

# Centrifugation

Introduction:-

Definition:-

"Centrifugation is a unit operation used for separating the constituents present in a dispersion with the aid of centrifugal force."

- \* Centrifugal force  $\rightarrow$  is used as driving force  
 $\downarrow$   
for separation.
- \* Centrifugation is useful  $\rightarrow$  when separation by ordinary filtration is difficult.
- \* for example  $\rightarrow$  Separation of highly viscous mixture  
 $\rightarrow$  colloidal dispersion (particles less than 5 mm)
- \* The equipment used are called centrifuges.

Process of Centrifugation:-

- \* The centrifuge consists of a container in which mixture of solid and liquid or two liquid is placed  
 $\downarrow$   
rotated at high speed  
 $\downarrow$   
mixture separated into its constituent parts by action of centrifugal force on their densities.
- \* A solid or liquid of higher specific gravity is thrown outward with greater force.

## Applications:-

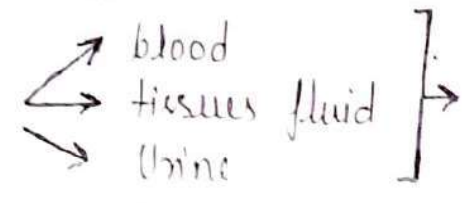
### (1) Production of bulk drugs:-

- \* Centrifugation technique is used to separate  
↓  
crystalline drugs from mother liquor  
(such as aspirin)

### (2) Production of biological products:-

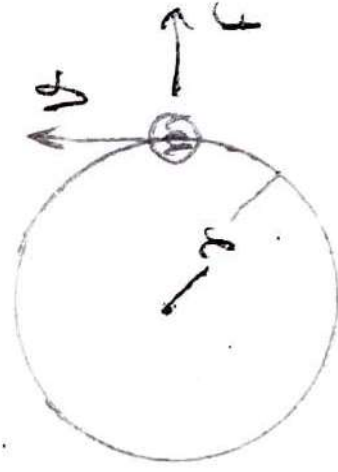
- \* Proteinaceous drugs > present in water as colloidal  
macromolecules dispersion  
↓  
centrifugal force is used to separate  
them from water.
- \* Insulin can be obtained in pure form  
↓  
by selective precipitation of other  
fraction of proteins  
↓  
subsequently separating by ultracentrifugation
- \* It is used to separate blood cells from blood.

### (3) Biopharmaceutical Analysis of drugs:-

- \* Drugs present in  Are present in the  
form of colloidal  
dispersion  
↓  
centrifugation is used for  
separating the drugs.

## Theory of Centrifugation

Consider a body of mass  $m$  kg rotating in circular path of radius  $r$  metres at a velocity  $v$  metre per minute



The force acting on the body in a radial direction is given by -

$$\text{force acting in radial direction } F = \frac{mv^2}{r} \quad \text{--- (1)}$$

where  $F$  is centrifugal force.

$$\text{Gravitational force } G = mg \quad \text{--- (2)}$$

where  $g$  = acceleration due to gravity

The centrifugal effect is expressed as a ratio of centrifugal force to gravitational force.

$$\begin{aligned} \text{Centrifugal effect } C &= \frac{F}{G} \\ &= \frac{mv^2}{r mg} \\ &= \frac{v^2}{rg} \quad \text{--- (3)} \end{aligned}$$

But  $v = 2\pi rn$  where  $n$  = speed of rotation.  
(revolution per sec)

$$C = \frac{(2\pi rn)^2}{rg} = \frac{4\pi^2 r^2 n^2}{rg}$$

$$C = \frac{4\pi^2 r n^2}{g}$$

$2r = d$  where  $d$  is diameter of rotation

$$C = \frac{2\pi^2 d n^2}{g}$$

$$\text{As } g = 9.807 \text{ m/s}^2$$

$$\pi = 3.14$$

$$\text{So } C = \frac{2 \times (3.14)^2 \times d n^2}{9.807}$$

$$C = 2.013 n^2 d //$$