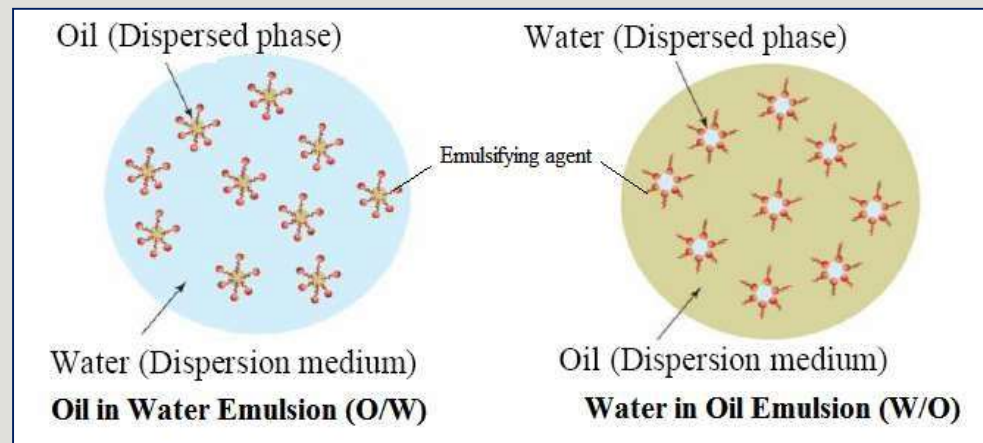


# Theories of Emulsification

# DEFINITION

- ❖ An emulsion is a thermodynamically unstable system consisting of at least two immiscible liquid phases, one of which is dispersed as globules (the dispersed phase) in the other liquid phase (the continuous phase), stabilized by the presence of an emulsifying agent.
- ❖ The particle diameter of the dispersed phase generally extends from about 0.1 to 10  $\mu\text{m}$ , although particle diameters as small as 0.01  $\mu\text{m}$  and as large as 100  $\mu\text{m}$ .



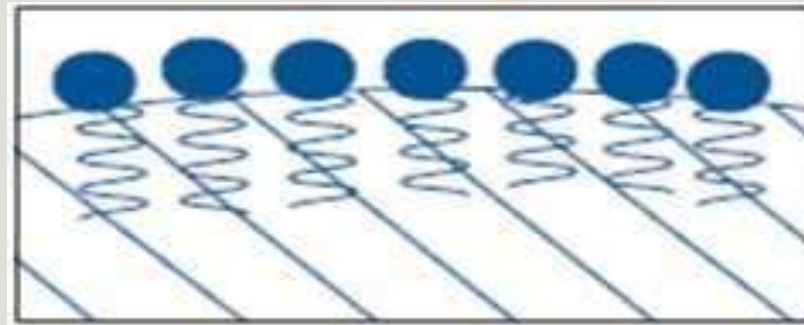
# Theories of Emulsions

- **Monomolecular Adsorption theory**
- **Oriented-Wedge Theory**
- **Oriented adsorption theory**
- **Plastic or Interfacial film theory**
- **Surface tension theory**
- **Interfacial tension theory**
- **Fischer's theory of hydrates and solvates**
- **Viscosity theory**

# Monomolecular Adsorption theory

## Concept

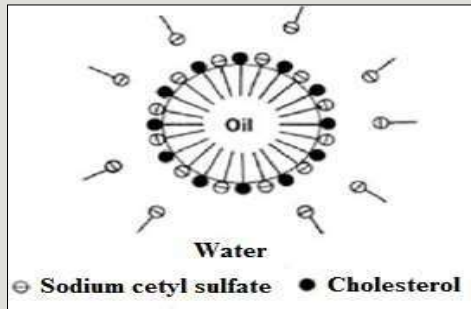
❖ **Surface-active agents, or amphiphiles, reduce interfacial tension because of their adsorption at the oil-water interface to form monomolecular films.**



## Explanation

- ❖ In practice, combinations of emulsifiers rather than single agents are used most frequently today in the preparations of emulsions. Hydrophilic emulsifier in the aqueous phase and a hydrophobic agent in the oil phase to form a complex film at the interface.

## Example



- ❖ Three mixtures of emulsifying agents at the oil-water interface. The combination of Sodium cetyl sulfate and cholesterol leads to a complex film that produces an excellent emulsion.

