

1 Answer the following :-

a) Evaporation :- It is a unit operation in which liquid is converted into vapour state on heating below its boiling point, termed as evaporation.

b) Pharmaceutics :-

It is science of dosage form design. It is a discipline of pharmacy that deals with the process of turning a new chemical entity or old drugs into a medication to be used safely and effectively by patients.

c) Equation on centrifugal force :-

The centrifugal effect is the ratio of centrifugal force to gravitational force.

So, Centrifugal effect, $C = \frac{\text{force acting in radial direction}}{\text{Gravitational force}}$

$$= \frac{F}{G}$$

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

$$\Rightarrow C = 2.013 n^2 d$$

Here,

d - Diameter of the rotation

n - No. of revolutions per second

g - Gravitational accelⁿ

C - Centrifugal effect.

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d) API :- Its extended form is Active Pharmaceutical ingredients.

APIs are the main component of the medicine which have therapeutic effect.

(e) I.P. :-

Its extended form is Indian Pharmacopoeia Pharmacopoeia.

It is an officially legalised book published by Indian govt. containing the standards for drugs and other related substances. It contains identification tests, monographs, formulas for medicament preparations.

2
11 (a) Unit operation

Each chemical process consists of a fewer number of distinct individual steps. Each step is called unit operation.

→ Several unit operations are involved in a unit process.

Some of the examples of unit operations are Drying, Size reduction, Distillation, Evaporation etc.

→ Distillation :-

It is a unit operation of converting liquid into vapour by heating and reconvertng vapour again into liquid by condensing the vapour.

This unit operation is used for obtaining oils from various parts of the plants.

(b) Theory of filtration:-

Filtration may be defined as a process of separation of solids from a liquid fluid by passing the same through a porous medium which retains the solids but allows the fluid to pass through.

In filtration process, the suspension to be filtered is termed as slurry. The porous medium used to retain the solids is known as filter medium. The accumulated solids on the filter are termed as filter cake while the clear liquid passing through the filter is filtrate.

The process of filtration occurs by the virtue of a pressure difference across the filter. Gravity is acting on the liquid column. Therefore solids are trapped on the surface of the filter medium.

→ filtration process has the following applications:

i) Production of sterile product - A solution is passed through a bacteria proof filter in order to obtain sterile products.

ii) Production of bulk drugs:- Drugs in bulk are obtained by separating solids of intermediates and finished products from reaction mixture by filtration technique.

iii) Production of liquid oral formulations:- filtration is an essential step in production of liquid oral solutions for obtaining clear solution.

→ The rate of flow of fluid during filtration may be expressed as

$$\left[\text{Rate} = \frac{\text{driving force}}{\text{Resistance}} \right]$$

And Resistance to movement = $\frac{P_{\text{upstream}} - P_{\text{downstream}}}{\text{length of capillaries}}$

Here, P - Pressure

An equation derived for rate of flow of fluid is Darcy's Equation, which is

$$\left[V = \frac{K A \Delta P}{\eta L} \right]$$

V → Rate of flow

K → permeability coefficient of cake

A → surface area of porous bed.

η → Viscosity.

L → Thickness of filter cake.

A-4 Ans: Application of filtration:-

(1) Production of sterile products:-

(a) Air is filtered through HEPA filters (high efficiency particulate air filters) to obtain sterile air, which maintain good environment during manufacture of sterile products.

(b) A solution is passed through bacteria proof filter in order to obtain sterile solution, particularly when heat sterilisation is not suitable on account of thermolabile nature of the contents.

(2) Production of bulk drugs:-

Solids of intermediates and finished products are separated from "tea" mixture by filtration technique.

(3) Production of liquid oral formulations:-

Filtration is an essential step in production of liquid oral solution for obtaining clear solution.

(4) Effluent and waste water treatment:-

waste solids must be separated by filtration from the waste liquid prior to its disposal.

