A probe into the aqueous behaviour of alkaline earth metal dodecylsulphates through density measurements (25-45^{0}C)

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ABSTRACT

The density measurement, $\rho(gcm^{-3})$ for aqueous solutions of dodecylsulphates of Ba, Sr, Ca, Mg [abbreviated as $Ba(DS)_2$, $Sr(DS)_2$, $Ca(DS)_2$, $Mg(DS)_2$] at different temperatures (25-45^{0}C) has been used to evaluate various parameters which might throw light on different aspects of solution behaviour. The critical micelle concentration (c.m.c.), as obtained from ρ-C plots, is found to decrease with increasing metal size and increasing temperature. Density for these solutions increases with increasing surfactant concentration and decreasing temperature. The ρ values for these compounds however vary as : $Ca(DS)_2 > Sr(DS)_2 > Mg(DS)_2 > Ba(DS)_2$. Partial molar volume ($\phi^o_v$) and experimental limiting slope (S_v) as determined from Masson's equation provide information on solute-solvent and solute-solute interactions, respectively. Apparent molar volume (ϕ_v) is found to increase with increasing concentration and increasing temperature.

Key words : Critical micelle concentration (c.m.c.), Alkaline earth metal dodecylsulphates, Density, Molar volume, Aqueous solution behaviour.

Data on molar volume has proved to be a useful tool to study the solute-solvent interactions (Bahadur, 1974). The apparent molar volume of glycine for inorganic salt solution of different concentrations was found to increase linearly with increasing concentration of the ions (Bhargava, 1976). Density data for aqueous solutions of 4-amino butyric acids at 25^{0}C are also found to vary linearly with molarity (Blockhra and Verma, 1977). The apparent molar volume of ammonium acetate solutions was also determined from density data using Young's rule (Blokhra and Thakur, 1981). Dielectric constant of the medium was used to characterize tetraalkylammonium iodides in ethanol-water mixtures (Franks and Ives, 1966). Dielectric constant however was found to play a dominating role in controlling the nature of the slope, Sv. Reference (Franks and Cuickenden, 1968; Franks *et al.*, 1968; Hepler, 1969; Jalicoeur and Philip, 1975; Kashimoto *et al.*, 2006 and Kay and Evans, 1966) on solute-solvent interactions indicate that density measurements proved useful to detect and explain the process of micellization. The density measurements were employed to study the micellar behaviour of the calcium soaps in water, methanol and water-methanol mixtures (Kim *et al.*, 2006). Density data was also used to determine the c.m.c. of Copper (Lafitte, 2005), iron (Mason, 1947 and Mehrotra *et al.*, 1970) and Cobalt (Millero, 1968) soaps of lower fatty acids in non-aqueous media.

Apparent molar volume and limiting apparent molar volume for electrolytes (Millero, 1970) and non-electrolytes (Millero, 1971) have found application to characterize solute-solute, solute-solvent and solvent-solvent interactions taking place in solutions. Hepler (Ram Goapl and Siddiqu, 1968) and Jolicoeur *et al.* (Ram Gopal *et al.*, 1970) have however studied the effect of temperature on partial molar volume of hydrophobic solutes so as to obtain significant informations on solute-solvent interactions. Recently, however, research workers (Ram Gopal *et al.*, 1973, Ram Gopal and Pathak, 1978 and Root, 1933) have shown a keen interest for surface charge density of various amphipathetic substances. Kim *et al.* (Ram Gopal *et al.*, 1973) in the year, 2006 have thus carried out an investigation on polymerized rod like nanoparticles with controlled surface charge dentisy. G. Lafitte and Co-workers (Ram Gopal and Pathak, 1978) have utilized mixtures of mucin and oppositvely charged surfactant aggregates with varying charged density to probe their phase behaviour, association, and dynamics. Kashimoto *et al.* (Root, 1933) have also probed the surface density of surface-active substances through total reflection x-rays absorption fine structure measurement.

Present investigation however incorporates work on partial molar volume and expansibility so as to obtain useful information on micellization and solution behaviour *i.e.* solute-solvent and solute-solute interactions. Increasing surfactant concentration and increasing temperature increases the apparent molar volume which is consistent with the general expectation. Partial molar expansibility (E^0_{surf}) for these surfactant systems are also found to increase with increasing temperature.

MATERIALS AND METHODS

Anala R-grade sodium dodeylsulphate (NaDS) and