Application of colloids

Applications of Colloids| Colloids play a very important role in nature, in our daily life and in industry. Some of the important applications of colloids are discussed below. 1. Foodstuffs and medicines: Many of our food stuffs are colloidal in nature. Milk, butter, whipped cream, fruit jellies, ice cream, bread etc. are all colloidal in nature. For example, milk is an emulsion of butter fat in water, stabilized by milk protein (casein). Ice cream is a dispersion of colloidal ice particles in cream. Similarly, bread consists of air dispersed in baked dough.

Colloidal medicines are more effective and are easily absorbed by the body system. Therefore a large number of pharmaceutical preparations are emulsions. Halibut-liver oil, cod-liver oil, skin ointments etc. are emulsions. Antibiotics such as penicillin, streptomycin etc. are usually injected in the body in colloidal form. Several metal sols are also used as medicines. 2. Purification of water: In water works, water is usually purified by the addition of certain electrolytes such as potash alum, aluminium sulphate etc. This involves the phenomenon of coagulation.

The impure water usually contains dispersed colloidal particles which cannot be removed by filtration. When potash alum is added to impure water, the negatively charged colloidal particles of impurities get coagulated by the action of Al3+ ions furnished by the alum and can be removed by filtration or decantation. 3. Sewage disposal: Sewage water contains particles of dirt, mud etc. which are colloidal in nature and carry some electrical charge. These particles may be removed by using the phenomenon of electrophoresis.

The sewage water is passed through a tunnel fitted with metallic electrodes and maintained at a high potential difference. The colloidal particles present in the sewage water migrate to the oppositely charged electrodes and get coagulated. This solves the problem of sewage disposal. Moreover, the rubbish matter obtained on account of the coagulation of colloidal dirt particles may be used as manure. | 4. Smoke precipitation: Smoke is colloidal system and consists of electrically charged colloidal particles of carbon dispersed in air. As smoke is a big source ofpollution.

It is always desirable to precipitate it, i. e. , to remove colloidal carbon particles present in it. The removal of colloidal carbon particles from smoke can be effected by using the phenomenon of electrophoresis. This is achieved in an apparatus called Cottrell precipitator as shown in figure. Smoke is allowed to pass through a chamber having a number of metal plates attached to a metal wire connected to a source of high potential (20, 000 to 70, 000V). The electrically charged colloidal particles of carbon and dust get discharged when come in contact with the oppositely charged plates and fall down to the bottom.

The clean hot air leaves the precipitator from an exit near the top. 5. Artificial rain: Clouds are colloidal systems and consist of water vapour mixed with dust particles. The water molecules present in a cloud develop some electrical charge. Therefore, clouds can be made to rain by neutralizing the charge present on colloidal particles (water molecules). This type of rain is called artificial rain and may be carried out by spraying oppositely charged colloidal dust or sand particles over a cloud. This neutralizes the charge on water molecules and compels them to get coagulated, i. . to rain. 6. Rubber

industry: Latex obtained from rubber trees is an emulsion consisting of a dispersion of negatively charged rubber particles in water. In order to obtain rubber from latex, the latter is boiled when rubber particles get coagulated. The coagulated mass is vulcanized and sold as natural rubber. Rubber-plated articles can be prepared directly from latex by electrically depositing the negatively charged rubber particles over the article to be rubber-plated by making the article an anode in the rubber-plating bath. 7.

Leather tanning: During the tanning of leather, the positively charged colloidal particles of raw skin and hides are coagulated by the negatively charged tanning materials which include tannin and compounds of aluminium and chromium. On soaking hides in the solutions of tanning materials, the coagulation of negatively charged tanning materials takes place in the pores of hides and the latter get hardened. 8. Cleansing action of soaps: Soaps solution is colloidal in nature and removes dirt and oil from clothes by forming water soluble emulsion as explained earlier. . Smoke screen: In chemical warfare, smoke screens are generally used to hide the movement of troops. Smoke screens are the colloidal dispersions of very fine particles of titanium oxide in air. 10. Formation of delta: When a river falls into the sea, extensive deposits of sand and clay are formed at the mouth of the river in the sea. Such deposits are called delta. The river water contains colloidal particles of sand and clay which carry negative charge. The sea water contains a number of positive ions such as Na^+, Mg^{2+}, Ca^{2+} ion etc.

