B PHARMACY

PHYSICAL PHARMACEUTICS- II

UNIT-1

DEPTH OF BIOLOGY

- **COLLOIDAL DISPERSION-** heterogeneous system in which dispersed phase is dispersed as very fine particle in another substance [dispersion medium]
- Made up of dispersed phase & dispersion medium
- Particle size ranges from 1 nm to 1000 nm
- Example- starch, glue, gelatin

Classification of dispersed system

Dispersed phase	Dispersion medium	Type of colloid	Example
Solid	Solid	Solid sol	Some coloured glasses, and gem stones
Solid	Liquid	Sol	Paints, cell fluids
Solid	Gas	Aerosol	Smoke, dust
Liquid	Solid	Gel	Cheese butter, jellies
Liquid	Liquid	Emulsion	Milk, hair cream
Liquid	Gas	Aerosol	Fog, mist, cloud, insecticide sprays
Gas	Solid	Solid sol	Pumice stone, foam rubber
Gas	Liquid	Foam	Froth, whipped cream, soap-lather

* Gas in gas is a homogeneous mixture

General characteristics

	Property	Suspension	Colloid Solution	True Solution
1.	**Nature**	Heterogeneous	Heterogeneous	Homogeneous
2.	**Particle size***	> 100 nm	1 nm-100 nm	< 1 nm
3.	**Separation by**			
	(*i*) *Ordinary filtration*	Possible	Not possible	Not possible
	(*ii*) *Ultra-filtration*	Possible	Possible	Not possible
4.	**Settling of particles**	Settle under gravity	Settle only on centrifugation	Do not settle
5.	**Appearance**	Opaque	Generally transparent	Transparent
6.	**Tyndall effect**	Shows	Shows	Does not show
7.	**Diffusion of particles**	Does not diffuse	Diffuses slowly	Diffuses rapidly
8.	**Brownian movement**	May show	Shows	Negligible

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- **SIZE & SHAPE OF COLLOIDAL PROPERTIES-**

 # PARTICLE SIZE- according to particle size, they are

1. **Molecular dispersion-** less than 1 nm
2. **Colloidal dispersion-** 1 to 1000 nm
3. **Coarse dispersion-** more than 1000 nm

- Particle size affect the colour of dispersion because wavelength of light is absorbed by particle
- Larger the particle = shorter wavelength

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- For example- gold [colloidal dispersion]- red
- Gold [coarse dispersion]- blue
- As particle size decreases the surface area increases & hence solubility is enhanced
- Example- platinum colloids

 # PARTICLE SHAPE- shape of particles depend upon type of interaction b/w dispersed phase & medium

Also it depends upon their preparation method

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- Shape may be cubical, spherical, cylindrical , disc, spiral thread, rod shaped etc
- It is visible in electron microscope
- Shapes also affect the colour of particle
- Gold [spherical]- red
- Gold [disc like]- blue

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- **CLASSIFICATION OF COLLOIDS & COMPARATIVE ACCOUNT OF THEIR GENERAL PROPERTIES-**
- Based on nature of interaction between dispersed phase & dispersion medium

1. Lyophillic colloids
2. Lyophobic colloids
3. Association colloids

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1. LYOPHILIC COLLOID-

- These are solvent loving
- Thermodynamically stable because of good interaction between solute & solvent
- Strong forces of attraction between dispersed phase & dispersion medium
- Highly viscous [viscosity increases on addition of dispersed phase]

