

PHB



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Emulsion is a biphasic liquid preparation containing two immiscible liquids one of which is dispersed as minute globules into the other with the help of an emulsifying agent.

The liquid that is broken up into globules is called dispersed phase & the liquid in which the globules are dispersed is known as continuous phase.

Types of emulsion: They are two types:

1. Oil in water (O/W):

In O/w type, oil is dispersed phase & water is continuous phase. In oil in water type, oil is surrounded by water. so, the un-pleasant taste & odour of the oil is masked. Therefore o/w type of emulsion is preferable for internal use. **E.g.:** Cold Cream

2. Water in oil (W/O):

In w/o type water is the dispersed phase & oil is in the continuous phase. In w/o type, water is surrounded by oil. so, application on the skin may be easier. Therefore w/o type of emulsion preferable for external use. **E.g.:** Vanishing Cream

example for natural emulsion:

- ❖ Milk is an example for o/w emulsion.
- ❖ Butter is an example for w/o emulsion.

Emulsifying agent/ surfactants

Surfactants are materials get adsorbed at the interface between the two phases. The surface adsorption lowers or decreases the tension between the two phases. It causes the inter mix of the phases with each other. Hence to reduce surface tension surfactants are used.

They are classified as follows:

1. Natural Emulgents from vegetable sources: These are anionic in nature & produce o/w type emulsions. They act as primary emulgents & stabilizers. **Ex:** acacia, tragacanth, agar, pectin

2. Natural emulsifying agents from animal sources:

a) Gelatin: It occurs in two forms

- Pharmagol A- used in acidic pH
- Pharmagol B-used in alkaline pH

b) Egg Yolk

c) Wool Fat

3. Semi synthetic polysaccharides: These produce o/w type of emulsion

Ex: Methyl cellulose, sodium CMC

4. Synthetic Emulgents:

a) **Anionic:** Its anionic part is responsible for emulsifying activity.

Ex: - Soaps & sodium lauryl sulphate

b) **Cationic:** Its cationic part is responsible for emulsification. Ex: - Cetrimide, Benzalkonium chloride.

They produce o/w type emulsion.

c) **Non-Ionic:** They do not ionize in aqueous solution. These are stable at wide range of pH & are not affected by addition of acids & electrolytes.

5. In-organic Emulgents: Ex: - Milk of magnesia, magnesium oxide, magnesium aluminium silicate & bentonite.

6. Alcohols: Ex: - Cetyl alcohol, stearyl alcohol, glycerol mono- stearate. Carbo waxes.

Methods of preparation of emulsions:

I. Small scale method:

In small scale method, stable emulsions are prepared by 3 methods. They are

a. Dry gum method: It involve the following steps

1. The mortar & pestle should be absolutely dry.
2. Measure the required quantity of oil in a clean measuring cylinder & transfer it into a dry motor.
3. Add the calculated amount of gum acacia to the mortar.
4. The gum (1 part) is triturated with oil (4parts) in a dry motor thoroughly to form a uniform mixture.
5. Add required quantity of water (2parts) and triturate till clicking sound is produced & the product becomes white. This indicates the formation of emulsion, called primary emulsion.
6. If any solid ingredients are present in the formation. They should be dissolved in small portion of water.
7. If any other soluble ingredients are to be added it must be incorporated after making primary emulsion.
8. Then more water is added to produce the required value.

Type of oil	Primary emulsion formula		
	Oil	Water	Gum
1. fixed oils Ex: - Arachis oil castor oil	4	2	1
2. Mineral oil Ex: - Liquid Paraffin	3	2	1
3. Volatile oil Ex: - Turpentine oil cinnamon oil	2	2	1
4. Oleo – resin Ex: - male fern extract, balsam of tolu, balsam of Peru	1	2	1

2. Wet gum method: -

The proportion of oil, gum, water is same as dry gum method for primary emulsion. The method of preparation of primary emulsion is similar to dry gum method but it a slower technical. But it gives better result than dry gum method. It is as follows.

1. Calculated quantity of gum acacia is triturated with required quantity of water form a mucilage.
2. To this, add oil in small portions with rapid triturating until the product becomes white & clickingsound is produced. i.e. the formation of primary emulsion.
3. If any solid ingredients are present in the formation. They should be dissolved small portion of water.
4. If any should ingredients is to be added it must be incorporated after make primary emulsion.
5. The more water is added to produce the required volume.

3. Bottle method:

1. In this method, oil is taken in a large bottle and then powdered dry gum is added.
2. The bottle is shaken vigorously until the oil and gum are mixed thoroughly.
3. Then the calculated amount of water is added all at once and the bottle is shaken vigorously until primaryemulsion is formed.
4. If any solid ingredients are present in the formulation, they should be dissolved in small portion of water.
5. This solution and other liquids are added to the primary emulsion and shaken thoroughly. Then morewater is added to produce the required volume.

II) Large scale method:

In large scale method, stable emulsions are prepared by using homogenizer & colloidal mill.

H.L.B. scale and its application.

1. H.L.B means Hydrophilic – Lipophilic balance.
2. It is used for the selection of emulsifying agent for the preparation of emulsion.
3. It made balance between the hydrophilic & Lipophilic portion of the emulgent.
4. As the emulsifying becomes more hydrophilic, its solubility in water increases & the formation of an o/w type emulsion.
5. As the emulsifier becomes more Lipophilic, its solubility increased & the formation of an w/o type emulsion.
6. The H.L.B Scale is a numerical scale extending from 1-20.
7. A number is given to the emulgent depending on the strength of the hydrophilic, lipophilic segment of the molecule.
8. The system mostly used for non-ionic emulgents.

