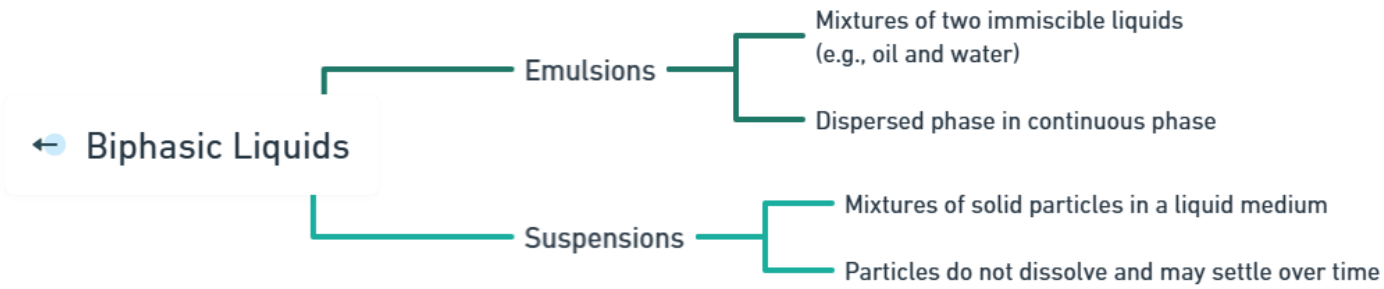
Biphasic liquids

Biphasic Liquids

Introduction

- Biphasic liquids are systems consisting of two immiscible (non-mixing) liquid phases.
- These systems are commonly used in the pharmaceutical, cosmetic, and chemical industries.
- They are typically created when two liquids with different polarities, such as oil and water, are combined.
- Due to differences in polarity, these liquids do not mix and form separate layers, creating a biphasic liquid system.
- When left undisturbed, biphasic liquids will naturally separate into their respective layers.

Classification of Biphasic Liquids



1. Emulsions

- Emulsions are mixtures of two immiscible liquids, such as oil and water, where one liquid (the dispersed phase) is broken down into small droplets and distributed within the other (the continuous phase).
- Emulsions can be further classified into:

A. Oil-in-water (O/W) emulsions

- Small droplets of oil are dispersed in an aqueous phase (water-based).

B. Water-in-oil (W/O) emulsions

- Small droplets of water are dispersed in an oil phase.

C. Multiphase emulsions

- Complex systems with multiple immiscible liquid phases, such as water-in-oil-in-water (W/O/W) or oil-in-water-in-oil (O/W/O) emulsions.

2. Suspensions

- Suspensions are mixtures in which solid particles are dispersed in a liquid medium without dissolving.

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- The solid particles remain suspended in the liquid but may settle at the bottom over time if left undisturbed.
- Suspensions are common in pharmaceutical formulations, such as liquid oral medications or topical creams, where the active ingredients are insoluble.

Suspensions

Definition of Suspensions

- A suspension is a heterogeneous mixture in which finely divided solid particles are dispersed in a liquid medium.
- The particles in a suspension are larger than those in a solution and do not dissolve in the liquid.
- Over time, these solid particles settle out due to gravity, making suspensions distinct from solutions and colloidal dispersions.
- **Examples**: Antacid suspensions, Calamine lotion, and some antibiotic suspensions.

Advantages of Suspensions

1. **Increased Stability**: Certain drugs that are unstable in solution form can be stabilized in a suspension, as the solid form of the drug is generally more stable than in solution.
2. **Ease of Administration**: Suspensions allow the administration of poorly soluble drugs in a liquid form, making them easier to swallow for pediatric or geriatric patients.
3. **Controlled Release**: Suspensions can be formulated to provide slow and sustained drug release, which is helpful in cases where controlled delivery is desired.
4. **Taste Masking**: Insoluble drugs can be suspended, masking their unpleasant taste better than in solution form.
5. **Flexibility in Dosing**: Suspensions allow for easy dose adjustments by measuring out different volumes.

Disadvantages of Suspensions

1. **Sedimentation**: Over time, particles tend to settle out of the suspension, leading to uneven distribution of the active ingredient if not shaken well before use.
2. **Poor Dose Uniformity**: Inadequate shaking may result in non-uniform dosing.
3. **Bulky and Inconvenient**: Suspensions are often bulkier than tablets or capsules, making them harder to store and transport.
4. **Stability Issues**: Suspensions are physically unstable and prone to caking, making resuspension difficult.

