BP 403T. Physical Pharmaceutics-II (Theory)

Unit1 (Part I)

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Unit -1. 7 hours.

Colloidal dispersions: Classification of dispersed systems & their general characteristics, size & shapes of colloidal particles, classification of colloids & comparative account of their general properties. Optical, kinetic & electrical properties. Effect of electrolytes, coacervation, peptization& protective action.

Introduction to Colloidal Dispersions

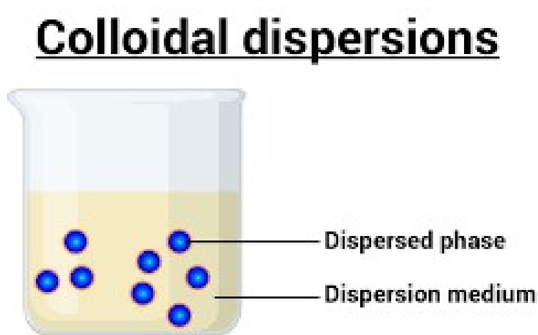
The word "colloid" was derived from the Greek, "kolla" for glue.

- ✓ Colloid is short synonym for colloidal system.
- ✓ The heterogeneous biphasic system.
- ✓ Size of colloidal particle ranges from 1nm to 100nm

They are consisting of two phases:

- Dispersed phase
- Continuous phase (dispersion medium/Solvent).

Eg: Suspensions & Emulsions



Classification:

- Dispersed systems consist of particulate matter (dispersed phase), distributed throughout a continuous phase (dispersion medium).
- They are classified according to the particle diameter of the dispersed material:

1- Molecular dispersions (less than 1 nm)

- ➢ In this particles invisible in electron microscope
- ➢ Pass through semipermeable membranes and filter paper
- ➢ Particles do not settle down on standing
- ➢ Undergo rapid diffusion
- ➢ E.g. ordinary ions, glucose

2- Colloidal dispersions (1 nm - o.5 um)

- In this particles not resolved by ordinary microscope, can be
- Pass through filter paper but not pass through semipermeable membrane.
- Particles made to settle by centrifugation
- Diffuse very slowly
- E.g. colloidal silver sols, natural and synthetic polymers

3- Coarse dispersions (> 0.5 um)

- In this particles are visible under ordinary microscope
- Do not pass through filter paper or semipermeable membrane.
- Particles settle down under gravity
- Do not diffuse
- E.g. emulsions, suspensions, red blood cells

Classification based on size:

Class	**Size**	**Example**
Molecular dispersion	<1nm	Glucose solution
Colloidal dispersion	1nm to 500nm	Gold sol, acacia mucilage, milk
Coarse dispersion	>500nm	Pharmaceutical suspension

Size and shape of colloids:

Particles lying in the colloidal size have large surface area when compared with the surface area of an equal volume of larger particles.

- Specific surface: the surface area per unit weight or volume of material.
- The possession of large specific surface results in:
  - Platinium is effective as catalyst only when found in colloidal form due to large surface area which adsorb reactant on their surface.
  - The colour of colloidal dispersion is related to the size of the paticles

e.g. red gold sol takes a blue colour when the particles increase in size

The shape of colloidal particles in dispersion is important. The more extended the particle the greater its specific surface the greater the attractive force between the particles of the dispersed phase and the dispersion medium.

Flow, sedimentation and osmotic pressure of the colloidal system is affected by the shape of colloidal particles. Even particle shape may also influence the pharmacologic action.

