

FACTORS AFFECTING RATE OF FILTRATION

AIM:

To study the effect of various factors on the rate of filtration.

Apparatus:

- ✓ Beaker
- ✓ Filter paper
- ✓ Measuring cylinder

Principle:

Filtration is a process of where by solid particles present in a suspension are separated from the liquid or gas employing a porous medium. Which retains the solid but allows the fluid to pass through the volume of the filtrate obtained through the filter paper per unit time is called “**rate of filtration**” can be given by mathematical equation.

$$dv/dt = K.A . \Delta P/\mu L - \text{darcy's law}$$

where,

A = area of filter

ΔP = pressure drop across the filter medium and cake

μ = viscosity of filtrate

L = thickness of cake

V = volume of the filtrate

T = time taken for filtration

K = constant for the filter medium and filter cake or resistance

Procedure:

a) Effect of thickness of cake:

Prepare two solutions of calcium carbonate using water as the solvent the concentration of the solutions are 5% and 10% respectively. Filter them and note the time taken for filtration to calculate the rate of filtration and compare them.

b) Effect of viscosity:

Effect of viscosity causing two solutions one with water and other with mixture of glycerine and water (20:80) ratio respectively. Prepare two different solutions of 5% calcium carbonate (CaCO_3) using above prepared water and glycerine mixture. Filter them and note the time for filtration to calculate the rate of filtration and compare them.

c) Effect of area:

This can be determined by using funnel of large (big) and small area for the same concentration of the solutions (5% CaCO_3) time taken for filtrations are noted. Calculate the rate of filtration and compare them.

d) Effect of pressure:

Prepare two solutions of calcium carbonate (5% CaCO_3) using water as a solvent filter one of the solutions through Buchner funnel. Which is connected to a suction pump and the other one is filtered through without suction pump and note the time taken for filtrate. Calculate the rate of filtration and compare them

Calculation:**Effect of thickness of cake:**

Sample: 50 ml of 5% CaCo₃

50 ml of 10% CaCo₃

Sample	Time Taken For Filtration	Volume of Filtrate	Rate of Filtration
5% CaCo ₃	5 minutes (300 seconds)	34 ml	$34/300 = 0.1134$ ml/sec
10% CaCo ₃	7 minutes (420 seconds)	40 ml	$40/420 = 0.0952$ ml/sec

Effect of viscosity:

Sample: 50 ml of 5% CaCo₃

50 ml of 10% CaCo₃

(Glycerine and water mixture 20:80)

Sample	Time Taken For Filtration	Volume of Filtrate	Rate of Filtration
5% CaCo ₃	8 minutes (480 seconds)	35 ml	$35/480 = 0.0729$ ml/sec
5% CaCo ₃ with glycerin and water mixture	6 minutes (360 seconds)	44 ml	$44/360 = 0.1222$ ml/sec

Effect of area of funnel:

Sample: 50 ml of 5% CaCo₃

Sample	Time Taken For Filtration	Volume of Filtrate	Rate of Filtration
5% CaCo ₃ filter in small funnel	7 minutes	42 ml	0.1 ml/sec
10% CaCo ₃ filter in big funnel	7 minutes	40 ml	0.09 ml/ sec

Effect of pressure:

Sample: 50 ml of 5% CaCo₃ (glycerine water mixture 20:80)

Sample	Time Taken For Filtration	Volume of Filtrate	Rate of Filtration
5% CaCo ₃ filter with pressure	36 seconds	46 ml	1.27 ml/sec
10% CaCo ₃ filter without pressure	6 minutes	42 ml	0.116 ml/ sec

Report:

Rate of filtration in thickness

5% caco₃ =

10% caco₃ =

Rate of filtration in viscosity

5% caco₃ =

5% caco₃ with glycerine =

Water mixture

Rate of filtration in area

5% caco₃ in small funnel =

5% caco₃ in big funnel =

Rate of filtration in pressure

5% caco₃ with pressure =

5% caco₃ without pressure =

2. FACTORS AFFECTING RATE OF EVAPORATION

AIM:

To study the effect of various factors on the rate of evaporation.

