Date _____

Expt. No. 1. Page No. 1

Aim :- Verified

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

Reference :-

Requirements :-

- Glasswares :- Beaker, filter paper, measuring cylinder, funnel, wire gauge.
- Chemicals :- Calcium carbonate.

Theory :-

Principle :- Filtration is a process of where solid particle suspension are separated from liquid or gas employing porous media which retain a solid particle but allow the fluid to pass through a volume of filtration obtain through the filter paper per unit time is called rate of filtration.

Teacher's Signature _____

Observation:

S.No.	Sample	Time taken	Vol. of filterate	Rate of filteration
1.	5% $CaCO_3$	197 sec	40 ml	0.20 ml/sec
2.	10% $CaCO_3$	300 sec	40 ml	0.13 ml/sec

Calculation:

$$\text{Rate of filteration} = \frac{\text{Vol. of filterate}}{\text{Time taken}}$$

(i) 5% $CaCO_3$ $= \frac{40\ ml}{197\ sec} = 0.20\ ml/sec$

(ii) 10% $CaCO_3$ $= \frac{40\ ml}{300\ sec} = 0.13\ ml/sec.$

eg :- $\left| \frac{dv}{dt} = K.A\,\Delta P / \mu L \right|$ - darey's law

where,
A = Area of filter,
V = Volume of filter,
K = Constant,
ΔP = Pressure drop across the filter media and cake,
μ = Viscosity of filterated
L = Thickness of cake
t = Time of filtration.

Procedure :-

i) Effect of thickness of cake :-

Prepare two solution of calcium carbonate using water as solvent the concentration of solution are 5% and 10%.

Filter them and note the time taken for filtration to calculate the rate of filtration and compare them.

(ii) Preparation of 5% solution of $CaCO_3$.

Accurately weigh 2.5g of $CaCO_3$ and dissolve into 50ml of distilled water.

(iii) Preparation of 10% solution of $CaCO_3$

Accurately weigh 5g of $CaCO_3$ and dissolve into 50ml of distilled water.

Result:-

The study of effect of rate of filtration was successfully performed in the laboratory.

Date

Expt. No. 2

Page No. 4

Aim:- (qulab)

To study the effect of viscosity on the rate of filtration.

Reference:-

Requirements:-

(a) Apparatus :- - Beaker, filter paper, measuring cylinder.

(b) ~~Glass~~ Chemical :- Glycerine, $CaCO_3$, distilled water.

Theory:-

Principle :- Filtration is a process where solid particle suspension are separated from liquid or gas employing porous media which retain a solid particle but allow the fluid to pass through volume of filtration obtain through the filter paper per unit time is called rate of filtration.

eg :→ $\boxed{\frac{dv}{dt} = KA.\Delta P/\mu L}$ - darey's law.

Teacher's Signature

Observation:→

S No.	Sample	Time taken	Volume of filtration	Rate of Fil.
1.	5% $CaCO_3$	342 sec	45 ml	0.13 ml/sec
2	5% $CaCO_3$ + Glycerine	679 sec	45 ml	0.06 ml/sec

Calculation:

Rate of filteration = $\frac{\text{Vol. of filterate}}{\text{Time taken}}$

(i) 5% $CaCO_3$ = $\frac{45 \text{ ml}}{342 \text{ sec}}$ = 0.13 ml/sec

(ii) 5% $CaCO_3$ + Glycerine = $\frac{45 \text{ ml}}{679 \text{ sec}}$ = 0.06 ml/sec.

where,
A = Area of filter,
V = Volume of filter,
K = Constant
ΔP = Pressure drop across the filter media and cake,
μ = Viscosity of filterated,
L = Thickness of cake,
t = Time of filtration.

Procedure:

(i) Take all glasswares and clean it and dry it.

(ii) Preparation of 5% $CaCO_3$ solution:-
→ (a) Take 2.5 gm of $CaCO_3$ and dissolve into 50 ml of distilled water then prepare 5% of solution of $CaCO_3$.

(iii) Preparation of mixture of glycerine water and calcium carbonate.
(a) Take 2.5 gm of $CaCO_3$ and dissolve it into 40 ml of distilled water. Now add 10 ml of glycerine in this mixture.

(iv) After preparation of solution filter with filter paper and note the time for filtration to calculate the rate of filtration and compare them.