When the river water comes in contact with sea water, the negative charge present on colloidal sand and clay particles get neutralized by the positively charged ions (present in sea water) and they get coagulated. The coagulated

sand and clay particles settle down and take the shape of delta in due course of time. 11. Blue colour of the sky: The sky is the empty space around earth and as such has no colour. It appears blue due to the scattering of light by the colloidal dust particles present in air (Tyndall effect). 12. Preparation of Nano-materials: Nano-materials which are used as catalyst are prepared by using reverse micelles. 3. Building roads: Now a day, roads are built asphalt emulsified in water. This technique does not require the necessity of melting the asphalt. 14. Metallurgical operations: Several metal ores are concentrated by froth floatation process. This process involves the treatment of the pulverized ore in emulsion of pine oil. What are the Applications of Colloids? Colloids play a very significant role in nature and in our daily life. Some of the important applications of colloids are discussed below: 1) Medicines: Medicines in colloidal form are easily adsorbed by the body tissues and hence are more effective.) Sewage disposal: Colloidal particles of the dirt, mud etc. carry electric charge, hence when sewage water is passed through the plates kept at a high potential, the colloidal particles are coagulated due to electrophoresis and the suspended matter gets removed. 3) Purification of water: The precipitation of colloidal impurities present in water can be done by adding certain electrolytes like alum etc. the negatively charged colloidal particles of impurities get neutralized by the Al3+ ions and settle down and pure water can be decanted off. 4) Cleansing action of soap: Soap solution is colloidal in nature.

It removes the dirt particles either by adsorption or by emulsifying the greasy matter sticking to the cloth. 5) Formation of Delta: River water contains charged colloidal particles of clay, sand and many other materials.

Sea water is very big store house of a variety of electrolytes dissolved in it. As soon as river water comes in contact with sea water coagulate the suspended colloidal particles which ultimately settle down at the point of contact. Thus the level of the river bed rises. As a result, water adopts a different course and delta is formed in due course of time.) Smoke precipitation: Smoke particles are actually electrically charged colloidal particles of carbon in the air. Precipitation of smoke particles is carried out by Cottrell precipitator which is based on the principle of electrophoresis. Smoke is allowed to pass through a chamber having a number of metal plates attached to a metal wire connected to a source of high potential. Charged particles of smoke get attracted by oppositely charge electrode get precipitated after losing their charge and the hot air passes out through the chimney.

The dust particles are also removed in this process. Thus the nuisance of smoke in big industrial cities can be avoided. 7) Photography: A colloidal solution of silver bromide in gelatin is applied on glass plates or celluloid films or paper to from sensitive plates in photography. 8) Artificial rain: Artificial rain can be caused by spraying oppositely charged colloidal dust or sand particles over a cloud. The colloidal water particles present in the cloud will be neutralized and coagulate to from bigger water drops causing artificial rain. 9) Rubber industry:

Latex is a colloidal solution of negatively charged rubber particles. From latex, rubber can be obtained by coagulation. Rubber plated articles are prepared by depositing negatively charged rubber particles over the article to be rubber plated by making that article an anode in a rubber plating bath.

10) Smoke screen: In warfare smoke screens are used which are nothing but colloidal dispersion of certain substances in the air. 11) Other applications: a) Blue color of the sky is due to the scattering of light by colloidal dust particles in air (Tyndall effect).

Similarly, sea water looks blue due to scattering of light by the colloidal impurities present in sea water. b) Tail of comets is seen as a Tyndall cone due to the scattering of light by the tiny solid particles left by the comet in its path. c) Blood is a colloidal solution and the stoppage of bleeding on applying ferric chloride solution is due to coagulation of blood forming a clot. Colloids-Chemistry and Applications What are Colloids ? In a true solution as sugar or salt in water, the solute particles are dispersed in the solvent as single molecules or ions.

