EMULSION

UNIT-III **10 Hours**

Coarse dispersion: Suspension, interfacial properties of suspended particles, settling in suspensions, formulation of flocculated and deflocculated suspensions. Emulsions and theories of emulsification, microemulsion and multiple emulsions; Stability of emulsions, preservation of emulsions, rheological properties of emulsions and emulsion formulation by HLB method.

Lecture - 2

PHysical PHarma.

Unit - 3

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Emulsion → Biphasic Liq. dosage form.

→ Here 2 Immiscible Liq. are Mixed. → With the Help of Emulsifying Agent.

- Here both phase

Dispersed PHase

Dispersion Medium.

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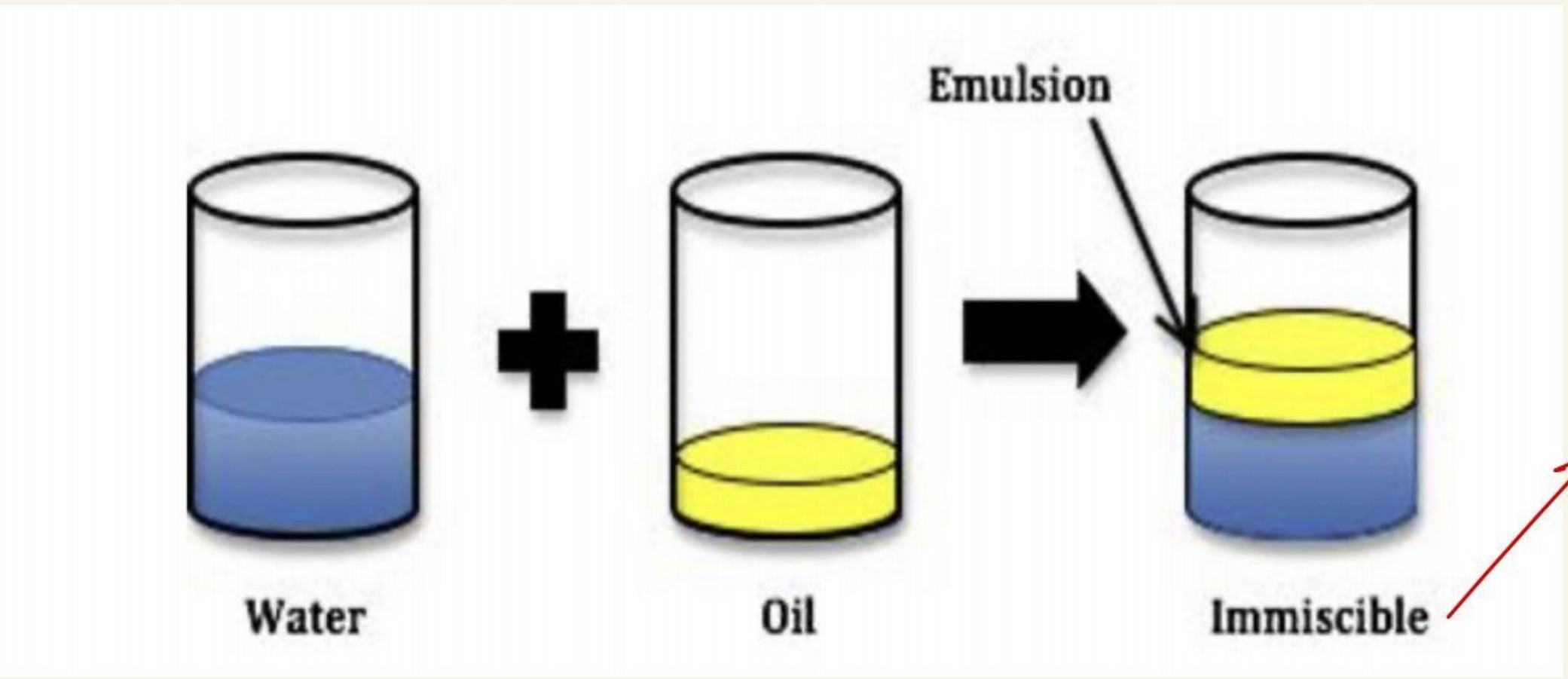
Both are in Liq. PHase.



Miscible with the Help of Emulsifying Agent.

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Some examples of emulsifiers are lecithin, soy lecithin, diacetyl tartaric acid ester of monoglyceride, Mustard, sodium stearoyl lactylate, and sodium phosphates.

Types of Emulsions

Emulsions can be classified on the basis of the properties of the dispersed phase and the dispersion medium.

1) Oil in water (O/W): Aqueous Emulsion

In this type of emulsion, the oil will be the dispersed phase, and water will be the dispersion medium. The best example of o/w emulsion is milk. In milk, the fat globules (which act as the dispersed phase) are suspended in water (which acts as the dispersion medium).