Teacher's Signature _____

Date _____

Expt. No. 2 Page No. 6

Result:-

The study of effect of rate of filtration was successfully performed in the laboratory.

Teacher's Signature _____

Date _____

Expt. No. 3 Page No. 1

Aim :-

To evaluate the given filter media.

Reference :-

Sona P.S., A Practical Manual of Pharmaceutical engineering 1st Edition, 2015, University Science Press Pg. No - 130 - 132.

Requirement :-

(a) Glassware :-
- Beaker (7)
- Funnel (7)
- Glass rod (3)
- Test tube (7)
- Test tube stand (1)
- Conical flask. (1)

(b) Chemicals → Calcium Carbonate.

(c) Filter media →
- Sand
- Cotton
- Polyster cloth
- Filter paper
- Membrane filter
- Cotton cloth.

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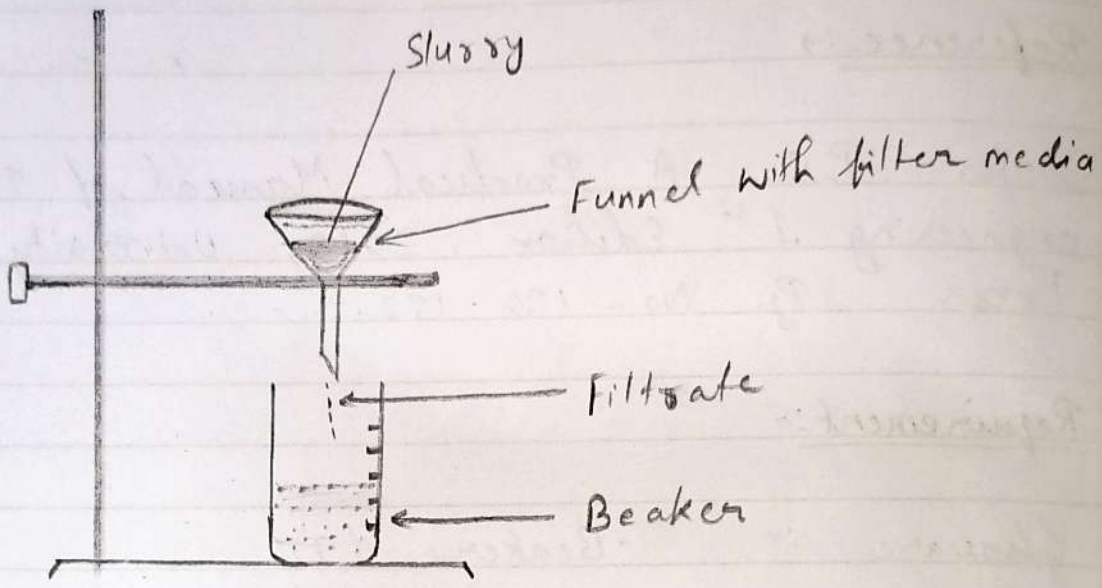

Fig :- Filtration assemble

Date

Expt. No. 3

Page No. 8

Theory :- Filtration is defined as a process in which the particles are separated from a liquid by Parsing the liquid through a permeable ~~liquid~~ material. The filtration can be classified into two types surface and depth filtration.

In surface filtration and screening action takes place by poses or holes. Solids are got deposited over filter medium. Filter media are available in different forms. Sand, Filter, Clothes, belts, bonded fabrics, kraft papers, membrane filters, surface type cartidges are some of the ~~fabrics~~ filter media commonly used. During the filtration depending on the pore size, Particles present in the slurry will either retain over the media or pass through the filter media.

Procedure :-

Filtration of the slurry :-

(i) Arrange filtration assemble as shown in the fig..

(ii) Keep ~~the~~ diff. filtration media to the funnels.

(iii) Prepare the slurry of $CaCO_3$ (10%).

(iv) Add 50 ml slurry to each of the filter media.

Teacher's Signature

S. No	Samples	% transmittance	Filter media
1.	10% $CaCO_3$	High	Sand
2.	10% $CaCO_3$	less than sand	Polyster cloth
3.	10% $CaCO_3$	less than Polyster cloth	Cotton
4.	10% $CaCO_3$	Low	Filter Paper

(v) Discard the first few drops.

(vi) Wait till 10 ml of filtrate is collected.

