

Unit: Colloidal Solution

B.Sc-I

Paper-I



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EMULSIONS

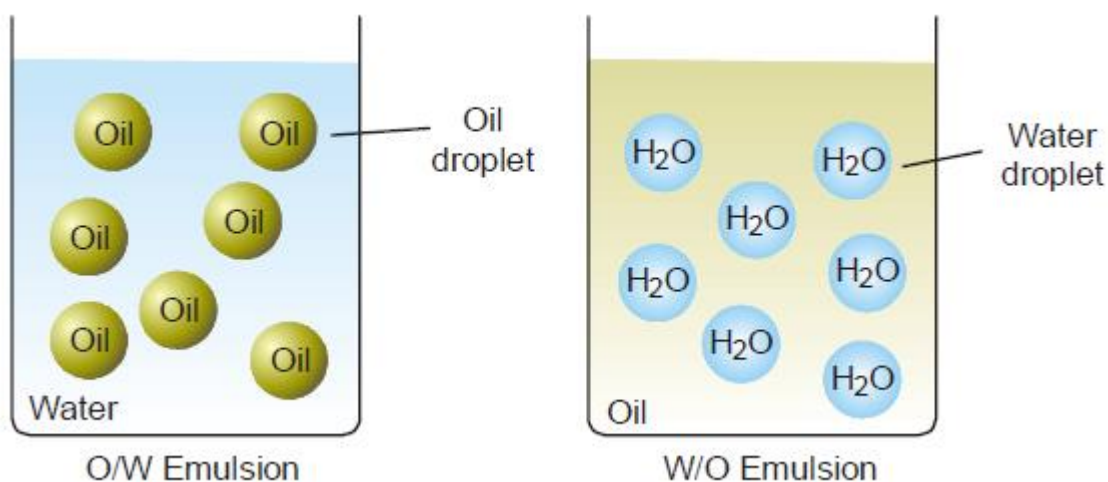
These are liquid-liquid colloidal systems. In other words, **an emulsion may be defined as a dispersion of finely divided liquid droplets in another liquid.**

Generally one of the two liquids is *water* and the other, which is immiscible with water, is designated as *oil*. Either liquid can constitute the dispersed phase.

Types of Emulsions

There are two types of emulsions.

(a) Oil-in-Water type (O/W type) ; (b) Water-in-Oil type (W/O type)



Examples of Emulsions

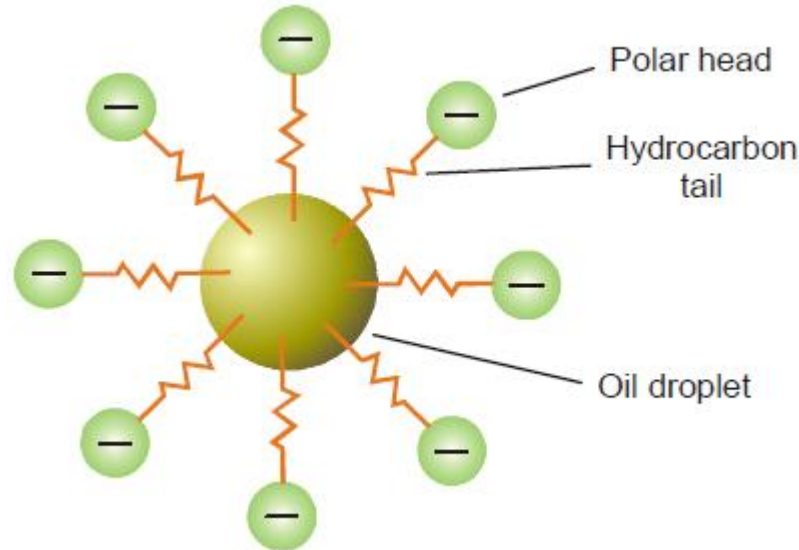
- (1) Milk is an emulsion of O/W type. Tiny droplets of liquid fat are dispersed in water.
- (2) Stiff greases are emulsions of W/O type, water being dispersed in lubricating oil.

Preparation of Emulsions

The dispersal of a liquid in the form of an emulsion is called **emulsification**. This can be done by agitating a small proportion of one liquid with the bulk of the other. It is better accomplished by passing a mixture of the two liquid through a colloid mill known as **homogenizer**. The emulsions obtained simply by shaking the two liquids are unstable. The droplets of the dispersed phase coalesce and form a separate layer. To have a stable emulsion, small amount of a third substance called the **Emulsifier** or **Emulsifying agent** is added during the preparation. This is usually a soap, synthetic detergent, or a hydrophilic colloid.

