

Unit - I

Colloidal dispersion

Dispersion system -

A dispersion system is defined as a system in which dispersed phase is distributed uniformly throughout dispersion medium.

Classification of dispersion system

<u>S.N.</u>	<u>Dispersion medium</u>	<u>Dispersed phase</u>	<u>Example</u>
1-	Gas	Liquid	Fog
2-	Gas	Solid	Smoke
3-	Liquid	Gas	Foam (aerosol)
4-	Liquid	Solid	Colloidal gold in water
5-	Liquid	Liquid	Oil globules or water globules
6-	Solid	Gas	Solid foam
7-	Solid	Liquid	Mineral oil in wax
8-	Solid	Solid	Colloidal gold in glass

Colloidal dispersion

A dispersion system in which dispersed phase size range $1\text{ nm} - 1\text{ }\mu\text{m}$ is distributed uniformly throughout the dispersion medium are called as colloidal dispersion.

Classification of colloidal dispersion

Colloidal dispersion are classified into following types —

- 1 - Lyophilic colloid.
- 2 - Lyophobic colloid.
- 3 - Association colloid.

1 - Lyophilic colloid —

- * Lyophilic colloids are
- * They are hydrophilic

Hydrophilic colloids

acacia which form water.

Lyo means solvent loving colloids and lipophilic types — include gelatin or colloidal dispersion in

Lipophilic colloids include rubber or polystyrene which forms colloidal dispersion in org. solvent.

Ex - i Benzene.

- * They are thermodynamically stable.
- * Viscosity \uparrow es with adding dispersed phase.

2 - lyophobic colloid - i

- * They are klas solvent hating colloids.
- * when dispersion medium is water they are klas hydrophobic colloids.

Ex - i Colloidal dispersion of gold or silver in water.

- * They are thermodynamically unstable.
- * Viscosity does not \uparrow es on adding dispersed phase.

3 - Association colloids

- * They are also klas amphiphilic colloids.
- * Few molecules or ions have both polar and non-polar groups.
- * They exist separately and associate at critical micelle concentration to form micelle of colloidal size.

* Viscosity increases by adding amphiphiles.

Properties of colloids

1- Optical properties -

Optical properties of colloids

are as follows -

- (a) Ultra microscopy.
 - (b) Electron microscopy.
 - (c) Light scattering.
 - (d) Tyndall effect.
- (a) Ultra microscopy -

* When a cell containing colloidal dispersion is viewed through a ultra microscope against dark background.

* The particle appear as bright spot against dark background.

(b) Electron microscopy -

* The electron microscopy is useful in getting picture of actual particle.

* It help in studying size, shape and structure of colloidal particles.

② Light scattering -:

- * When a beam of light is passed through a colloidal dispersion.
- * Some light absorbed, some is scattered and remainder is transmitted.
- * Absorbed light is responsible for coloured nature.
- * Scattered light causes the colloidal dispersion to appear turbidity.

② Tyndall effect -:

- * When a narrow beam of light is passed through a colloidal dispersion.
- * The path of light became illuminated.
- * This can be observed at right angle under ultra microscope.
- * This is k/as Tyndall effect.
- * Lyophobic system show intense Tyndall effect than lyophilic system.

2 - kinetic properties -;

(a) Brownian movement -;

The colloidal particles in dispersion are always in a state of random motion.

* This random motion can be observed under ultra microscope.

* It was first observed by Robert Brown.

* The velocity of the particles decreases with the increase in particle size.

(b) Diffusion -;

Particles diffuse from a region of higher concentration to lower concentration until the system is uniform.

* The rate of diffusion is expressed by Fick's first law -

$$\frac{dq}{dt} = -D_s \frac{dc}{dt}$$

where \rightarrow $dq =$ Amount of material diffusing in time dt .

S = Surface area.

D = Diffusion coefficient.

$\frac{dc}{dt}$ = concentration gradient.

(c) Sedimentation - 1

* In colloidal dispersion, the brownian movement tend to disturb sedimentation.

* Therefore strong external force must be applied for sedimentation.

* Ultra centrifuge is used for studying sedimentation.

(d) Viscosity - 1

viscosity is an expression of resistance to flow under applied stress (pressure).

* The more viscous a liquid, the greater the applied force to make it flow.

* Viscosity study provide shape of particles in solution.

$$\eta = \eta_0 (1 + 2.5 \phi)$$

where -
 η = viscosity of dispersion
 η_0 = viscosity of dispersion medium
 ϕ = volume fraction of colloidal particles.

3 - Electrical properties -:

When an electric is applied to a colloidal dispersion, the particle carrying charged move toward opposite charge electrode.

- * The negatively charged particles (such as kaoline and sulphur) move toward anode.
- * The +vely charged particles (such as metal hydroxide and ferric hydroxide) move toward cathod.
- * The rate of particle movement is observed by ultra-microscope.
- * The rate of movement is a function of charge on the particle and related to

zeta potential.

* zeta potential can be calculated by —

$$S = \frac{V}{E} \cdot \frac{4\pi\eta}{\epsilon} \times (9 \times 10^9)$$

where -; S = zeta potential in volt.

V = Velocity of movement of colloidal particles.

E = Applied potential.

η = Viscosity of the medium

ϵ = Dielectric constant.