(vii) Take the filtrates separately into test tube and mark it accordingly.

(viii) Analyze the samples with the help of spectrophotometer

Result:

The given filter media are evaluated.

Date

Expt. No. 04

Page No. 10

Aim :-

To determine the Reynold's number by Reynold's apparatus.

Reference :-

Requirement :-

Reynold's apparatus (1)
Pump (1)
Water tank (1)
Coloured solution ($KMnO_4$).

Theory :-

Fluid can flow through a pipe in two different ways. At low flow rates the pressure drop in the field fluid increases directly with the fluid velocity and at high rates it increases much more rapidly. At low velocity the fluid velocity and at high rates it increases much more rapidly. At low velocity the fluid will travel as layers and there is no mixing of the layers of the fluid. This type of flow is called laminar flow. At high velocity this

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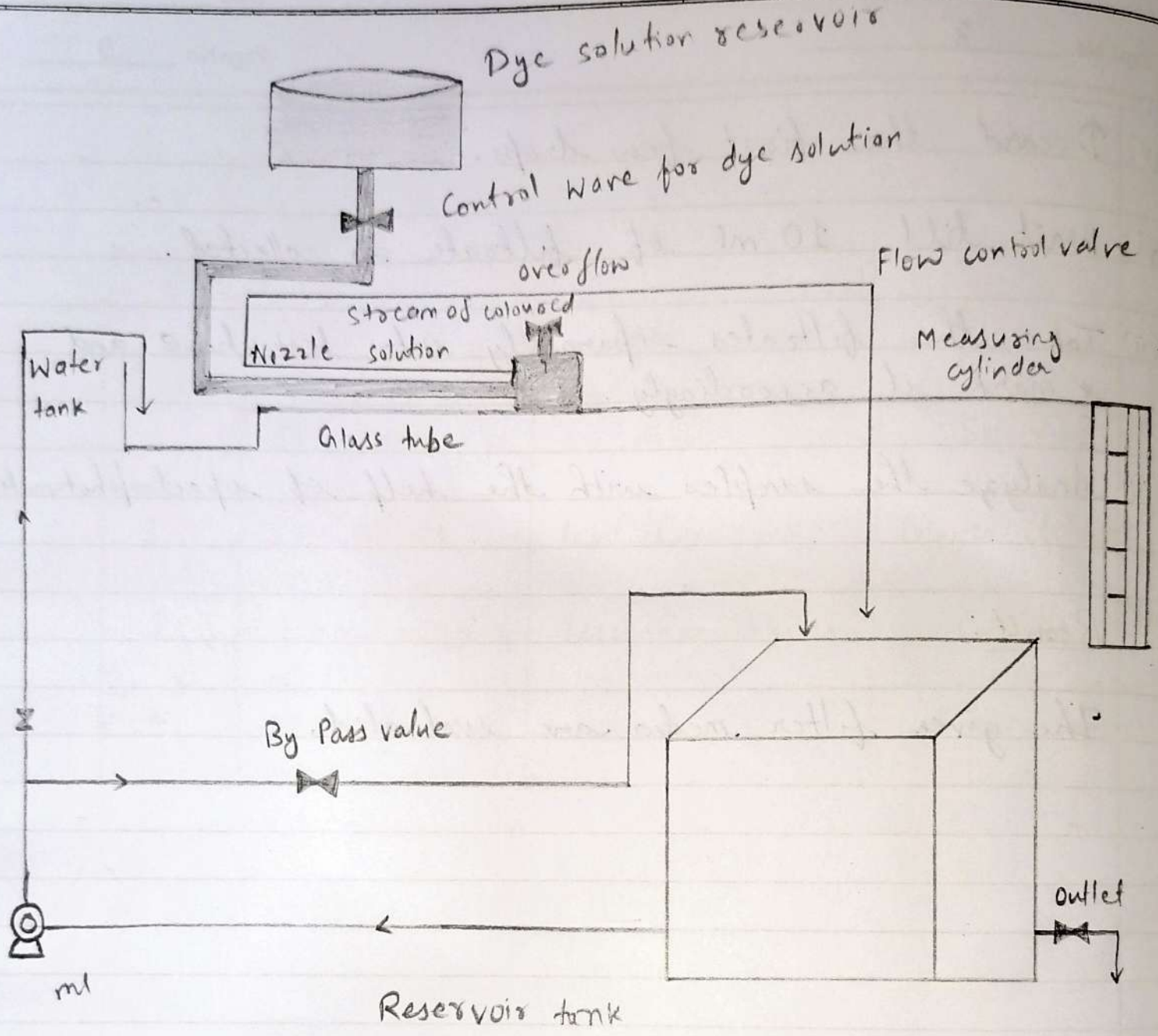

Fig :- Assemble of Reynold's Apparatus.

pattern of flow is called laminar flow. pattern of flow is disturbed and there will be a complete mixing of the layers and production of turbulence. This type of flow is called ~~and~~ turbulent flow.