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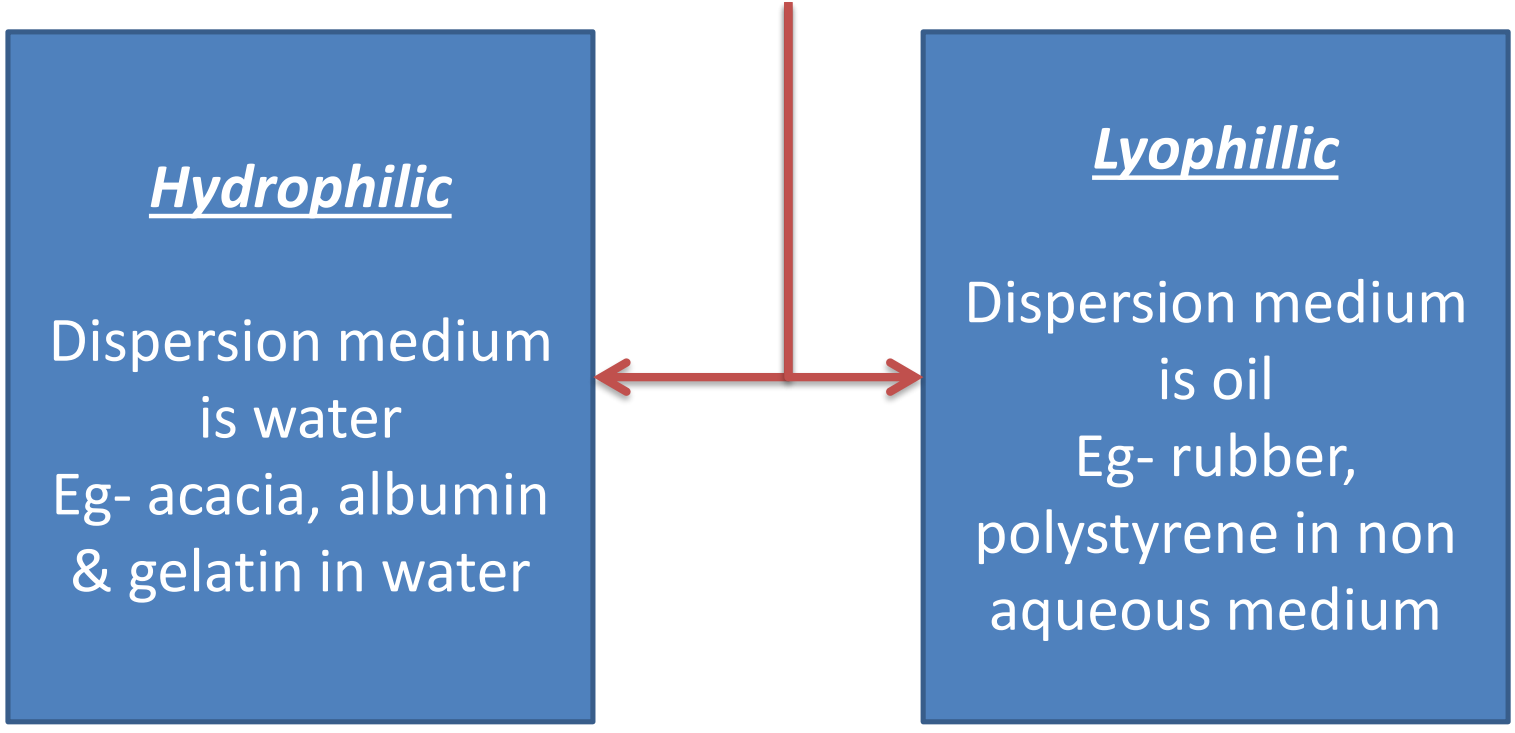
LYOPHILIC COLLOID



3. ASSOCIATION COLLOID-

- These are amphiphillic colloids
- Molecules have both polar & non polar groups
- Exist separately at low concentration
- They associate at CMC [Critical Micelle Concentration] to form micelle of colloidal size]
- Thermodynamically stable