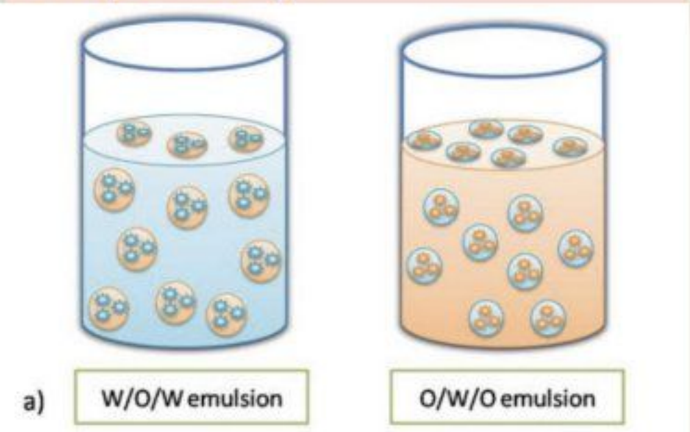
2) Water in oil (w/o): Oil Emulsion

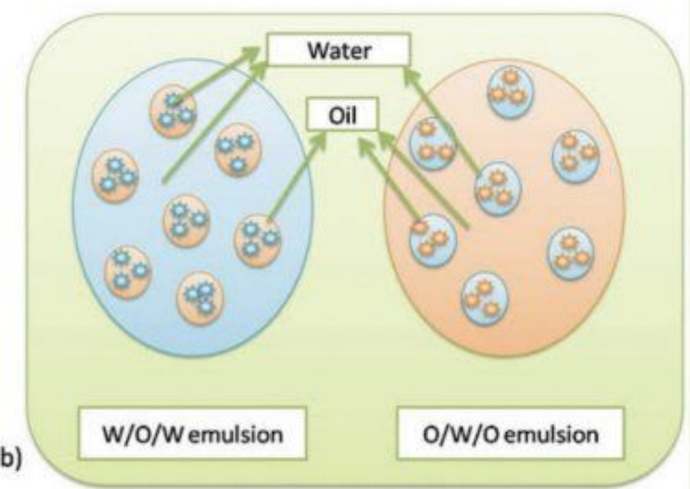
In this type, water will be the dispersed phase, and oil will be the dispersion medium.

Margarine (a spread used for flavouring, baking and working) is an example of water in oil emulsion.

(3) Multiple Emulsion (Double Emulsion)

Multiple emulsions are complex polydispersed systems where both oil in water and water in oil emulsion exists simultaneously which are stabilized by lipophillic and hydrophilic surfactants respectively.





(4) Microemulsion

A microemulsion is a thermodynamically stable fluid that differs from kinetically stable emulsions, which will separate into oil and water over time. The particle size of microemulsions ranges from about 10–300 nm. Because of this small particle size, microemulsions appear as clear or translucent solutions.

Some Instab. occur during Storage & formulation of Emulsion ⇒

(a) Creaming.

(b) Coalescence

(c) Breaking -

(d) flocculation

(e) Phase Inversion

(f) Physical & Chemical prop.

(a) Creaming ⇒

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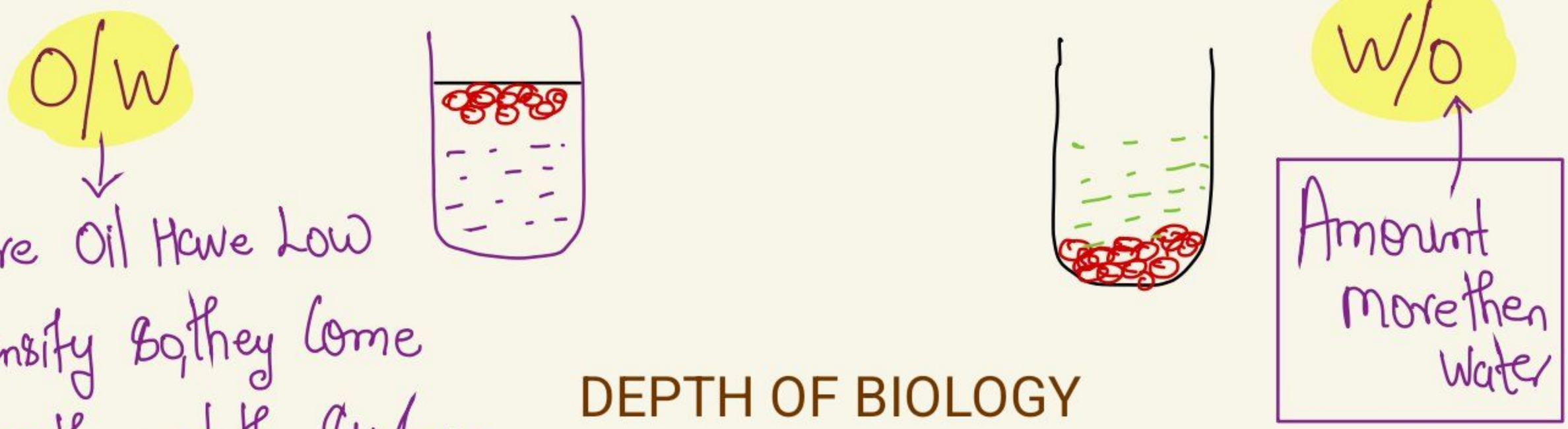
The rise of dispersed particles to the surface of an emulsion is referred to as creaming, which occurs due to density differences between the dispersed particles and the serum phase. The creaming rate (Cr) of particles in a dilute system follows Stokes's law and is given by.
Creaming rate



Here Oil Have Low density So, they Come Together at the Surface of Emulsion

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☆ Upward Creaming.

