Ministry of Higher Education and Scientific Research
Al- Rasheed University College/ Department of Pharmacy

Pharmaceutical Technology for 3rd year students

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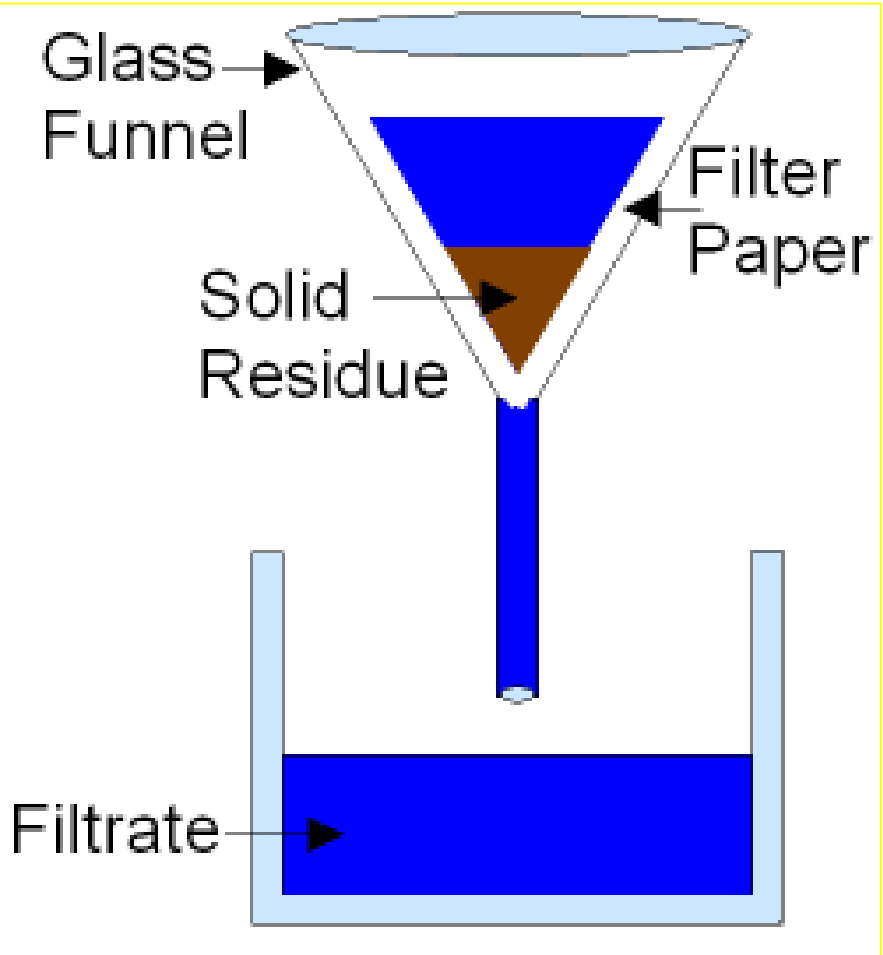
Lec. 5

FILTRATION



FILTRATION

- *Filtration* may be defined as the separation of solid from a fluid by means of a porous medium that retains the solid but allows the fluid to pass.
- **the slurry.**
- **the filter medium;**
- **filter cake,**
- **filtrate.**

Factors Affecting Filtration

- Filtration is affected by the characteristics of the slurry, including:

1- **The properties of the liquid,**

2- The properties of the solid,

3- The proportion of solids in the slurry.

4- **Whether the objective is to collect the solid**, the liquid ,or both.

5- Whether the solids have to be washed free from the liquid or a solute

Rate of Filtration:

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The factors affecting rate of filtration is known **as Darcy"s law** and may be expressed as:

$$dV/dt = KAP/ul$$

where;

V= volume of filtrate,

t = time of filtration ,

K = constant for the filter medium and filter cake,

A = area of filter medium ,

P = pressure drop across the filter medium and filter cake ,

u = viscosity of the filtrate ,

and l = thickness of cake.