9. Emulsifying agents with the higher H.L.B numbers produce o/w emulsion & lower numbers produce w/o type emulsions.
10. Emulsifying agents with 3-6 value produce w/o emulsion & emulsifying agents with 8-18 value produce o/w type emulsion.

Application:

The following are the H.L.B values of few important emulsifying agents.

S. No.	Range	Application
1.	1-3	Antifoaming agents
2.	3-6	Emulsifying agents (w/o type)
3.	7-9	Wetting agents
4.	8-18	Emulsifying agents (o/w type)
5.	13-18	Detergent
6.	15-18	Solubilizing agents

Different tests for the identification of emulsion type.

O/W type	W/O type
<p>1. Dilution test: If water is added to o/w type the preparation remains homogeneous. But if oil is added, oil separates out as layer.</p> <p>2. Dye test: Mix scarlet red an oil soluble dye with o/w type. Take one drop is placed on the glass slide & focused under microscope. If dispersed phase appears in colour, it is said to be o/w type.</p> <p>3. Electrical conductivity test: O/w type conducts electricity. A pair of electrodes is connected to a low voltage lamp. The electrodes are dipped in o/w type of emulsion & current is passed. The bulb glows.</p> <p>4. fluorescence test: Water does not produce fluorescence in UV light under microscope. A drop of emulsion is examined in UV light under microscope. The spotty fluorescence is produced providing that oil in dispersed phase.</p>	<p>1. If water is added to w/o type the preparation remains homogeneous. But if water is added, the water separates out as layer.</p> <p>2. Mix scarlet red with w/o type of emulsion. Take one drops with w/o is placed on a glass slide & focused under the microscope. If the dispersed phase appears colourless. It is said to be w/o type.</p> <p>3. W/o type does not conduct electricity. A pair of electrodes is connected to a low voltage lamp. The electrodes dipped in w/o type emulsion & current is passed. The bulb does not glow.</p> <p>4. Many oils produce florescence when expose to UV light. A drop of Emulsion is examined in UV light. The entire field is produced. Florescence proving that oil in continues phase</p>

Stability of Emulsions:

Stability: A formulated emulsion should retain its original characters like size of the emulsion and their uniform distribution throughout the continuous phase.

The following are some of the symptoms of instability of emulsions:

1. Creaming:

Creaming is defined as the upward movement of the dispersed phase towards the surface and form a thick layer at the surface of the emulsion.

Reason for creaming:

1. The size of globules.

2. The viscosity of continuous phase.
3. The difference between the densities of the dispersed phase and continuous phase.
4. The temperature.

To prevent creaming:

1. By reducing size of globules
2. By increasing the viscosity if continuous phase
3. By reducing the difference between the densities of the dispersed phase and continuous phase.
4. By storing the emulsion in a cool place.

2. Sedimentation:

Definition: It is defined as the downward movement of the dispersed phase towards the bottom & form a separate layer over the sedimented particles.

Reasons for sedimentation:

1. The size of the globules
2. The difference between the densities of the dispersed phase & continuous phase.

Prevention: Sedimentation can be reduced by the following ways.

1. By reducing the size of the globules.
2. By reducing the difference between the densities of dispersed phase & continuous phase.

3. Cracking:

Cracking can be defined as the separation of the dispersed phase and continuous phase as two separate layers. They cannot be re-dispersed on shaking.

Cracking may be caused by physical or chemical or microbial effects. They change the nature of the emulsifying agent & reduce the emulsifying property.

4. Phase inversion:

Change of phase that is o/w type of emulsion changes into w/o type of emulsion and vice versa is known as phase inversion.

Reason for phase inversion:

1. By the addition of electrolyte.
2. By changing the phase volume ratio
3. By temperature changes.

To minimise phase inversion:

1. By using the proper emulsifying agent in sufficient concentration.
2. By keeping the concentration of dispersed phase between 30 to 60 percent.

By storing the emulsion in a cool place.

Factors effecting the cracking of emulsions:

i) Chemical factors:

Decomposition or precipitation of emulsifying agents.

- a) **Acids:** Acids decompose alkali soaps & the emulsion separate into two phases
- b) **Electrolytes:** Electrolytes like sodium chloride precipitate the sodium soap & the emulsion separates into two phases.
- c) **Alcohols:** Alcohol precipitates the gum & the protein emulsifying agent. The emulsion is separated into two phases.

ii) Physical factors:

- a) **Addition of opposite type of emulsifying agent:** By adding of o/w type of emulsifying agent to a w/o type of emulsion, the emulsion separates into two phases. **Ex:** Addition of soft to a calcium soap emulsion.
- b) **Addition of common solvent:** Addition of solvent in which both dispersed phase & the continuous phase are soluble. The emulsion from the phase system & destroys the emulsion. **Ex:** Addition of alcohol to turpentine oil, for soft soap emulsion.
- c) **Addition of excess dispersed phase:** If the dispersed phase is incorporated to the emulsion the dispersed globules coagulate & the emulsion separates into two phases. **Ex:** Addition of turpentine oil to the turpentine oil soft soap emulsion.
- d) **By increasing the temperature:** If increase in temperature the viscosity of the emulsion will be decreased & causes creaming. The creaming is more liable to crack the emulsion.

iii). Microbial factor:

If the emulsion is not used immediately & does not contain preservative. There may be growth of mould & bacteria in the emulsion. It destroys the emulsifying agent. It causes separation of emulsion into two phases.