☆ Downward Creaming.

(b) Coalescence →

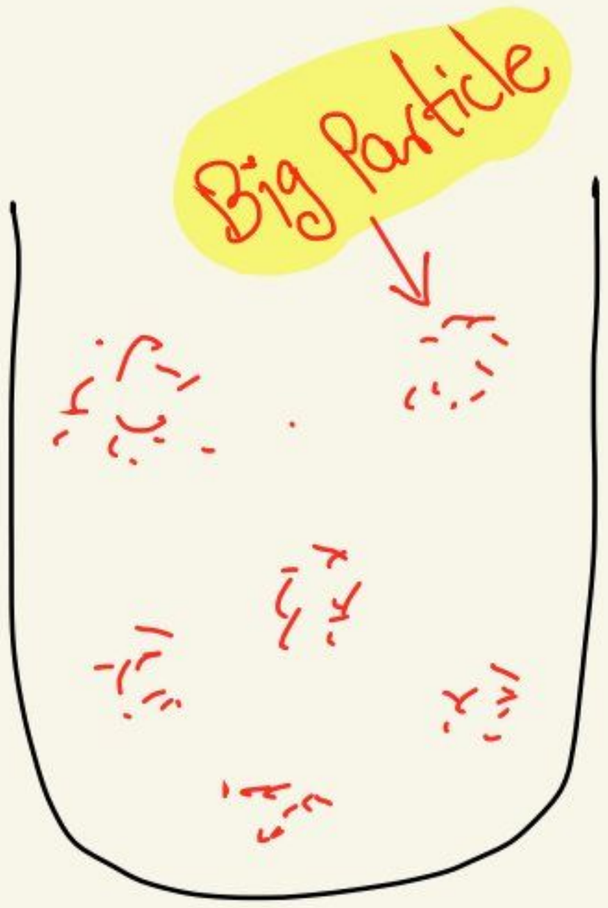
Dispersed Phase (oil particle)

↓

Sticky In Nature attract each other

↓

form Aggregate & make Big Particle

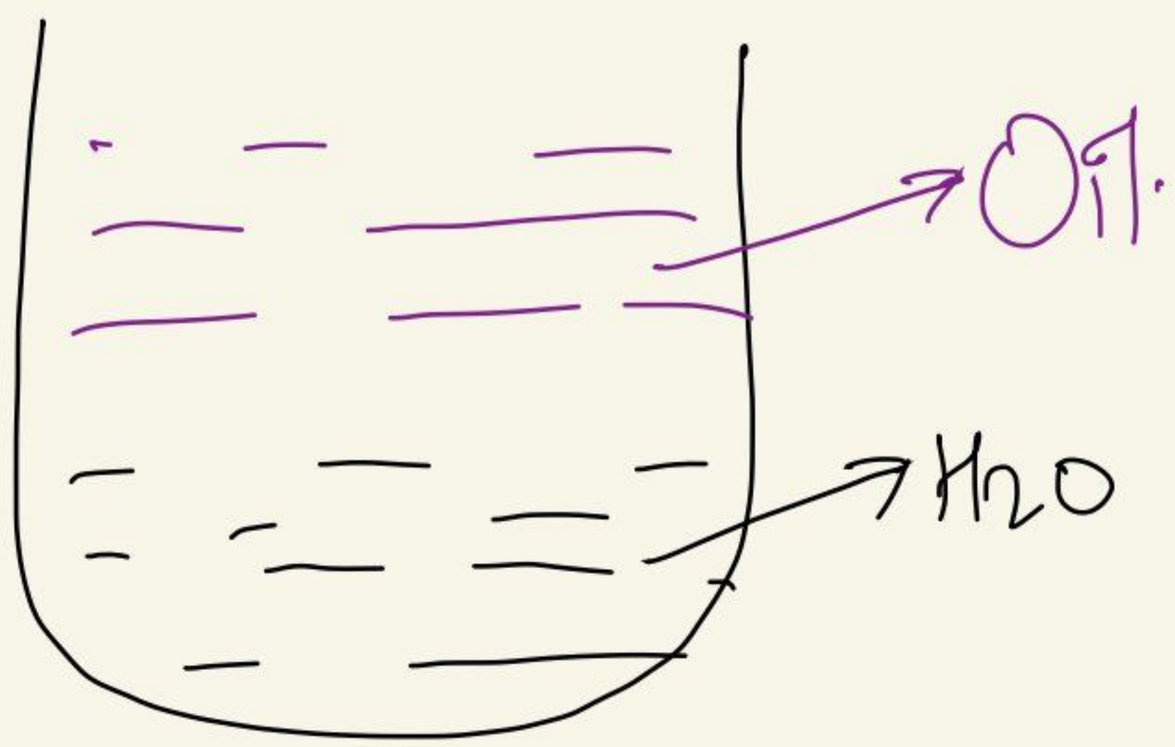


(3) Breaking / Cracking → (Because of Improper ratio of oil & H2O Mixed)

