

## Application of Adsorption.

The phenomenon of adsorption finds a number of applications. Important applications are given as follows.

(1) **Production of high vacuum:** A bulk of charcoal cooled in liquid air is connected to a vessel which has already been exhausted as far as possible by a vacuum pump. The remaining traces of air are adsorbed by the charcoal. Then a very high vacuum is produced.

(2) **In Gas masks:** It is a device which consists of activated charcoal or a mixture of adsorbents. This apparatus is used to adsorb poisonous gases (e.g.  $Cl_2$ ,  $CO$ , oxide of sulphur etc.) and thus purify the air for breathing.

(3) **For desiccation or dehumidification:** Certain substances have a strong tendency to absorb water such as silica and alumina ( $Al_2O_3$ ). These substances can be used to reduce/remove water vapors or moisture present in the air. Silica gel is also used for dehumidification in electronic equipment.

(4) **Removal of coloring matter from solution:** (i) Animal charcoal removes colors of solutions by adsorbing colored impurities. (ii) Animal charcoal is used as decolorizer in the manufacture of cane sugar.

(5) **Heterogeneous catalysis:** Mostly heterogeneous catalytic reactions proceed through the adsorption of gaseous reactants on solid catalyst. For example,

(i) Finely powdered nickel is used for the hydrogenation of oils.

(ii) Finely divided vanadium pentoxide ( $V_2O_5$ ) is used in the contact process for the manufacture of sulphuric acid.

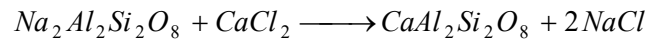
(iii) Pt, Pd are used in many industrial processes as catalyst.

(iv) Manufacture of ammonia using iron as a catalyst.

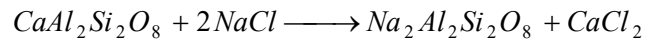
(6) **Separation of inert gases:** Due to the difference in degree of adsorption of gases by charcoal, a mixture of inert gases can be separated by adsorption on coconut charcoal at different low temperatures.

**(7) Softening of hard water**

- (i) The hard water is made to pass through a column packed with zeolite (sodium aluminum silicate) (ii)  $Ca^{++}$ ,  $Mg^{++}$  ions which are responsible for hardness, get adsorbed on zeolite, exchanging sodium ions.



- (iii) The exhausted zeolite is regenerated with 10% of sodium chloride solution.



**(8) De-ionization of water**

- (i) Water can be de-ionized by removing all dissolved salts with the help of cation and anion-exchanger resin.  
(ii) Cation-exchanger is an organic synthetic resin such as polystyrene-containing a macroanion ( $R - SO_3^-$  etc.) which has adsorbed  $H^+$  ions.  
(iii) A resin containing a basic group ( $R_3N^+$  etc.) which has adsorbed  $OH^-$  ions acts as anion exchanger.

**(9) In curing diseases:** A number of drugs are adsorbed on the germs and kill them or these are adsorbed on the tissues and heat them.

**(10) Cleaning agents:** Soap and detergents get adsorbed on the interface and thus reduce the surface tension between dirt and cloth, subsequently the dirt is removed from the cloth.

**(11) Froth floatation process**

- (i) A low grade sulphide ore is concentrated by separating it from silica and other earthy matter by this method.  
(ii) The finely divided ore is added to water containing pine oil and foaming agent.  
(iii) The air is bubbled through the mixture.  
(iv) The foam formed rises to the surface on which mineral particles wetted with oil are adsorbed while earthy matter settle down at the bottom.

(12) **In adsorption indicators**

- (i) Surface of certain precipitates such as silver halide, have the property of adsorbing some dyes like eosin, fluorescein etc.
- (ii) In this case of precipitation titrations (for example  $AgNO_3$  Versus NaCl) the indicator is adsorbed at the end point producing a characteristic color on the precipitate.

(13) **Chromatographic analysis**

- (i) The phenomenon of adsorption has given an excellent technique of analysis known as chromatographic analysis.
- (ii) The technique finds a number of applications in analytical and industrial fields.
- (iii) Chromatographic technique based on differential adsorption of different constituents of a mixture.

(14) **In dyeing:** Many dyes get adsorbed on the cloth either directly or by the use of mordants.