- The head is hydrophilic/polar while the tail is hydrophobic/ non-polar

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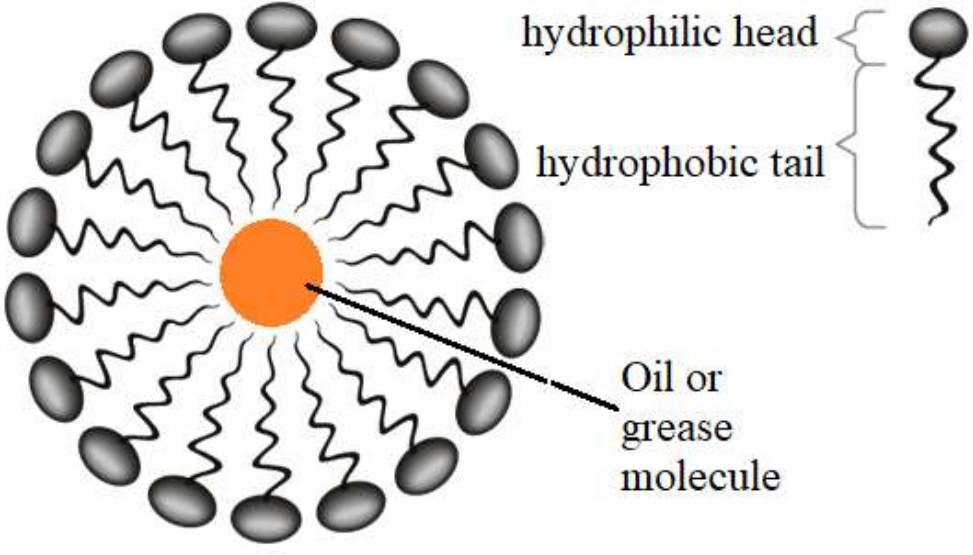
- CMC [Critical Micelle Concentration]-
- Minimum concentration at which micelle is formed
- Viscocity increases with addition of amphiphiles
- These amphiphiles are known as surfactants



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PROPERTY	LYOPHILIC COLLOIDS	LYOPHOBIC COLLOIDS	ASSOCIATION COLLOIDS
Dispersed Phase	Mostly organic molecules	Largely inorganic particles	Aggregation of surface active agents
Nature of Interaction	Stronger solvent sheath around particle	Little interaction	Aggregates are solvated
Presence of charge	Less charged	Highly charged	Charged micelles
Method of Preparation	Readily form sol	Special methods are required	Readily forms when concn is equal to cmc
Viscosity of Dispersion	Higher than that of medium alone	Nearly same as dispersion medium	Viscosity increases but not appreciably.
Reversibility	reversible	irreversible	reversible

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Optical, kinetic & electrical properties-

1. **OPTICAL PROPERTIES-** these properties helps to know about size, shape, structure & molecular weight of colloids.

These are-

i. Tyndall effect [scattering light]
ii. Ultramicroscopy
iii. Electron microscopy
iv. Turbidity

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i. Tyndall effect [scattering light]

- It is the scattering of light as a light beam passes through a colloid, the individual suspension particles scatter & reflect light making the beam visible. Eg- milk
- True homogeneous solution does not show this effect as they have small particle size
- Heterogeneous mixture; lyophobic show more tyndall effect while lyophilic show less or no effect