Principle:

Evaporation is the process by which liquid water goes directly to the vapour phase due to an increase in temperature. The main objective of evaporation is to get a concentrated product by vaporizing volatile liquid. Evaporation is conducted by non-volatile solute and volatile solvent to produce thick liquor. Rate of evaporation is controlled by rate of heat transfer.

Objectives of evaporation:

Evaporation is done by following,

- To get a concentrated product
- To remove water from aqueous solution
- To evaporate sea water for developing drinking water
- To get solid from water which is used in boiler for chemical process

Factors influencing evaporation:

1. Temperature

The evaporation rate is directly related to the temperature. As the temperature increases the rate of evaporation also increases because the temperature is rising the water molecules begin to move faster.

2. Surface area

The rate of evaporation is directly proportional to the surface area of the vessel exposed to evaporation.

3. Agitation

Agitation is necessary for evaporation.

4. Vapour pressure

Liquids with low boiling point evaporate quickly due to high vapour pressure.

5. Types of product required

The selection of the method and apparatus to be used for evaporation depends upon type of product required for example open pan produce liquid or dry concentrate while film evaporator yield liquid concentrates.

6. Density

As the density increases, the rate of evaporation decreases.

7. Time of evaporation

Exposure to a relatively high temperature for a short time may be loss destructive of the active ingredients than a lower temperature with exposure for a longer period.

8. Economic factors

When selecting the method and apparatus the economic factors are important. Evaporators are designed to give maximum heat transfer to liquid.

9. Moisture content

Some drug constituents decompose more rapidly in the presence of moisture especially as raised temperature.

Effect of surface area on the rate of evaporation:

Requirements:

- Three petridishes of diameter 2.50 cm, 5 cm, 7.5 cm with cover, 10 ml of pipette and stop watch

Procedure:

- ❖ Clean and dry all petri plates and mark them as A, B, and C.
- ❖ Pipette out of 10 ml diethyl ether in each of the petri dishes A, B, and C and cover them immediately.
- ❖ All the petridish heated in water at constant temperature for 10 minutes

- ❖ Note the remaining volume after 10 minutes
- ❖ From the rate of evaporation is calculated

Effect of viscosity on the rate of evaporation:

Requirements:

- Glycerine, distilled water, beaker, measuring cylinder.

Procedure:

- ❖ Different concentration of glycerine and water are prepared in different beakers.
- ❖ Note the weight of beaker containing glycerine- water mixture.
- ❖ All the beakers are heated in water at constant temperature for 10 minutes.
- ❖ Again note the weight of the beakers after heating.
- ❖ Difference between the weights is measured. The difference indicated the amount of water evaporated during 10 minutes.
- ❖ From the rate of evaporation is calculated

Effect of concentration on the rate of evaporation:

Procedure:

- ❖ Clean all the glassware's
- ❖ Prepare different concentration (2%, 4%, 6%, 8%) solution of sodium chloride in 50 ml water in different beakers
- ❖ Weigh of the beaker containing sodium chloride solution
- ❖ All the beakers are heated in water at constant temperature for 10 minutes
- ❖ Again weigh the beakers after heating
- ❖ The difference between weights is measured. The difference indicated the amount of water evaporated during 10 minutes
- ❖ From this rate of evaporation is calculated.

Effect of surface area:

Petridish Marked	Diameter of Petridish	Volume Taken	Remaining Volume	The Volume of Liquid Evaporated	Rate of Evaporation (ml/sec)
A	2.5	10 ml			
B	5	10 ml			
C	7.5	10 ml			

Report:

Rate of evaporation in surface area

A =

B =

C =

Effect of viscosity:

Glycerin (ml)	Water (ml)	Concentration % V/V	Initial Weight of Solution (g)	Final Weight (g)	Weight of Water Evaporated	Rate of Evaporation g/sec
2	5	2%				
4	10	4%				
6	15	6%				
8	20	8%				
10	25	10%				

Rate of evaporation in viscosity

2 ml =

4 ml =

6 ml =

8 ml =

10 ml =

Effect of concentration:

Concentration % W/V	Initial Weight of Solution (g)	Final Weight of Solution (g)	Weight of Water Evaporated	Time of Heating	Rate of Evaporation (g/sec)
2%	20				
4%	20				
6%	20				
8%	20				

Rate of evaporation in concentration

2% =

4% =

6% =

8% =