

CHEMISTRY STUDY MATERIALS FOR CLASS 12

(NCERT BASED NOTES OF CHAPTER – 05)

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DATE:- 30/06/2021

Surface Chemistry

a) Peptization:

The process of conversion of a freshly prepared precipitate into a colloidal sol by shaking it with suitable dispersion medium in the presence of small amount of electrolyte is called *peptization*. The electrolyte added is called *peptizing agent*.

During peptization, the precipitate adsorbs one of the ions of the electrolyte on its surface and forms a positive or negative charge on it. Thus the particles of the precipitate break up into smaller particles of the colloidal size.

Purification of colloids

The colloidal solution prepared contains excess amount of electrolyte and some other soluble impurities. Even though small amount of electrolyte is required for the stability of colloid, large amount may cause precipitation. The process of reducing the concentration of electrolyte and other impurities is known as purification of colloids. Some methods used for purification are:

1. **Dialysis**: It is the process of removing dissolved substances from a colloidal solution by means of diffusion through a semi-permeable membrane. Here the sol particles are taken in a parchment or cellophane bag and it is suspended in a running stream of water. The impurities are diffused through the membrane and the sol particles are left behind. These particles are then suspended in suitable dispersion medium so as to get a colloidal dispersion.

The speed of dialysis can be increased by using hot water instead of cold water. Then the process is known as *hot water dialysis*.

The speed of dialysis can also be increased by dipping two electrodes and passing electricity. Then the process is known as *electro dialysis*.

2. **Ultra filtration**: It is the process of separating the colloidal particles from the impurities by using a special type of filter paper called ultra filters or ultra filter paper. It is prepared by dipping ordinary filter paper in *colloidion solution* (a 4% solution of nitrocellulose in a mixture of alcohol and ether).

When colloidal particles are filtered using ultra filters, the sol particles are retained on the filter paper while the impurities and the electrolyte are passed through it. When these sol particles are suspended in suitable dispersion medium, we get a colloidal solution.

Properties of colloids

1. *Colligative properties*:

In colloids, the numbers of particles are very small compared to that of true solution. So the values of colligative properties such as relative lowering of vapour

pressure, elevation of boiling point, depression of freezing point and osmotic pressure are small compared to that of true solution.

2. Tyndall effect:

When a light beam is passed through a colloidal solution, we can see the path of the light beam. This phenomenon is known as Tyndall effect. It is due to the scattering of light beam by the colloidal particles. The visible path is called *tyndall cone*.

Tyndall effect is observed only when the following conditions are satisfied:

- (i) The diameter of the dispersed particles is much larger than the wavelength of the light used.
- (ii) The refractive indices of the dispersed phase and the dispersion medium differ greatly in magnitude.

True solutions do not show Tyndall effect since the size of particles is very small so that they cannot scatter the light beam. Thus Tyndall effect is used to distinguish a colloidal solution from a true solution.

Ultra microscope used to see the colloidal particles works on the principle of Tyndall effect.

3. Brownian movement

In colloids, the particles of dispersion medium are in a state of continuous zig-zag motion. This motion was first observed by Robert Brown and it is known as Brownian movement. It is independent of the nature of the colloidal particles but depends on the size of the particles and viscosity of the solution. Smaller the size and lesser the viscosity of the medium, faster is the motion.

Brownian movement is due to the unbalanced bombardment of particles of the dispersed phase by the particles of dispersion medium. It is responsible for the stability of colloids.

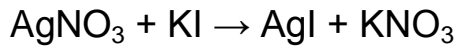
4. Charge on colloidal particles:

Colloidal particles always carry an electric charge. For a given colloidal solution, the nature of the charge is the same on all the particles.

<i>Positively charged sol</i>	<i>Negatively charged sol</i>
Hydrated metallic oxides like $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$, $\text{Al}_2\text{O}_3 \cdot x\text{H}_2\text{O}$, $\text{CrO}_3 \cdot x\text{H}_2\text{O}$ etc.	Metal sols (e.g. Cu sol, Ag sol, Au sol)
Basic dyes (e.g. methylene blue)	Metallic sulphides (e.g. As_2S_3 , CdS etc)
Haemoglobin in blood	Acid dyes (e.g. eosin, congo red etc.)
Metal oxides (TiO_2)	Sols of starch, gum, gelatin, clay, charcoal etc.

The charge on the sol particles is mainly due to *preferential adsorption of ions* from solution. When 2 or more ions are present in the dispersion medium, preferential adsorption of the ion common to the colloidal particle takes place.

e.g. when AgNO_3 is added to KI, AgI is precipitated, which adsorbs iodide ions from the dispersion medium and thus get a negative charge.



But when KI is added to AgNO_3 , the precipitated AgI adsorbs Ag^+ ions from the solution and thus get a positive charge.

Due to the positive or negative charge in the sol particles, they attract the counter ions (opposite ions) from the medium. Thus a double layer of opposite charges is formed.

This is known as ***Helmholtz electrical double layer***. The layer in which the ions are directly adsorbed to the sol particles is termed as *fixed layer*. The second layer is mobile and is termed as *diffused layer*.

Due to the opposite charges on the fixed and diffused layers, there arises a potential difference between these layers. This *potential difference between the fixed layer and the diffused layer of opposite charges is called the **electro kinetic potential or zeta potential***.

The presence of similar charges on colloidal particles leads to repulsion between the particles and prevent them from coagulation when they come closer. So the charge on the sol particles is mainly responsible for the stability of colloidal solution.

5. Electrophoresis:

Since colloidal particles carry charge, they move under the influence of an electric field. This movement of colloidal particles is called *electrophoresis*. The positively charged sol particles move towards cathode (*cataphoresis*) and the negatively charged particles move towards the anode (*anaphoresis*).

If the movement of the sol particles is prevented by some suitable method, the particles of dispersion medium itself move under the presence of electric field. This migration is termed as ***electro-osmosis***.

6. Coagulation (precipitation or flocculation)

The process of settling of colloidal particles is called coagulation or precipitation of the sol. This can be done by different ways:

- i) By electrophoresis
- ii) By mixing two oppositely charged sols

- iii) By continuous dialysis
- iv) By boiling
- v) By the addition of electrolyte

When an electrolyte is added to the sol, the ions carrying opposite charge to that of the sol neutralize the charge and causes precipitation. *The ion of the electrolyte which causes the precipitation is called the coagulating ion or the flocculating ion.* A negatively charged ion causes the precipitation of positively charged sol and vice versa.

Generally, ***the greater the valency of the coagulating ion, the greater will be the coagulating power. This is known as Hardy – Schulze rule.***

Thus for the coagulation of a negative sol like As_2S_3 , the flocculating power of the +ve ions is of the order: $\text{Al}^{3+} > \text{Ba}^{2+} > \text{Na}^+$

Similarly for a +ve sol like ferric hydroxide, the flocculating power of the counter ion is of the order: $[\text{Fe}(\text{CN})_6]^{4-} > \text{PO}_4^{3-} > \text{SO}_4^{2-} > \text{Cl}^-$

Coagulating value: The minimum concentration of an electrolyte in millimoles per litre required for the coagulation of a sol within 2 hours is called coagulating value. The smaller the coagulating value, the higher will be the coagulation power.

Protection of colloids

Lyophilic sols are self stabilized, while lyophobic sols require some stabilizing agents. For this purpose, some lyophilic sols are added to lyophobic sols. These lyophilic sols are called protective colloids.

When a lyophilic sol is added to a lyophobic sol, the lyophilic particles form a layer around lyophobic particles and thus protect them from electrolytes.