Cracking is occur due to Improper Mixing of oil & water in Emulsion

↓

Emulsion Get Separated Into two Layer → Oil, H2O



④ Flocculation → Particle Size ↓ → Surface Area ↑

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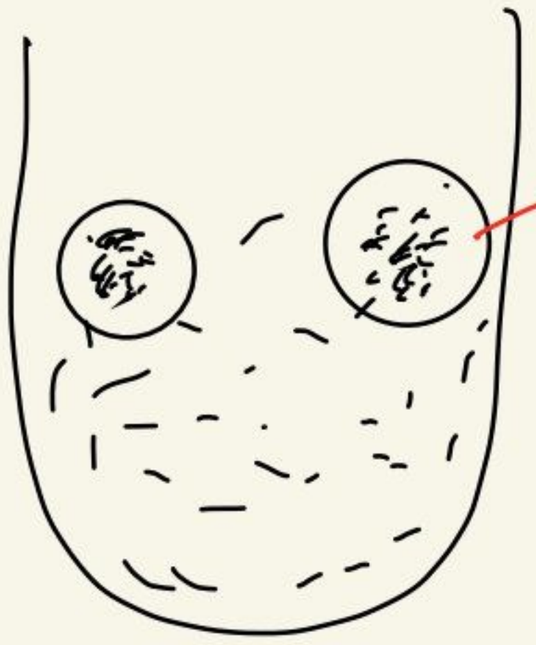
Surface free Energy ↑ → Stab ↓↓



→ floccule → Surfacea Area ↓ → SFE ↓

Stab ↑

But due to floccule formation It is Unstable

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⑤ PHase Inversion → PHase of Emulsion get Changed during formulation

It is due to Mixing Problem or by adding Wrong dispersed PHase.

o/w → w/o

w/o → o/w.

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⑥ Physical & Chemical Prop. Change → DEPTH OF BIOLOGY

Emulsifying Agent is req. to formulate Emulsion.

↓

Make More Stable Emulsion.

Sometime this Emulsifying Agent Lead to Change in property Like pH, odour, Taste.

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Theories of Emulsion

↓↓

Theories.

- Monomolecular Theory
- Multimolecular Theory
- Solid particle Theory.

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⑨ Monomolecular → DEPTH OF BIOLOGY

As We Know in Emulsion particle Size is too small

⇓

Due to Small particle Size More will be the Surface Area.

⇓

If Surface Area ↑ then Surface free Energy ↑

↓

Lead to ↓ in Thermodynamic Stability.

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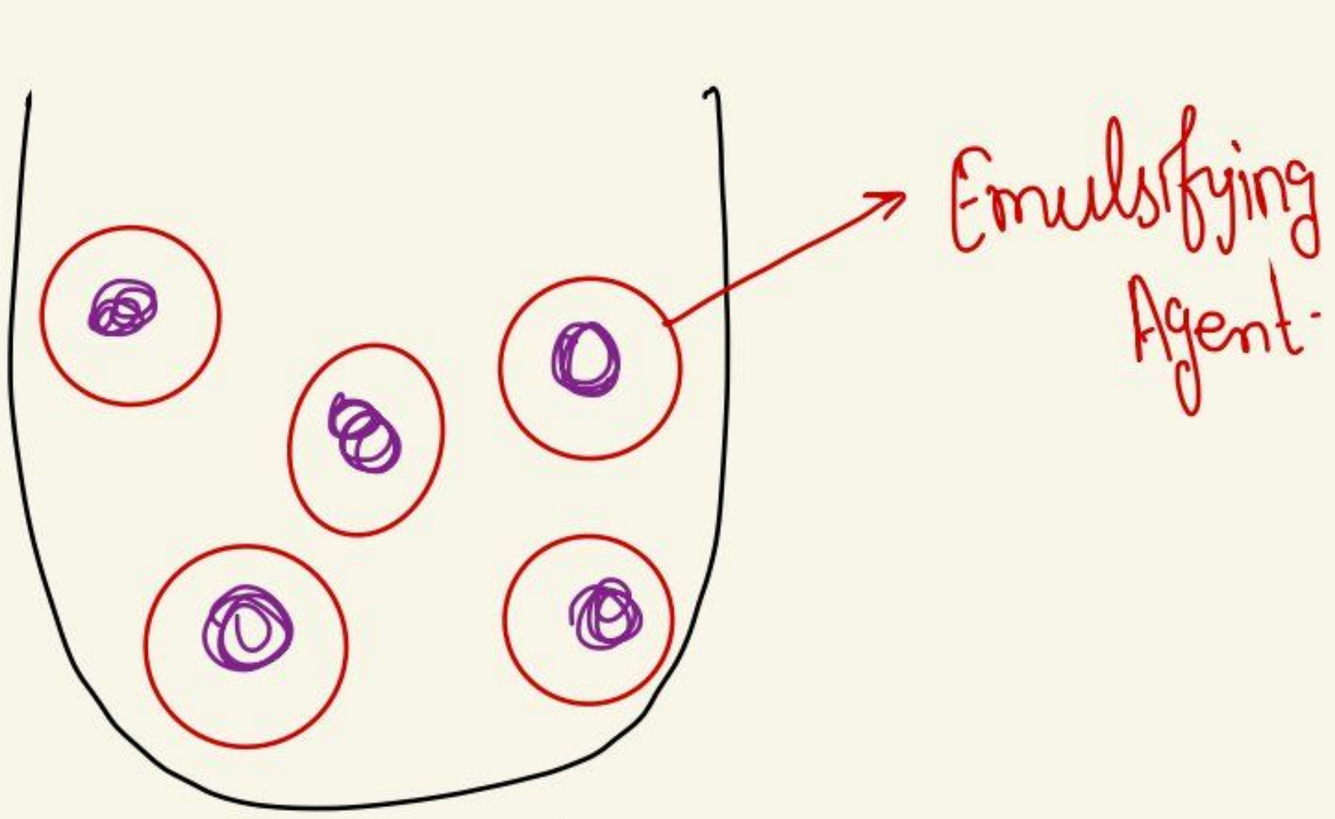
We Have to add Surfactant to Make it More Stable.