Factors affecting rate of filtration :

1- Permeability coefficient:

- As the **thickness** of the cake increase, the rate of filtration will **decrease.**

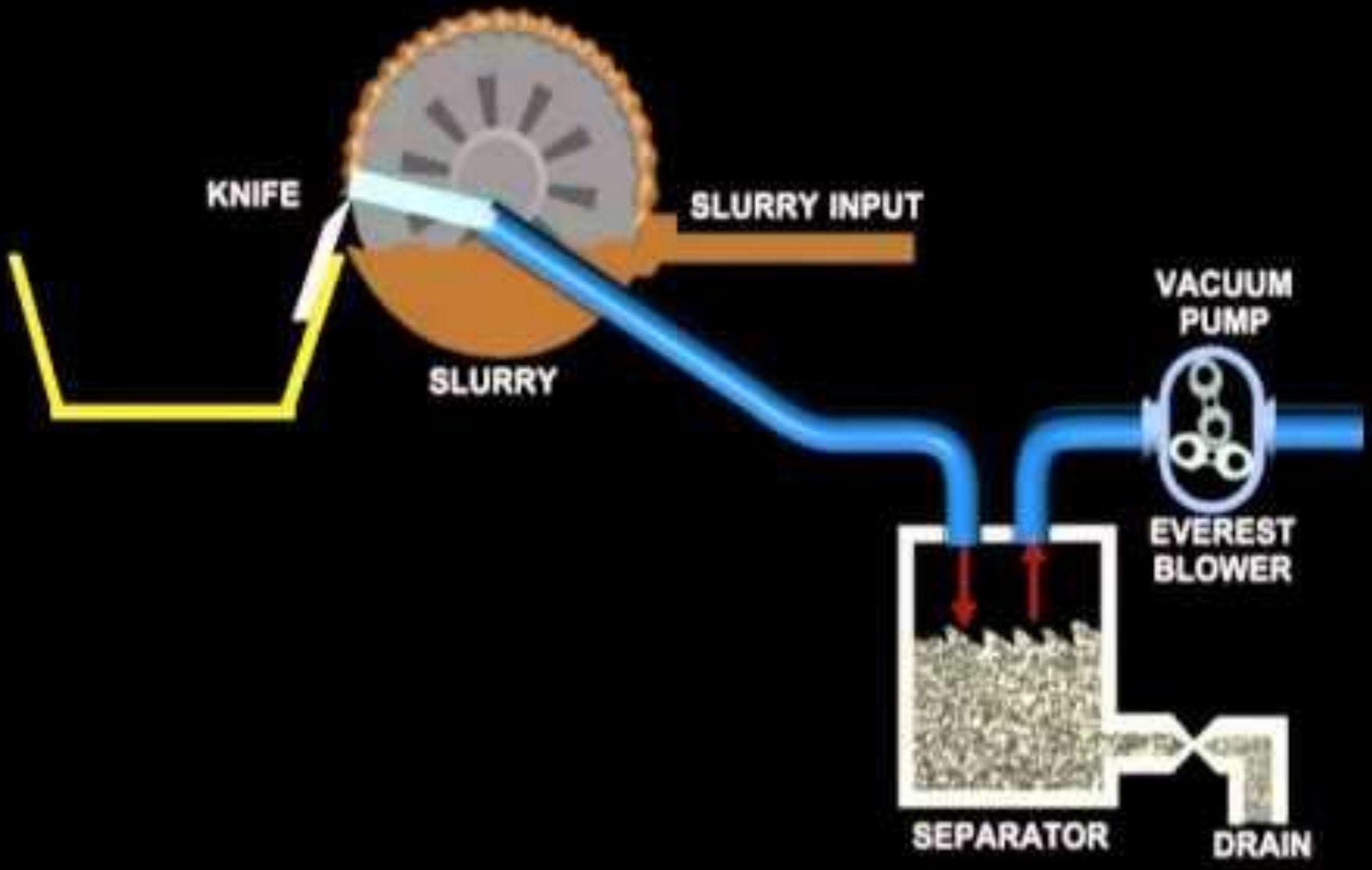
2- Area of filter medium:

The total volume of filtrate flowing from the filter will be proportional to the area of the filter.

The area can be increased by using **larger filters**.

In the rotary drum filter, the continuous removal of the filter cake will give an infinite area for filtration.

ROTARY VACUUM FILTRATION



3- Pressure drop;

The **pressure drop** can be achieved in a number of ways:

- **Gravity:**
- **Vacuum:**
- **Pressure:**
- **Centrifugal force:**

4- Viscosity of filtrate:

- It would be expect that an increase in the viscosity of the filtrate will increase the resistance of flow , so that the rate of filtration is inversely proportional to the viscosity of the fluid.

