DISPERSE SYSTEMS-SUSPENSION

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DISPERSE SYSTEMS

- The term "Disperse System" refers to a system in which one substance (The Dispersed Phase) is distributed, in discrete units, throughout a second substance (the continuous Phase or vehicle).
- Each phase can exist in solid, liquid, or gaseous state .

SUSPENSION

- mixture of two substances, one of which is finely divided and dispersed in the other.
- Suspensions:
- S-S,
- L-S (OR S-L),
- G-S

Colloidal suspension 1 nm to 0.5 µm

Coarse suspension 1 to 100 µm

- A suspension of liquid droplets or fine solid particles in a gas is called an aerosol.
- Blood is an example of suspensions
- Suspensions are useful for administering insoluble or poorly soluble drugs or in situations when the presence of a finely divided form of the material in the GI tract is required.

The Difference Between Solution & Suspensions

- When the 2 substances totally mix it is called a solution.
- E.g. Solute + Solvent = Solution
- (sugar) + (water) = Solution
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- We then say sugar is soluble in water, it has dissolved.

The Difference Between Solution & Suspensions

- Suspensions
- Sometimes when we mix substance[illegible]y in clusters. We therefore say it is insol[illegible]ater.
- E.g. Chalk + Water = Suspension

- Eventually the particles sink to the [illegible]tom to form sediment.

Uses of Suspensions

- To administer an insoluble compound as a liquid.
- To lessen the unpleasant taste of an insoluble compound by:
  - formulating a vehicle in which the drug is not soluble
  - using an insoluble form of the drug (ie. salt form or prodrug)
  - adsorbing the drug onto an insoluble carrier
- To modify the release rate of the drug.
- To improve the stability by reducing the fraction of drug in solution

Properties of an Ideal Suspension are:

- Uniform dispersion
- Palatable
- Pleasing odor and color
- No grittiness
- Easy to pour yet not watery
- No cap-lock
- Temperature insensitive

SUSPENSION

Properties of an Ideal Suspension are:

- particles should settle slowly
- formulation should allow the easy redispersion of sedimented particles
- a flocculated suspension is desirable than a deflloculated suspension
- a suspension should not be too viscous to reduce the sedimentation rate

Routes of Administration

- Oral
- Ocular
- Rectal
- Parenteral
- Topical

Examples of Pharmaceutical Suspensions:

1. Antacid oral suspensions
2. Antibacterial oral suspension
3. Dry powders for oral suspension (antibiotic)
4. Analgesic oral suspension
5. Anthelmentic oral suspension
6. Anticonvulsant oral suspension
7. Antifungal oral suspension

Preparation

- Large scale: colloid mill
- : mortar and pestle small scale
- witting agents: alcohol, glyrecin (hygroscopic liquids)

METHODS OF PREPARATION

- (1) use of controlled flocculation .
- (2) use of structured vehicle.

Packaging and Storage of Suspensions:

1) Should be packaged in wide mouth containers having adequate air space above the liquid.
2) Should be stored in tight containers protected from:

- freezing.
- excessive heat & light.

3) Label: "Shake Before Use" to ensure uniform distribution of solid particles and thereby uniform and proper dosage.

