Lecture 38

Colloids

A mixture in which one substance is divided into minute particles (called colloidal particles) and dispersed throughout a second substance. The substances are present as larger particles than those found in solution, but are too small to be seen with a microscope. The mixture is also called a colloidal solution, colloidal system, or colloidal dispersion. Examples of colloids are foams, milk, smoke and detergents etc.

Dispersed Systems:

The term "Disperse System" refers to a system in which one substance is distributed, in discrete units, throughout a second substance. Dispersed systems are particulate matter (dispersed phase) distributed in a medium. A continuous phase (dispersion medium) containing dispersed phase. They are classified according to the particle diameter of the dispersed material.

Colloidal Dispersion:

Particles in colloidal dispersion are not resolved by ordinary microscope instead these are detected by electron microscope. These particles can pass through filter paper but not pass through semi-permeable membrane. Particles can be settled down by centrifugation. These particles can diffuse very slowly. E.g. colloidal silver solutions, naural and synthetic polymers

Size of Colloids:

Specific surface is defined as the surface area per unit weight or volume of material. The colloidal size has large surface area of particles. The possession of large specific surface results in effectiveness of platinum as catalyst, The colour of colloidal dispersion changes for example Red gold solution takes a blue colour when the particles increase in size.

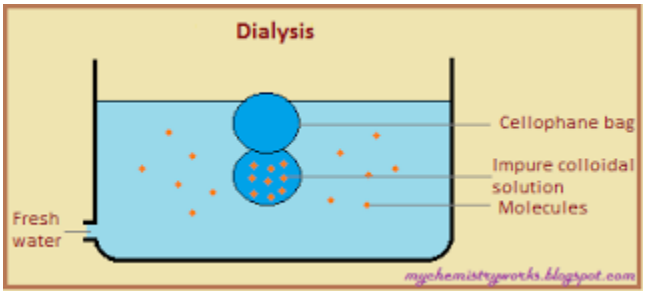
Colloidal Shapes:

The shape of colloidal particles in is important in dispersion. Extended particle exhibits greater attractive forces between them. Shape of colloidal particles affects the flow, sedimentation and osmotic pressure of colloidal system. Particle shape may also influence the pharmacologic action.

Purification using Cellophane Membrane:

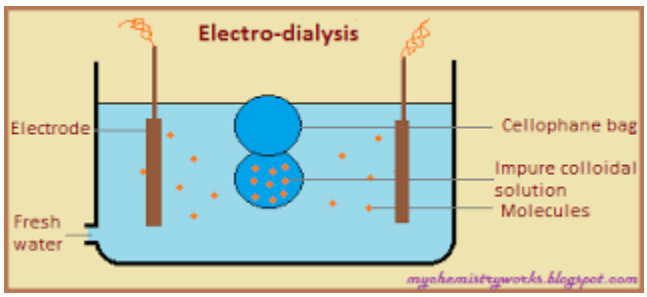
Dialysis is the removal of soluble impurities from sols by the use of semipermeable membrane. The ordinary process of dialysis is slow. The apparatus used for this purpose is called Dialyser. Cellophane bag is filled with impure colloidal solution and placed in fresh water (distilled water). The cellophane bag does not allow the colloidal particles to pass through, but particles of true solution can pass through it. The molecules and ions diffuse through the membrane into the

outer water and pure colloidal solution is left behind. The water is renewed frequently to avoid accumulation of the crystalloid as otherwise they may start diffusing back into the bag.



Purification by Electrodialysis:

Electro dialysis is the removal of soluble impurities from sols by the use of semipermeable membrane in the presence of electric field. Cellophane bag is filled with impure colloidal solution and placed in fresh water (distilled water). The cellophane bag is not allow the colloidal particles to pass through, but particles of true solution can pass through it. Now the electric field is applied. The soluble particles passed through the membrane and migrate towards the oppositely charged electrodes. Leaving behind the pure colloidal solution. The most important application of dialysis process in purification of the artificial kidney mechaine, used for the purification of blood.



Applications of colloidal solutions:

The colloids of Silver is used as a germicidal, Copper colloid as an anticancer while Mercury colloid as an ant syphilis. Lyophobic colloids (Having no affinity for the dispersion medium) prevent flocculation (aggregate in which particles not in physical contact) in suspensions. For example colloidal dispersion of gelatin is used in coating over tablets and granules which protect them from adverse conditions. A colloidal solution of silver bromide in gelatine is applied on glass plates to generate photography. Blood is a colloidal solution and is negatively charged. On applying a solution of $FeCl_3$ bleeding stops and blood clotting occurs. Fe+3 ions neutralize the ion charges on the colloidal particles and cause blood clotting.

Types of Colloids:

The table below lists various types of colloids with various examples.

Phase of Colloid	Dispersing (solvent-like) Substance	Dispersed (solute-like) Substance	Colloid Type	Example
Gas	Gas	Gas	—	None (all are solutions)
Gas	Gas	Liquid	Aerosol	Fog
Gas	Gas	Solid	Aerosol	Smoke
Liquid	Liquid	Gas	Foam	Whipped cream
Liquid	Liquid	Liquid	Emulsion	Milk
Liquid	Liquid	Solid	Sol	Paint
Solid	Solid	Gas	Solid foam	Marshmallow
Solid	Solid	Liquid	Solid emulsion	Butter
Solid	Solid	Solid	Solid sol	Ruby glass

Fog and smoke are aerosol which are liquid droplets or solid particles dispersed throughout a gas. When liquid droplets are dispersed throughout another liquid phase this results in emulsion, as in the case of butterfat dispersed throughout homogenized milk. A sol consists of solid particles dispersed in a liquid. Foam consists of gas being dispersed in a liquid phase as in the case of whipped cream.
Colloidal systems, depending on the nature of attraction between the dispersed phase and the dispersion medium are classified into lyophobic (solvent hating) and lyophilic (solvent loving). If water is the dispersion phase is water, then the colloids are either hydrophilic or hydrophobic.

Lyophilic colloids:

Lyophilic colloids are liquid loving colloids (Lyo means solvent and philic means loving). When these colloids are mixed with the suitable liquid, high force of attraction exists between colloidal particles and liquid. This result in formation of very stable solution called lyophilic sol. These sols are formed by substances like gums, starch and proteins. Lyophilic sol can be easily prepared by directly mixing colloid with the liquid. Lyophilic Sols are very stable and do not precipitate/coagulate easily. Under the influence of electric field the sol particles does move in definite direction. Depending upon the type of charge, they move towards anode or cathode or may not move at all.

Lyophobic Colloid:

In this type of colloidal sols, the dispersed phase has little affinity for the dispersion medium. These colloids are easily precipitated on the addition of small amounts of electrolytes, by heating or by shaking and therefore are not stable. 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. Lyophobic sols need stabilizing agents to keep the dispersed phase from precipitating out.

Hydrophobic sols are often formed when rapid crystallization takes place. With rapid crystallization, many centres of crystallization called nuclei are formed at once. Ions are attracted to these nuclei and very small crystals are formed. These small crystals are prevented from settling out by the random thermal motion of the water molecules.

References:

http://www.tutorvista.com/content/chemistry/chemistry-iv/surface-chemistry/colloids-types.php#2)-lyophobic-colloids
study.com/academy/lesson/colloids-definition-types-examples.html
www.chemistrylearning.com/lyophilic-colloids