

## Quadrant II – Transcript and Related Materials

**Programme: Bachelor of Science (First Year)**

**Subject: Chemistry**

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**Paper Title: General Industrial Chemistry**

**Unit: III**

**Module Name: Preparations, Properties and Applications of Emulsions, Microemulsions, Micelles and Aerosols.**

**Effects of Surfactants and Hydrophile-Lipophile Balance (HLB)**

**Module No: 7**

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### Notes

## EMULSION

### Types of Emulsions

- ❖ **Water in oil type:** Type in which water is the dispersed phase and its particles are distributed in oil which acts as dispersion medium.
  - Example: butter, etc. It is designated by W/O or w-in-o.
- ❖ **Oil in water type:** Type in which oil is the dispersed phase and its particles are distributed in water which acts as dispersion medium.
  - Example: milk, vanishing creams etc. it is designated by O/W or o-in-w.

## PREPARATION OF EMULSION

Emulsions can be prepared by shaking or stirring the two phases with the addition of a suitable emulsifier.

- Stable emulsions containing about 0.1% of O/W can be made by pouring a solution of the oil in alcohol or acetone into an excess of water.
- A condensation method developed by Sumner is used to prepare concentrated O/W emulsion. It consists in allowing vapours of oil to pass through aqueous solution containing an emulsifying agent.

## PROPERTIES OF EMULSION

- I. **Electrophoresis:** Like colloidal particles, the droplets of emulsion are also electrically charged. Hence, they migrate towards the oppositely charged electrode under the influence of electric current.
- II. **Dilution:** On increasing the amount of dispersion medium, a separate layer is formed.
- III. **Brownian motion:** Just like colloidal particles, droplets of emulsion are also in a state of constant rapid zig-zag motion.

## APPLICATIONS OF EMULSION

1. Milk is an emulsion of fat dispersed in water stabilised by casein and is practically a complete food.
2. A number of medicines and pharmaceutical preparations are emulsion in nature.
3. A variety of emulsions of oils and fats are used in leather industry to make leather soft and pliable and also to make it waterproof.

## MICROEMULSION

There are three kinds of microemulsions:

1. **Oil dispersed in water (O/W):** The presence of O/W droplets is likely to be a characteristic of microemulsions where the amount of oil is low.
2. **Water dispersed in oil (W/O):** The presence of W/O droplets is likely to be characteristic of microemulsions where the water fraction is low.

3. **Bicontinuous:**Bicontinuous microemulsions may result where the amount of water and oil are equal.

### **PREPARATION OF MICROEMULSION**

- They are prepared by simple mixing of the components and do not require specific preparation conditions.

### **PROPERTIES OF MICROEMULSION**

- Several interesting characteristics of microemulsions, namely, enhanced drug solubilisation, good thermodynamic stability, ease of preparation, low viscosity.
- High drug-loading capacity and small droplet size.

### **APPLICATIONS OF MICROEMULSION**

1. Water-in-oil microemulsion for some dry cleaning processes.
2. Floor polisher and cleaners
3. Personal care products.
4. Pesticides formulations.

## **MICELLES**

There are three types of micelles

- **Normal Micelles**
- **Reverse Micelles**
- **Bilayer lamella**

### **MECHANISM OF MICELLE FORMATION**

- Soap is consist of sodium or potassium salt of higher fatty acids and represented as  $\text{RCOO}^- \text{Na}^+$  . Sodium stearate is a major component of

many bar soap. When soap is dissolved in water, it dissociates as  $\text{RCOO}^-$  and  $\text{Na}^+$  ions.

- The  $\text{RCOO}^-$  contains the non-polar “tail” which is hydrophobic in nature and a polar “head” which is hydrophilic in nature.
- The  $\text{RCOO}^-$  group present in water and hydrocarbon chain stays away from it.
- At low concentration they remain on the surface of water but at CMC (critical micelle concentration) all stearate ions comes inside the bulk.
- All their heads pointing outwards and the tail pointing towards the centre of sphere.
- This aggregation forms the ionic micelles.

### **APPLICATIONS OF MICELLES**

1. Micelles acts as emulsifiers when surfactants are above the critical micelle concentration allowing a compound to dissolve which are usually insoluble.
2. Extraction of food proteins, simultaneous extraction of oils and proteins.

### **AEROSOLS**

1. **Space sprays:** these are finely divided sprays having particle size upto  $50\mu$ . E.g. insecticides, disinfectants and room deodorizers.
2. **Surface coats:** These are also sprays but disperse particles are coats with size upto  $200\mu$ . They produce a wet coat when sprayed on a surface. E.g. hair sprays, personal deodorant, powder sprays and topical medicaments sprays.
3. **Foam:** These are produced by rapid expansion of propellants through an emulsion. Hence, the product comes out in the form of a foam or froth. E.g. shaving cream etc.

## PREPARATIONS OF AEROSOLS

Formulation consists of two essential components:

**Product concentrate:** Active ingredient or mixture of active ingredients and other necessary agents such as solvents, anti oxidants and surfactants.

**Propellant:** Single or blend of various propellants is used. Blend of solvents is used to achieve desired solubility characteristic.

- The propellants are selected to give the desired vapour pressure, solubility and particle size.

## PROPERTIES OF AEROSOLS

### Physical Properties:

- They are miscible with non-polar solvents at desired temperature and have ability to dissolve many substances.
- They are immiscible with water, and hence to make miscible with water, co-solvents such as ethanol can be added.

### Chemical Properties:

- They are chemically inert, non-toxic.

## APPLICATIONS OF AEROSOLS

1. They are used to spray cosmetic preparations such as perfumes.
2. They are used to spray disinfectants, deodorizers and air sanitizers.
3. Drugs can be given by oral inhalation.

## EFFECT OF SURFACTANTS

**Definition:** Surfactants are those substances which get preferentially adsorbed at the air-water, oil-water and solid-water interface forming an oriented monolayer, wherein the hydrophilic groups point towards the aqueous phase while the hydrocarbon chains point towards the air or towards the oil phase.

- In other words, substances that drastically lower the surface tension of water even at low concentrations are called **surface active compounds** or **Surfactants**.
- Because of their ability to lower the interfacial tension, surfactants are useful as emulsifiers, detergents, dispersing agents, foaming agents, wetting agents, penetrating agents and in many other applications.
- Surfactants are classified on the basis of the charge carried by the polar head group as:
- **Anionic, Cationic, Non-ionogenic, amphoteric, biosurfactants.**

## **HYDROPHILE-LIOPHILE BALANCE (HLB)**

- The term was first suggested by Clayton, refers to the balance in size and strength between the hydrophilic and lipophilic parts of surfactant molecule.
- The HLB value is an empirical number assigned to non-ionic surfactants on the basis of a wide variety of emulsion experiments carried out on surfactants.
- The HLB value range from 1-40. The low number generally indicate solubility in oil and high number solubility in water.
- An emulsifier has two different actions, it promotes the formation of an emulsion and it determines whether an O/W or a W/O emulsion will be formed. The second action is clearly connected with the HLB value.
- The HLB value of the mixture of two or more surfactants are additive and are given by :

$$(\text{HLB})_{\text{mixture}} = X_1 (\text{HLB})_1 + X_2 (\text{HLB})_2$$

**$X_1, X_2$  = mole fraction of 1, 2.**