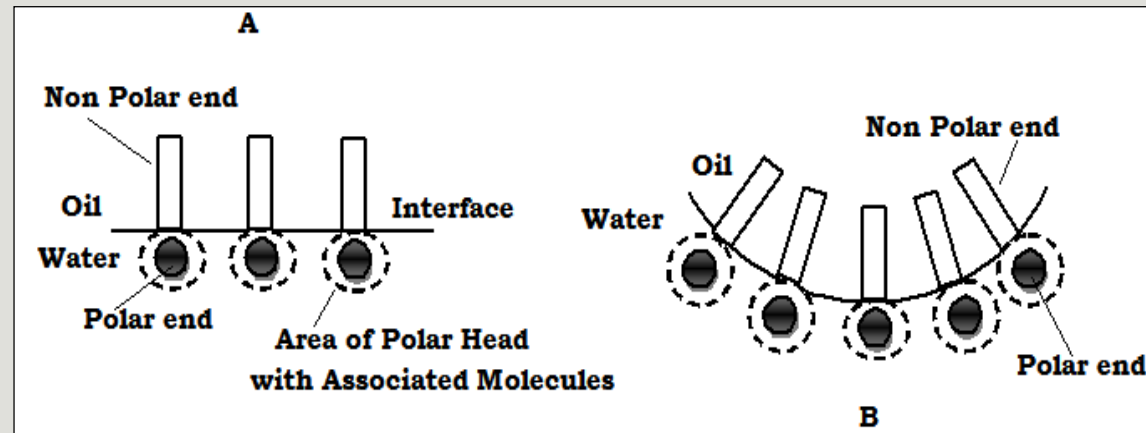


- ❖ Sodium cetyl sulfate and Oleyl alcohol do not form a closely packed or condensed film, consequently, their combination results in a poor emulsion.

## Oriented-Wedge Theory

### Concept

- ❖ This theory deals with formation of monomolecular layers of emulsifying agent curved around a droplet of the internal phase of the emulsion.



- A. Emulsifier molecules oriented at interface. Dotted lines indicate the large volume occupied by polar head due to formation of hydrated complex.
- B. Shows that close packing of molecules 'fits' this curvature.

### Example

- ❖ In a system containing two immiscible liquids, emulsifying agents would be preferentially soluble in one of the phases and would be emulsified in that phase.

## Oriented adsorption theory

- ❖ As per this theory, the added emulsifying agent forms a mechanical film by getting adsorption at the interface of the liquid and offers stability to emulsion.
- ❖ However, this theory could not explain the formation of type of emulsion.

## *Plastic or Interfacial film theory*

- ❖ The plastic or interfacial film theory places the emulsifying agent at the interface between the oil and water, surrounding the droplets of the internal phase as a thin layer of film adsorbed on the surface of the drops.
- ❖ The formation of an o/w or a w/o emulsion depends on the degree of solubility of the agent in the two phases, with water-soluble agents encouraging o/w emulsions and oil-soluble emulsifier the reverse.



## Surface tension theory

- ❖ According to the surface tension theory of emulsification, the emulsifying agents cause a reduction in the interfacial tension of the two immiscible liquids, reducing the repellent force between the liquids and withdrawing the attraction of liquids for their own molecules. In this way, the surfactants convert large globules into small ones and avoid small globules from coalescing into large ones.
- ❖ In this way, the surfactants convert large globules into small ones and avoid small globules from coalescing into large ones.

## *Interfacial tension theory*

- ❖ When two immiscible liquids come in contact, the force causing each liquid to resist breakage is known as interfacial tension. When a high interfacial tension existed between two liquids emulsification is difficult, and if the tension could be reduced emulsification facilitated.
- ❖ The explanation that in oil in water dispersion, the interfacial tension is so great that when two globules of dispersed phase approach each other it withdraws the liquid from between them, with the result they coalesce. When the interfacial tension is greatly reduced by the addition of emulsifier the globules remain separate.

## *Fischer's theory of hydrates and solvates*

- ❖ Fischer's observed that the use of specific ratios of emulsifying agent to continuous phase, he claimed that the quantity of water in these specified ratios was all used up in forming a colloidal hydrate.
- ❖ This theory does not attempt to explain the formation of concentrated emulsions and not explains how globules in an emulsion are prevented from coalescing and separation into two layers.

## Viscosity theory

- ❖ As per this theory, an increase in viscosity of an emulsion will lead to an increase in the stability.
- ❖ This theory failed to explain about the milk which shows considerable stability even though its viscosity is less.
- ❖ This theory is holds good for emulsions prepared with gums as emulsifying agents, but it collapse or no explanation of emulsions made which comparatively low viscosity and great stability