0.293	3.1
5.	0.0015	9.59	6.393	0.282	3.2
6.	0.0016	9.91	6.193	.0273	3.2
7.	0.0018	10.29	5.716	0.252	3.5
8.	0.0020	10.69	5.345	0.235	3.8
9.	0.0022	11.11	6.050	0.222	4.1
10.	0.0025	11.71	4.684	0.206	4.7
11.	0.0028	12.29	4.389	0.193	5.2
12.	0.0032	13.08	4.087	0.180	6.1
13.	0.0037	14.01	3.786	0.167	7.6
14.	0.0043	15.10	3.511	0.154	8.9
15.	0.0051	16.67	3.268	0.144	12.5

Table – III Value of CMC, Limiting Molar Conductance and Ionization, μ_0 Constant, k of Thorium Soap

Name of soap	CMC10^2 (gmol l^{-1})	μ_0	K
Thorium Laurate	00.34	12.87	5.8410^{-3}
Thorium Myristate	00.20	11.08	3.3410^{-3}

Conclusion

The specific conductance of the solution of soaps increases where as the molecular conductance decreases with the increase in soap concentration .the plots of specific conductance vs soap concentration show a break at the definite soap concentration which corresponds of the CMC of soap indicating the formation of the micelles in these soap solution th concave nature of the plots of molecular conductance vs square root of soap concentration so that these soaps behave as weak electrolyte in these solutions and Debye-huckel- Onsagars equation is not applicable to these soap solution.

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