Centrifugation

Centrifugation is a process which involves the use of the centrifugal force for the sedimentation of heterogeneous mixtures with a centrifuge, used in industry and in laboratory settings. Centrifugation may be used to separate solid particles from a liquid or two immiscible liquids of different densities from each other, or both.

Basic Principles

- In a solution, particles whose density is higher than that of the solvent sink (sediment), and particles that are lighter than it float to the top.

- The greater the difference in density, the faster they move. If there is no difference in density, the particles stay steady.

- To take advantage of even tiny differences in density to separate various particles in a solution, gravity can be replaced with the much more powerful “centrifugal force” provided by a centrifuge.

- A particle, whether it is precipitate, a macromolecule or cell organelle when rotated at high speed is subjected to a centrifugal force.

- Centrifugal force is defined as:

$$F=mw^2r$$

Where,

F=intensity of centrifugal force

m=effective mass of sedimenting particle

w=angular velocity of rotation

r=distance of migrating particles from central axis of rotation

- A more common measurement of F, in terms of θ Gravitational force g, is Relative Centrifugal Force (RCF), is given as:

$$RCF = (rpm)^2(r)$$

- Thus this equation indicates that RCF varies with r, (the distance of the sedimenting particles from axis of rotation. Thus it gives idea of only basic principle, it does not take into account other factors i.e. mass, shape, density of medium.

Applications

Following are a few of the many applications of mechanical centrifugation in the food industry:

Milk separation: one of the oldest and most widespread uses of the centrifuge in the food industry is the separation of whole milk to skimmed milk and cream. The centrifuges used for this purpose are known as ‘separators’

Cheese production: in modern dairy plants, centrifuges are used for the rapid separation of curd from whey

Pulp control in fruit and vegetable juices : centrifugation is used for the reduction of pulp content in fruit juices and for the production of clear juices by total removal of the pulp

•**Edible oil processing:** several operations in the production and refining of edible oils involve the separation of the oil from an aqueous phase. Centrifugation is the preferred method of separation

- **Essential oil recovery :** essential oils of citrus fruit are recovered by centrifugal separation of aqueous mixtures formed in the course of juice extraction

- **Production of starch** : one of the methods for the separation of starch from suspensions is mechanical centrifugation

- **Production of yeast:** centrifuges are used for the separation of commercial yeast from the liquid growth medium.