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An Article :

Interfacial chemistry and interface

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Operation and effects of surfactants can be understood as follows; Surfactants reduce the surface tension of water by adsorbing at the liquid-gas interface. They also reduce the interfacial tension between oil and water by adsorbing at the liquid-liquid interface. Many surfactants can also assemble in the bulk solution into aggregates. Some of these aggregates are known as micelles. The concentration at which surfactants begin to form micelles in known as the *critical micelle concentration* or *cmc*. When micelles form in water, their tails form a core that can encapsulate an oil droplet, and their (ionic/ polar) heads form an outer shell that maintains favourable contact with water. When surfactants assemble in oil, the aggregate is referred to as a *reverse micelle*. In a reverse micelle, the heads are in the core and the tails maintain favourable contact with oil. Surfactants are also often classified into four primary groups; anionic, cationic, non-ionic and zwtterionic (dual charge). Thermodynamics of the surfactant systems are of great importance, theoretically and practically. This is because surfactant systems represent systems between ordered and disordered states of matter. Surfactant solutions may contain an ordered phase (micelles) and a disordered phase (free surfactant molecules and / or ions in the solution). Ordinary washing up (dishwashing) detergent, for example, will promote water penetration in soil, but the effect would only last a few days (although many standard laundry detergent powders contains levels of chemicals such as sodium and boron, which can be damaging to plants, so these should not be applied to soils). Commercial soil wetting agents will continue to work for a considerable period, but they will eventually be degraded by soil micro-organisms. Some can however, interfere with the life-cycles of some aquatic organism, so care should be taken to prevent run- off of these products into streams, and excess product should not be washed down gutters. When a water droplet is in the air, surface tension, a force to reduce the surface area acts on the surface of the water, resulting in spherical water droplets. When water and oil are present in a container, they do not mix together even after stirring and separate in two layers (Fig. 1).

