

## Colloids

Thomas Graham has classified the substance into

- **Crystalloids** : Which diffuse rapidly through parchment membrane.
- **Colloids** : which diffuse slowly through parchment membrane are Eg: starch, gum, gelatin etc.,
- In practice it is found that a crystalloid can be made into colloid and some of the colloids were found to be crystalline in nature.
- Therefore, the term colloidal substance is replaced by colloidal state.
- Based on the size of disperse particle in a medium the binary systems are classified into 3 types.

### True solution:

Properties	Colloidal solution	True solution	Suspension
Size	$1\text{ m}\mu \rightarrow 1\mu$	Less than $1\text{ m}\mu$	More than $1\mu$
Diffusion through animal membrane	Diffuses slowly	Diffuses rapidly	Will not diffuse
Settling of particles	Will not settle by gravity but settles by centrifugation	Will not settle at all	Settles by just gravity
Filterability	Can not be filtered	Can not be filtered	Can be filtered
Filtration with ultrafilter	Can be filtered	Can not be filtered	Can be filtered
Appearance	Turbid (clear)	Very clear	Opaque
Nature	Heterogeneous	Homogenous	Heterogeneous
Tyndall effect	Will show tyndall effect	Does not show	Will show tyndall effect
Number of molecules are in one particle	Particle is the aggregate of few hundreds of molecules	Particle is single molecule or ion	Particle is the aggregate of millions of molecule

### Colloidal solution:

- It is the heterogeneous binary system in which the dispersed particle is the aggregate of few hundreds of molecules or ions.
- Colloid consists of two phases.
  1. dispersed phase  $\rightarrow$  particles which are dispersed in medium . It is also called distentiguous phase or internal phase.
  2. Dispersion medium  $\rightarrow$  It is the medium in which particles are dispersed. It is also called as external phase.
- Dispersed phase can be a solid or liquid or gas.
- Dispersion medium can be a solid or liquid or gas.
- Based on the physical state phase and medium colloids are classified into 8 types.

- Gas in gas will not form colloid because it is homogenous mixture.
- Most common type among the colloidal solution side is sol that is solid in liquid.

Type of colloidal solution	Adsorbate	Adsorbent	Name	Example
1. Gas in liquid	Gas	Liquid	Froths	Shaving cream, soda water froth, soap surf lemonade froths
2. Gas in solid	Gas	Solid	Solid foam	Rubber cork, foam heads, pumice stones.
3. Solid in liquid	Solid	Liquid	Sol	Blood, starch in water, metal particles in water ink etc.
4. Solid in gas	Solid	Gas	Solid aerosol	Smoke, dust.
5. Solid in solid	Solid	Solid	Solid sol	Coloured glass
6. Liquid in gas	Liquid	Gas	Liquid aerosol	Clouds, fog
7. Liquid in liquid	Liquid	Liquid	Emulsion	Milk, cod liver oil, syrups, tonics
8. Liquid in solid	Liquid	Solid	Gels	Shoe polish, butter, cheese

- Based on the nature of medium sols are of many types.  
Eg. : If water is medium it is aquasol or hydrosol.  
If alcohol is medium it is alchasol.  
If Benzene is medium it is Benzosol.
- Based on the affinity between particles and medium, colloids are classified into two types  
**1) Lyophilic colloids (or) Hydrophilic colloids:**  
Strong attractions will exist between colloids particles and medium.  
Eg: organic substances like Starch, RBC, Albumin, Blue gelatin etc., and certain polymers in organic medium also formed.

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## 2) Lyophobic colloids or Hydrophobic colloids:

No attractions will exist between colloidal particles and medium

Eg: Metalsols, Metaloxidesols, Metalsulphide sols.