Operating Procedure :-

i) Clean the apparatus make all the parts of the apparatus dust free.

(ii) Close the drain valves provided.

(iii) Fill the reservois tank 3/4th with clean water.

(iv) Prepare a dye solution ($KMnO_4$) and litre in Pure water. close the flow control valve for the dye solution.

(v) Put this sol^n on the dye vessel after removing all the solid particles from it.

(vi) Open the flow control valve and the bypass valve.

(vii) Switch on the Power supply.

(viii) Switch on the pump.

Teacher's Signature _____

Observation and Calculation

S.No	Type of flow observed	Volume collected (ml)	t (sec)	V (m/sec)	Q (m^3/s)	Reynold's number (RE)
1						
2						
3.						
4						
5						
6						

Internal diameter of the glass tube = ... mm, = ... m

Area of the glass tube = ... m^2

Kinematic viscosity of water = at 0°c = 1.788×10^{-6} m^2/s

= at 20°c = 1.006×10^{-6} m^2/s

To convert litre to m^3 multipled with 0.001.

Reynold's no (RE) = Pvd/μ

where,

P = Density of the fluid in kg/m^3

μ = Viscosity of the fluid in Ns/m^2

V = Average velocity of the fluid flow in m/sec...

v = Volume of water collected m^3.

t = time taken to collect. V m^3 of water

A = Area of the glass tube

μ/P = Kinematic viscosity m^3/s

Discharge of the fluid (V/t) = ... m^3/s

Velocity of the fluid (v) = Q/A = ... m/sec.

ix) The water is filled in the I water tank, and the overflow is maintained at minium.

(x) Allow the water to pass through the glass tube from the water tank at minimum flow rate by regulating the valve at the end of the glass tube.

xi) Adjust the flow of the dye solution through the capillary tube so as to get a narrow fine coloured line of the dye sol^{n} at the centre of the glass tube.

xii) Determine the flow rate with the help of measuring cylinder and stop clock.

xiii) Now slowly increase the flow through the glass tube with the help of flow control valve present at the end of the glass tube.

xiv) Now the clear ~~coated~~ coloured sol^{n} starts to travel in a ~~way~~ wavy form (upper critical velocity).

xv) Find out the discharge and the flow rate.

xvi) Further increase the flow rate so that coloured sol^{n} completely diffusing in to the water (Turbulent flow)

~~xvi)~~

xvii) Determine the discharge and the flow rate.

Teacher's Signature _____

xviii) Decrease the flow of the liquid so as to get the flow in such a way the coloured sol^n travels in wavy form. Find out the discharge and flow rate.

xix) Again decrease the flow so that the wavy fashion of the flow of the coloured solution starts to change in to straight line. Find out the flow rate (lower critical velocity)

xx) Finally keep the flow in such a way that the coloured sol^n is moving in a straight line without any disturbance.

xxi) After taking all the readings switch off the pump and the power supply.

Report :-

Different types of flow Pattern is demonstrated and studied Reynold's ~~no~~ number for

Laminar flow :
Transition flow =
Turbulent flow :

The critical velocity is found to be =

Teacher's Signature _____

Date _____

Expt. No. 05 Page No. 14

Aim :-

To determine the relative humidity by wet bulb depression method.

Reference :-

Requirement :-

Wet bulb and dry bulb thermometers (mansion's type), Humidity Chart (Psychrometric chart), Water.

Theory :-

Water exist in the air at all tempt. It is always in the vapour foom. The Quantity of the air is the heat contained in water vapour. Water vapour would condense when it comes in contact with any material at lower tempt. The quantity of the heat offered by the atmosphere is depends upon these evaporations.

Wet bulb Depression = Dry bulb temperature - wet bulb temperature.