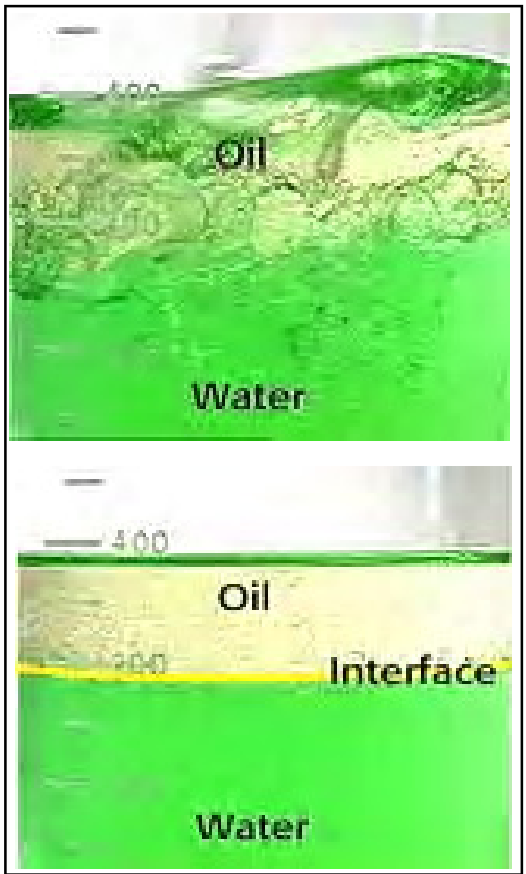


Fig. 1 : Depiction of an interface

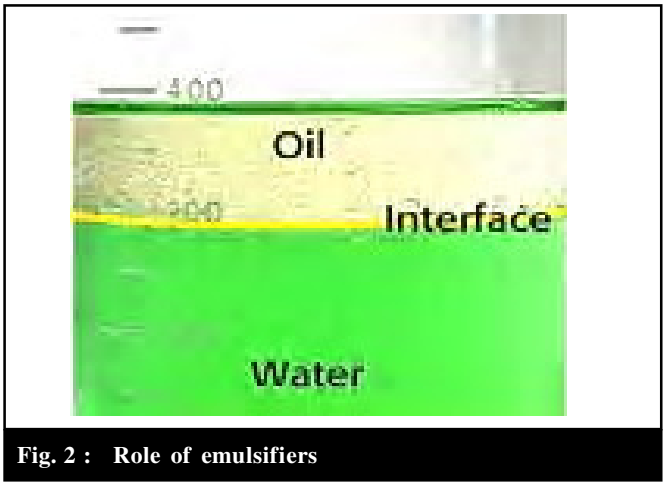


Fig. 2 : Role of emulsifiers

When two immiscible substances are in contact, the contact surface is called interface. Interfacial tension, a kind of surface tension acts on the interface so that the two substances separate from each other. As interfacial tension increases, the force to separate two substances becomes stronger. Surfactant weaken interfacial tension and changes the properties of an interface.

Food emulsifieres (Role of emulsifiers):

Events almost impossible under ordinary conditions are made possible by these effects. Interface is not only present between water and oil, but also in the boundary among various immiscible substances, and as foods are generally composed of carbohydrates, protein, fats and oils, water and air, they include many interfaces. Surfactant for food is called food emulsifier which distinguishes it from other surfactants for industrial use. Surface-active agent is a substance (such as a detergent) which, when added to a liquid, reduces its surface tension thereby increasing its spreading and wetting properties. In the dyeing of textiles, surface-active agents help the dyel penetrate the fabric evenly. They are used to disperse aqueous suspension of insoluble dyes and perfumes. The surface-active molecule must be partly hydrophilic (water-soluble) and partly lipophilic (soluble in lipids, or oils). It concentrates at the interfaces between bodies or droplets of water and those of oil, or lipids, to act as an *emulsifying agent* or *foaming agent*. Other surface-active agents that are more lipophilic and less hydrophilic may be used as *defoaming agents*, or as demulsifiers. Certain surface-active agents are germicides fungicides, and insecticides. Surface-active agents are used in corrosion inhibition, in ore flotation, to promote oil flow in porous socks, and to produce aerosols (Fig. 2).

HLB and emulsifiers in water / oil or oil / water:

The hydrophilicity and lipophilicity are different among emulsifiers, and the balance between the two is called *HLB value*. *The value ranges from 0 to 20*. An emulsifier with higher lipophilicity shows a lower HLB whereas higher hydrophilicity has higher HLB, and the behaviours and functions to water depend on the *HLB*.

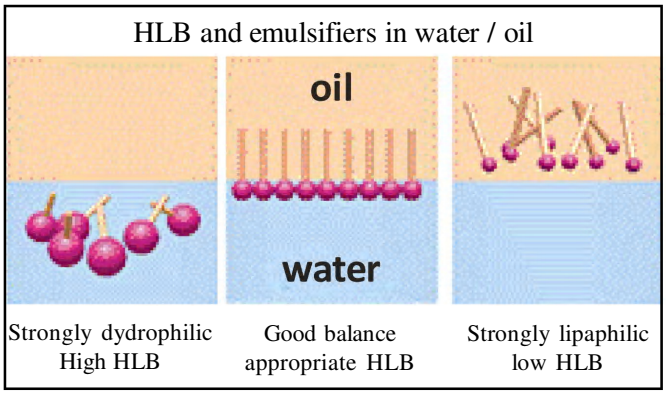
All compounds that have hydrophilic parts are not always useable as an emulsifier. When hydrophilicity is too great, such compounds disperse into water and the ones with great lipophilicity would disperse into oil.

The references (1–12) are in plenty to suggest the versatility and multifarious industrial utilities of anionic surfactants. Alkalimetal soaps/heavy metal soaps, sulphated fatty alcohols, sulphated polyoxyethylated alcohols and sulphated oils etc. constitute this important class of surfactants *i.e.* anionic surfactants. There is no gain– saying the technological significances of soaps. The full swing in research activities in recent or distant past would confirm the validity of the statement.

