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Data Collection in Qualitative Research of Conductometric Analysis on Carboxylates of Vanadium

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Abstract

The data collection in qualitative research of conductometric analysis on carboxylates of vanadium were determined in a mixture of benzene and DMSO. The data so obtained were used to determine the critical miceller concentration (CMC), limiting molar conductance, degree of ionization and dissociation constant.The results show that carboxylates of vanadium behave as simple electrolytes in dilute solutions. The CMC of vanadium carboxylates decreases with increasing the chain length of fatty acid constituent.

Keywords: Conductance, dissociation, carboxylates.

Introduction

Recently the study of metal carboxylates is becoming increasingly important in technological and academic field. The metal carboxylates has been a subject intence investigation in the recent past on account of its role in such diversified fields as lubricant, Stabilizers, emulsifiers, water proofing agent, medicines, cosmetic, anti oxidant and germicides. The technological application of metal carboxylates are mostly based up on imperical know-how and the selection of the metal carboxylates specific purpose mainly dependent largely on economic factors.The methods of preparation and uses of metal carboxylates were reviewed by several workers[1-8]. The thermogravimetric analysis of yttrium soaps in solid state was studied by Khirwar[9] . The IR spectra, X-ray and thermal analysis of lanthanum soaps were studied by Shukla et. al[10]. The studies of ultrasonic velocity and allied properties of magnese, cobalt and copper soaps in non aqueous medium Rawat[11]. The viscometric and spectral studies of copper soap in benzene and methanol mixture were studied by Rawat[12]. The ultrasonic behavior on carboxylates of vanadium in mixed organic solvent was studied by Khirwar[13].The present work deal with the data collection in qualitative research of conductometric analysis on carboxylates of vanadium in Benzene and DMSO mixture with a view to evaluate various allied parameters related to the acoustical properties of metal carboxylates solutions.

Aim of the Study

From the survey of literature reveals that the data collection in qualitative research of conductomeric analysis on carboxylates of vanadium have not been systematically investigated while they have many uses in academic field, technological and industries . The goal of this research work is that the systematically conductometric analysis on carboxylates of vanadium in mixture of benzene and DMSO.

Experimental

The carboxylates of vanadium were synthesized by direct metathesis of corresponding potassium carboxylates with the required amount of aqueous solution of vanadium nitrate at 50-55^{0}C under vigorous stirring. The precipitated soaps were washed several times with distilled water and then acetone to remove the fatty acid and metal nitrate. The soaps were purified by recrystallization with the benzene and DMSO mixture, dried in an air oven at 50-60^{0}C and the finally drying of the soaps were carried out under reduced pressure. The absence of hydroxyl group in the metal carboxylates were confirmed by studying its infrared absorption spectrum. A digital conductivity meter (Toshniwal CL 01.10A) and dipping type conductivity cell with platinized electrodes (cell constant 0.985 cm^{-1}) were used for measuring the conductance of metal carboxylates at constant temperature (40 ± 0.05^{0}C).

Results and Discussion

Specific Conductance

The specific conductance , k of the solutions of vanadium carboxylates in a mixture of 70% benzene + 30% DMSO (V/V) increases with increase in the soap concentration, C (Table 1). The increase in the specific conductance with the increase in the soap concentration may be due to the ionization of vanadium carboxylates into a simple metal cation M^{3+} and fatty acids anions $RCOO^-$ (where M is vanadium and R is $C_{13}H_{27}$, $C_{15}H_{31}$ and $C_{17}H_{35}$) in solutions and also due to the formation of micelles at higher concentration of metal carboxylates.The plots of specific conductance K, against the concentration,C of metal carboxylates are characterized by an intersection of two straight lines at a definite metal carboxylates concentration which corresponds to the CMC of metal carboxylates. The values of CMC for vanadium carboxylates at constant temperature (40 ± 0.05^0C) are recorded in (table 2).