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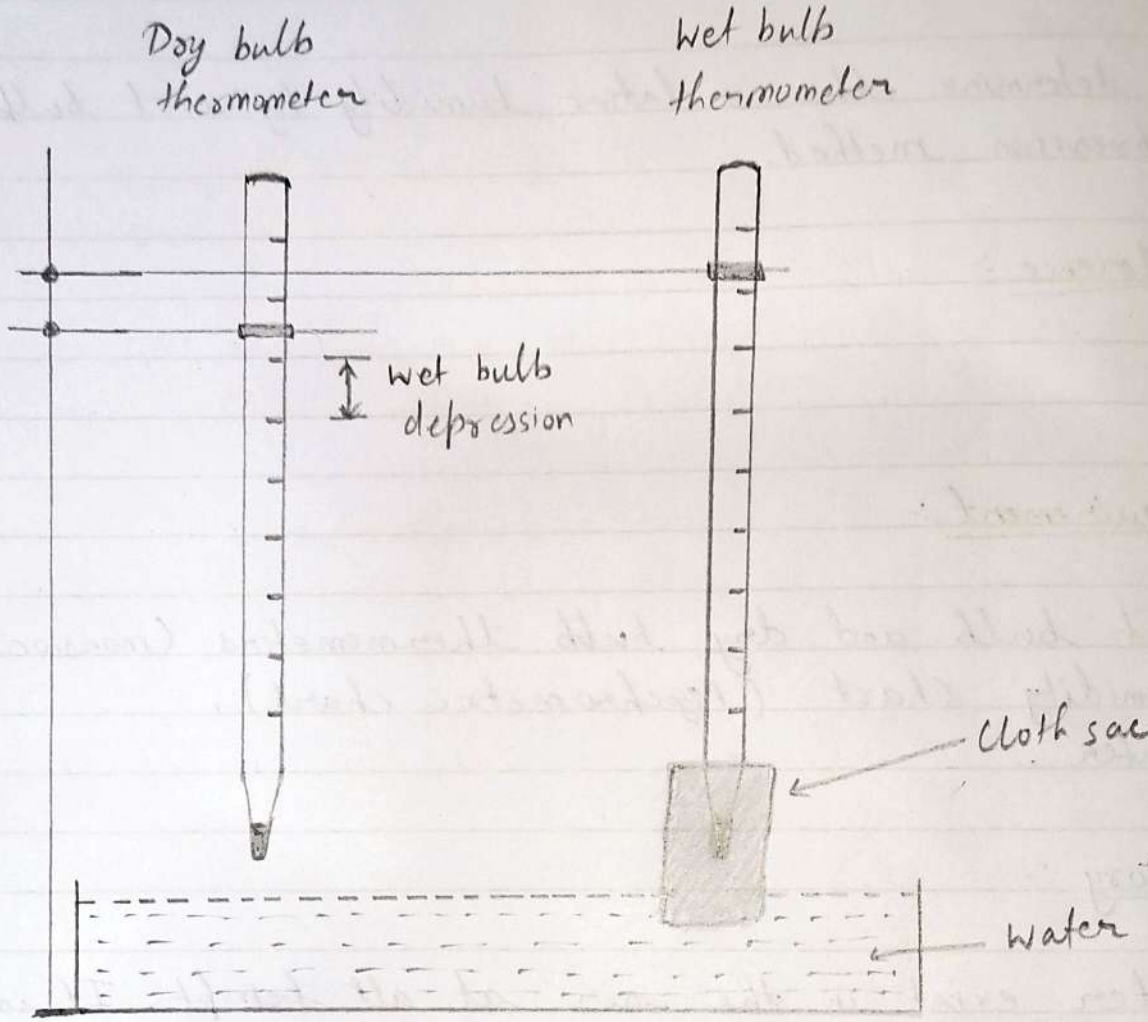

Fig → Arrangement of the determination of wet bulb depression by dry bulb and wet bulb thermometer (Monsion's type).

With the help of the wet bulb depression chart provided it is possible to determine the exact % of relative humidity.

Procedure :-

i) Arrange the wet and dry bulb thermometer. One thermometer is exposed to the air (dry bulb thermometer) and the bulb of the second with a cloth sac. (wet bulb thermometer).

