congratulation

Presented by –

Deepak Kumar Kashyap

zoology department

(D. P. Vipra college Bilaspur)

CONTENTS

- Introduction
- Principle
- Types of centrifugation techniques
- Density gradient centrifugation
- Differential centrifugation
- Ultra centrifugation
- Application in Water Treatment
- Commercial applications

Introduction

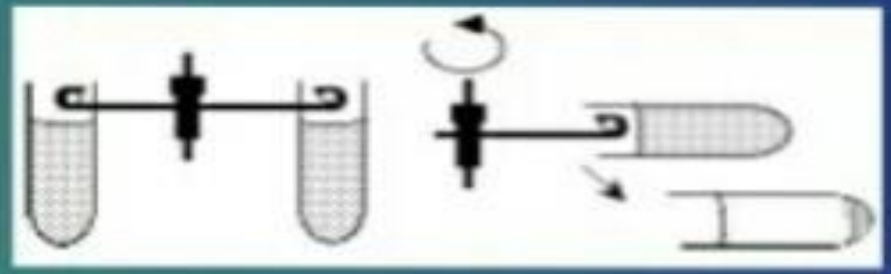
- Centrifuge is device for separating particles from a solution according to there size, shape, density, viscosity of the medium.
- Centrifuge uses centrifugal force to separate phases of different densities.
- The centrifugal force is proportional to the rotation rate of the rotor.
- The centrifuge consists of a rotor enclosed in a refrigerated chamber spun by an electric motor

Centrifuge Rotors

- **Fixed Angle Rotor**

Sedimenting particles have only short distance to travel before pelleting. Shorter run time. The most widely used rotor type.

- **Swinging Bucket Rotor**



Longer distance of travel may allow better separation, such as in density gradient centrifugation. Easier to withdraw supernatant without disturbing pellet.

Principle

- Centrifugation is based on the fact that any object moving in a circle at a steady angular velocity is subjected to an outward directed force , F.
- The magnitude of this force depends on the angular velocity in radians ,omega , and the radius of rotation ,r, in cm.

$$F = \omega^2 r$$

When the centrifuge tubes are spun, the centrifugal action creates an induced gravitational field in an outward direction relative to the axis of rotation and this drives the particles or precipitated matter towards the bottom of the tube. Typical rotation speeds of laboratory centrifuges range from 1,000 - 15,000 rpm.

The magnitude of the induced gravitational field is measured in terms of the G value: a G value of 1000 refers to an induced field that is thousand time stronger than that due to gravity.

The G value which is also referred to as the RCF (relative centrifugal force) value depends on the rotation speed as well as the manner in which the centrifuge tubes are held by the rotor:

- $G = r\,\omega^2 r\,/g$
- $\omega = 2\pi n$
- Substituting for ω
- $G = r\,(2\pi n)^2/g$
- $G = r\,(2*3.14*[n/60])^2/9.81$
- $G = 1.12*10^{-3}\,r\,n^2$
- $G = 1.12*10^{-3}\,r\,(RPM)^2$
- Where:
- r = distance from the axis of rotation (m)
- ω = angular velocity (radians/s)
- g = acceleration due to gravity (m/s2)
- n = rotation speed, RPM

Types of centrifugation techniques

- Density gradient centrifugation

I. Rate zonal centrifugation

II. Isopynic or sedimentation equilibrium centrifugation

- Differential centrifugation
- Ultra centrifugation

Density gradient centrifugation

- It allow separation of many or all components in a mixture and allows for measurement to be made
- There are two forms of Density gradient centrifugation :