Common examples of colloidal systems

- Aerosol (Liquid or Solid in Gas)
- Foam (Gas in Liquid)
- Emulsion (Liquid in Liquid)
- Sol (Solid in Liquid)
- Smoke (Solid in Gas)
- Fog (Liquid in Gas)

Dispersed Phase	Dispersion Medium	Common Name	Examples
Solid	Solid	Solid Sol	Coloured gemstones, coloured glasses
Solid	Liquid	Sol	Paints, muddy water, gold sol, starch sol, arsenous sulphide sol
Solid	Gas	Aerosol	Smoke, dust
Liquid	Solid	Gel	Gellies, cheese
Liquid	Liquid	Emulsion	Milk, cod liver oil
Liquid	Gas	Liquid alcosol	Mist, fog, cloud
Gas	Solid	Solid foam	Foam rubber, pumice stone
Gas	Liquid	Foam	Froth, whipped cream

Types of colloids on basis of nature of interaction between dispersed phase and dispersion medium:

A-Lyophilic colloids (solvent loving) – The particles in a lyophilic system have a great affinity for the solvent. If water is the dispersing medium, it is often known as a hydrosol or hydrophilic. These are readily solvated (combined chemically or physically, with the solvent) and dispersed, even at high concentrations.

- Examples of lyophilic sols include sols of gum, gelatin, starch, proteins and certain polymers (rubber) in organic solvents.
- The dispersed phase does not precipitate easily
- If the dispersion medium is separated from the dispersed phase, the sol can be reconstituted by simply remixing with the dispersion medium. Hence, these sols are called reversible sols.

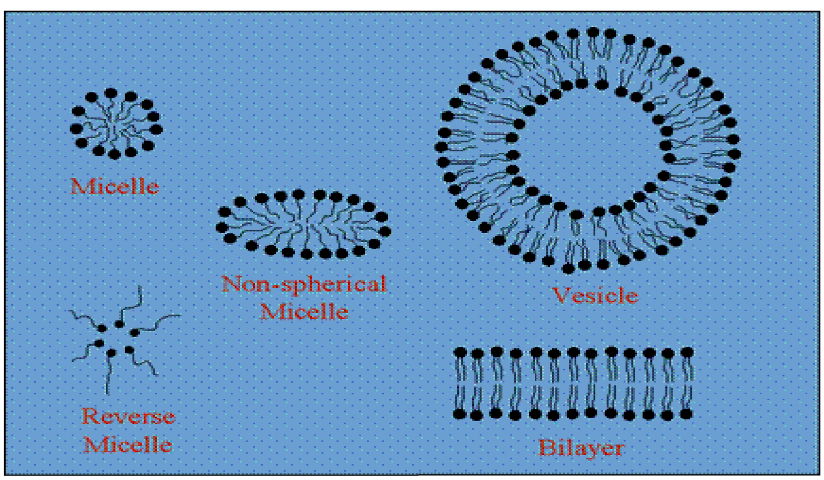
- Prepared simply by dissolving the material in the solvent being used e.g. dissolution of acacia in water.

B-lyophobic (solvent hating) - The particles resist solvation and dispersion in the solvent.

- The concentration of particles is usually relatively low.
- Less viscid (sticky)
- These colloids are **easily precipitated** on the addition of small amounts of electrolytes, by heating or by shaking
- Once precipitated, it is not easy to reconstitute the sol by simple mixing with the dispersion medium. Hence, these sols are called irreversible sols.
- Examples of lyophobic sols include sols of metals and their insoluble compounds like sulphides and oxides.

