

cover the entire area of the droplets, otherwise coalescence will occur to the extent that the area, A , of the droplets will be reduced to such a point that it now will be completely covered by surfactant and protective colloid.

If, for instance, 1 g of emulsion contained W g of droplets of a size d μm and the oil had a density of ρ g/cm^3 , then there would be n droplets per cm^3 , where n is given by Eq. (10.14). Each particle has a surface area of πd^2 , so that the total area is

$$A = n\pi d^2 = \frac{6Q}{\rho d} \quad (10.17)$$

Example 10.1.

If the density of the oil is $0.9 \text{ g}/\text{cm}^3$, the amount of oil phase per cm^3 , is 0.75 g , and the diameter of the oil globules is $10 \mu\text{m}$ (10^{-3} cm) what is the surface area of the oil phase?

Answer.

$$A = \frac{0.75}{10^{-3}} \frac{6}{0.9} = 5 \cdot 10^3 \text{ cm}^2 \quad (10.18)$$

Example 10.2.

If a surface active agent of molecular weight 800 and cross-sectional molecular area of 30 \AA is present in a concentration of 0.2% will that suffice to cover the surface in Example 10.1?

Answer

$2 \text{ mg}/\text{cm}^3 = 2/800 = 2.5 \cdot 10^{-3}$ millimoles $= 2.5 \cdot 10^{-6}$ moles, which in turn equals $2.5 \cdot 10^{-6} \cdot 6 \cdot 10^{23} = 1.5 \cdot 10^{18}$ molecules $= 30 \cdot 1.5 \cdot 10^{18} \text{ \AA}^2 = 4500 \text{ cm}^2$, this is the surface the surfactant could cover. This is slightly less than the 5000 cm^2 surface area of the oil, so that the entire surface of the oil globules cannot be covered by the surfactant.

The above calculations are oversimplified. They assume, for instance, that all the surfactant is adsorbed onto the oil, which is not the case. It is important, however, to check, originally, whether enough surface coverage of the oil is provided for. If not, there will be an initial shrinkage of surface area (increase in droplet size) attributable to this. Hence, if the coverage of the droplets with surfactants and/or protective colloid is incomplete at the time of manufacture, then the droplets will grow in size as time progresses. Rowe (1965) for instance demonstrated that the globule size decreases with increasing surfactant concentration, as shown in Fig. 8.

4.2. Globule Size and Viscosity

The breakage of suspensions will be dealt with shortly, but (Fig. 7) it might be suspected that breakage would be a function of Stokian motion [Eq. (10.11)], i.e., the globules move and collide and hence coalesce. This is true in a sense, but