**6th Semester (Major)**

**2nd Paper (Physical Chemistry)**

**Macromolecules and Coloids**

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**Colloid:**

Colloids refer to dispersions of small particles usually with linear dimensions from around 1 nm to 10 micrometres.These particles may be either dissolved macromolecules or having macromolecular structures formed from smaller structural units, or they may constitute a separate phase as in aerosols, powders, pigments dispersions, emulsions or even finely pigmented plastics.

These multiphase colloids mentioned above make an account of the properties of both phase and the interface between them and so their investigation is a natural adjunct to the study of the interface and reaching down to the size of  [colloid particles](https://byjus.com/jee/colloids/).

**Colloids Solutions Examples:**

The use of colloids vs crystalloids is still very specifically controversial. A colloid preferred by a physician or basically a plasma expander may work better if colloids are present instead of crystalloids. Many of the colloids might contain albumin which has osmotically equal to plasma and 25% of solutions.

Colloids help in pulling fluid into the blood stream. Their effects last several days if the lining of the capillaries is found to be normal.

Most of these colloid solutions have the following characteristics.

* Thermal kinetic energy helping the mobility
* The inertial effect’s absence from fluids
* Now or negligible gravitational effects
* The type of interactions due to [electromagnetic radiation](https://byjus.com/chemistry/wave-nature-electromagnetic-radiation/)
* Closer at home we get to see milk which is considered to be the best example of colloid, the shampoo that we get to use, liquid hand wash we use and moreover, the liquid metal polisher we usually use at home.

**Examples of Colloids Chemistry:**

The properties of colloidal dispersions are closely linked to the high surface area of the dispersed phase and the chemistry of these interfaces. This natural combination of colloid and surface chemistry represent a major research space and we get to see a variety of categories of colloids based on these basic properties.

***Examples:*** fog, smog, and sprays

* The dispersed phase for the above examples is liquid and a dispersion medium of gas. These are usually termed as a liquid aerosol.

***Examples:*** smoke and dust in the air

* The dispersed phase for the above mentioned examples is solid and the dispersion medium is gas. This is termed as a solid aerosol.

***Examples:*** milk and mayonnaise

* The dispersed phase for the above mentioned examples is liquid and the dispersion medium is liquid as well. The term used for these are an emulsion.

***Examples:*** pigmented plastics

* The dispersed phase for the above mentioned example is solid and the dispersion medium is solid as well. The term used for such mix is solid suspension.

***Examples:*** silver iodide sol, toothpaste, and Au sol

* The dispersed phase for the above mentioned examples is solid and the dispersion medium being liquid. The term used for such colloidal solution paste at high temperature is sol.

The huge difference in surface area of colloids and surface of attachments follows the natural fact that particulate matter has a high surface area to mass ratio. This leads to one of the properties of the surface as a factor for colloidal solutions.

For example, the molecules of organic dye or pollutants can possibly be removed effectively from water by the method of adsorption onto particulate activated charcoal. This is because of the coal’s high surface area. This property and process are widely used for water purification and all kinds of oral treatments.

Molecules in the bulk of liquid can interact via attractive forces with many nearest neighbours than those at the surface. The molecules at the surface must have higher energy than those in bulk as they are partially freed from bonding with neighbouring molecules.

Work must be done to take fully interacting molecules from the bulk of liquid to create any new surface. This gives rise to surface energy or tension of a liquid and hence stronger the molecular force between liquid molecules the greater will be the work done.

**Types of Colloids and Examples:**

Colloids are classified according to the state of the dispersed phase and the dispersion medium.

