

## CHAPTER II

### LITERATURE SURVEY

Barry *et al.* (1973) studied liquid paraffin-in-water emulsions stabilized by cationic (cetrimid) or non-ionic (cetomacrogol) surfactants and cetostearyl alcohol. Rheological properties were examined at 25<sup>0</sup>C in oscillatory mode with parallel plates coupled to a digital transfer function analyser. Ternary systems, formed by dispersing the mixed emulsifiers in water, were similarly investigated. Each preparation was tested in the linear viscoelastic region, and fundamental rheological function, the storage modulus ( $G'$ ) and the real viscosity ( $\eta'$ ) were measured as functions of frequency. All ternary systems behaved similarly with respect to frequency. At high frequencies,  $G'$  rose and  $\eta'$  fell. These trends were related to the viscoelastic nature of the systems. Both mixed emulsifiers exhibited selfbodying mechanisms, so that emulsion stability increased as the mixed emulsifier concentration rose. This was shown by increases in  $G'$  and  $\eta'$  at each frequency. The shapes of the plot and other rheological properties were related to viscoelastic gel networks formed in the emulsion continuous phases. The ternary system functions measured implied that emulsion networks were similar to ternary gels, that is, they formed by the interaction between the long chain alcohol and the aqueous surfactant solution.

Martino (1985) reported that the lamellar phases formed with SHBS, DDAB and C12E5 at relatively high surfactant concentration and at 25<sup>0</sup>C broke up as water was gradually replaced with propylene glycol. In addition, the SHBS lamellar phase became unstable at progressively lower temperatures as propylene glycol content increased. The break-up of the lamellar phase accompanied a reduction in the lamellar repeat distance for the ionic

surfactants, but the repeat distance was constant for the nonionic surfactant. With E12E5, the stability of the lamellar phase can result from the balance between van der Waals attraction forces perhaps was accompanied by a reduction in the elastic content of the surfactant membrane, leading to the break-up of the lamellar phase. In the ionic surfactant mixtures, both intra and inter aggregate interaction were responsible for lamellar stability. They established that the addition of propylene glycol decreased the electrostatic repulsive forces between lamellae and disturbed the hydration shell around the ionic aggregate head groups by breaking the water hydrogen bonding network.

Schambil *et al.* (1986) reported the mixture of cetyl and stearyl alcohol increased the viscosity and stability of emulsion instead of using cetyl alcohol or stearyl alcohol alone. He explained that only the crystals of cetostearyl alcohol were able to contribute to emulsion stability and the microscopical observation showed that third phase consisted of a lamellar liquid crystal. He also found that increasing the emulsifier concentration induced in some cases a change from thixotropic to Newtonian and rheopectic behavior. The viscosity effect and the long term stability of cosmetic emulsions did not depend on the properties of fatty alcohol alone but the mixed phases formed by the emulsifier and the alcohol.

Telman *et al.* (1987) found that for the emulsions containing lauryl, oleyl, and cetostearyl alcohols as oil-soluble components the viscosity can be controlled by adding cetostearyl alcohol. This increased the yield stress value and the plastic viscosity of the emulsion studied.

Axon (1990) reported that the viscosity of oil in water emulsions containing 70% dispersed phase increased with increasing concentration of an emulsifying agent. In emulsions prepared with equal oil and a number of

univalent soaps as emulsifiers, an increase in soap concentration produced in most cases an increase in viscosity, with the magnitude varying with the type of soap and the nature of the dispersed phase.

Sharman (1991) reported that the viscosity of emulsion could be increased upon aging when the dispersed particles of an emulsion aggregated. Part of the continuous phase was immobilized by being trapped between the aggregated particles. This had the same effect as decreasing the continuous phase concentration, and as a consequence the viscosity increased.

Pal *et al.* (1992) reported that for monodispersed or unimodal dispersion systems (emulsions or suspension), the relative viscosity was independent of the particle size. These results were applicable as long as the hydrodynamic forces were dominant. In other words, forces due to the presence of an electric double layer or a stearic barrier (due to the adsorption of macromolecules onto the surface of the particles) were negligible. In general, the hydrodynamic forces were dominant (hard-sphere interaction) when the solid particles were relatively large (diameter  $>10\mu\text{m}$ ). For particles with diameters less than  $1\mu\text{m}$ , the colloidal surface forces and Brownian motion can be dominant, and the viscosity of unimodal dispersion was no longer a unique function of the solids volume fraction.

Pal *et al.* (1993) reported that emulsions can exhibit Newtonian, shear thinning, and viscoelastic behaviors. In the absence of colloidal forces of a monodispersion, the relative viscosity was independent of the particle size. When Brownian motion and /or colloidal forces were present, the relative viscosity of dispersion became a function of the particle size. The viscosities of bimodal dispersion were strong function of the particle size ratio of the two particle fractions. Mooney or Pal-Rhodes-type correlation was used to

correlate emulsions relative viscosities with the dispersed-phase volume fraction.

Hoffmann *et al.* (1994) investigated and compared the rheological properties of different kinds of viscoelastic surfactant solutions. The first system (type1) consisted of entangled flexible rodlike micelles in an isotropic micellar phase ( $L_1$ -phase), while the second (type2) consisted of tightly packed uni and multilamellar vesicles (dilute L-Phase). The rodlike micelles could be formed with a nonionic, a zwitterionic and an ionic surfactant or with a combination of two surfactants. The systems of type 2 had a yield stress value and the samples did not flow, if the applied shear stress was below the yield stress value. At small stress values the systems of type 2 behaved like true permanent networks, while the systems of type 1 behaved like temporary networks. It was evident that the microstructures in both cases must be very different. The network with the elastic properties in the systems of type 2 consisted of tightly packed uni and multilamellar vesicles. In normal temporary networks in viscoelastic surfactant solutions the modulus were determined by entropy elastic forces, while in the type 2 the modulus was given by energy elastic forces. In case 1 the modulus was independent of the ionic strength, while in case 2 the modulus broke down with increasing ionic strength. The different viscoelastic behaviors became evident with increasing deformation of the samples. While the strain of the entropy elastic solution could be about 100% until the modulus broke down, in the energy elastic solution the modulus started to decrease at strain values of about 10% of the shear modulus.

Alargova *et al.* (1998) studied the electric properties of adsorption monolayers of an amphoteric surfactant. In the experiment. they measured the zeta-potential of latex particles covered with the surfactant. The influence of

pH, ionic strength, and surfactant concentration on the electric properties of the adsorption monolayer had examined. They found that the cationic form was predominant at the lower pH. One sees that at the higher pH (for  $\text{pH} > 7.5$ , for which surfactant was expected to be in zwitterionic form) zeta potential leveled off, but still there was a difference of about 30mV between the zeta-potential of the coated and bare latex.