Mono Molecular.

(Single Layer formed Or Single E.Agent particle is Used.

(b) Multimolecular Theory.

Here we Have to Make More Stable Emulsion.

We Have to Mix Dispersed PHase & dispersion Medium Properly.

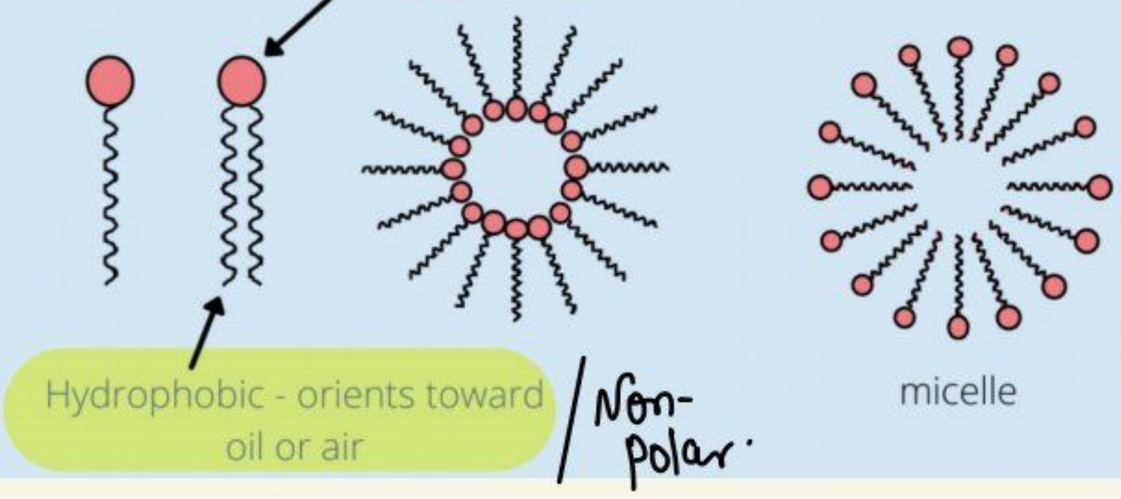
Oil & H_2O Mixed by Emulsifying Agent / Surfactant / Wetting Agents.

What Is a Surfactant?

A surfactant is a chemical that lowers surface tension.

Each surfactant molecule has a hydrophilic or water-loving component and a hydrophobic or water-fearing component.