Sulphated fatty alcohols are salts (usually sodium) of the sulphuric esters of the higher fatty acids. The most common example is sodium lauryl sulphate B.P. which is a mixture of sodium alkyl sulphates, the chief of which is sodium dodecyl sulphate $C_{12}H_{25}SO_4Na^+$. Sodium lauryl sulphate is used pharmaceutically as a pre- operative skin cleanser having bacteriostatic action against gram-positive bacteria and also in medicated shampoos. The lower chain length compounds around C_{12} have better wetting properties whereas the higher members, C_{16} - C_{20} have better detergent properties. Triethanolamine and ammonium salts are used in hair shampoos and cosmetics.

Density measurements, were used to determine the critical micelle concentration of copper (13) and cobalt (14) soaps of lower fatty acids in non-aqueous media. Theoretical evaluation of sound velocity and other acoustic parameters for aqueous solutions of sodium dodecylsulphate (NaDS) at different temperatures were

Characteristic behaviors related to water	HLB	Ratio		Functions	
		Hydrophilic part	Lipophilic part		
Not dispersing	0	0	100		
	2	10	90	anti-foaming agent	
Slightly dispersing	4	20	80		W/O emulsification
	6	30	70	wetting agent	
Milky dispersion	8	40	60		
Stable milky dispersion	10	50	50		
Transparent dispersion	12	60	40		
	14	70	30	cleaning agent	O/W emulsification
	16	80	20	solubilizing agent	
Colloidal solution	18	90	10		
	20	100	0		



computed (15, 16). Research workers (17–20) have recently shown keen interest in the study of various physical properties of transition metal soaps. It is now almost thirty-three years since "solubilization by surface active agents" appeared. Since the publication of that monograph the subject has expanded rapidly as unique potential of surfactants has become known to a wider circle of scientists. Two important investigations: One on the solubilization of 2- Phenyl ethanol in surfactant vesicles and micelles (21), and the other on the solubilization of perfume compounds by pure surfactants and mixtures of

Type		W/O							O/W											
	HLB	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0
Monoglycerides	3~4																				
Acetylated monoglycerides	1																				
Lactylated monoglycerides	3~4																				
Citlated monoglycerides	9																				
Succinylated monoglycerides	5~7																				
DATEM	8~10																				
Polyglycerol esters	1~14																				
Sucrose esters	1~16																				
Sorbitan esters	2~9																				
CSL, SSL	7~9																				
Lecithin	3~4																				

surfactants have been reported (22). Several phenomena in mixed surfactant systems have also been studied (23). Performance and chemical stability of a new class of ethoxylated sulphate surfactants in a subsurface remediation application has also been reported (24). A conference on detergent industry has brought forth the significance of the role of surfactants in the environment (25). Modification of Krafft temperature or solubility of surfactants using surfactant mixtures has been studied (26). Clean-up of oily wastewater by froth flotation: Effect of micro emulsion formation has been investigated by S.P. Pondstabodee and co–workers (27).

The latest publications (28–30) by W.J. Leigh and co–workers have stated the significance of organometallics to the wide surfactant domain. Several national and international publications (31–39) in recent past have also appeared indicating keen interest by research workers in the study of different physical properties of surfactants. Some more latest investigations (40, 41) have appeared in the literature. An investigation (40) on micellar-enhanced ultrafiltration in a spiral wound ultrafiltration module and comparision with stirred cell performance has been carried out. An important publication by J.F. Scamehorn and J.H. Harwell on 'surfactant-based representation: Science and technology' has appeared in the literature (41).

It is obvious from the perusal of the reported literature (1-41) that the physico-chemical characterization, better termed as macroscopic or bulk behaviour of transition metal dodecyl (lauryl) sulphates needs be thoroughly examined. It has, therefore, been our earnest endeavour to synthesise and characterise the lauryl sulphates of chromium, manganese, iron and cobalt, so as to secure some significant data that might be useful to various industries technologically.

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