### Some example of colloids:

Property	Lyophilic	Lyophobic
Attractive forces	Strong attractions will exist [H –H bonds]	No attractions will exist
Salvation	Particles are more solvated	Particles are not solvated
Viscosity	Is more than that of medium	Same as that of medium
Ease of preparation	Can be easily prepared by direct mixing of particles with medium	Cannot be prepared by direct mixing and requires special methods.
Reversible nature	Reversible	Irreversible
Tyndall effect	Weak	Strong Tyndall effect
Stability	More stable due to salvation	Less stable because of no salvation.
Presence of electric charge	Particles may carry little charge or no charge	Particles defiantly carry charge
Ease of coagulation	Not easily coagulated. It requires large amounts of electrolyte for coagulation.	Easily coagulated by adding little amount of electrolyte.

### SMOKE IS :

- An aerosol,
- A colloidal solution of carbon in air.
- A lyophobic colloid, dispersion phase is carbon and dispersion medium is air.
- A solid in gas sol. Carbon particles are precipitated electrically to avoid pollution in electrified chimney, where carbon particals can get discharged.

### CLOUD :

- Is an aerosol.
  - It is a colloidal suspension of water droplets in air.
  - It is a lyophobic colloid.
  - Droplets in cloud precipitate as rain.
  - It is a liquid in gas sol.
  - Dispersion phase is droplets of water (liquid) and dispersion medium is air (gas).
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### **BLOOD :**

- It is an aquasol or hydrosol.
- It is a colloidal suspension of albuminoid substance in water.
- Addition of ferric chloride (large amounts) coagulates the blood and clot during bleeding of wound.
- Dispersion phase is albuminoid substance containing RBC (erythrocytes) WBC (leucocytes).
- Dispersion medium is water containing some inorganic ions and organic molecules.
- It is a solid in liquid colloid.
- Impure blood is purified by kidneys through dialysis.
- It is a negative colloid, It coagulates with positive ions like  $\text{Al}^{+3}$  or  $\text{Fe}^{+3}$  etc.,

### **MILK :**

- It is an emulsion.
- It is an oil in water (O/W) type emulsion.
- It is a liquid in liquid type colloid.
- Dispersion phase is droplets of liquid fat and dispersion medium is water.
- Milk on coagulation gives emulsified fat (casein).
- Milk cream from milk can be separated by centrifugation.
- Curding of milk is coagulation of milk.
- On souring lactose in milk converts to lactic acid which coagulates the milk.

### **STARCH SOLUTION.**

- It is an aquasol or hydrosol.
- It is a lyophilic sol.
- It is a solid in liquid type colloid.
- Small amounts of electrolyte cannot coagulate starch sol.
- Large quantities of electrolytes can coagulate starch sol.
- Dispersion phase is starch and dispersion medium is water.

### **GOLD SOL :**

- It is an aquasol or hydrosol.
- It is a lyophobic colloid.
- It is a solid in liquid type colloid.
- It is coagulated by adding small amount of electrolytes.
- Dispersion phase is gold particles and dispersion medium is water.
- It is prepared by **Bredig arc** method.

### **Preparation of gold sol by Briedig arc's method :**

Two gold rods are immersed in water. When electric arc is struck between the gold rods. Some of the gold is vapourised. Gold vapour then gets condensed. In condensation gold atoms will aggregate to form colloid size particles. Which are dispersed in water.

- If gold particle is big in size it is blue colour.
  - If particle is small gold sol is red in colour.
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- ## Micelles:

- Associated colloides :**

- Lauryl sulphate  $\rightarrow$   $\text{C}_{12}\text{H}_{25}\text{OSO}_3$

## Emulsion :

- Soap emulsified kerosene oil in water.

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- Egg albumen emulsifies oil volume in water.
  - $\text{Hg I}_2$  emulsified water in benzene.
  - The type emulsion [o/w or w/o] form will depend on
    - a) the relative proportion of two liquids
    - b) the liquid with lower surface tension acts as medium.
    - c) the liquid which is more soluble in emulsifier will act as medium.

**Applications of emulsions :**

- 1) In washing and cleaning of clothes by soaps and detergents.
- 2) In the digestion of fats in small intestine.
- 3) In the conversion of cream in to butter.
- 4) In metallurgy for concentration of ores.
- 5) Various medicines, lotions, ointments etc are used in the forms of emulsions.
- 6) In pharmaceutical and cosmetic industry.
- 7) In the separation of oil from water [emulsification, in nature oils of well].