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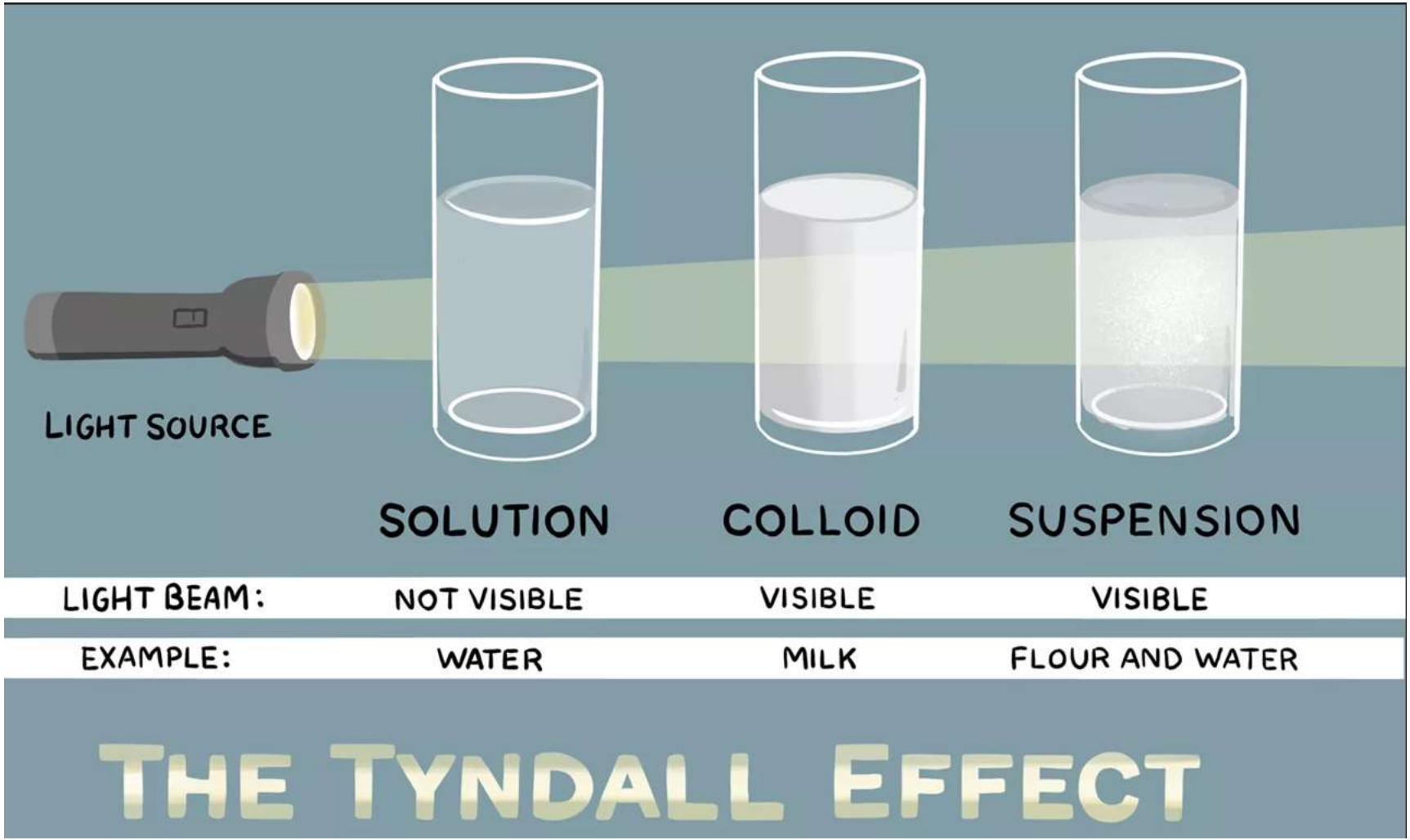
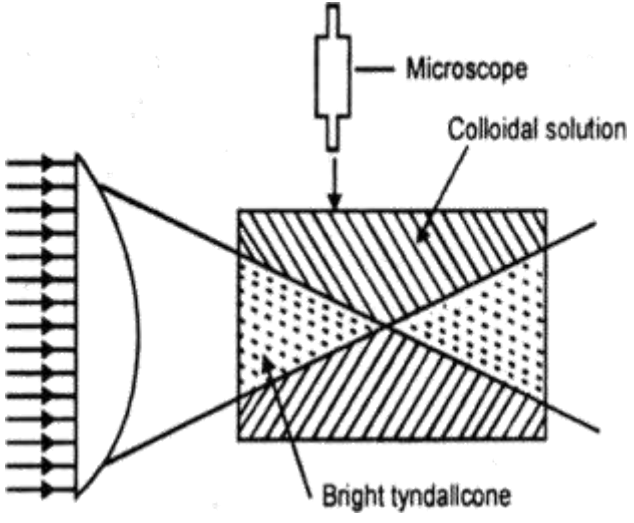


ii. Ultramicroscopy-

- When a light beam is passed through the colloidal dispersion against a dark background at right angle to the plane of observation, the particle will appear as a bright spot which can be observed & counted



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iii. Electron microscopy-

- In this highly energy electron beam is passed and used to observe size, shape and structure of colloidal particles, it gives actual picture of colloidal particles and useful for lyophilic

iv. Turbidity-

- All colloidal dispersion show turbidity according to molecular weight of colloid particle
- Turbidity directly proportional to molecular weight [spectrophotometer used to check turbidity]

