Synthesis of Some Organic Surfactants and Using as Inhibitors for Corrosion of Carbon Steel in Aqueous Solution

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Surface active agents Surface active agents can be defined as those which affect the interfacial tensions between two surfaces such as solid/liquid, liquid/liquid, or even liquid/gas. They include compounds with emulsifying, wetting, softening, penetrating and detersive properties. As cen well be understood, not all surface active agents must fulfill all the above requirements. The chemical constitution of the surface active agents is an important factor in its behavior.Classification of surface active agentsa- Anionic has negative charge like (sulfate, sulfonate, carboxylate, hydroxyl),b- Uncharged likes nonionic (poly glycol ether groups) and hyDROPhobic part (is a hydrocarbon chain linear or branched) has sufficient length to give the required oil solubility.c- Cationic has positive charge likes tetra alkyl ammonium chlorided- Amphoteric has both positive and negative charges like betaineA- Anionic surface active agents.They are surface-active substances in which e.g. one hyDROPhobic hydrocarbon group is connected with one or two hyDROPhilic groups. In aqueous solution, dissociation occurs into a negatively charged ion -(anion) and positively charged ion (cation). The anion is the carrier of the surface active properties. The sulfated and sulfonated materials represent the largest group of surface-active agents, exclusive of soap. Chemically, these products are divided into two categories:1- Sulfates.Compounds in which sulfur is attached to the carbon chain through an oxygen:1.1- Sulfated oils.The sulfation of fatty materials to yield surface-active compounds was discovered by Fermy almost 150 years ago, when he treated olive oil with sulfuric acid [1]. Historically, it is the earliest reported example of a non-soap organic surfactant. This called “sulfuric acid oil” was used as a mordant and was found to be superior to untreated olive oil which was also used for this purpose. Castor oil and rapeseed oils were ethoxylated and sulfates [2,3]. The resultant product were used in dying with alizarin red, laundering, dishwashing and detergents [4].1.2- Sulfated monoglycerides.Colgate-Palmolive Company.[5-7] produced sulfated fatty monoglycerides in the united states in the early 1940. Sulfated monoglycerides were produced by the reaction of three relatively inexpensive raw materials; fat (coconut oil), glycerol and sulfuric acid (eq. 1).Coconut oil monoglycerides were used for many years by Colgate-Palmolive Co. in a number of major products, including a synthetic detergent, light-duty detergents, shampoos and toothpaste. The surface active properties of pure monoglycerides sulfates were reported by Biswas and Mukherji [8,9] who found that the C14 homologues have the best foaming power and exhibit the greatest surface tension-lowering effect.1.3- Fatty alcohol sulfates.The fatty alcohols are normally derived from fatty acids by catalytic reduction under pressure [10]. Various -glycerides and simple esters have been reduced to fatty alcohols with either sodium alcohol, lithium aluminum hydride (LAH) [11], catalytic hydrogenolysis or by sodium borohydride ($NaBH_4$) in a mixture of t-butanol and methanol [12], sulfuric acid, chlorosulfonic acid, amidosulfonic acid also gaseous sulfur trioxide may be utilized in the production of primary fatty alcohol sulfates (eq. 2-5).1.4- Alkyl ether sulfates.Higher alcohol ethoxylate sulfate (C8-C20) linear or branched are prepared by sulfation of $RO-(C_2H_4)_nOH$ (R1, n = same as above) using SO_3 diluted to 0.1-3 vol. % with an inert gas to give 93.3% sulfated products. On the other hand, sulfates were prepared from oxypropylated alkyl glucosided by reacting with chlorosulphonic acid in cooled system [13].Weil et al. [14] reported the preparation of anionic surfactants through sulfation of the polyoxypropylation products of certain fatty alcohols. Similar compounds were obtained through sulfation of polyoxypropylated lauryl alcohol [15]. Also, polyoxypropylene glycol alkyl monoethers were obtained from C8-C18 aliphatic alcohols and propylene oxide in presence of a basic catalyst. These compounds were used to synthesize a series of sulfate-type anionic surfactants. It was also found that, the presence of oxypropylene units in a molecule of the compound enhances the surface activity and wetting ability of these surfactants [16].2- Sulfonate.Compounds in which the sulfur is attached directly to the carbon chain. A large number of sulfated and sulfonated surface-active agents are comer-cially available:2.1- Alpha-Sulfonated fatty acids and esters.α-Sulfonated fatty acids and esters, because of their wide range of application and biological properties, represent an interesting class of surfactants. A technical method for the preparation of α-sulfonated fatty acids was described [17].A novel series of glycerol-based double or triple-chain surfactants with two sulfonate, two sulfate or two carboxylate groups was conveniently prepared by reactions of 1-o-alkyl glycerol diglycidyl ether with long chain fatty alcohols and followed by reactions with propanesultone, chlorosulphonic acid or bromoacetic acid respectively [18].2.2- Ester sulfonates.Sulfonates with an intermediate ester (31) between the hyDROPhobic fatty chain and the sulfonate group were introduced in Germany by G. Farben industries in 1930 under the Igepon [19].Igepon surfactants are prepared by reacting isethionate with a fatty acid chloride or directly with the fatty acid. The acid chloride are manufactured from the fatty acids by reaction with phosphorus trichloride (eq. 7) or with thionyl chloride (eq. 8).Reaction of acid chloride with isethionates (eq.9) is carried out in a stainless steel vessel with a slow heavy – duty agitator. High vacuum is applied to remove HCl formed during the reaction.The efficiency of hydrochloric acid removal affects yield and quality, continuous processes for the manul for Igepon have also been reported [20]. Salts of α-sulfonated fatty esters (32) have been known for a considerable period of time.A series of sodium sulfoalkyl-2-hydroxy alkonates and disodium sulfoalkyl-2-sulfated alkonates were prepared by means of sodium isethionate or sodium 2-hydroxy propane-1-sulfonate with normal 2-hydroxy fatty acids and their 2-sulfated products composed of 14,16 and 18 carbon atoms, respectively. The results show that the products obtained have pronounced surface activity [21].Hydroxy fatty acids were converted to methyl esters and then reduced to the corresponding alkane-1,2-diols.The hydroxy acids were reacted with monoethanolamine and diethanolamine to the corresponding fatty alkanol amides,then a series of sulfonation products at the hydroxy groups of 2-hydroxy acids, ester and alkanol amides were achieved. Also the 1,2-diols were sulphated [22].3- Anionic surface active agents containing heterocyclic ring.Sodium salt of α-sulphonated fatty acid hydrazide was used as starting material to synthesis some important heterocycles as pyrazoles, thiazoles, oxadiazoles, benzoxazoles, pyridazines, and phthalazines to produce a novel groups of anionic surfactants having a double function, antimicrobial and surface active agents [32].Sodium salt of α- sulphonated fatty acid isothiocyanate was utilized as starting material to synthesis some important biologically active heterocycles as thiazoles, oxazoles, triazoles, benzoxazoles and quiazolines by reaction with different nucleophiles to produce a novel groups of anionic surfactants having a double function, as antimicrobial and surface active agents which can be serve in the manufacture of drugs, cosmetics, antibacterial and/or antifungal [23].