* Any colloid with water as the dispersing medium can be classified as hydrophobic or hydrophilic.
* A hydrophobic colloid is one in which only weak attractive forces exist between the water and the surface of the colloidal particles.
* The best example would the precipitation of silver chloride and the result ends up as colloidal dispersion. The precipitation reaction occurs too rapidly for ions to gather from long distances and make large crystals. The ions aggregate to form small particles that remain suspended in the liquid.
* A stable hydrophobic colloid can be made to coagulate by introducing ions into the dispersing medium.
* For example, the milk which contains a colloidal suspension of protein-rich casein micelles with a hydrophobic core. When milk ferments the lactose is converted to lactates and hydrogen ions. The protective charge on the surface of the colloidal particles are overcome and the milk coagulates forming clumps of curds.
* Similarly, soil particles are often carried by water in rivers and streams as hydrophobic colloids. Finally, when the river meets the seawater which has a high concentration of salts the particles coagulate to form silt at the basin of the river.
* Even the municipality water treatment plants often add salts such as [aluminium sulphate](https://byjus.com/chemistry/aluminium-sulfate/) to clarify water, where aluminium ions hydrated cations neutralize the charge on hydrophobic colloidal soil particles causing these particles to aggregate and settle out.

In all of these specific cases, the liquid is strongly absorbed on to the surface of particle which makes the interface between particle and liquid similar to the interface between liquid and itself. This makes the system intrinsically stable as there is a reduction in Gibbs free energy when the particles are dispersed.

**Examples of Colloids in Daily Life:**

There is a huge number of products that we get to use either directly or indirectly on a daily basis. Some of these products are quite relevant to our life. Rest are although used in some way or other, but we never get to see them in our immediate surroundings.

The examples of colloids that we usually find around us are as follows.

**1. Liquid aerosol**

* The aerosol sprays that we either use as personal perfumatory products usually contain aerosol
* The various types of insecticide spray or repellents we use against mosquitoes and other insects
* Smog or the smoke and fog combination which creates a thick slowly moving colloidal material. Naturally occurring fog and clouds

**2. Solid aerosol**

* The naturally occurring smoke or man-made fire smoke carries suspended particles in the air
* Dust storm or simply dust in the atmosphere

**3. Foam**

* The shaving cream lather used for shaving purpose
* The whipped cream we get to see in cream batter

**4. Emulsion**

* Various types of cosmetic lotions we use on a daily basis
* Mayonnaise we use as bread spread
* Naturally occurring milk

**5. Gels**

* The butter that we usually use as bread spread
* Jelly products that we use as various spreads

**6. Sols**

* Man-made paints
* Ink and other products which are basically combination made at a high temperature

**7. Solid sols**

* Various products made from Styrofoam, insulation and other cushion materials
* Apart from the above mentioned list, there are many bio colloids which we get to see on a daily basis like medicines and injectables

**Examples of Colloids in Medicine:**

* Colloids are considered as very good intravascular volume expanders. These are fluids containing high molecular weight substances that usually do not pass through capillary membranes.
* The colloid osmotic pressure these materials exert is related to the size of the molecule. Smaller the size of molecule, higher is the initial oncotic pressure as smaller molecules fit in a volume of fluid than larger molecules.
* As the molecules become larger it lasts longer. For example, synthetic products like dextran and hydroxyethyl starches and haemoglobin based oxygen-carrying solutions along with natural colloids like plasma, whole blood and human serum, etc.
* Usually, the colloids used in the medicinal field are isosmolar and have the potential to cause allergic reactions in body but clinically these appear to have limited exposure to such synthetic ones.
* Daltons are considered to be potent colloids but are not long-lasting. They have no direct effects on the coagulation of platelets. Dextrans are polysaccharides produced by the bacterium in sucrose media. Due to many particles per unit volume Dex 40 has better oncotic pull than Dex 70.
* Hydroxyethyl starch is made from maize or sorghum which is primarily amylopectin and can expand almost 1. 4 times the volume infused and is hence used for anti-inflammatory uses and for better capillary permeability.
* The infusion of synthetic colloids begins when a patient has gone through acute haemorrhage or loss of albumin. Synthetic colloids are given as slow intravenous push as patients in shock require sustained intra vascular volume expansion.

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