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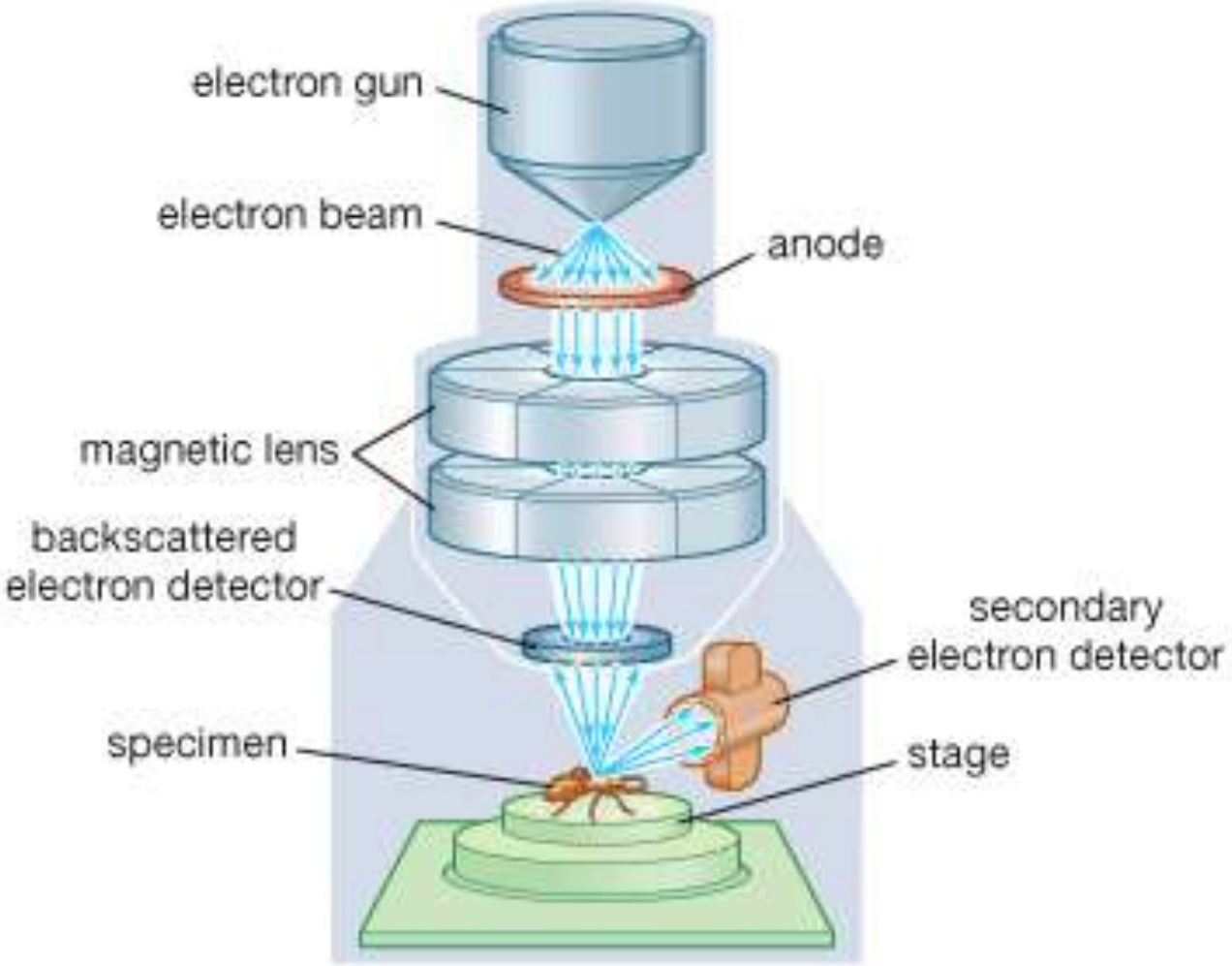

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2. **KINETIC PROPERTIES-** these properties used to check motion of colloidal particles & colloidal dispersion.

These are-

i. Brownian motion
ii. Diffusion
iii. Sedimentation
iv. Viscosity

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i. ***Brownian motion-***

- Zigzag motion of particles in colloidal dispersion
- Particles strike each other & walls of the container
- Given by robert brown
- If particle size decrease, velocity increase as a result Brownian motion & stability increase

ii. ***Diffusion-***

- Movement of particles from higher to lower concentration

- It is fick`s first law, particle diffuse continuously untill equilibrium is reached

iii. Sedimentation-

- Due to gravity dispersed phase particles settle down in dispersion medium
- Directly depend upon molecular weight of colloidal particle, as weight increases the sedimentation rate also increases
- Also depend upon density difference of dispersed phase to medium