Thus the diameter of the dispersed particles ranges from 1A to 10 A. On the other hand, in a suspension as sand stirred into water, the dispersed particles are aggregates of millions of molecules. The diameter of these particles is of the order 2, 000 A or more. Applications of Colloids Colloids play an important role in our daily life and industry. A knowledge of colloid chemistry is essential to understand some of the various natural phenomena around us. Colloids make up some of our modern products. A few of the important applications of colloids are listed below. (1) Foods: Many of our foods are colloidal in nature.

Milk is an emulsion of butterfat in water protected by a protein, casein. Salad dressing, gelatin deserts, fruit jellies and whipped cream are other examples. Ice cream is a dispersion of ice in cream. Bread is a dispersion of air in baked dough. (2) Medicines: Colloidal medicines being finely divided, are more

effective and are easily absorbed in our system. Halibut-liver oil and cod-liver that we take are, in fact, the emulsions of the respective oils in water. Many ointments for application to skin consist of physiologically active components dissolved in oil and made into an emulsion with water.

Antibiotics such as penicillin and streptomycin are produced in colloidal form suitable for injections. (3) Non-drip or thixotropic paints: All paints are colloidal dispersions of solid pigments in a liquid medium. The modern nondrip or thixotropic paints also contain long-chain polymers. At rest, the chains of molecules are coiled and entrap much dispersion medium. Thus the paint is a semisolid gel structure. When shearingstressis applied with a paint brush, the coiled molecules straighten and the entrapped medium is released. As soon as the brush is removed, the liquid paint reverts to the semisolid form.

This renders the paint ‘ non-drip’. (4) Electrical precipitation of smoke: The smoke coming from industrial plants is a colloidal dispersion of solid particles (carbon, arsenic compounds, cement dust) in air. It is a nuisance and pollutes the atmosphere. Therefore, before allowing the smoke to escape into air, it is treated by Cottrell Precipitator. The smoke is let past a series of sharp points charged to a high potential (20, 000 to 70, 000 V). The points discharge high velocity electrons that ionise molecules in air. Smoke particles adsorb these positive ions and become charged.

The charged particles are attracted to the oppositely charged electrodes and get precipitated. The gases that leave the Cottrell precipitator are thus freed from smoke. In addition, valuable materials may be recovered from the precipitated smoke. For example, arsenic oxide is mainly recovered from the

smelter smoke by this method. (5) Clarification of Municipal water: The municipal water obtained from natural sources often contains colloidal particles. The process of coagulation is used to remove these. The sol particles carry a negative charge.

When aluminium sulphate (alum) is added to water, a gelatinous precipitate of hydrated aluminium hydroxide (floc) is formed, Al3+ + 3H2O ---- Al(OH)3 + 3H+ Al(OH)3 + 4H2O + H+ ----- Al(OH)3(H2O)4 The positively charged floc attracts to it negative sol particles which are coagulated. The floc along with the suspended matter comes down, leaving the water clear. (6) Artificial Kidney machine: The human kidneys purify the blood by dialysis through natural membranes. The toxic waste products such as urea and uric acid pass through the membranes, while colloidal-sized particles of blood proteins (haemoglobin) are retained.

Kidneyfailure, therefore, leads to death due to accumulation of poisonous waste products in blood . Now-a-days, the patient’s blood can be cleansed by shunting it into an ‘ artificial kidney machine’. Here the impure blood is made to pass through a series of cellophane tubes surrounded by a washing solution in water. The toxic waste chemicals (urea, uric acid) diffuse across the tube walls into the washing solution. The purified blood is returned to the patient. The use of artificial kidney machine saves the life of thousands of persons each year.

The phenomenon of the scattering of light by the sol particles is called Tyndall effect. (7) Blue colour of the sky: This is an application of Tyndall effect. The upper atmosphere contains colloidal dust or ice particles dispersed in air. As the sun rays enter the atmosphere these strike the

colloidal particles. The particles absorb sunlight and scatter light of blue colour (4600–5100A). The light that is incident at earth’s surface is considerably reddened due to the removal of most of the blue light in the upper atmosphere.