COLLOIDS

CSIR Chemistry Brief Notes

INTRODUCTION

- Colloid (disperse phase) is the dispersion of small particles of one material in another bulk (dispersion medium).
- The size of colloid is less than 500 nm diameter (wavelength of visible light approximately). Colloidal particles are not seen on viewing under the microscope and they pass through filter paper.
- Detection methods include light scattering, sedimentation and osmosis.

CLASSIFICATION

- 1) SOL – dispersion of solid in a liquid or solid in a solid. Eg. Ruby glass (gold in glass sol)
- 2) AEROSOL – dispersion of liquid in a gas eg. Fog, sprays or solid in a gas eg. Smoke
- 3) EMULSION – dispersion of one liquid in another (eg. Milk)
- 4) GEL – Liquid in solid eg. Jellies
- 5) FOAM – Gas in solid eg. Pumice stone, or gas in liquid eg. Froth, whipped cream.

- Another classification is as follows:
- 1) LYOPHILIC – solvent-attracting eg. Gel (semirigid mass)
- 2) LYOPHOBIC – solvent-repelling eg. Metal sols

PREPARATION OF COLLOIDS

- **1) ARCING BETWEEN ELECTRODES immersed in the support medium**
- **2) CHEMICAL PRECIPITATION eg. Clays may be peptized by alkalis**
- **3) CRUMBLING OF ELECTRODE into colloidal particles'**
- **4) GRINDING OF MATERIALS such as quartz in presence of dispersion medium**

- **Emulsions are prepared by vigorous shaking. Emulsifying agent is added to stabilize the emulsion. Eg. Homogenized milk is prepared by intense agitation with ultrasonics. Casein protein is the emulsifying agent present in milk. Mayonnaise and egg yolk are also emulsions. The emulifying agent in egg yolk is lecitihin. Soaps are surfactant molecules which act as emulsifying agents to lower the surface tension at oil-water interface.**
- **Aerosol is prepared by tearing apart a spray of liquid by a stream of gas. Electric charge applied to the liquid can result in the formation of droplets. One natural way of making aerosol is sneezing!**
- **PURIFICATION OF COLLOIDS IS DONE BY DIALYSIS**
- **Eg. Electrodialysis which is the very slow acceleration of colloidal particles under the influence of an electric field.**

PROPERTIES OF COLLOIDS

- Tyndall effect – lyophobic sols scatter light because they are heterogenous. Lyophilic sols don’t show this effect.
- Brownian motion is exhibited. Equation that describes it is Stokes-Einstein equation.
- Electrophoresis- movement of colloidal particles under the influence of an electric field.
- Electrosmosis
- Sedimentation potential (Dorn effect)- movement of clay particles down a column of liquid produces a potential
- Streaming potential – A potential is set up across a membrane diaphragm when a liquid is forced through it.
- Coagulation/Flocculation – Hardy-Schulze rule- greater the value of charge on oppositely charged electrolyte added, faster coagulation rate.
- *Research protective colloid and Gold number*

GELS

- Elastic gels – eg. Gelatine, agar-agar. They exhibit imbibition or swelling when placed in a liquid and can eventually become sols on significant swelling.
- Inelastic gel –eg. Silicic acid gel

- Properties of some gels include:
- Synerisis (oxidation of liquid)
- Thixotropy(Upon shaking, they liquefy)
- Dilatancy (Upon applying pressure they liquefy)
- Liese-gang phenomenon of precipating repeatedly.

STABILITY OF COLLOIDS

- Colloids are kinetically nonlabile but thermally unstable.
- Colloidal particles attract each other over long distances by long range forces.
- The long range attraction is opposed by:
- 1) Protective films in the case of fats and soaps which have hydrophilic heads, and also in platinum sols in water by a
- $Pt\ (OH)_3H_3$ shell.
- 2)Micelle formation and the hydrophobic interaction

MICELLE FORMATION AND THE HYDROPHOBIC INTERACTION

- Micelles form only above critical concentration called Critical Micelle Concentration (CMC) and above a critical temperature called the Krafft Temperature.
- Micelles find application in detergents, drug carriers, froth flotation process, organic synthesis and petroleum recovery.
- Micelles are polydisperse, and they are flattened spheres near the CMC, and lamellar micelles above CMC.
- Micelle formation is endothermic and due to hydrophobic interaction between phases.

APPLICATIONS OF COLLOIDS

-In pharmaceuticals as medicine formulation
-Sewage disposal
-Water purification
-Soap cleaning action
-Formation of river delta
-Smoke precipitation
-Photography
-Bringing about artificial rain
-Smoke screen in warfare
-Rubber industry

Blue colour of sky due to scattering by colloidal particles in air (Tyndall effect)
…also responsible for colour of blue water by colloidal impurities in the sea…
that scatter sunlight by the same effect!

Tail of comets also seen due to this effect (Tyndal cone)

Coagulation of blood- Blood is a colloidal solution…