Ultrasonic Studies of a surfactant SHS in Water and in Aqueous Alanine Solutions

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Abstract: The present communication deals the structural behaviour of Sodium Hexane Sulphonate (SHS) in water and in aqueous alanine solutions at 303°K in terms of classical absorption, relaxation frequency, relaxation time and relaxation strength.
Keywords: Ultrasonic, SHS, Aqueous Alanine Solution.

I. INTRODUCTION

Surface science is the branch of physical organic chemistry which deals with the behaviour of molecules at/near a surface/interface. The interface can be liquids, solids or gasses or any combination thereof. The molecules which modify their behaviour at interface and called surface-active-agents or 'surfactants'. In others words surfactant are chemical compounds having ability to alter the properties of fluid interface and belongs to a class of amphiphiles possessing dual strong conflicting chemical characteristics[1].

Surfactants are amphiphathic molecules which consists of a non-polar hydrophobic portion, usually a straight/branched hydrocarbon/fluorocarbon chain containing 8-18 carbon atoms which is attached to a polar/ionic portion (hydrophilic). The hydrophilic portion can, therefore, be non-ionic, ionic/zwitterionic and accompanied by counter-ions in the last two cases. The hydrocarbon chain interacts weakly withthe water molecules in an aqueous environment whereas the polar ionic head groups interacts strongly with water molecules via dipole or ion-dipole interactions [2].

Sodium hexane sulphonate (SHS) in an anionic surfactant with the formula $Na^+.C_6H_{13}.SO_3^-$. The molecular weight of SHS is 206.24. SHS is a white crystal type solid and 100 percent soluble in water.

Alanine is hydrophobic molecule. It is ambivalent, meaning that it can be inside or outside of the protein molecule. The α-carbon of alanine is optically active, in protein, on the L-isomer is found. Alanine is the α-amino acid analog of the α-ketoacid pyruvate and intermediate in sugar metabolism. Alanine and pyruvate are interchangeable by a transmination reaction its molecular formula $C_3H_7NO_3$, weight 89.09. Sodium Hexane Sulphonate is used as household cleaner. This is also used in preparing methyl, 6,6-dim ehtyl-3-azobiccyclo [3.1.0] hexane 2-2 carboxylate free base and the process for preparing the bisulfite adduct intermediate it has medicinal value [3].

The present paper deals with the ultrasonic studies of SHS in water and in alanine solution. This paper also deals the interaction of SHS with alanine in its aqueous solution in relation to the acoustical parameters viz. classical absorption, relaxation frequency relaxation time and relaxation strength.

II. MATERIALS AND METHODS

All chemical used in work were either Sarabhai M Chemical are CDH or BDH A-R grade with minimum asse 99.8%. Binary solutions of SHS of different molarities (0-10m) were prepared by weight-dilution method using its aqueous stock solution of molarity (10mM) and double distilled ionized water. The ternary solution of SHS of different molarities were also prepared in similar way using its aqueous stock solution of molarity (10mM) and stock solution of 0.5 m alanine solutions.

In the present study, ultrasonic interferometer has been used for measuring ultrasonic velocity of solutions at 303K. Single crystal ultrasonic interferometer (Miltalenterprised, New Delhi, Model F-81) was used at a fixed frequency of 1.5 MHz.

The densities of water and binary solution of SHS in water and ternary solution (0.5M), alanine were measured at 303K by calibrated bi-capilarypyknometer in conventional way. Density data were found to be accurate within 10.2%.

III. RESULT AND DISCUSSION

The results of ultrasonic studies of SHS in water and in0.5 M alanine ternary solution at 303ºK are shown in the Tables 1 and 2. From the table (1) it is quite clear that there are non-linear relationship which exhibits maximum deviation from linearity which further indicates strong-solvent-solute interactions in binary solution and strong solute-solute interaction in ternary solution.

The relation of relaxation frequency (fr) vs SHS molarity at 303ºK are shown in the Table-1. The data show maximum deviation from linearity which further indicates strong solvent-solute interaction in binary solution and strong solute-solute interactions in ternary solutions.

Table-1. Classical Absorption (α/F^2) $\times 10^{30}$/mS^{-2} and Relaxation Frequency (F$_r$) 10^{-14}/S^{-1} of SHS in water and in 0.5M Alanine Solution at 303K

SHS Molarity (mM)	0.0M Water		0.5M Alanine	
	α/F^2	F_r	α/F^2	F_r
00	6.43	32.83	5.74	35.52
01	5.92	35.64	5.77	35.28
02	5.89	35.84	5.86	37.90
03	5.72	36.48	6.15	33.48
04	5.95	35.00	5.60	36.63
05	6.38	33.08	6.00	33.98
06	6.33	33.22	5.65	05.79
07	6.32	33.29	5.93	35.14
08	5.83	36.09	5.93	04.66
09	6.36	33.05	5.82	35.20
10	5.94	35.54	5.95	34.18

The relaxation strength is also most significance relaxation parameter for investigating relaxation behaviour of a system and has been estimated using the equation (3.42). The relation of relaxation strength (γ) vs SHS (mM) in water and in 0.5 M alanine solution at 303K are shown in the Table-2. The data are almost linear which indicates the presence of short range weak interactions.

The relation of relaxation time (τ) vs SHS (mM) in water and in (0.5M) alanine at 303K are shown in table (2). The relaxation time is most important parameter. The data are non non-linear and exhibit maximum deviation from linearity which also indicates the presence of strong solvent-solute interaction in binary solution and strong solute-solute interactions in ternary solution.

Table-2. Relaxation Time (τ) $\times 10^4$/s and Relaxation Strength (γ) of SHS in water and in 0.5M Alanine Solution at 303K

SHS Molarity (mM)	0.0M Water		0.5M Alanine	
	τ	γ	τ	γ
00	484.68	-8636.36	447.95	-9335.38
01	446.43	-8682.92	450.80	-9275.08
02	443.96	-8717.88	465.892	-9179.04
03	435.87	-8882.05	475.03	-9131.18
04	454.42	-8870.27	436.81	-9239.02
05	480.77	-8694.57	468.05	-9275.08
06	478.94	-8741.26	444.58	-9408.00
07	477.91	-8752.93	452.78	-9239.02
08	440.83	-8788.05	458.83	-9119.24
09	481.41	-8694.55	451.89	-9251.04
10	447.69	-8648.00	465.57	-9311.26

III. CONCLUSION

From the present study it can be concluded that there is strong interaction with the water molecules which renders the surfactants solute in water. The balance between hydrophobic and hydrophilic parts of the molecule give these systems there specific properties such as accumulation at various interfaces and association in solution (formation of micelles) [4].

The driving force of surfactant adsorption is defined as the lowering of the free energy of the phase boundary. The interfacial free energy per unit area is the amount of work required to expand the interface. This interfacial free energy is called surface/interfacial tension (γ).

Adsorption of surfactant molecules at the interface lowers the surface/interfacial tension. The degree of surfactant adsorption at the interface depends on surfactant structure and the nature of the two phases which meet at the interface [5].

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