(ii) Place water in the Plastic container, and the cloth sac is dipped into it. So that by capillary action the ~~doser~~ water will reach the bulb of the wet bulb thermometer and wet the bulb.

iii) Carefully watch the readings in both the thermometer.

iv) The reading of the wet bulb thermometer is decreases as it is in direct contact with moisture content.

v) After sometime the reading in the wet bulb thermometer reaches an eq constant tempt and note down this reading.

vi) Simultaneosly note down the dry bulb tempt.

vii) Take 2 more reading after a time interval of 5 min.

Teacher's Signature _____

Observation and Calculations

S.No.	Condition	Dry bulb temperature				DBT (°F)	Wet Point. Temperature				WB.T (°F)	Wet bulb depression	.Rq
		1	2	3	AV		1	2	3	AV			
1.	Inside Lab												
2.	Outside Lab												
3.	AC cold room												

Table :- Determination of Relative Humidity.

viii) Record the values and find out the difference b/w the wet bulb and dry bulb tempt.

ix) This value is called as the wet bulb depression.

x) After calculating the wet bulb depression the relative humidity can be found directly from table provided.

xi) Locate the reading of dry bulb and wet bulb depression value and the intersection of two columns read the % of the relative humidity.

xii) The same experiment is repeated in the open air outside the lab and in an air conditioned room.

Result:-

The relative humidity of air at different condition is determined. It is found that the relative humidity is in the order of

..... > ..... > .....

Date _____

Expt. No. 06 Page No. 17

Aim :-

To determine the centrifugal effect during the separation of emulsion of different ~~of~~ RPM.

Reference :-

Requirement :-

- Centrifuge (1)
- Mortar and Pestle
- Beaker
- Measuring cylinder
- Glass rod
- Castor oil
- Acacia
- Water.

Theory :-

Centrifugation is based on the well known theory (of centrifugal force) that an object which is rotated about a centre point at a constant radial distance from the point is acted upon by a force. It is measure in terms of the number of times the centrifugal force is greater than that of

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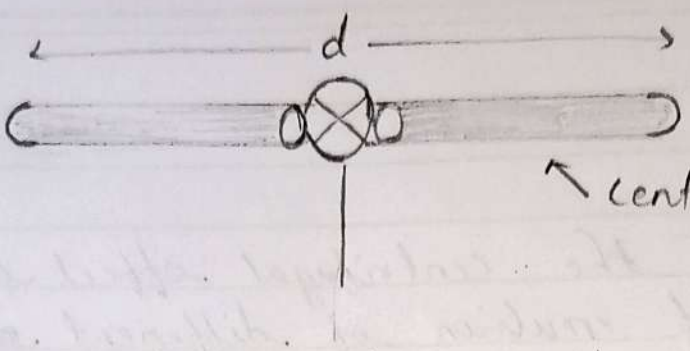

Fig :- Determination of diameter of rotation

Observation and calculation.

S. No	RPM (s^{-1})	Diameter of rotation (m)	Centrifugal Effect (m/s^2)	Volume of oil separated (ml)
Big Centrifuge	500 1000 2000 3000 5000			
Small Centrifuge	500 1000 2000 3000 5000			

Note :- Volume of oil is separated is the average volume of oil present in all the tube of the centrifuge after each operation.

gravitational force. The centrifugal effect can be determined with the help of the the eqn.

$$C.E. = 2.012 n^2 d$$

Where,

n = Number / speed of rotation (S^{-1}).
d = diameter of the rotation (m).

When the speed of rotation increases then C.E. increases and when the diameter of the rotation increases, C.E. increases.

In the Present experiment, we are demonstrating how the C.E. effect changes with diameter and speed of rotation of the centrifuge.

1. Preparation of Emulsion

i) Emulsion is prepared with the help of ~~motor and~~ Mortar and pestle.

ii) The standard formula for the emulsion is
Castor oil - 37.5 ml
Acacia - 10.9 gm
Water to produce - 100 ml.

iii) Transfer the prepared emulsion into a clean beaker.