Polar / Hydrophilic - orients toward water

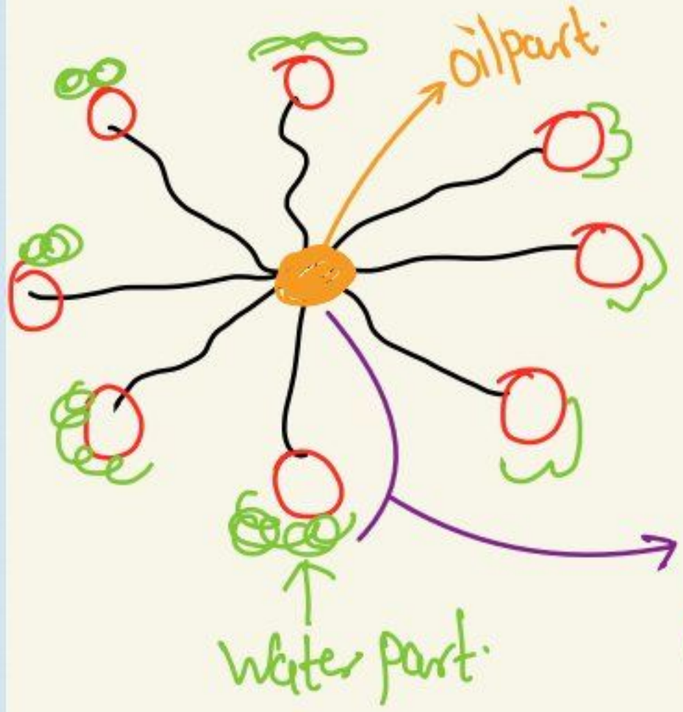


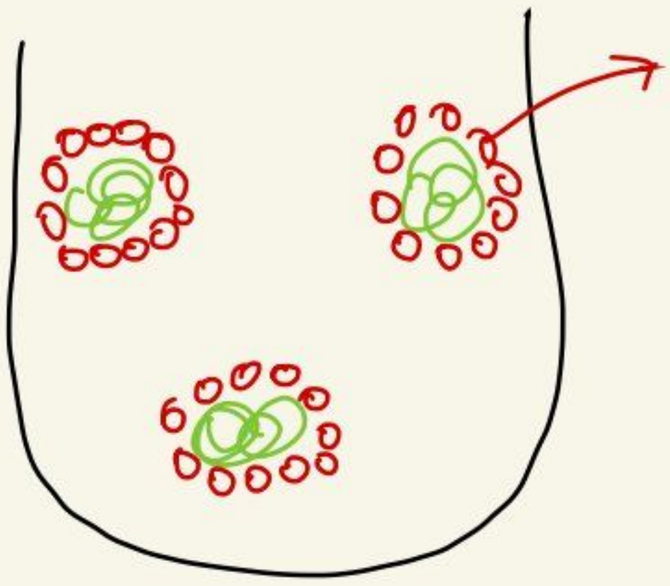
Hydrophobic - orients toward oil or air / Non-polar.

micelle

Examples

- detergent
- emulsifier
- wetting agent
- foaming agent





⇒ MultiMolecular.

③ Solid particle Adsorption Theory →

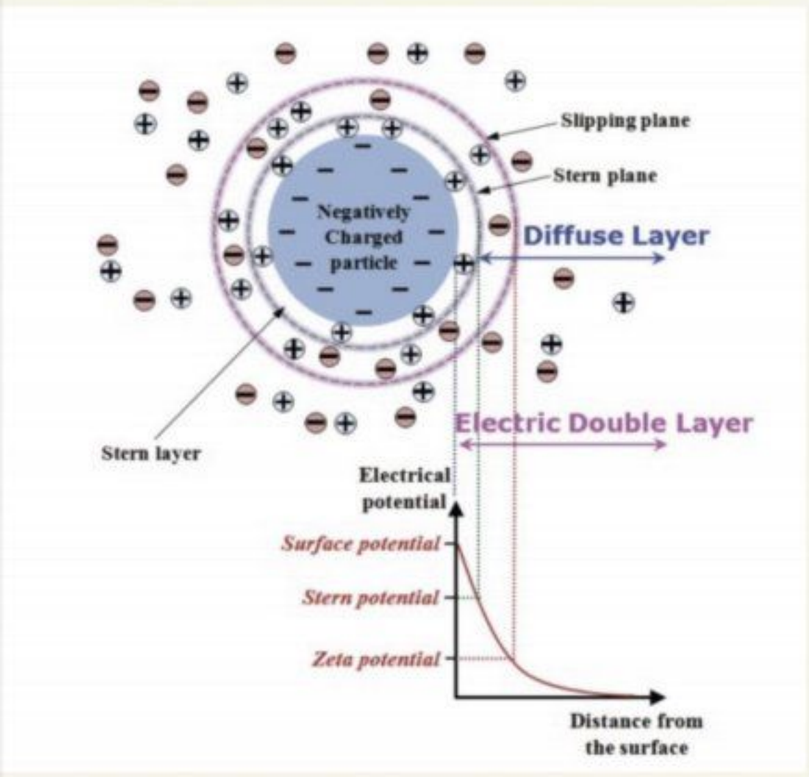
May be dispersed particle (Liq.) ⟶ Settle Down.

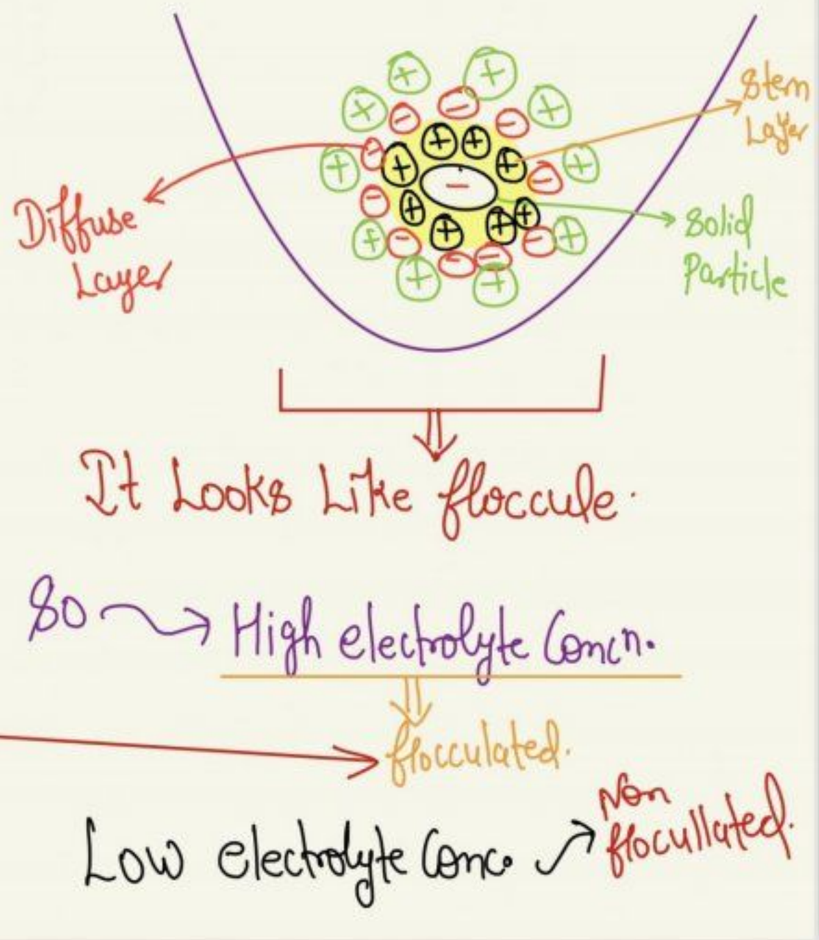
⇩

We Have to ↑se Viscosity of Dispersion Medium.

