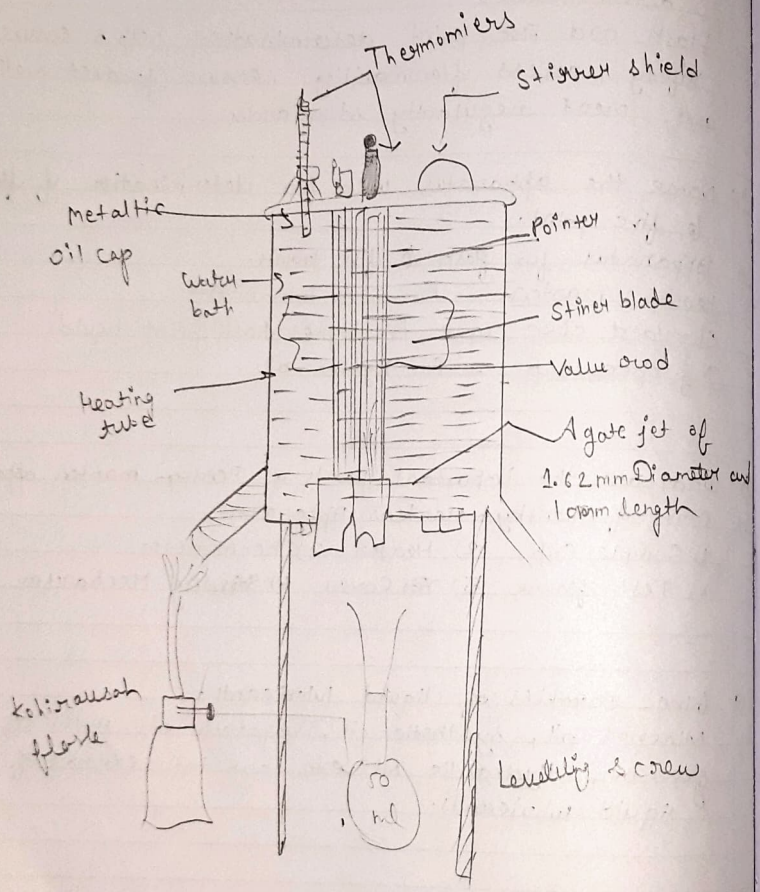

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Object :- To determination the viscosity of a given sample of lubricating oil at given temperature using Redwood viscometer no. 1

Apparatus & Reagent :- Redwood viscometer No. 1, given sample of lubricating oil and stop watch, kohlrausch flask.

Theory :- Internal resistance to motion of lubricating film in between the moving parts is measured as viscosity. Absolute viscosity as it defines as the tangential force per unit area required to maintain unit viscosity gradient between two parallel in the fluid at a unit distance apart.

It is represented by η (eta) in CGS system & its unit is poise or centipoises (centi stokes). The viscosity of water at room temperature (20°C) is about 1 centi poises.

Poise = One dyne/sec x cm.

The ratio of absolute viscosity to density for any fluid is known as its kinematic viscosity.

Absolute kinematic viscosity $\nu = \eta/\rho$ = absolute viscosity / density of fluid.

This rate of change of viscosity with temperature is known as viscosity index. It is an important parameter, which suggests the efficiency of oil as a lubricant in varying temperature. It is always measured as relative viscosity index of different oils.

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$$V = At - B/t$$

where V = kinematic viscosity (in centistokes, Cst), t = time of flow in seconds., A & B = instrument constant
A = 0.264 and B = 190 when t = 45 - 85 sec.
A = 0.247 and B = 65 when t = 85 - 2000 sec.

Redwood viscosity no. 1 consists of the following parts:-

Oil Cup:- It is a silver plated brass cup, which is opened at the upper end. Oil has to be filled upto a certain mark. The bottom of the cup is fitted with a jet made up of agate and can be opened by a valve rod fitted with a brass ball. The lid of the cup is fitted with a thermometer for recording temperature of the oil.

Heating Bath:- The oil cup is surrounding by a water bath provided with an outlet for taking out the water, a stirrer with four blades & a thermometer.