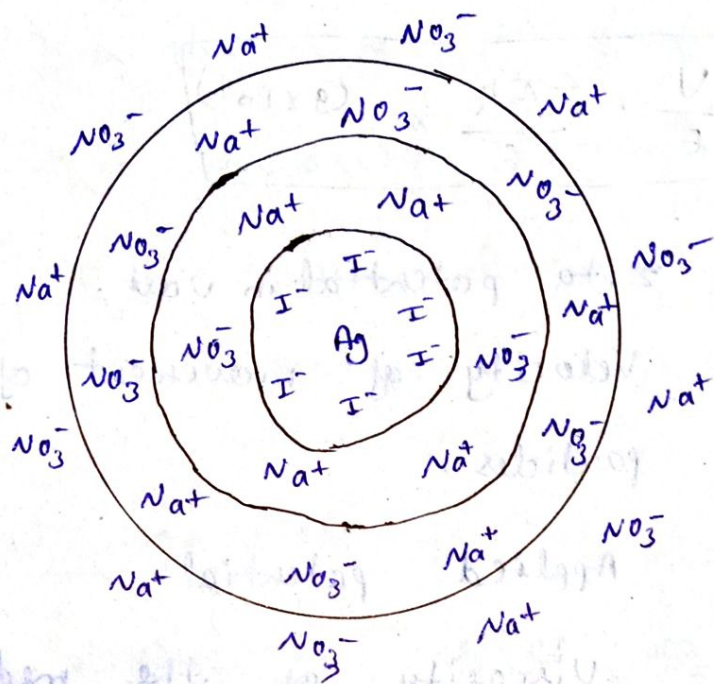
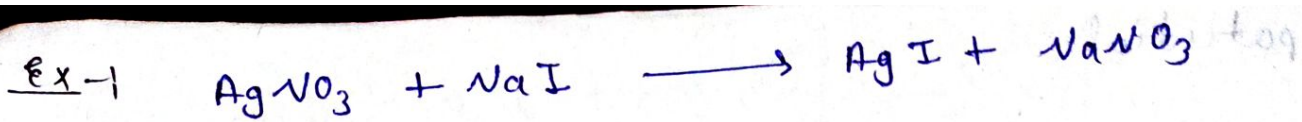
Effect of electrolyte

* Consider a solid surface carrying a -ve charge and is in contact with aqueous solution containing both +ve and -ve ion.

* The -vely charged solid surface will influence distribution of ions.

* The thermal motion also influence distribution of charges.

* The resulting effect will be formation of electric double layer.



* The surface of AgI contains more I^- ions than Ag^+ ion.

* Aqueous salt contain large amount of Na^+ ion and NO_3^- ion and traces of H^+ and OH^- .

* AgI surface is -vely charge due to I^- ion.

* It attract +ve ions (Na^+) towards its surface.

* The thermal motion causes equal distribution

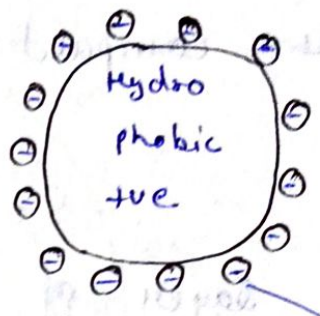
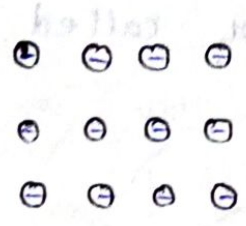
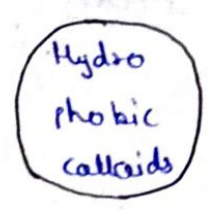
of ion.

- * Na^+ concentration is high over I^- ion surface and form compact layer called as stern layer.
- * An other layer of NO_3^- ion forms, called as gouy chapman layer.
- * Thus combination of 2 layer of opposite charges are called as electrical double layer.

Protective action -;

- * Large concentration of hydrophilic colloids \uparrow the stability of hydrophobic colloids towards precipitation by electrolytes.
- * The hydrophilic colloids adsorb on the surface of hydrophobic colloids and form a protective layer.
- * This layer prevent them from precipitation on addition of electrolyte.
- * This phenomena is k/a protection or protective action.

Ex - 1



Highly charged Large quantity of hydrophillic colloid

Protective colloid

Addition of electrolyte

Most stable ion cannot reach the colloidal particles, no coagulation.

* When bismuth sub nitrate is suspended in tragacanth dispersion.

* These phenomena involve coagulation of gum by bismuth ion.

* The flocculated gum aggregates with the bismuth ion to form gel or hard cake.

* If phosphate, citrate or tartrate added. They protect from coagulating influence of bismuth ion.

Peptization

* It is a process of converting ppt of large particle size to colloidal size by means of electrolyte is k/as peptization.

* Some ionic materials get adsorbed on the surface of finely divided solid and convert it into colloidal dispersion.

Coacervation (Phase separation)

* When oppositely charged hydrophilic colloids are mixed, a colloidal rich layer separates out.

This process is k/as coacervation.

(11)

* The phenomena in which a micro-molecular dispersion on mixing, separated into two layers is called as coacervation.

Ex-1, - Gelatine is positively charged below pH 4.7.

- Acacia is -vely charged at this pH.

- When they 2 are mixed together, 2 layers

are formed.

- The upper layer of low viscosity have poor concentration of colloidal material.
- The lower layer have high viscosity contain high concentration of colloidal material.