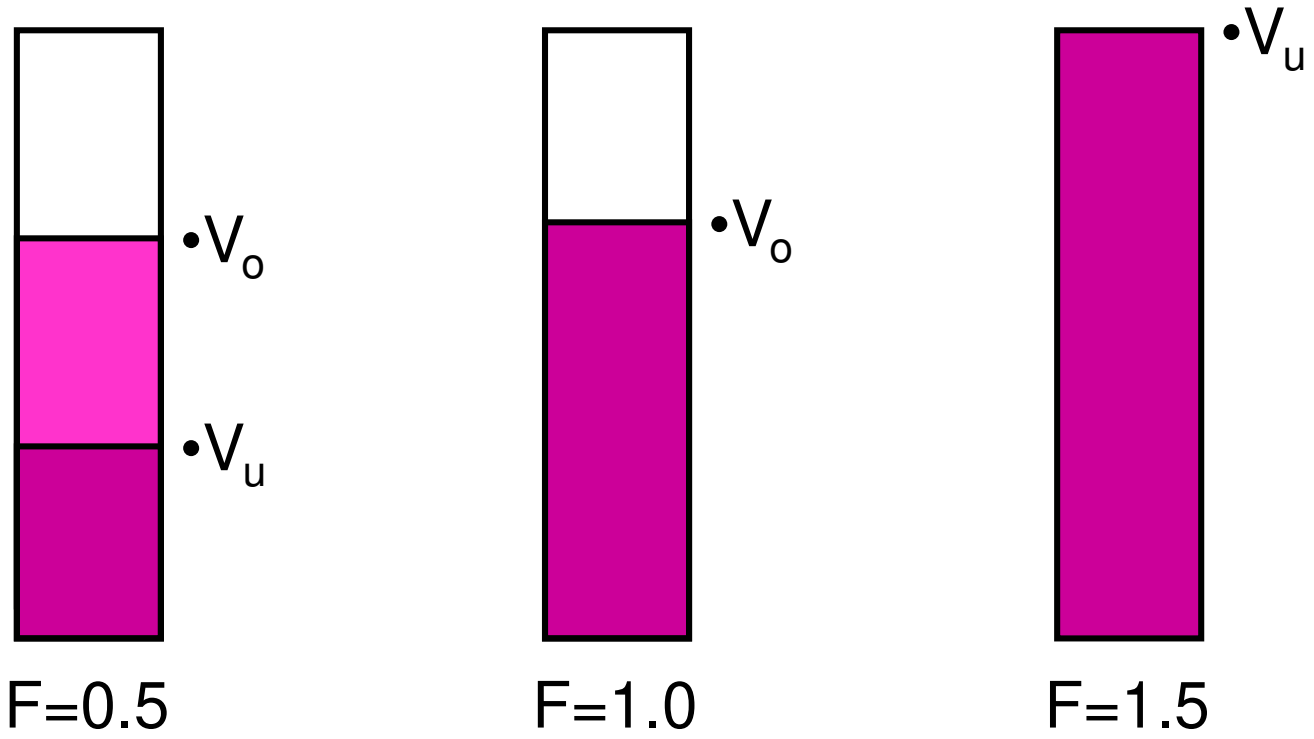
FACTORS TO BE CONSIDERED

- Sedimentation.
- Particle size.
- Nernst and zeta potential.
- Deflocculation and flocculation.
- Electrokinetic Properties.
- Density of the vehicle.
- Viscosity of the vehicle.

FACTORS TO BE CONSIDERED

Sediment Volume

F={volume of sediment V_u}/{original volume V_o}



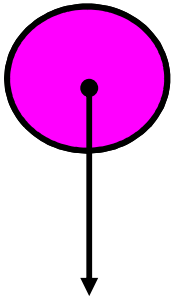
FACTORS TO BE CONSIDERED

- Sedimentation volume-
- $F = V_{sed}/V_{tot}$
- The value of F normally lies between 0 to 1 for any pharmaceutical suspension.
- The value of F provides a qualitive knowledge about the physical stability of the suspension.