Kohlrausch flask (Receiver):- It is a special type of receiving the oil. Its capacity is 50 ml.

Procedure:- (1) Level the viscometer by levelling screws.
(2) Fill the bath with water according to the temperature of the experiment.
(3) Seal the official orifice by means of the brass ball and put the Kohlrausch's flask below the jet.
(4) Maintain the desire temperature & stir the water &

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the water and oil in bath & cup respectively.

(5) At the equilibrium temperature, lift the ball & simultaneously start the stop watch. Note the time for collecting the oil up to the mark of the reciever.

(6) Replace the ball & seal the cup. Refill the cup. Perform the experiment to get reproducible results.

(7) Repeat the whole process at five different tempe & respective times.

Observation :-

S.No.	Temperature	Time in (Sec)	Kinematic Viscosity

Results :- The viscosity of given sample of an oil at any temperature can be obtained by plotting a graph between temperature (x axis) & Redwood viscosity (on Y axis). for example, viscosity at 65°C is _____ seconds.

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Precautions :-

(i) Filter the oil throught 100 mesh wire sieve before testing its viscosity.
(ii) Cup & the receiver should be properly washed with suitable solvent.
(iii) Receiving flask should be properly placed & does not cause foaming.

Industrial Application :-

1) It is used to select the proper lubricant on the basis of viscosity in vehicles and machine.
2) This indicates the resistance of a liquid to flow.
3) Oil with higher viscosity can stand greater pressure without being squeezed out of the lubricanting surfaces. However, the high internal friction of the oil may offer greater resistance to the movement of the lubricanting parts.
4) An oil of lower viscosity offers less resistance to the moving parts but the oil can be easily squeezed out of the lubricating surfaces. It is therefore important to select a lubricating oil of appropriate viscosity to achieve optimum lubrication effect.
5) Increase in oil viscosity achieved by addition of polymers can be polymers can be partially lost again through degradation of the polymer molecules by shear stress such as heavily loaded gears. Oil that can resist viscosity change due to shear are said to have high shear stability.

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Viva Question

Q1. What is viscosity?

Ans Viscosity is the measure of a fluid's resistance to flow. Higher viscosity means the fluid is thicker & flow slower while lower viscosity means it's thinner & flows faster.

Q2. Discuss about the effect of temperature on viscosity of lubricant?

Ans As the temperature increases, viscosity decreases. means, lubricant becomes thinner & flows more easily.

As the temperature decreases, viscosity increases. means, lubricant becomes thicker & flows more slowly.

Q3 What do you mean by viscosity index?

Ans Viscosity index measures how stable a lubricant's viscosity is with temperature changes.

Higher VI = More stable viscosity

Lower VI = More change in viscosity with temperature.

Q4 What is the significance of determination of viscosity determination?

Ans Viscosity determination important for:-

- Evaluating performance
- Ensuring temperature stability

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- Protecting engine parts.
- Improving efficiency
- Quality control.

Q. What is kinematic viscosity?

Ans Kinematic viscosity is the measure of a fluid's resistance to flow under the influence of gravity. It is calculated by deviding the dynamic viscosity by the fluid's density.
Unit - Stokes (St) or centistokes (cSt)

Q. Name the apparatus used for determination of viscosity of lubricants.

Ans Apparatus for viscosity determination -
Saybolt Viscosity-meter.
Rotational Viscosity-meter.
Brookfield Viscosity-meter.
Capillary Viscosity-meter.

Q. Differentiate between Redwood viscometer No. 1 & 2.

Ans

Feature	Redwood Viscometer No. 1	Redwood Viscometer No. 2
• Purpose	For oils with higher viscosity	For oils with lower viscosity
• Viscosity Range	50-1000 sec	200-3000 sec
• Orifice Size	larger (used for thicker fluid)	Smaller (used for thinner fluid)
• Typical Application	Heavy oils, industrial lubricants	Lighter oils, like kerosene, diesel.