This problem can be overcome by two methods????

5- Thickness of filter cake;

- The rate of flow of the filtrate through the filter cake is inversely proportional to thickness of the cake. Preliminary decantation may be useful to decrease the amount of the solids.

Filter Media

The surface upon which solids are deposited in a filter is called the "**Filter medium**"

Properties of ideal filter medium:

1- It must be capable of delivering a clear filtrate at a suitable production rate.

2- It must withstand the mechanical stresses without rupturing or being compressed.

3- No chemical or physical interactions with the components of the filtrate should occur.

4- It must retain the solids without plugging at the start of filtration.

5- Sterile filtration imposes a special requirement since the pore size must not exceed the dimension of bacteria or spores.

Classification of filter media

1- <u>Woven filters</u>: these include

a- wire screening .

b- **fabrics** of cotton, wool, nylon.

Nylon is superior for pharmaceutical use, since it is unaffected by mold, fungus or bacteria and has negligible absorption properties .

<u>2- Non- woven filters</u>:

Filter paper is a common filter medium since it offers controlled porosity, limited absorption characteristic, and low cost.

3- Membrane filters:

These are basic tools for **micro-filtration**, useful in the preparation of sterile solutions. These filters are **made by casting** of various esters of cellulose, or from nylon, Teflon, polyvinyl chloride. The filter is a thin membrane with millions of pores per square centimeter of filter surface.

4-Porous plates:

These include **perforated metal** or rubber plates, natural porous materials such as ston**e, porcelain** or ceramics, and sintered **glass.**

Filter Aid

- The **object** of the filter aid is to prevent the medium from becoming **blocked** and to form an **open, porous cake**, so reducing the resistance to flow of the filtrate.

Filter aids may be used in either or **both two ways:**

1-Pre- coating technique:

2-Body- mix technique:

The following filter aids may be used:

- Diatomite (Kieselguhr) , obtained from natural siliceous deposites.

Perlite , it is an aluminium silicate.

Cellulose and Asbestos.

Industrial Filters

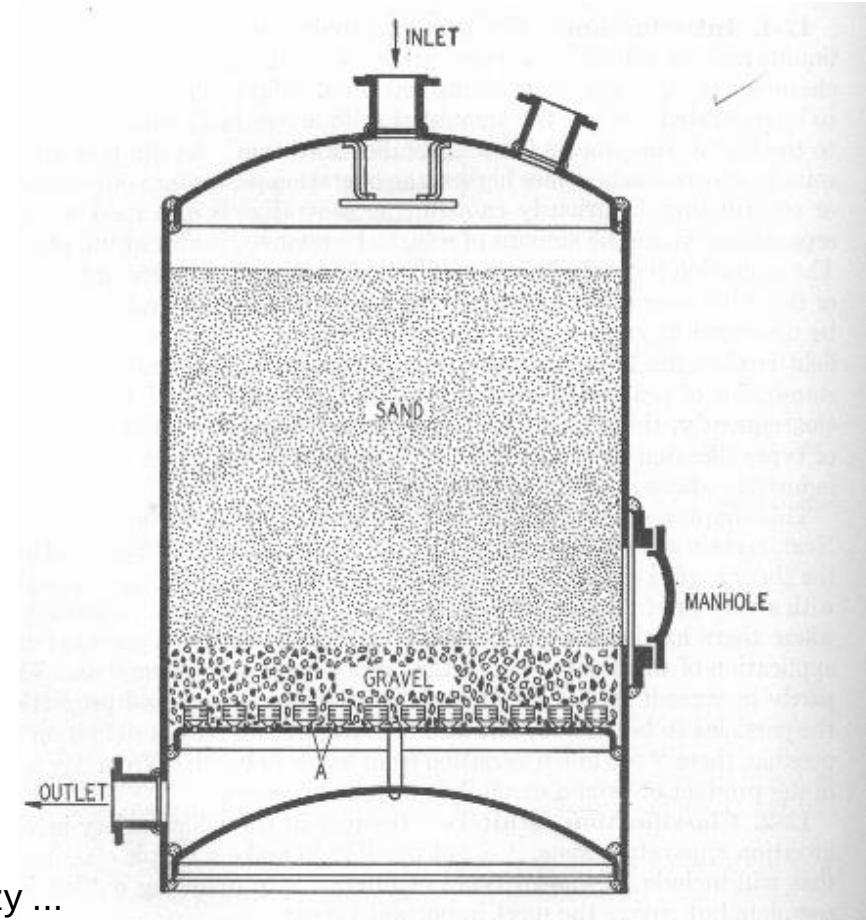
Four groups may be listed:

A- Gravity filters.