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- Sedimentation decreases as Brownian motion increases
- Sedimentation increases = stability increases

iv. Viscocity-

- Resistance in flow of fluid
- It depends upon shape, size, molecular weight, interaction b/w phase & medium

**molecular weight directly increases with viscocity*

- Einstein describe an equation of flow to dilute colloidal dispersion of spherical particle

- $n = n_o (1 + 2.5 \theta)$
- n_o = viscosity of dispersion medium
- n = viscosity of dispersion
- Θ = volume fraction

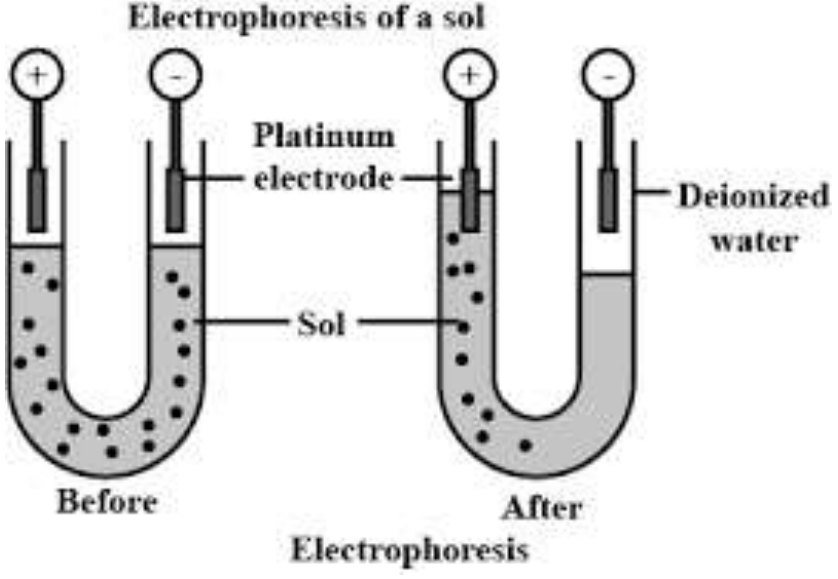
3. ELECTRICAL PROPERTIES-

These properties help us know about the charge on colloidal particles in dispersion

i. Electrophoresis ii. Electrical double layer

i. Electrophoresis-

- When electrical field is applied on colloidal dispersion then particles carrying charge move towards opposite charge electrode



ii. Electrical double layer-

- Helmolz explained it in 1879
- At the first layer, charge imparted to surface of particle which is immovable also known as static layer
- Second layer consist of diffused mobile ions
- The charge develops on both layer are equal

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❖ ZETA POTENTIAL OR ELECTROKINETIC POTENTIAL-

- It is difference between static and diffused layer

1. Effect of electrolytes
2. Coacervation
3. Peptization
4. Protective action

i. *Effect of electrolytes-*

- Stability may be affected by adding / removing electrolytes in colloidal dispersion
- On adding excess of electrolytes the particles of colloidal dispersion precipitate due to accumulation of opposite charged particles

➢ HARDY SCHULZE LAW-

- In this phenomenon we add opposite charge molecules [electrolytes] in colloidal dispersion. As we know opposite charges attract each other so it leads to formation of precipitate

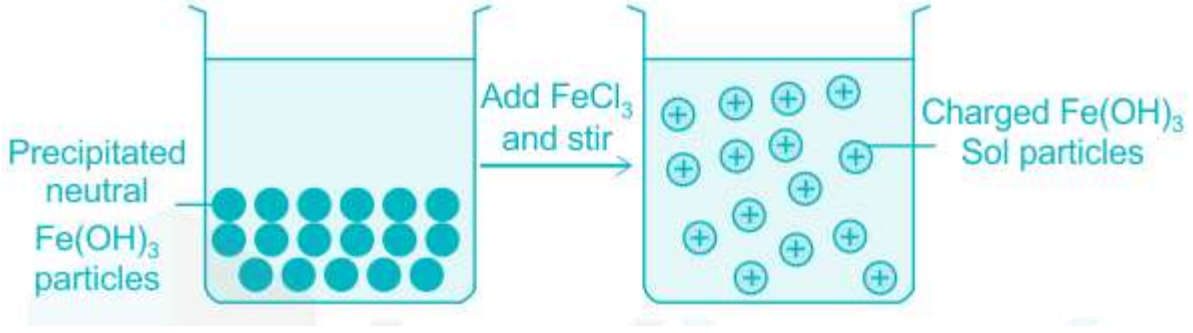
- Higher the charge [cation/anion] higher the precipitation
- $Al^{+3} > Mg^{+2} > Na^{+}$
- $PO_4^{-3} > SO_4^{-2} > Cl^{-}$