e.g. gold in water

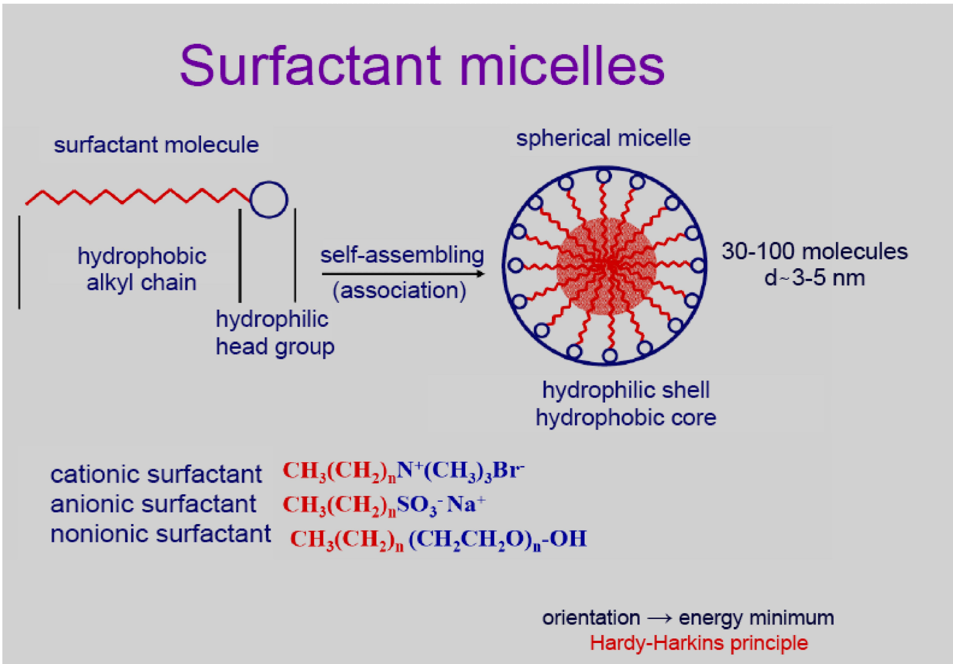
C-Association colloids



Critical micelle concentration (C.M.C) : the concentration at which micelle form

- The phenomenon of micelle formation can be explained:

- Below C.M.C: amphiphiles are adsorbed at the air/water interface
- As amphiphile concentration is raised: both the interphase and bulk phase become saturated with monomers (C.M.C)
- Any further amphiphile added in excess: amphiphiles aggregate to form micelles



Applications of colloidal solutions

❖ Therapeutic application:

Eg: Silver colloid-Burn Relief & germicidal

Copper colloid-anticancer

Mercury colloid-Antisyphilis

❖ Stability---e.g. They also prevent flocculation in suspensions hence incease the stability.

❖ Absorption Enhancement :Eg: sulphur colloid

❖ Targeted Drug Delivery: like Liver targeting & colon targeting

❖ Clotting of blood:

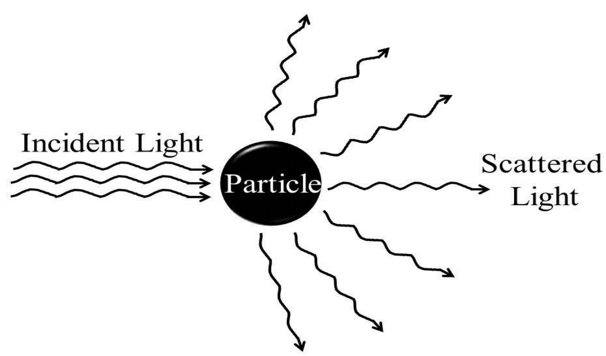
- Blood is a colloidal solution and is negatively charged (due to high content of proteins)
- On applying a solution of Fecl3 bleeding stops as Fe+3 ions neutralize the ion charges on the colloidal content of blood

Properties of Colloidal Dispersions (Optical, kinetic and electric)

Optical Properties of Colloids

The same effect is noticed when a beam of sunlight enters a dark room through a slit when the beam of light becomes visible through the room.

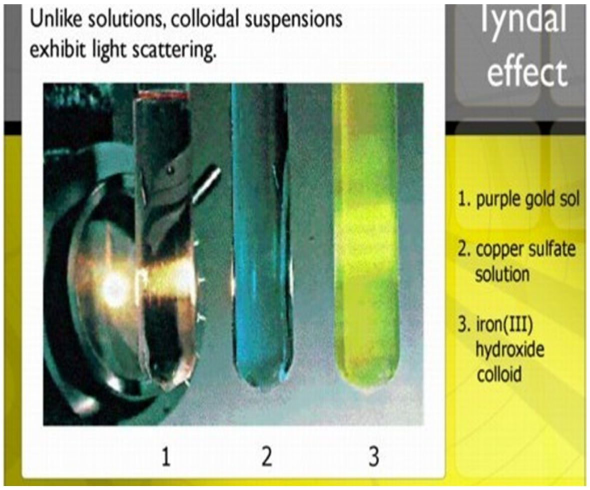
This happens due to the scattering of light by particles of dust in the air.