B- Vacuum filters

C- Pressure filters.

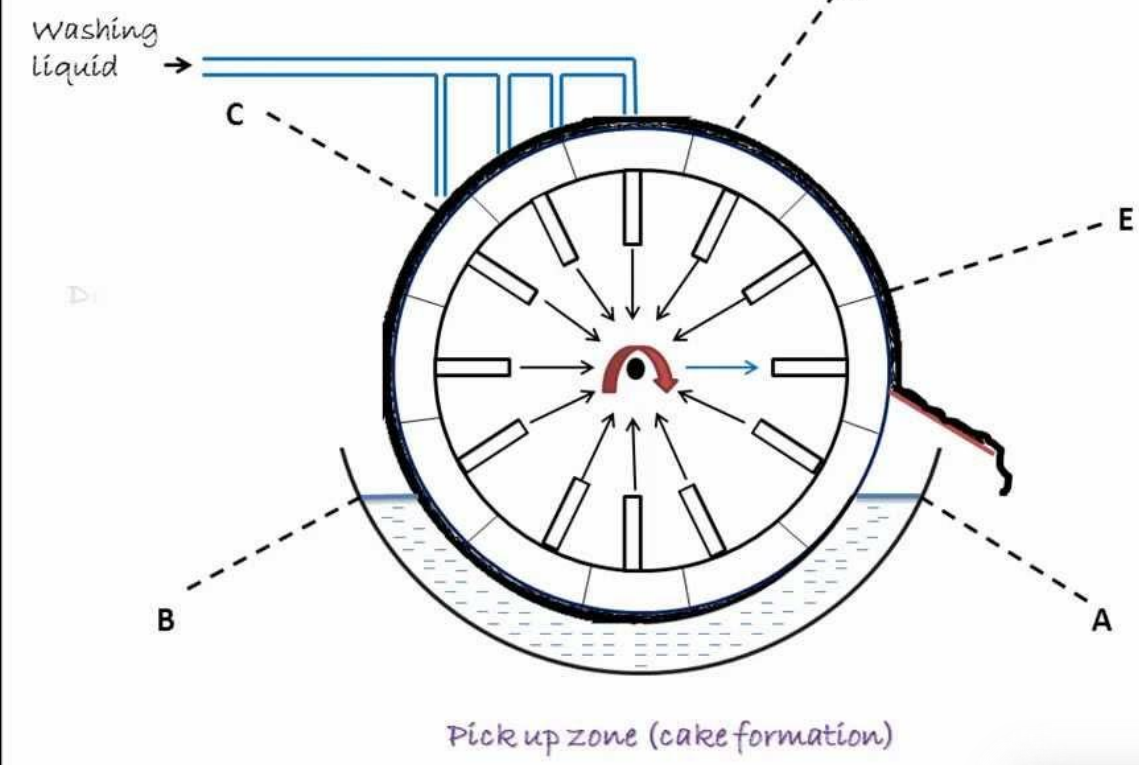
D- Centrifugal filters.