➢ Rate zonal centrifugation

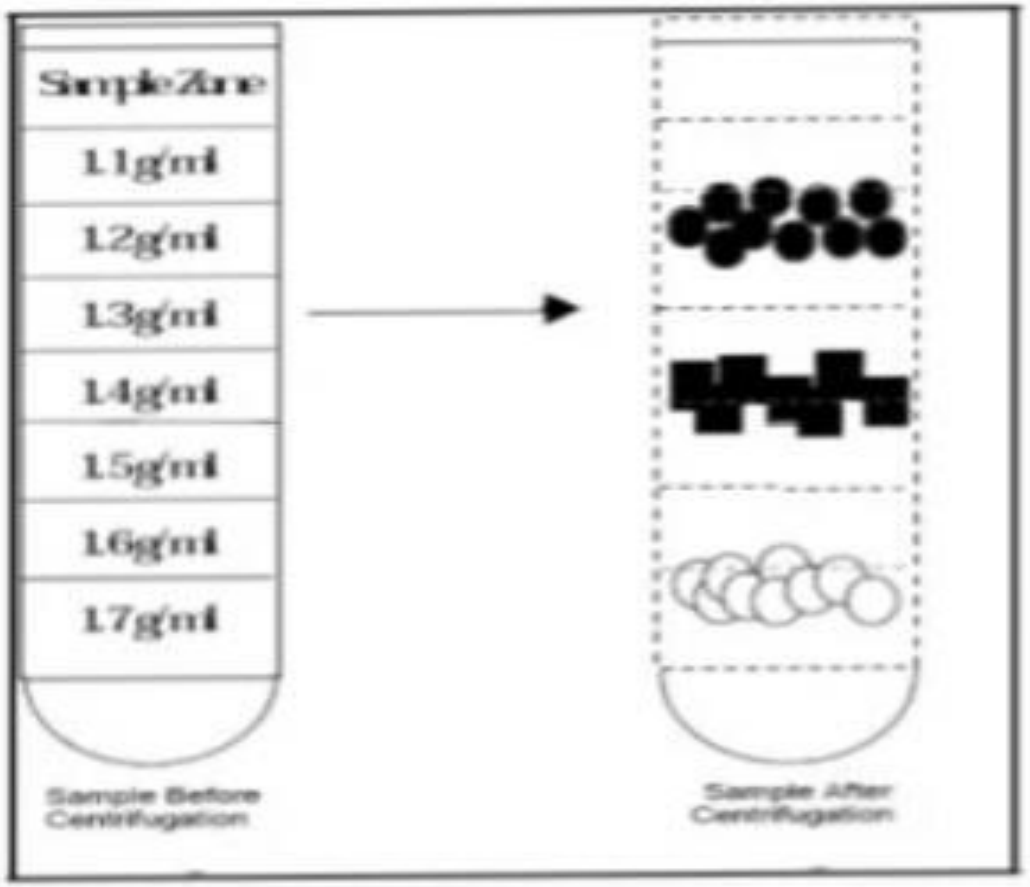
➢ Isopynic or sedimentation equilibrium centrifugation

Rate zonal centrifugation

- In Rate zonal centrifugation the solution have a density gradient. The sample has a density i.e. greater than all the layers in the solution.

- The sample is applied in a thin zone at the top of the centrifuge tube on a density gradient. Under centrifugal force, the particles will begin sedimenting through the gradient.

Rate zonal centrifugation

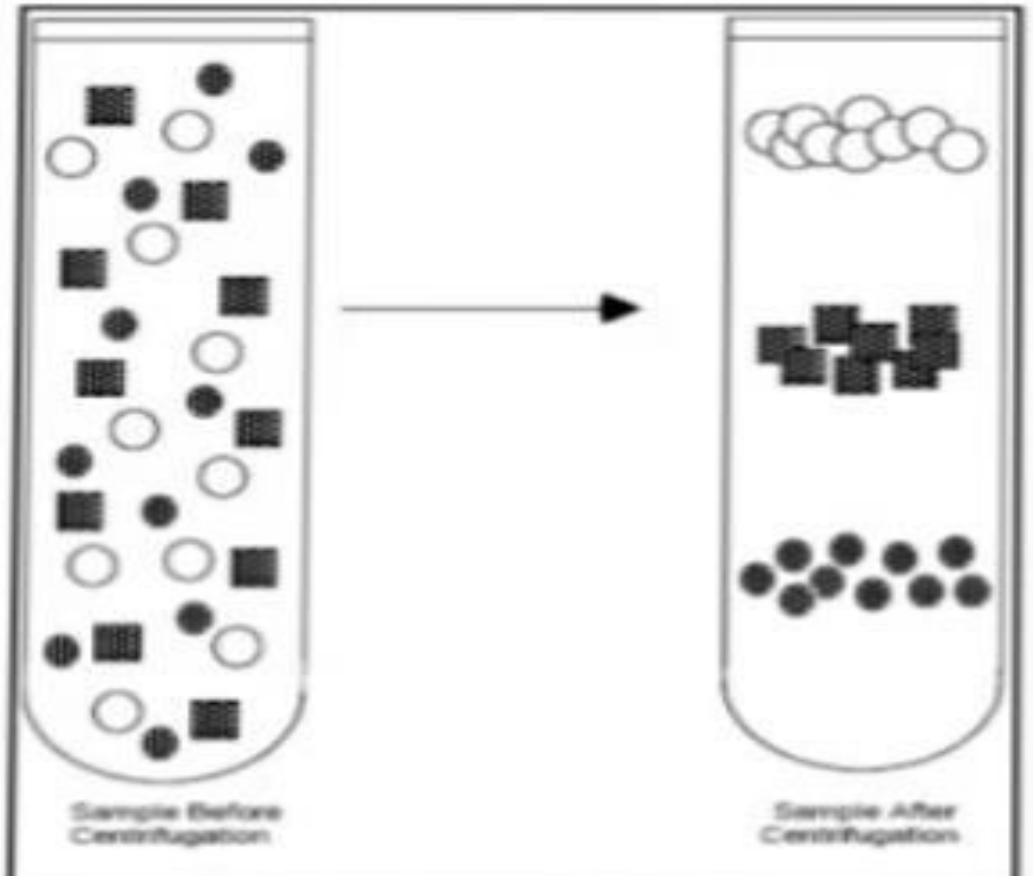


- The particles will begin sedimenting in separate zones according to their size shape and density.