Teacher's Signature _____

Date _____

Expt. No. 06 Page No. 19

iv) Select and thoroughly clean two ~~set~~ centrifuges. (Big and small).

v) Find out the diameter of rotation for both the centrifuges. (from the centre to the tip of the tube when placed in the horizontal direction).

vi) Fill equal amount of the emulsion in the ~~set~~ centrifugal tubes of both the ~~set~~ centrifuges. (The volume can be selected according to the capacity of the tube. (normally 15-50 ml).

vii) Arrange the samples properly in the centrifuge to avoid the accidental breakage during operation.

viii) Allow to operate the centrifuges at 500 RPM for 10 min.

ix) Stop the centrifuges and wait ~~un~~till the rotation stops.

x) Open the lid and take out the tubes.

xi) Find out the amount of the oil separated.

xii) Calculate the C.E. using the eqn.

xiii) ~~Poor~~ Pour out the content present in the centrifugal tubes and clean it properly.

Teacher's Signature _____

xiv) Repeat the steps 6 and 7.

xv) Allow to rotate the centrifuge at 1000 RPM for 10min.

xvi) Calculate the amount of the oil separated and C.E.

xvii) The ~~values are tabulated~~. some steps (6, 7, 9-12) is repeated for RPM 2000, 3000, 5000.

xviii) The values are tabulated.

xix) Graphs are drawn as shown in the model graphs.

Result:-

~~Performed the~~
The C.E. separtion of emulsion at different speed of rotation has been successfully performed in the laboratory.

Teacher's Signature _____

Date _____

Expt. No. 07

Page No. 21

Aim :- To perform the crystallization by cooling.

Reference :-

Requirements :-

- Test tubes (10)
- Test tube stand (1)
- Hot water bath (2)
- Thermometer (2)
- Beaker (250 ml) (1)
- Stirrer (1)
- Tripod stand (1)
- Funnels (3)
- Filter papers
- Weighing balance.

KNO_3

ICE

Theory :-

Crystallization is a process of spontaneous arrangement of particle into repeatedly arrange geometrical pattern from a supersaturated sol^n. Crystallization can occured if sol^n is in a supersaturated state. The supersaturation can be produced by either of these following ways.

Teacher's Signature _____

S.No.	Time (min)	Weight of empty filter paper (W_1)	Weight of filter paper with crystals (W_2)	Weight of crystals W_3 ($W_2 - W_1$)	% Weight of crystals
1.					
2					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

(i) Super saturation by cooling.

ii) Super saturation by the evaporation of the solvent.

iii) Super saturation by adiapatic evaporative cooling.

iv) Super saturation by adding a substance that reduces the solubility of the substance in the sol^{n}.

This experiment is based on crystallization by cooling and is only applicable to the solute whose solubility increases with increase in ~~tet~~ tempt. cooling can be done by 2 methods.

(i) Shock cooling.
(ii) Slow cooling.

Rate of crystallization during shock cooling is fast and the size of the crystals produces is small. But during slow cooling the rate of crystallization is slow and it will ~~active~~ achieve compoaratively big crystals. Saturated sol^{n} are prepared by elevating the tempt. tone of the sol^{n}. During cooling the solubility of the solute decreases as a results the dissolved solute starts to crystallize. The yield is dependent on the time of contact and the tempt.. yield is calculated in terms of %age. A graph can also be plotted by taking