Molar Conductance

The molar conductance, µ of the solutions of vanadium carboxylates in a mixture of 70% benzene + 30% DMSO (V/V) decreases with increase in the concentrationof metal carboxylates (Table 1) .The plot of the molar conductance , µ against the square root of the metal carboxylates concentration, $C^{½}$ is not linear which indicates that the metal carboxylates behaves as a simple electrolyte in these solutions. The limiting molar conductance, μ_0 cannot be obtained by the usual extrapolation method as the Debye-Huckel-Onsager's equation is not applicable to thesemetal carboxylates solutions.Assuming that the metal carboxylates are completely dissociated into M^{3+} and $RCOO^-$ ions. The dissociation of metal carboxylates may be represented as :

$$\underset{C(1-\alpha)}{M(RCOO)_3} \rightarrow \underset{C\alpha}{M^{3+}} + \underset{3C\alpha}{3RCOO^-} \ldots\ldots\ldots\ldots(1)$$

Where M stands for vanadium and R is Myristate, Palmitate and Stearate respectively , α and C are the dissociation constant , concentration of metal carboxylates, respectively.

The dissociation constant, K can be written as:

$$K = \frac{[M^{3+}][RCOO^-]}{[M(RCOO)_3]} \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

$$K = \frac{C\alpha[3C\alpha]^3}{C[1-\alpha]}$$

$$K = \frac{27C^3\alpha^4}{[1-\alpha]} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3)$$

Assuming that the solutions do not deviate appreciably from their ideal behavior the activities of ion can be taken almost equal to concentrations. Thus α may be replaced by conductance ratio μ/μ_0 where µ is the molar conductance at a finite concentration that is attributed to the ions formed by the dissociation of metal carboxylates and μ_0 is the limiting molar conductance of these ions.

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

The plots of μ^3C^3 against 1/µ is linear with intercept and slope equal to $K\mu_0^3/27$ and $K\mu_0^4/27$ respectively. The values of the limiting molar conductance, μ_0 are recorded in Table 2.

Table 1

Conductivity measurements of vanadium carboxylates in70% benzene + 30% DMSO (V/V) at 40 ± 0.05^0c

Sr No.	Concentration(mol/l)	Vanadium myristate		Vanadium palmitate		Vanadium stearate	
		Specific conductance K × 10^6 $\Omega^{-1}cm^{-1}$	Molar conductance Ω $\Omega^{-1}cm^{-2}mol^{-}$	Specific conductance K × 10^6 $\Omega^{-1}cm^{-1}$	Molar conductance Ω $\Omega^{-1}cm^{-2}mol^{-}$	Specific conductance K × 10^6 $\Omega^{-1}cm^{-1}$	Molar conductance Ω $\Omega^{-1}cm^{-2}mol^{-1}$
1.	5.2	25.3	8.12	27.6	8.23	30.5	9.63
2.	4.7	21.6	9.23	26.4	8.79	26.4	10.21
3.	3.5	20.9	9.56	24.3	9.53	24.5	13.52
4.	3.0	20.1	10.24	23.9	10.12	23.8	15.26
5.	2.9	16.3	11.41	22.2	12.25	23.1	17.95
6.	2.3	16.0	13.45	22.0	15.36	22.9	18.64
7.	1.9	15.8	15.02	21.9	16.12	22.4	20.36
8.	1.6	15.5	15.93	21.6	18.63	21.7	24.95
9.	1.2	15.4	16.26	21.1	20.76	21.2	24.12
10.	1.5	15.3	19.34	20.4	21.34	21.4	25.15

Table 2 : Values of CMC and Limiting molar conductance of metal carboxylates in70% benzene + 30% DMSO (V/V) at 40 ± 0.05^0c

Sr No.	Metal Carboxylates	CMC (mol/l)	μ_0
1.	Vanadium Myristate	0.0027	32.1
2.	Vanadium Palmitate	0.0025	18.6
3.	Vanadium Stearate	0.0023	10.9

Conclusion

The conductivity results confirms that the vanadium carboxylates behave as a simple electrolyte in these solutions and Debye-Huckel equation is not applicable to these metal carboxylates solutions. The values of the limiting molar conductance (obtained by the usual extrapolation method) and dissociations constant K, obtained from equation (3) are in agreement with values obtained from the slope and intercept of the plot of μ^3C^3 Vs 1/µ.

Endnotes

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