Faraday-Tyndall effect

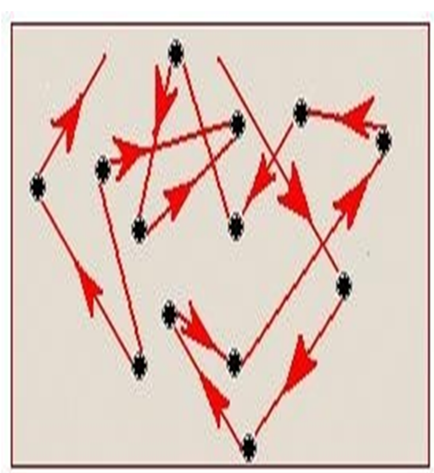
When a strong beam of light is passed through a colloidal sol, the path of light is illuminated

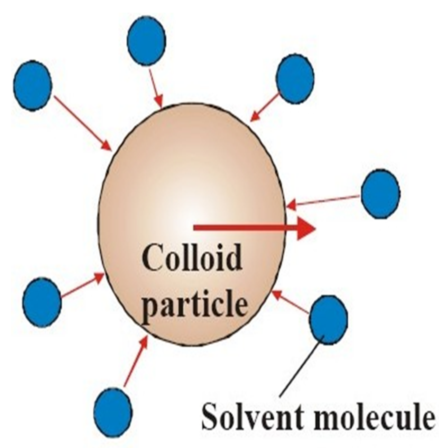
(a visible cone formed). This phenomenon resulting from the scattering of light by the colloidal particles.



Kinetic Properties Of Colloids

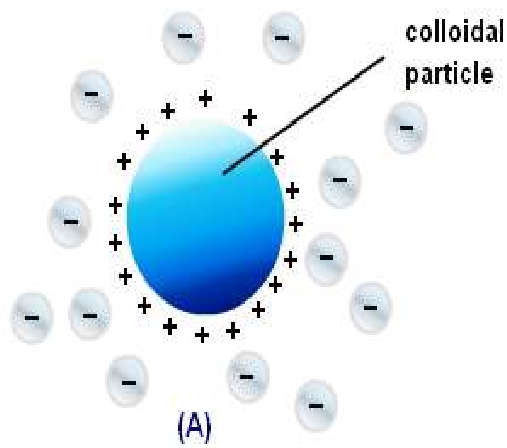
- The zig-zag movement of colloidal particles continuously and randomly.
- This Brownian motion arises due to the uneven distribution of the collisions between colloid particle and the solvent molecules.
- Brownian movement was more rapid for smaller particles.
- It decrease with increase the viscosity of the medium.

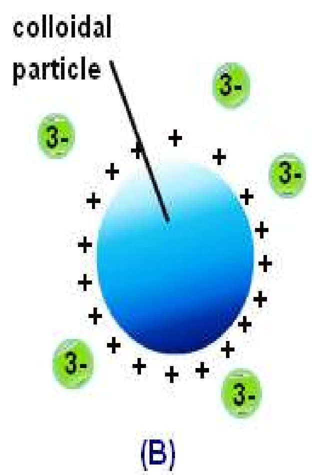




Electric Properties Of Colloids

- The particles of a colloidal solution are electrically charged and carry the same type of charge, either negative or positive.
- The colloidal particles therefore repel each other and do not cluster together to settle down.





Electric Properties Of Colloids

- The charge on colloidal particles arises because of the dissociation of the molecular electrolyte on the surface.
- It is seen though the electrophoresis process.

- Zeta potencial is the indicator of the net electric charge on the colloidal system & their stability.