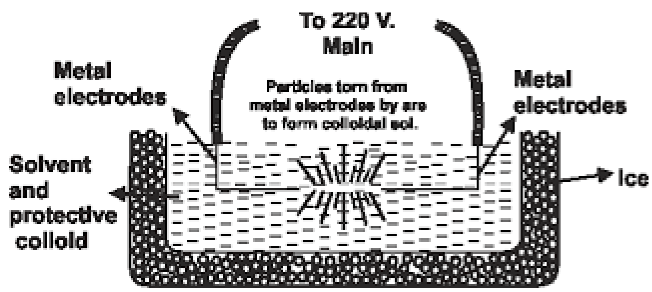
Lecture 39

Methods of Preparation of colloids

Physical Method:

Physical Bridge‘s arc method:

This process involves dispersion as well as aggregation. Colloidal solutions of metals such as gold, silver, platinum etc. can be prepared by this method. In this method electric arc is struck between electrodes of metal immersed in the dispersion medium. The intense heat produced vapourises some of metal, which then condenses to form particles of colloidal size.



Chemical Method:

By oxidation:

A Colloidal sol of sulphur can be obtained by passing hydrogen Sulphide into solution of sulphur dioxide in water or through a solution of an oxidising agent (Bromine water, nitric acid).

$$SO_2 + 2H_2S\text{-------->}3S + 2H_2O$$

$$H_2S + (O)\text{-------->}S + H_2O$$

Amphiphilic Colloids:

Amphiphile is a term describing a chemical compound possessing both hydrophilic and lipophilic properties. At low concentration amphiphiles exist separately (sub-colloidal size). At high concentration amphiphiles form aggregates or micelles (50 or more monomers).

Critical Micelle Concentration:

In colloidal and surface chemistry, the critical micelle concentration (CMC) is defined as the concentration of surfactants above which micelles form and all additional surfactants added to the system go to micelles. The CMC is an important characteristic of a surfactant. Before reaching the CMC, the surface tension changes strongly with the concentration of the surfactant. After reaching the CMC, the surface tension remains relatively constant or changes with a lower slope. The value of the CMC for a given dispersant in a given medium depends on temperature, pressure, and (sometimes strongly) on the presence and concentration of other surface active substances and electrolytes. Micelles only form above critical micelle temperature. For example, the value of CMC for sodium dodecyl sulfate in water (no other additives or salts) at 25 °C, atmospheric pressure, is 8x10−3 mol/.

Colloids in Different Environments:

In water the hydrocarbon chains surrounded by the polar portions associated with water molecules. In non-polar liquid hydrocarbon chains are associated with non-polar liquid surrounds all inward oriented polar heads. At concentrations close to C.M.C spherical micelles are fprmed. At higher concentrations of CMC lamellar micelles are formed.

Optical Properties of colloidal solution:

Robert Brown an English Botanist, observed that the pollen grains in aqueous suspensions were in constant motion. Similar phenomenon was, later on, found in case of colloidal solution, when observed ultra-microscopically. This continuous and rapid zig-zag motion of the colloidal particles is called Brownian movement. This motion is independent of the nature of the colloidal particles. It is more rapid when the size of the particles is small and the solution is less viscous. A beam of sunlight enters a dark room through a slit. Beam of light becomes visible through the room. It is scattering of light by particles of dust in the air.

Electron Microscope:

Ultra-microscope does not able to resolve lyophilic colloids. Electron microscope is capable of yielding pictures of actual particles like size, shape and structure of colloidal particles. It has high resolving power, as its radiation source is a beam of high energy electrons while optical microscope radiation source is visible light.

Applications of Colloidal Suspensions:

Light scattering of colloidal suspension depend on tyndall effect which give information about particle size and shape and for molecular weight determination. It is used to study proteins, association colloids and lyophobic sols. Scattering is described in terms of turbidity. The fractional decrease in intensity due to scattering as the incident light passes through 1 cm of solution is proportional to the molecular weight.

$$HC / T = 1/M + 2BC$$

Where T is for Turbidity ,C is for Concentration of solute in gm/cc of solution, M is Molecular weight, B is Interaction constant and H is Constant for a particular system.

Brownian Motion:

Brownian motion also called Brownian movement, Brownian motion any of various physical phenomena in which some quantity is constantly undergoing small, random fluctuations. This zigzag movement is continuous and random. Brownian movement may be used to distinguish between solutions and colloids. Brownian motion is the random movement of colloidal particles suspended in a liquid or gas, caused by collisions with molecules of the surrounding medium. The particles in solutions and colloids are in constant motion. However colloid particles are large enough to be observed and are small enough to still be affected by the random molecular collisions. Colloid particles resist settling rapidly to the bottom of a vessel due to Brownian motion.

Diffusion and Brownian motion:

Brownian motion is the mechanism by which diffusion takes place. Brownian motion is that random motion of molecules that occurs as a consequence of their absorbtion of heat. Molecules will diffuse from areas/volumes of high concentration to low concentration; the reason this happens is that the molecules are in constant random motion (Brownian), and they bump into each other more if the move towards more concentrated areas. Hence, they tend to move apart (diffusion).
Fick's first law is used to describe the diffusion: The amount of Dq of substance diffusing in time dt across a plane of area A is directly proportional to the change of concentration dc with distance dx traveled.

$$dq = -DA\ (dc/dx)\ dt$$

Diffusion Coefficient:

The amount of the material diffused per unit time across a unit area is called diffusion coefficient.

$$dc/dx = \text{Unity}$$

The measured diffusion coeffecient can be used to determine the radius of particles and molecular weight.

Viscosity:

It is the resistance to flow of system under an applied stress. The more viscous a liquid, the greater the applied force to flow. The viscosity of colloidal dispersion is affected by the shape of particles of the disperse phase. In case of sphere colloids viscosity of dis persion is low and in case of linear colloids viscosity of dispersion is high.

References:

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