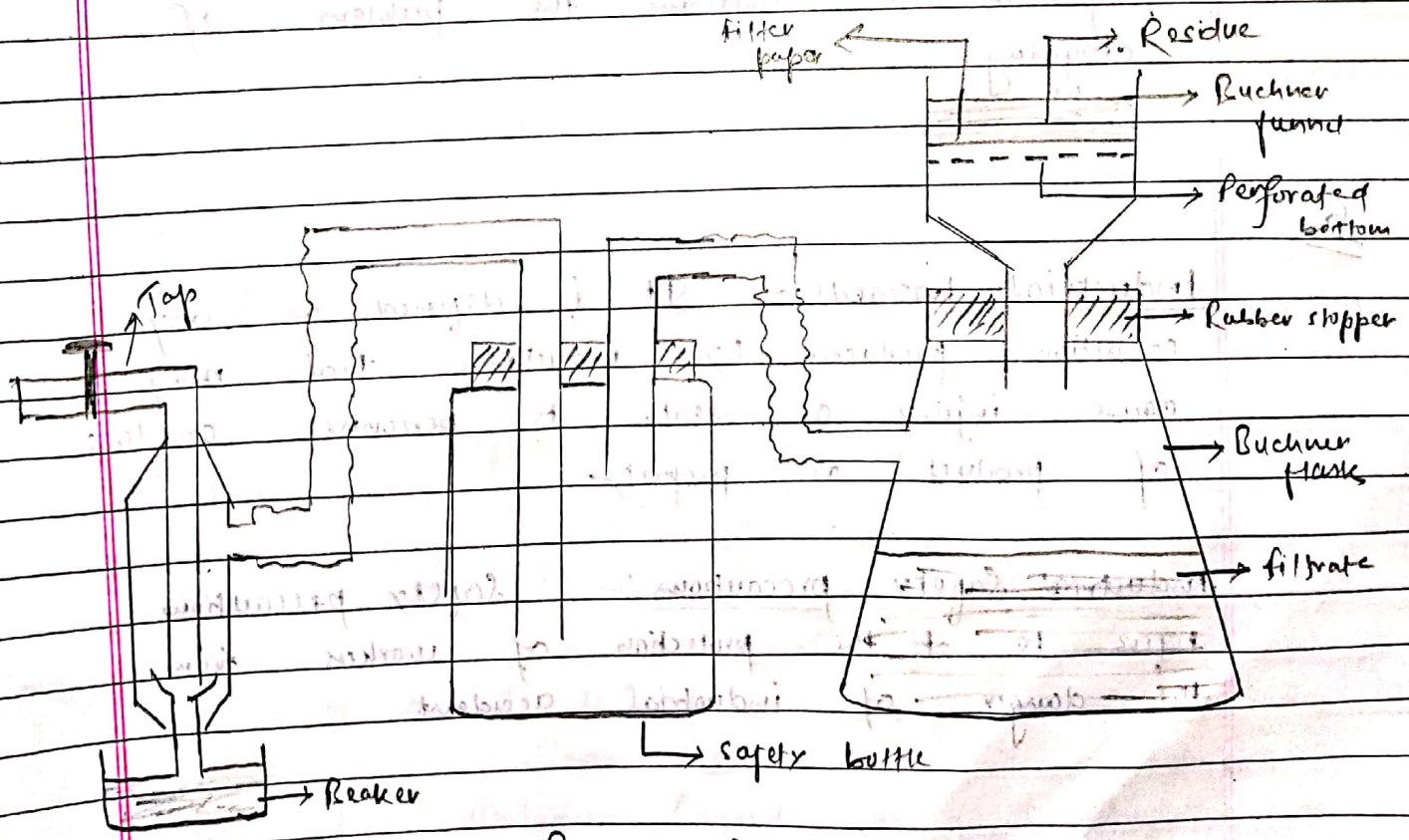
Applications of crystallization —

- (1) Purification of drugs:-
Crystallization is used as a purification process, for removing impurities from pharmaceutical product.
- (2) Better Processing characteristics:-
Crystallization technique is used to change the micromeritics of drugs such as compressibility and wettability.
- (3) Ease of handling:-
Crystallization facilitates various operations such as transportation and storage.
- (4) Better chemical stability:-
Crystallization increases the stability of drugs.
Example:- Amorphous penicillin G is less stable than crystalline salt.
- (5) Improved physical stability:-
Crystalline forms play an important role in product properties such as suspension stability and hardness of a tablet.