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Q8 What is the unit of viscosity?
Ans For Dynamic Viscosity = Poise (P)
for Kinematic viscosity = Stokes (St)

Q9 Give the names of oils which are assigned viscosity index of 0 & 100.
Ans For viscosity index 0 = Solar oil. (crude oils)
For viscosity index 100 = Neutral oil (Paraffin oils)

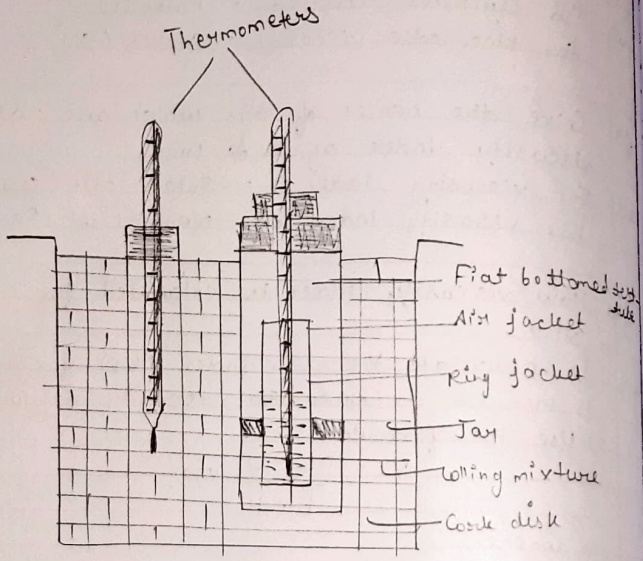
Q10 How viscosity index is calculated for an unknown oil?
Ans To calculate Viscosity index (VI) for an unknown oil:
1) measure its kinematic viscosity at 100°C & 40°C
2) Use the formula

$$VI = \frac{L - U}{L - H} \times 100$$

where

L = Viscosity at 100°C of oil with VI = 0
U = Viscosity at 100°C of the unknown oil.
H = Viscosity at 100°C of oil with VI = 100

This gives the temperature stability of the oil's viscosity.



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Object :- To find out the cloud and pour point of a given lubricating oil.

Apparatus & Reagent required :- Cloud & pour point apparatus, lubricating oil samples, freezing mixture.

Theory :- Most of the petroleum based lubricants contain dissolved paraffin wax & asphaltic impurities. When the oil is cooled, these impurities have a neutral tendency to crystallize & seperate out.

As petroleum oil is cooled under specified conditions, it gets cloudy at first & then solidifies. The temperature at which a cloudy or hazy appearance is noticed is called the 'cloud point' of the oil.

The temperature at which the oil ceases to flow or pour or become semisolid is known as 'pour point'.

The apparatus employed for the determination of cloud and pour point is shown below & is known as cloud & pour point apparatus.

It consists of the following parts :-

1) **Flat bottomed tube :-** It is made of glass with standard dimension (12 cm height & 3cm diameter)

2) **Glass jacket :-** Above tube is enclosed in a glass or metal jacket which is firmly fixed in a cooling bath having suitable freezing mixtures and a thermometer.

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Procedure :-

(i) Thoroughly clean and dry the flat bottomed tube.
(ii) Fill the oil inside the tube and then fit the cork.
(iii) Adjust the thermometers inside the oil properly & in the cooling bath.
(iv) The tube is then kept in the freezing mixture. Prepare freezing mixture in a way as mentioned below.

S.No.	Freezing mixture	Temperature range
1.	Ice + water	Upto + 10°C
2.	Ice + NaCl	Upto - 10°C
3.	Ice + $CaCl_2$	Upto - 25°C
4.	Solid $CaCl_2$ + Acetone	Upto - 60°C

(v) The temperature of the oil falls on cooling. Take out the tube from the freezing mixture after every 1°C fall in temperature and then inspect for a moment. It is restored if the cloudiness has not formed. This step should be completed within 3 seconds.
(vi) Note the temperature for hazy appearance which is the cloud point to the lubricating oil under test.
(vii) For determining pour point, continue the cooling process. After every 3°C fall in temperature, the tube is withdrawn and tilts to horizontal position for about 5-10 sec.
(viii) When oil stop flowing out of the jar, note the temperature which is pour point.