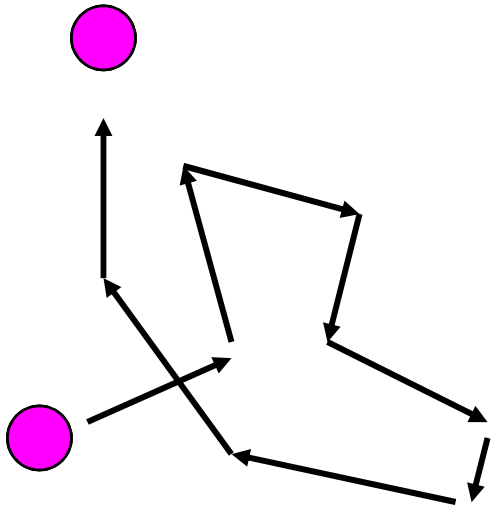
FACTORS TO BE CONSIDERED

"External" Forces Acting on Particles

Gravity



Brownian Movement



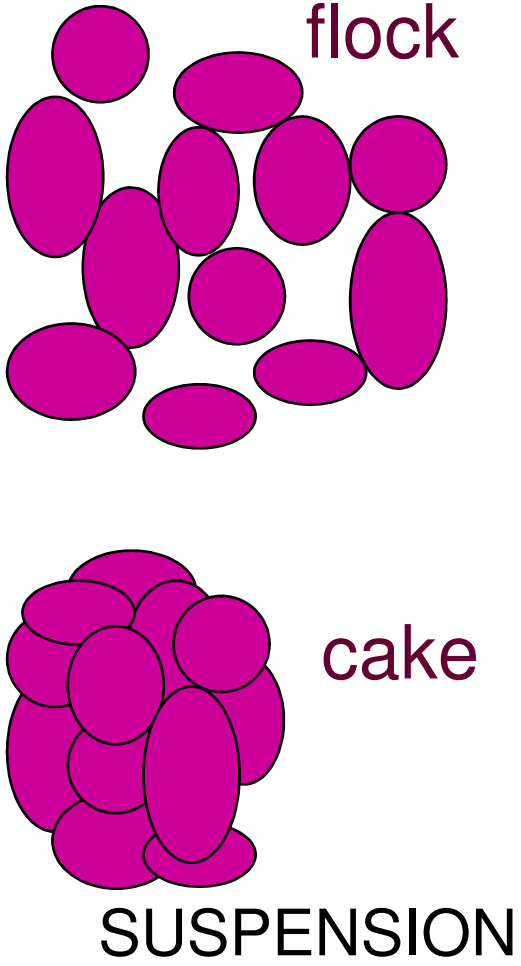
- **Sedimentation equilibrium:** Gravity is neutralized by Brownian movement.

SUSPENSION

SETTLING & AGGREGATION

- The suspension shall form loose networks of **flocks** that settle rapidly, do not form cakes and are easy to resuspend.

- Settling and aggregation may result in formation of **cakes** (suspension) that is difficult to resuspend or phase separation (emulsion).



FACTORS TO BE CONSIDERED

Nernst potential

- The difference in electric potential between the actual surface of the particle and the electroneutral region is referred to as Nernst potential.

FACTORS TO BE CONSIDERED

Zeta potential

- Potential difference between the ions in the tightly bound layer and the electroneutral region, referred to as zeta potential.

FACTORS TO BE CONSIDERED

Deflocculation

- Deflocculation of particles is obtained when the zeta potential is higher than the critical value and the repulsive forces supersede the attractive forces.
- These deflocculated particles when sediment form a close packed arrangement with the smaller particles filling the voids between the larger ones. -SOLID HARD CAKE

SUSPENSION

FACTORS TO BE CONSIDERED

Flocculation

- When this zeta potential goes below the critical value, the attractive forces supersede the repulsive forces and flocculation occurs.
- These loosely packed particles or floccs settle faster than the deffloccculated particles because of their larger sizes.
- But unlike deffloculated particles this sediment of floccs does not form solid cake.
- This sediment of floccs is easy to redisperse by minute agitation.

FACTORS TO BE CONSIDERED

Degree of flocculation-

$$\beta = F_{floc}/F_{defloc}$$

$$= \frac{(V_{sed}/V_{tot})_{floc}}{(V_{sed}/V_{tot})_{defloc}}$$

FACTORS TO BE CONSIDERED

- When the total volume of both the flocculated and the deflocculated suspensions are same, the degree of flocculation,

- $ß = (V_{sed})_{floc}/(V_{sed})_{defloc}$

THIXOTROPIC SUSPENSION

- A thixotropic suspension is the one which is viscous during storage but loses consistency and become fluid upon shaking.
- A well-formulated thixotropic suspension would remain fluid long enough for the easy dispense of a dose but would slowly regain its original viscosity within a short time.