Classifications of Suspensions

Suspensions can be classified based on several factors:

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1. **Based on Route of Administration:**
    A. **Oral suspensions**: For ingestion (e.g., antacids, antibiotics).
    B. **Topical suspensions**: Applied to skin (e.g., calamine lotion).
    C. **Parenteral suspensions**: Injected into the body (e.g., depot injections).
    D. **Ophthalmic suspensions**: For application in the eyes.
2. **Based on Particle Size:**
    A. **Coarse suspensions**: Particle size > 1 µm.
    B. **Colloidal suspensions**: Particle size < 1 µm.
3. **Based on Electrokinetic Properties:**
    A. **Flocculated Suspensions**: Particles form loose aggregates or flocs.
    B. **Deflocculated Suspensions**: Particles remain as individual entities and do not form aggregates.
4. **Based on Concentration of Solid Content:**
    A. **Dilute suspensions**: Solid content < 2%.
    B. **Concentrated suspensions**: Solid content > 2%.

Preparation of Suspensions

The preparation of suspensions involves several critical steps to ensure a homogenous and stable formulation:

1. **Wetting of Particles**
    - The solid drug particles must first be wetted to prevent clumping or floating.
    - Wetting agents like glycerin, ethanol, or surfactants (e.g., polysorbates) can be used.
2. **Dispersion of Solid Particles**
    - The wetted solid is dispersed uniformly in the dispersion medium (aqueous or non-aqueous).
    - High-speed mixers or colloid mills may be employed for this process.
3. **Stabilization of the Suspension**
    - Stabilizing agents such as viscosity enhancers (e.g., methylcellulose, carbopol) are added to reduce the settling rate of particles.
    - Surfactants can also be added to prevent flocculation or caking.
4. **Homogenization**
    - The suspension is passed through a homogenizer to reduce particle size and ensure uniform distribution.
5. **Packaging**

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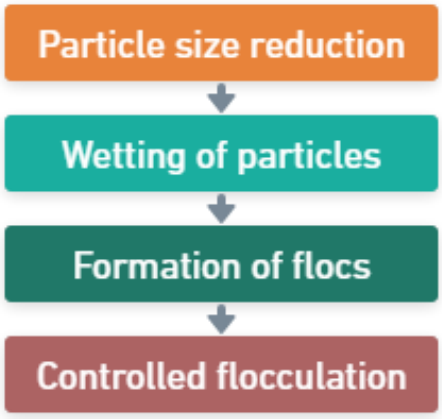
- The suspension is then packaged in appropriate containers, ensuring stability and protection from light and air.

Flocculated suspension

Definition

- A **flocculated suspension** is one in which solid particles form loose, fluffy aggregates called **flocs**.
- These flocs settle quickly but can be easily redispersed upon shaking.
- Flocculated suspensions are preferred in pharmaceuticals due to their **better stability** and **ease of redispersion**.

Preparation of Flocculated Suspensions



1. **Particle size reduction:**
   - The solid drug is **milled or micronized** to achieve a suitable particle size for proper dispersion.
2. **Wetting of particles:**
   - A **wetting agent** is used to reduce interfacial tension between solid particles and the liquid medium.
3. **Formation of flocs:**
   - A **flocculating agent** (e.g., electrolytes or polymers) is added to promote the formation of loose, easily dispersible flocs.
4. **Controlled flocculation:**
   - The concentration of the flocculating agent is adjusted to achieve the desired degree of flocculation without excessive settling or caking.

Stability Problems & Solutions

1. **Sedimentation:**
   - **Problem:** Rapid settling can lead to uneven dosing and difficulty in redispersion.

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- **Solution:** Adjust flocculating agent concentration and increase the viscosity of the medium with thickening agents like **hydroxyethyl cellulose** or **xanthan gum** to slow sedimentation.

2. Caking:

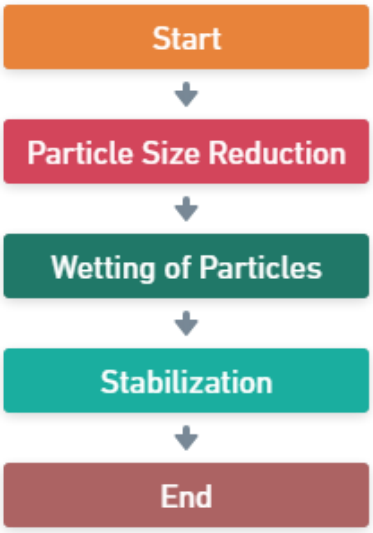
- **Problem:** If flocs settle too tightly, they may form a hard cake that is difficult to redisperse.
- **Solution:** Optimize flocculation by adjusting flocculating agents and increasing viscosity with suitable thickeners. Shake the suspension gently before use.

Deflocculated suspension

Definition

- In a deflocculated suspension, solid particles remain discrete and uniformly dispersed throughout the liquid medium.
- While initially more uniform, these suspensions are prone to sedimentation and caking, making redispersion difficult.

Preparation of Deflocculated Suspensions



1. Particle size reduction:

- The solid drug is **milled or micronized** for proper dispersion, similar to flocculated suspensions.

2. Wetting of particles:

- A **wetting agent** is used to reduce interfacial tension between the particles and the liquid medium.

3. Stabilization:

- A **stabilizing agent** (e.g., non-ionic surfactant or hydrophilic polymer) is added to prevent aggregation.

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