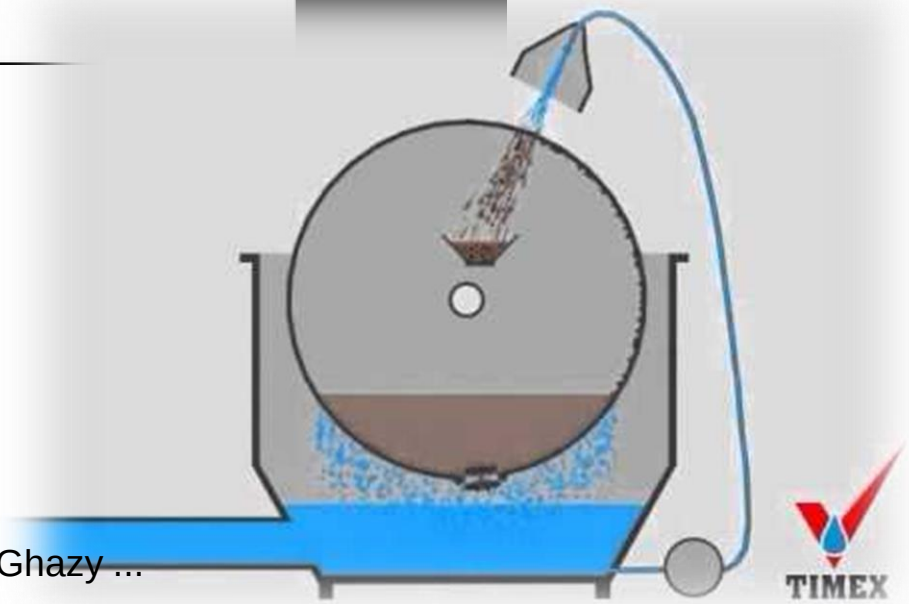


Rotary vacuum filter (Rotary filter)

- ***concentrated slurries.***

It is a metal cylinder mounted horizontally, the curved surface being a perforated plate, supporting a filter cloth. Internally, it is divided into several sectors and a separate connection is made between each sector and a special rotary valve.

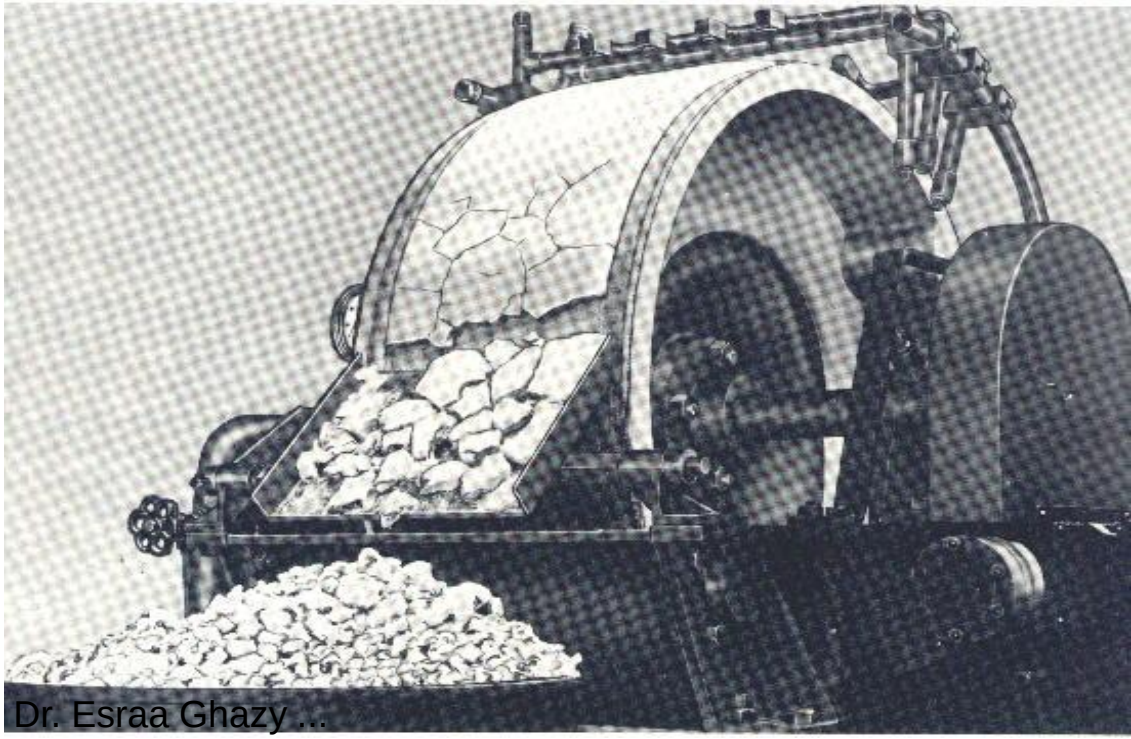

Washing
liquid
C
E
B
A
Pick up zone (cake formation)


TIMEX

Operation:

1- The drum is immersed to the required depth in the slurry, which is agitated to prevent settling of the solids, and vacuum is applied to those sectors of the drum which is submerged.