With the Help of Colloidal Clay we can ↑se Viscosity of dispersion Medium.

④ Formation of Electrical double Layer. ⇒





⇩

It Looks Like floccule.

So ⟶ High electrolyte Concn.

⇩

flocculated.

Low electrolyte Conc. ↗ Non flocullated.

Interaction b/w particle ↑ ⟶

Interaction b/w Particle ↓

Formulation of Emulsion

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Check Description / Or Search formulation of Emulsion by depth of Biology.

Formulation by HLB Method ⇒ Hydrophilic Lipophilic Balance

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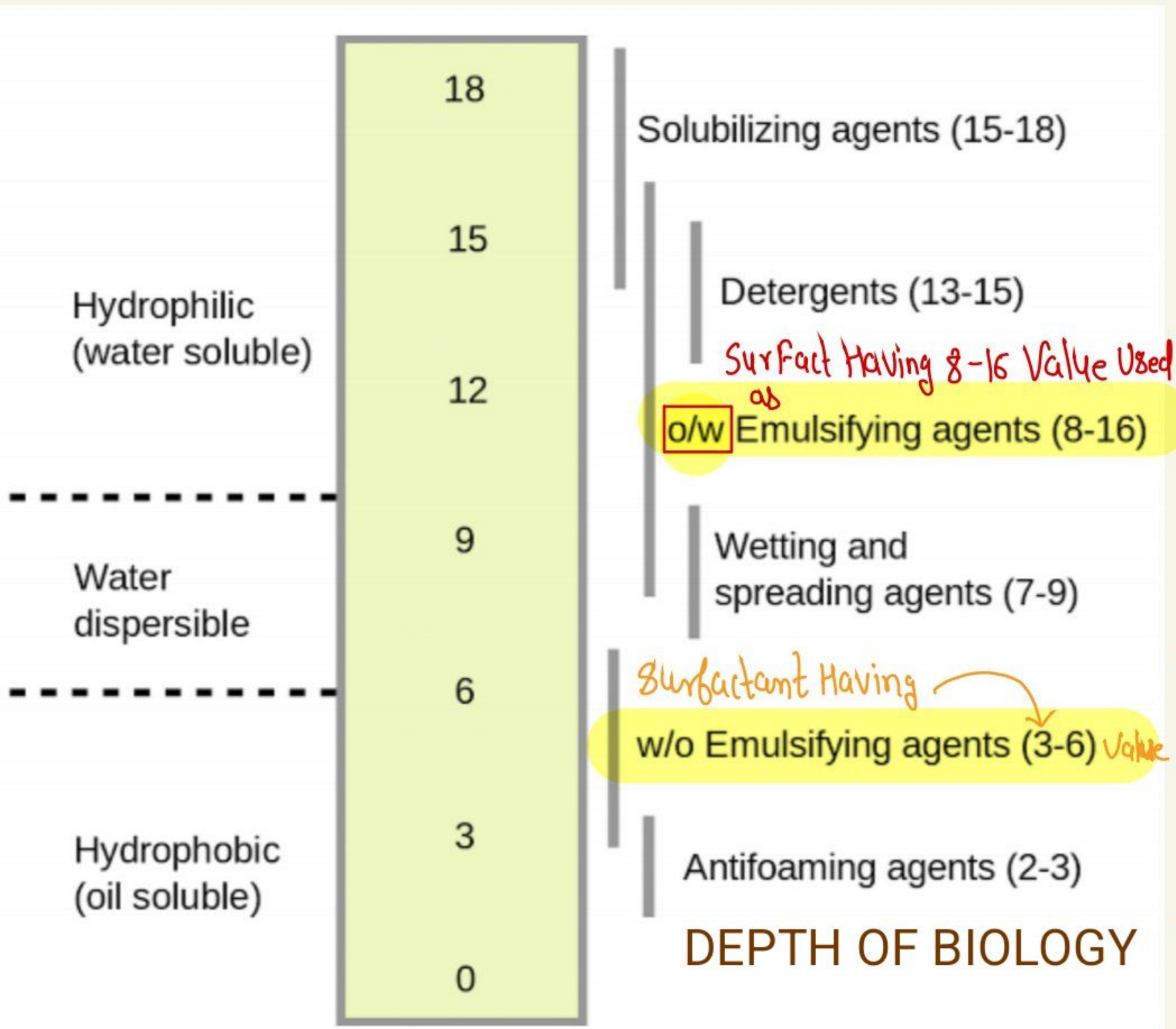

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With the Help Of this We Can Easily Choose which Emulsifying Agent is Used in Emulsion

Preservation of Emulsion.

