Thermodynamics of the Dissociation of Neodymium Soap Solutions in Benzene-Dimethyl Sulphoxide

Chhaya Chauhan*

Department of Chemistry, Christian Eminent College, Indore, (M. P.), India

ABSTRACT: To determine the critical micellar concentration (CMC), limiting molar conductance at infinite dilution, degree of dissociation and dissociation constant .The values of CMC decreases with increasing chain length of fatty acid component of soaps .The results shows that Neodymium soaps behaves as a weak electrolyte in dilute solutions below the CMC and Debye-Huckel-Onsager equation is not applicable to these soap solutions. The thermodynamic parameters indicate that the micellization process is favored over the dissociation process.

Keywords: Critical micellar concentration; micellization; thermodynamic parameters; Neodymium soaps

INTRODUCTION: Metallic soaps are widely used in many industries as anti-oxidants, catalyst, lubricants, cosmetics, medicines, preservatives, fungicides, insecticides, emulsifiers, water-proofing agents, plasticisers, softeners and detergents. The technological application of these soaps depends on the physicochemical properties like their physical state, thermal stability, chemical reactivity and solubility in polar and non-polar solvents. Several workers[1-6] have used different techniques for studying the preparation, properties and uses of metal soaps. Metal soaps with element of lanthanide series were synthesized for the first time by Mishra et al[7]. Mehrotra et al[8-9] investigated acoustical and thermodynamic properties of lanthanide soaps and concluded that these soaps behaves as weak electrolyte in dilute solutions. Upadhyaya et al[10] studied the thermodynamics of dissociation, micellization and conductance behaviour of alkaline-earth metal soaps. Topallar et al[11] investigated conductance of erbium soaps in different solvents.

The present paper deals with the study of conductance, micellar behaviour and thermodynamic parameter of Neodymium soaps in a mixture of 60/40 benzene-dimethylsulphoxide mixture (V/V) at different temperatures.

MATERIAL AND METHODS: Anal R grade higher fatty acid (caprylic acid and lauric acid), potassium hydroxide, neodymium acetate (purity 99% received from Indian Rare Earth Limited, Kerala) were used for the present investigation. Neodymium soaps (caprylate and laurate) were prepared by the direct metathesis of corresponding Neodymium soaps by pouring a slight stoichiometric excess of aqueous neodymium acetate solution into the clear dispersion at raised temperature with vigorous stirring. The precipitated soaps were filtered off and washed with hot distilled water and acetone. After initial drying the final drying was carried out under reduced pressure. The soaps were purified by recrystallization and the purity of the soaps was established by observing their melting points, IR spectra and elemental analysis.

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Solutions of Neodymium soaps were prepared by dissolving a known amount of soap in a mixture of 60% benzene and 40% dimethylsulphoxide and kept for 2 hours in a thermostat at a desired temperature.

Measurements: The conductance of solutions were measured with a "Systronics conductivity Bridge 305" and a dipping type conductivity cell (cell constant 1.0 cm-1) with platinised electrodes at 25-40°C (±0.05°C). The specific and molar conductance were expressed in mhos cm-1and mhos cm-1(g mol)-1litre respectively.

Table 1: Critical Micellar Concentration, CMC (g mole l-1) of Neodymium Caprylate and laurate in a mixture of 60/40 benzene-dimethylsulphoxide (V/V) at various temperatures.

Name of the Soap	CMC x 10^3 (gm mol l^{-1})			
	25 ^{0}C	30 ^{0}C	35 ^{0}C	40 ^{0}C
Neodymium Caprylate	4.50	4.70	4.80	5.10
Neodymium Laurate	4.0	4.15	4.50	4.80

RESULTS AND DISCUSSION:

Specific Conductance: The specific conductance, k of the solutions of Neodymium caprylate and neodymium laurate in 60/40 benzene-dimethylsulphoxide mixture (V/V), increases linearly with increase in the temperature and increase in soap concentration .The increase in specific conductance may be due to partial dissociation of these soaps in mixed solvent in dilute solution and due to formation of micelles at higher soap concentration. The specific conductance decreases with increase in chain length of fatty acid constituent of the soap molecule may be due to increasing size and decreasing mobility of anions .The plots of specific conductance ,k Vs. Soap concentration C are characterized by an intersection of two straight line at a concentration which corresponds to the CMC of the Neodymium soaps which indicates that these soaps are considerably ionized in dilute solutions and the formation of ionic micelles takes place at this concentration.

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