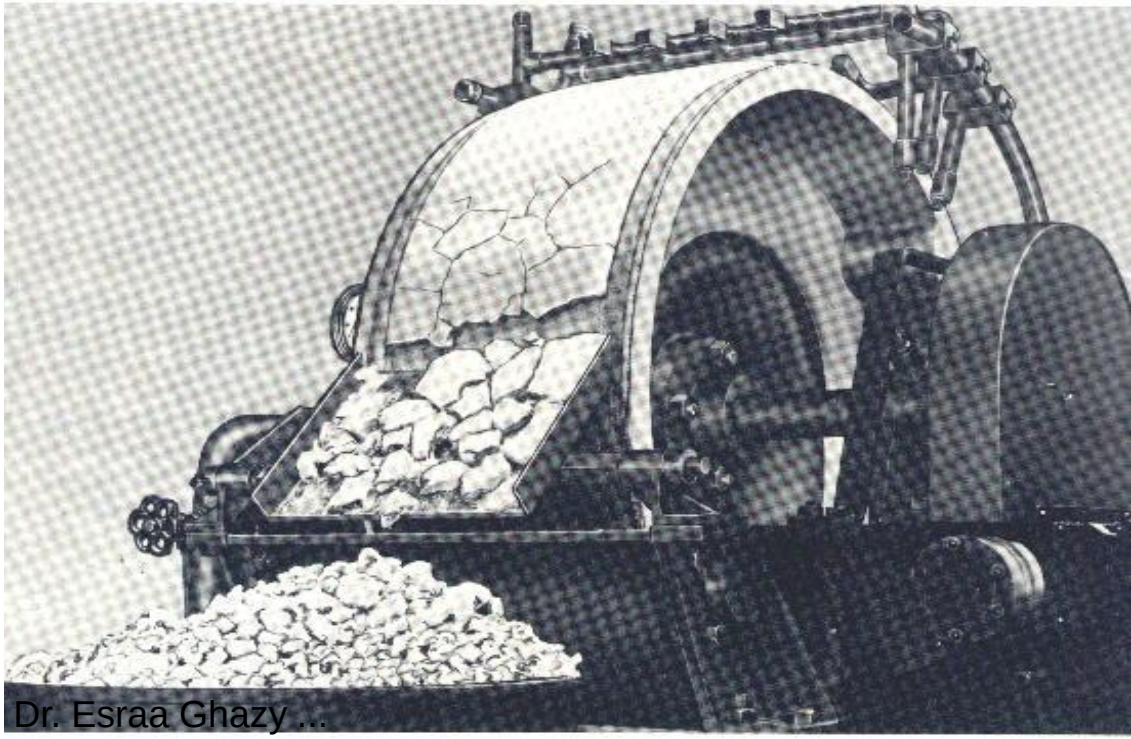
2- cake of the desired thickness is produced by adjusting the speed of rotation of the drum.



3-Each sector is immersed in turn in the slurry and the cake is then washed and partially dried by means of a current of air.

4-Finally, pressure is applied under the cloth to aid the removal of the cake.

5- Removal of the washed and partially dried cake is affected by means of a doctor knife.



Advantages & disadvantages of rotary drum filter

Advantages:

1-The rotary filter is **automatic** and is **continuous** in operation, so that the labor costs are very low.

2- The filter has a large capacity , so it is suitable for the filtration of highly concentrated solutions.

3- Variation of the speed of rotation enables the cake thickness to be controlled.

4- Pre-coat of filter aid could used to accelerate the filtration rate.

Disadvantages:

1- The rotary filter is a complex piece of equipment , with many moving parts and is very expensive.

2- In addition to the filter itself, some accessories are connected ,e.g, a vacuum pump, vacuum receivers , slurry pumps and agitators are required

3- The cake tends to crack due to the air drawn through by the vacuum system, so that washing and drying are not efficient.

Uses:

1- The rotary filter for continuous operation on large quantities of slurry.

2- Suitable for slurry contains considerable amounts of solids in the range 15-30%.