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Result:- The cloud point of the given semple is _____ °C & pour point is _____ °C

Precautions:-

(1) The observation of the tube should be completed within 2-3 sec.
(2) A suitable freezing mixture be chosen depending upon the pour point of the oil.
(3) When the wax crystals start separating from the oil, care should be taken to see that the oil & the thermometer in it are not distributed unduly.

Industrial Application

(1) It is used to select proper lubricant especially in high altitudes on the basis of cloud & pour point.
(2) The lubricating oil used in capillary fed systems should have low cloud point otherwise the crystals of impurities will separate out resulting in clogging of capillary.
(3) In the fuel intake system of diesel engines, the lubricants having high cloud point may clog the filter screens.
(4) Pour point determines the suitablity of the lubricants for low temperature installation which may be required to start & operate at sub zero temp. e.g. Refrigerator plants & air craft engines.

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(5) High pour point leads to solidification of the lubricant that may cause jam of the machine.

Viva Question

Q1 Define the term Lubricants & Lubrication.

Ans Lubricant:- It is a substance (usually a liquid) that is applied between two moving surfaces to reduce friction wear, & heat generated during motion. Common lubricants include oil, greases & synthetic compounds.

Lubrication:- Lubrication is the process of applying a lubricant to reduce friction & wear between two surfaces in relative motion. It helps in smooth operation, reduces energy loss, & extends the life of mechanical components.

Q2 Give any four important functions of lubricants.

Ans Functions of lubricant -
(i) Reduces friction.
(ii) Minimizes wear & tear
(iii) Remove heat
(iv) Prevents corrosion.

Q3 Explain various types of lubrication?

Ans Hydrodynamic-Lubrication - Full Fluid film, no contact.
Boundry Lubrication - Thin film, some surface contact.

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Mixed Lubrication :- Both fluid film & surface contact
Elastohydrodynamic Lubrication (EHL) - Thin film under high pressure.
Solid lubrication - Uses solids like graphite, for extreme conditions.
Dry lubrication - No oils / greases, used in clean setups.

Q. Give important properties of lubricants?
Ans Properties of Lubricants -
(i) Viscosity - Proper thickness
(ii) Thermal stability - Resist heat
(iii) Oxidation Resistance - Prevents sludge
(iv) Corrosion protection - Prevents rust
(v) Adhesiveness - Sticks to surface
(vi) Flash / Fire Point - High for safety
(vii) Pour Point - Flows at low temp.

Q. What do you mean by Pour point & Cloud point?
Ans Pour Point :- Lowest temperature at which a lubricant remains fluid & can still flow. Below this point, the oil becomes too thick & solidifies.
Cloud Point :- Temperature at which wax crystals begin to form in the lubricant, making it look cloudy. This is an early sign of ~~thicking~~ thickening before solidification.

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Q6 What is the significance of determination of cloud & pour point?

Ans Significance -
(i) Assesses cold water weather performance.
(ii) Prevents equipment failure.
(iii) Guides storage conditions
(iv) Indicates oil quality.

Q7 What are freezing mixtures?

Ans A combination of substances that lower the temperature when mixed, often used to freeze of cool items quickly. Examples include ice & salt.

Q8 What are the important parts of the apparatus used in cloud & pour point determination?

Ans The key parts are -
Test tube - Holds the sample
Thermostatic Bath - Controls temperature
Thermometer - Measures temperature
Stirring Mechanism - Ensures even cooling
Observation Tube - For visual inspection.

Q9 Give temperature ranges of different types of freezing mixtures.

Ans Here are the temp. ranges of different type of freezing mixture -
Ice + Salt = -10°C to -20°C

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Ice + calcium chloride : -30°C to -40°C
Ice + megnesium chloride = -15°C to -25°C
Actone & Dry ice = -70°C to -80°C
Ethylene Wlycol & water : -10°C to -20°C

Q10 Give examples of solid & semi solid lubricants.
Ans For Solid lubricant - Graphite, calcium carbonate, molybdenum disulphide (MoS_2), Teflon (PTFE)

For semi solid lubricants - Grease (oil thicked with soap or other substance), petroleum jelly, Silicon grease, Lithium-based grease.