Isopynic or sedimentation equilibrium centrifugation

- In this type of centrifugation , the solution contains a greater range of densities.
- The density gradient contains the whole range of densities of the particles in the sample.
- Each particle will sediment only to the position in the centrifuge tube at which the gradient density is equal to its own density.

Isopynic or sedimentation equilibrium centrifugation



- In Isopycnic centrifugation separation of particles occurs into zones on the basis of their density differences, independent of time.

Differential centrifugation

- Differential centrifugation is a common procedure in microbiology and cytology used to separate certain organelles from whole cells for further analysis of specific parts of cells.
- In the process, a tissue sample is first homogenized to break the cell membranes and mix up the cell contents.
- The homogenate is then subjected to repeated centrifugations, each time removing the pellet and increasing thecentrifugal force.

Ultracentrifugation

- Svedberg coined the term “ultracentrifuge". He was colloid chemist.
- He used the ultracentrifuge to determine the MW and subunit structure of hemoglobin , studies which changed the ideas concerning the structure of proteins.
- The first commercial ultracentrifuge was produced in 1940 by SPINCO.

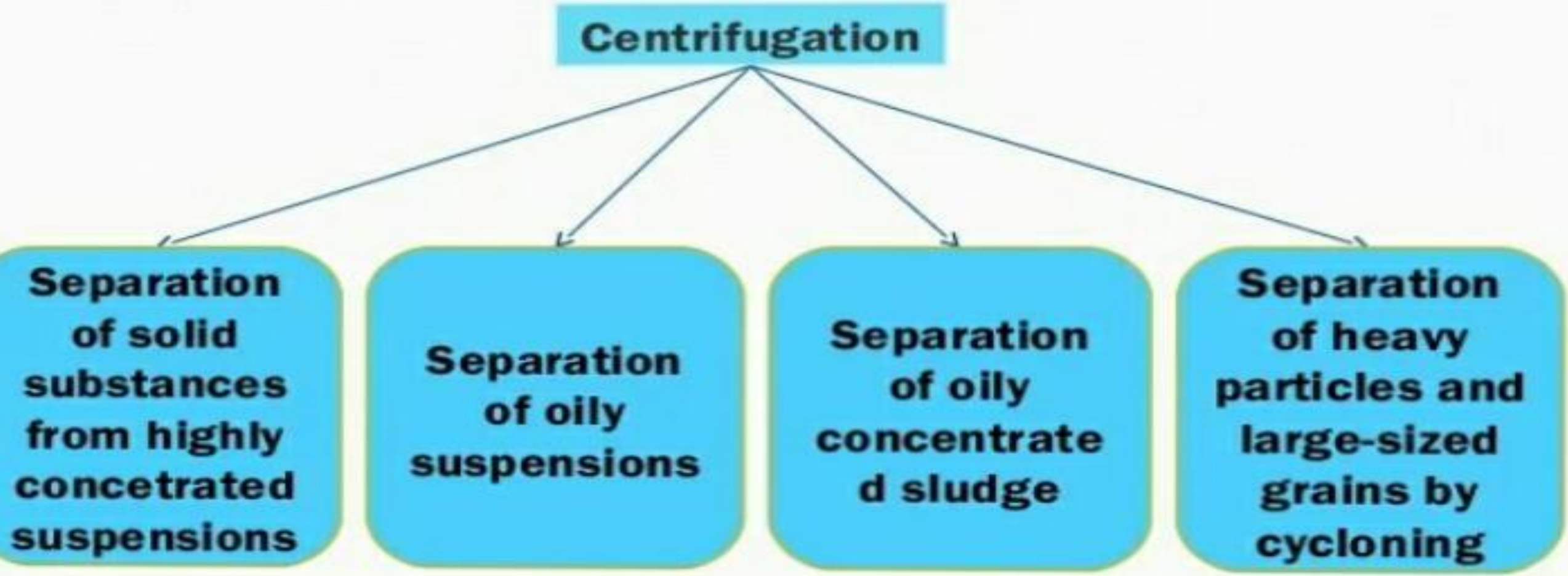
Analytical ultracentrifuge

- In an analytical ultracentrifuge, a sample being spun can be monitored in real time through an optical detection system, using ultraviolet light absorption and/or interference optical refractive index sensitive system
- This allows the operator to observe the sample concentration versus the axis of rotation profile as a result of the applied centrifugal field.

Preparative ultracentrifuge

- Preparative ultracentrifuges are available with a wide variety of rotors suitable for a great range of experiments.
- Most rotors are designed to hold tubes that contain the samples. Swinging bucket rotors allow the tubes to hang on hinges so the tubes reorient to the horizontal as the rotor initially accelerates.
- Preparative rotors are used in biology for pelleting of fine particulate fractions, such as cellular organelles mitochondria, microsomes,ribosomes and viruses.

Application in Water Treatment



Commercial applications

- **Centrifuges with a batch weight of up to 2,200 kg per charge are used in the sugar industry to separate the sugar crystals from the mother liquor .**
- **Standalone centrifuges for drying (hand-washed) clothes – usually with a water outlet.**
- **Large industrial centrifuges are also used in the oil industry to remove solids from the drilling fluid.**

Thankyou