String-discharge rotary drum filter

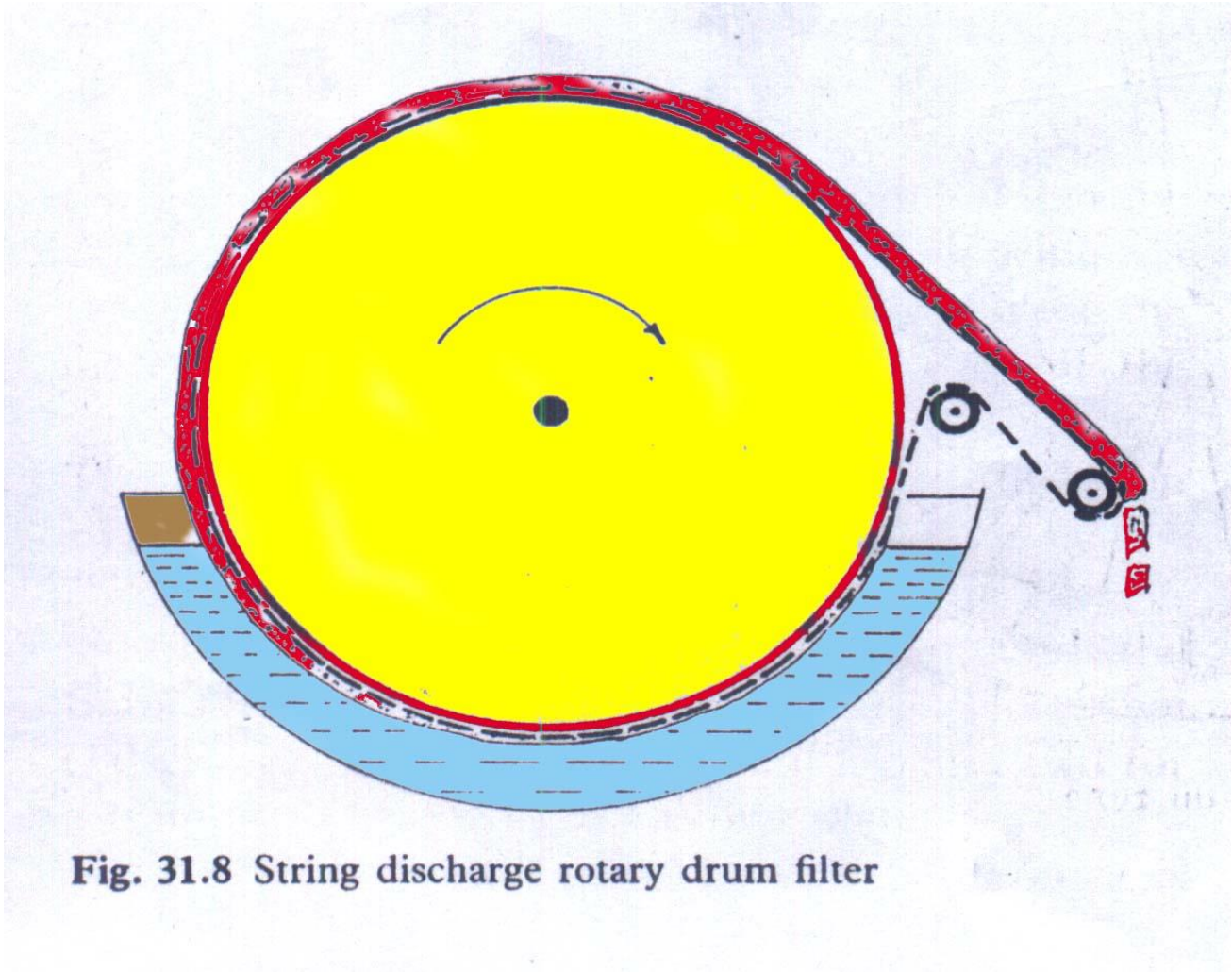


Fig. 31.8 String discharge rotary drum filter

What are the Application of solid/liquid filtration

- Clarification - Separation without use of filters. e.g. temperature, gravity, sedimentation.

- Colation/Straining; Crude filtration process where liquid is poured through a porous medium (like a cloth).
  Decantation Pouring off top layer of liquid where a sediment has settled.

Best Wishes Ever .. ☺