Buchner flask and funnel is a filtering unit used for laboratory scale filtration.

Construction of Buchner flask and funnel:

- Ordinary Buchner flask consists of a cylindrical porcelain funnel carrying a fixed flat and perforated plate.
- The funnel is fitted to the neck of the thick walled filtering flask by means of a rubber stopper.
- This assembly is then attached to a safety bottle and the latter is attached to the rubber tubing to a filter pump.



Buchner flask and funnel

Working of Buchner funnel and filter paper:-

- A filter paper is selected, trimmed to the size and is placed in the Buchner funnel. Its diameter should be slightly less than the inside diameter of the funnel.
- Slurry is then transferred into the moistened filter paper into the funnel and it is then filtered.
- Then, bulk of the residual slurry is transferred. This procedure is often quicker than initially bringing all the solids into suspension and pouring it into the filter.
- A suitable filter aid is added to the suspension to overcome the problem of clogging.

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Industrial hazards - It is defined as any condition produced by industries that may cause injury or death to personnel or loss of product or property.

Industrial Safety precautions:- Safety precautions refers to the protection of workers from the danger of industrial accident.

The various types of industrial hazards with their safety precautions can be described as below,

(1) Mechanical Hazards -

Mechanical hazards occurs when the machine is mal functioning. This also occur due to ill-attention caused by fatigue, distraction or deliberate chance taking and curiosity.

→ Safety precaution for mechanical hazards:

- i) Machinery should be shield with adequate protection shields so that human contact with moving part is prevented.
- ii) Workers should protect themselves with adequate protection guards such as shoes, gloves, facemasks and goggles etc.
- (iii) frequent maintainance of machinery and careful adjustments are necessary.

(2) Electrical Hazards -

Electrical hazards occurs when human come in contact with the conductor carrying current and simultaneously in contact with the ground. It is referred as short circuit.

Some sources of electric hazards are static electricity hazards of combustible and explosive materials.

Safety precautions for electrical hazards :-

- (i) Capacitors should be discharged.
- (ii) Fully trained and expertised engineers should be employed for repairing electrical equipments.
- (iii) Explosion proof and non-sparking devices should be fitted.

(3) Chemical Hazards :-

Chemical Hazards occurs due to unwanted reactions of raw materials during manufacturing process. It also occurs when any ~~the~~ chemical reactions get out of control.

Safety precautions for chemical hazards :-

- (i) All chemical reactions should be carried into a suitable environment.
- (ii) Raw materials should be free from impurities.

The general law of conservation can be applied to any process.

- (i) Material balance
- (ii) Energy balance

(a) Material balance :-

The law of conservation of matter states that material cannot be destroyed or created it can change from one form to another.

$$\begin{array}{ccc} \text{Input} & = & \text{Output} \\ \text{Amount of} & & \text{Amount of changed} + \text{Amount of} \\ \text{raw materials} & & \text{material} \quad \text{unchanged} \\ & & \text{material} \end{array}$$

- Radioactive process is an exception because it does not obey the material balance calculⁿ.
- Advantage \rightarrow The mass balance calculation can provide information such as yield value (practical and theoretical) and percent recovery.

Application \rightarrow If one of the component is 'tie substance' in a reaction, the unknown (other component) can be solved.

Tie substance \rightarrow A material is called tie substance, if the material that comes into process in just one stream and leaves unchanged in only one stream.

Centrifugation

Centrifugation :- It is a unit operation employed for separating the constituent present in a dispersion with the aid of centrifugal force.

Centrifugal force provide the driving force for the separation. It replaces gravitational force operating during the sedimentation.

Centrifugation is particularly useful when separation by ordinary filtration is difficult.

for ex :- Separating highly viscous mixtures and colloidal dispersion (particle size less than 5mm), in which difference in the densities is less.

Application :-

- (i) Production of bulk drugs
- (ii) Production of biological product
- (iii) Biopharmaceutical analysis of drug
- (iv) Evaluation of suspension and emulsion
- (v) Determination of molecular weight of colloids.