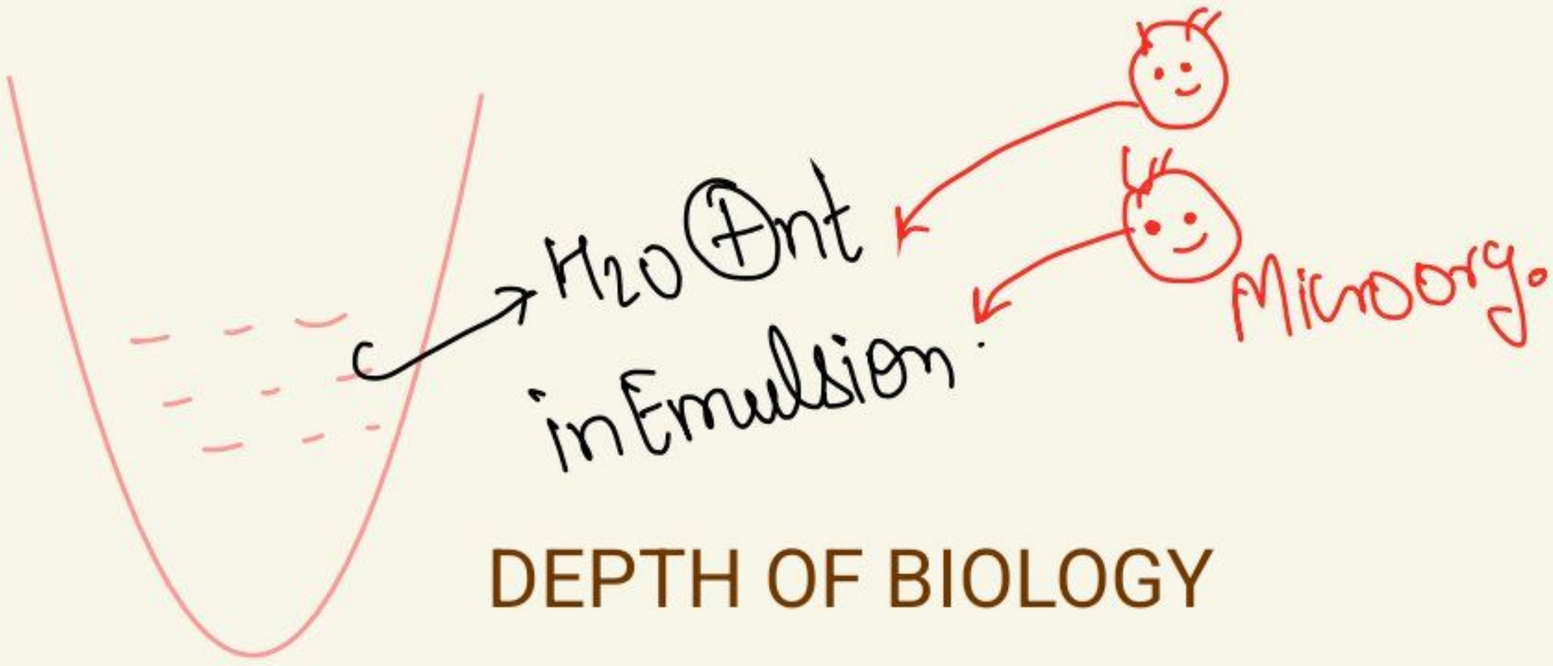
To Keep Emulsion Stable & Effective till Expiry date.

Preservatives.

- Non-Toxic
- Inert.
- Cheap

Stable

(a) Preservation from Microorg. ⇒



We Have to add Methyl Paraben Benzoic Acid Which Inhibit Bacteria Growth.

- Preservative should be → Tasteless, Colourless, odourless

↓

Non-Toxic, Non-Irritant, Stable

(b) Preservation from Oxidation ⇒

Due to Oxidation → Lead to Rancidity & Spoilage of Emulsion.

↓

Add Antioxidant.

(eg → BHT)

↓

Stable, Non-Toxic effective at Low Conc^n.

To prevent Oxidation.

- Rheological Properties of Emulsion.

↓

flow Properties.

RHEOLOGICAL PROPERTIES OF AN EMULSION

In order for an emulsion to perform optimally, the following flow-related characteristics are desirable:

- Emulsions are removed from bottles and tubes.
- A hypodermic needle applied to an emulsion.
- Emulsion spreadability on the skin.
- Flow changes during manufacturing under stress.

Emulsions are rheologically similar to suspensions, but they differ in three main ways -

- Interfacial rheology is important when considering the liquid/liquid interface that contains a surfactant or polymer layer.
- Dispersion phase viscosity is dependent on the medium viscosity in determining emulsion rheology.
- A dispersed phase droplet's deformability has an effect on the rheology of an emulsion, particularly a large droplet.

→ Microemulsion.

Dilute emulsions generally exhibit Newtonian flow. As the viscosity of emulsion increases, flocculated globules will diminish because their mobility is restricted. A viscosity of optimum is desirable to ensure a stable emulsion.

Emulsions that are concentrated show non-Newtonian flow.

→ eg → Lotion.

Rheological prop. of Emulsion can be controlled by.

- Conc. of dispersed Phase.
- Particle Size of dispersed Phase.
- Viscosity of continous phase.