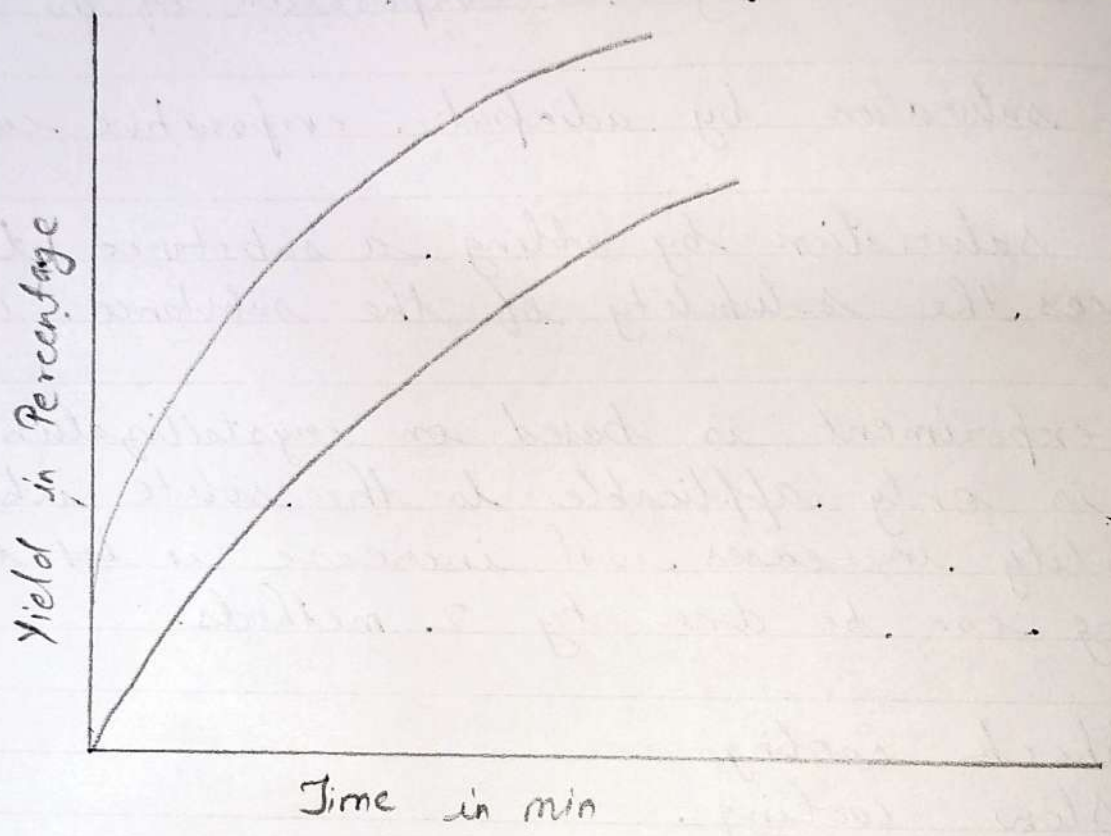

Fig :- Model graph showing comparisons of yield obtained by shock cooling and slow cooling with time.

time on x-axis and yield in percentage on y-axis.

Procedure:

i) Weigh 150 gm of KNO_3

ii) Take 100 ml of water in beaker.

iii) Keep the beaker in a water bath at 60°C.

iv) Slowly add the KNO_3 in small portions in to the beaker containing water.

v) Stir the sol^n continuously and stop the addition of solute when a small portion of the solute remains undissolved at the bottom.

vi) Weigh the remaining quantity of the KNO_3 and find out the amount of KNO_3 used to produce the saturated sol^n.

vii) Note down the amount of KNO_3 used to produce a saturated sol^n at elevated tempt. (i.e. x gm in 100ml)

viii) Keep the sol^n in the same water bath for five min to ensure the saturation.

ix) Mark and Arrange 10 test tubes in a test tube rack.

Teacher's Signature _____

Date _____

Expt. No. 07

Page No. 24

x) Add 10 ml of hot ~~st~~ o saturated in to all of the test tubes.

xi) Keep the entire test tube immediately into an ice bath.

xii) Take out the first test tube after the commencement of 10 min.

xiii) Filter the sol^{n} present in the test tube (using pre weighed filter paper.

xiv) The ~~graphs~~ crystals in the filter paper are kept for air drying. (a hair dryer can also be used for drying the crystals.).

xv) After drying the crystals find out the yield.

xvi) Find out the percentage yield (Amount of crystals produced from 10 ml / amount of solute present in 10 ml) x 100

xvii) Take out 2nd, 3rd, ... 10th test tubes at an interval of 15, 20, 25, 30, ... 60 min respectively.

xviii) The same procedure 13-16 is repeated for all the sol^{n}.

Teacher's Signature _____

xix) A graph is plotted by taking percentage yield at different time interval on Y-axis and time in min on x-axis.

xx) Repeat the steps 1-10.

xxi) Now keep the test tubes in the normal atmosphere temp.

xxii) After 10 min filter the content present in the first test tube.

xxiii) Repeat the steps 14-16.

xxiv) Take out 2nd, 3rd, 4th .... 10th test tubes at an interval of 15, 20, 25, 30 .... min respectively.

xxv) Repeat the steps 13-16.

xxvi) A graph is plotted by taking percentage yield at different time interval on y-axis and time in min on x axis.

xxvii) Compare the two graphs.

Result :-

The % of KNO_3 crystals by shock cooling after 45 min = ...

The percentage of KNO_3 crystals by slow cooling after 45 min. = ...

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