Role of Emulsifier

The emulsifier concentrates at the interface and reduces surface tension on the side of one liquid which rolls into droplets. Soap, for example, is made of a long hydrocarbon tail (oil soluble) with a polar head $\text{—COO}^-\text{Na}^+$ (water soluble). In O/W type emulsion the tail is pegged into the oil droplet, while the head extends into water. Thus the soap acts as go-between and the emulsified droplets are not allowed to coalesce.



Properties of Emulsions

(1) **Demulsification.** Emulsions can be broken or 'demulsified' to get the constituent liquids by heating, freezing, centrifuging, or by addition of appreciable amounts of electrolytes. They are also broken by destroying the emulsifying agent. For example, an oil-water emulsion stabilized by soap is broken by addition of a strong acid. The acid converts soap into insoluble free fatty acids.

(2) **Dilution.** Emulsions can be diluted with any amount of the dispersion medium. On the other hand the dispersed liquid when mixed with it will at once form a separate layer. This property of is used to detect the type of a given emulsion.

GELS

A gel is a jelly-like colloidal system in which a liquid is dispersed in a solid medium. For example, when a warm sol of gelatin is cooled, it sets to a semisolid mass which is a gel. The process of a gel formation is known as **Gelation**.

Explanation. Gelation may be thought of as partial coagulation of a sol. The coagulating sol particles first unite to form long thread-like chains. These chains are then interlocked to form a solid framework. The liquid dispersion medium gets trapped in the cavities of this framework. The resulting semisolid porous mass has a gel structure. A sponge soaked in water is an illustration of gel structure.

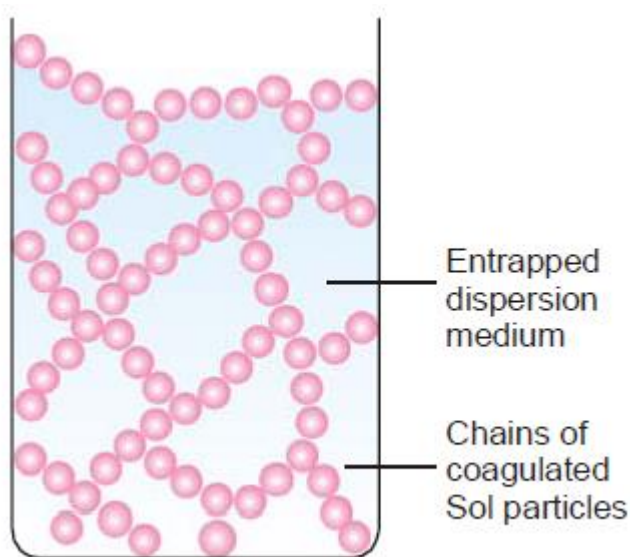


Figure 1: The network of the coagulated sol particles enclosing liquid, forming a gel.

Two types of Gels

Gels may be classified into two types :

(a) **Elastic gels** are those which possess the property of elasticity. They change their shape on applying force and return to original shape when the force is removed. Gelatin, starch and soaps are examples of substances which form elastic gels. Elastic gels are obtained by cooling fairly concentrated lyophilic sols. The linkages between the molecules (particles) are due to electrical attraction and are not rigid.

(b) **Non-elastic gels** are those which are rigid *e.g.*, silica gel. These are prepared by appropriate chemical action. Thus silica gel is produced by adding concentrated hydrochloric acid to sodium

silicate solution of the correct concentration. The resulting molecules of silicic acid polymerise to form silica gel. It has a network linked by covalent bonds which give a strong and rigid structure.

Properties of Gels

(1) **Hydration.** A completely dehydrated elastic gel can be regenerated by addition of water. But once a nonelastic gel is freed from moisture, addition of water will not bring about gelation.

(2) **Swelling.** Partially dehydrate elastic gels imbibe water when immersed in the solvent. This causes increase in the volume of the gel and process is called **Swelling**.

(3) **Syneresis.** Many inorganic gels on standing undergo shrinkage which is accompanied by exudation of solvent. This process is termed **Syneresis**.

(4) **Thixotropy.** Some gels are semisolid when at rest but revert to liquid sol on agitation. This reversible sol-gel transformation is referred to as **Thixotropy**. Iron oxide and silver oxide gels exhibit this property. The modern thixotropic paints are also an example.