ii. Coacervation-

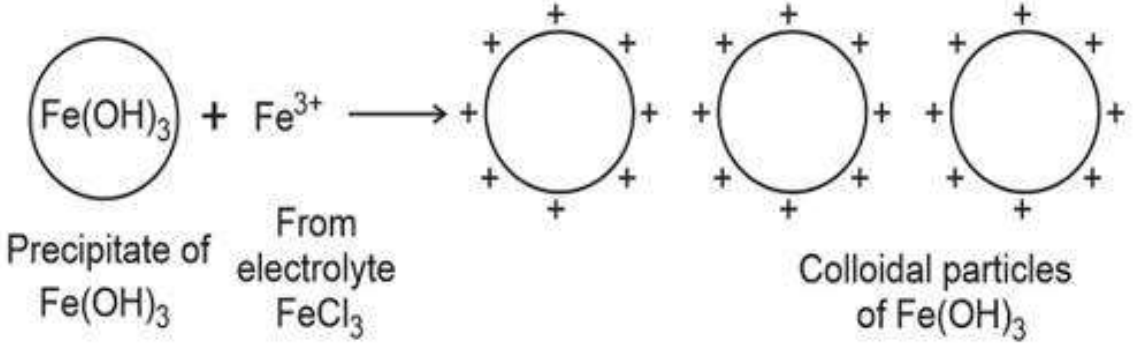
- A colloid rich layer will form if 2 opposite charged hydrophilic colloids are mixed
- This colloid rich layer is known as coacervate

iii. Peptization-

- Used for the formation of stable colloidal dispersion
- By adding small amount of electrolyte/ peptizing agent, converting precipitate into colloidal dispersion



Example-

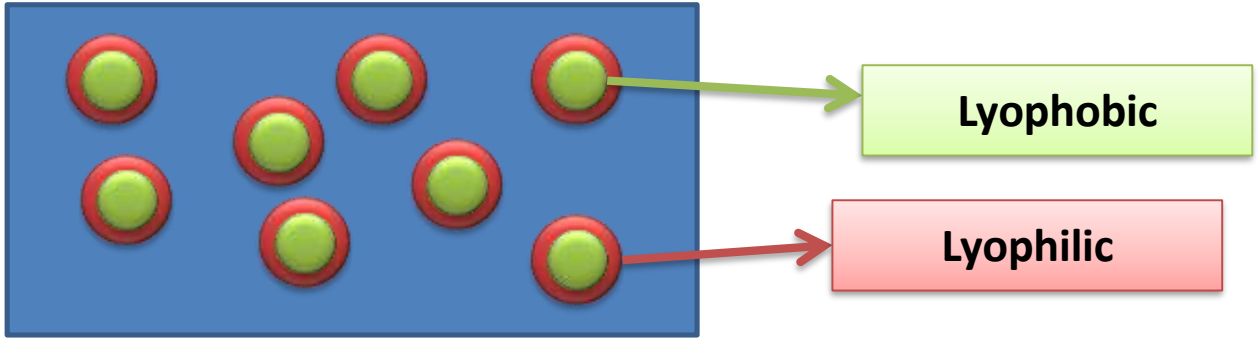


Preparation of colloidal sol by peptization

iv. Protective action-

- When lyophilic is added to lyophobic colloid, then the particles of lyophillic cover the surface of lyophobic particles. It behaves as protective colloid

- Now this covered lyophobic particle behave as lyophillic & prevent from coagulation



- GOLD NUMBER- the amount of protective colloids in mg which prevents the coagulation of gold solution [10ml] when 1 ml of NaCl is added to it

Amount of 0.1 % $AgNO_3$ to make it stable