

FUEL TECHNOLOGY-2

LAB MANUAL

LIST OF EXPERIMENT:

1. To determine the viscosity of the given oil sample using Engler's viscometer
2. To determine the Cloud point and Pour point of a given fuel / lubricant / oil using Cloud and Pour point apparatus
3. To determine the Flash and Fire point of the given sample of oil using Pensky Marten's apparatus
4. To determine the carbon residue of the given sample of lubricating oil / fuel using Conradson Apparatus
5. To determine the Smoke point of a given oil using smoke point apparatus.
6. To determine the Acid value of a given oil
7. To determine the aniline point of a given oil / fuel

EXPERIMENT-1

AIM OF THE EXPERIMENT: To determine the viscosity of the given oil sample using Engler's viscometer

APPARATUS REQUIRED:

1. Engler's Viscometer
2. Stop watch
3. Thermometer
4. Measuring flask

SAMPLE REQUIRED: Fuel oil

THEORY:

The viscosity of given oil is determined as the time of flow in Engler's seconds. The viscosity of a fluid indicates the resistance offered to shear under laminar condition. Dynamic viscosity of a fluid is the tangential force on unit area of either of two parallel planes at unit distance apart when the space between the plates moves relative to the other with unit velocity in its own plane. The unit of dynamic viscosity is dyne-sec/cm². Kinematic viscosity of a fluid is equal to the ratio of the dynamic viscosity and density of the fluid. The unit of kinematic viscosity is cm²/sec.

DESCRIPTION:

Engler's viscometer consists of a water bath and oil bath, both provided with two thermometers inside them. There is an ebonite valve stick, which is located at center of oil bath to flow of oil through the orifice. A heater with regulator is fixed for heating purpose.

PROCEDURE:

1. Clean the oil cup with a suitable solvent thoroughly and dry it using soft tissue paper.
2. Keep the ebonite valve stick in its position so as to keep the orifice closed.
3. The water is taken into the water bath and the oil whose viscosity is to be determined is taken into the oil cup up to the mark.
4. Before switch on the electric supply, at room temp note down the time taken in Engler's seconds for a collection of 200 cc of oil with a stopwatch.
5. Heat the bath and continuously stir it taking care to see that heating of the bath is done in a careful and controlled manner.

6. When the desired temperature is reached, place the cleaned 200 cc Flask below the orifice in position.
7. Remove the ebonite valve stick and simultaneously start a stopwatch. Note the time collection of oil up to the 200 cc mark. During the collection of oil don't stir the bath.
8. Repeat the process at various temperatures.

OBSERVATIONS:

Sl no	Oil temp. (°C)	Time for collecting 50 cc of oil sec	Kinematic viscosity $\nu=(A*t)-(B/t)$ cm ² /sec	Density (ρ) gm/sec	Absolute Viscosity $\mu=\nu*\rho$ dyne=sec/cm ²

Where $A=0.0026 \text{ cm}^2/\text{sec}^2$ & $B=1.8 \text{ cm}^2$

GRAPHS TO BE DRAWN

1. Engler's seconds vs. temperature
2. Kinematic Viscosity vs. temperature
3. Absolute Viscosity vs. temperature

PRECAUTIONS

1. Stir the water continuously so that the temp of the oil and water are equal.
2. Before collecting the oil at a temp., check whether the oil is up to the indicator in the oil cup.
3. Always take the readings at a stable temp.
4. Ensure proper setting of the Ebonite stick to avoid leakage.

RESULTS

Variation of Engle's seconds, Absolute viscosity and kinematic viscosity with temp., were observed and found to be decreasing with temp.



ENGLER'S VISCOMETER

EXPERIMENT-2

AIM OF THE EXPERIMENT: To determine the cloud point and pour point of a given fuel / lubricant / oil using cloud and pour point apparatus

APPARATUS REQUIRED:

1. Cloud and pour point
2. Digital temp thermometer

SAMPLE REQUIRED: fuel oil

THEORY:

CLOUD POINT: The temperature expressed to the nearest degree centigrade, at which a cloud or haze appear when the oil is cooled under prescribed conditions.

POUR POINT: The lowest temp., expressed as a multiple of 3°C, at which the oil is observed to flow when cooled & examined under prescribed conditions.

PROCEDURE:

CLOUD POINT:

1. Bring the sample to a temperature of at least 15 °C above the approximate cloud point and pour point it into the jar to a height of 51 to 57 mm.
2. Close the jar with the cock so that the temp bulb rests on the centre of the bottom of the jar.
3. Fit the gasket on to the jar 25 mm from the bottom and insert the jar into gasket.
4. Support the jacket and jar in a vertical position in the bath so that not more than 25mm projects from the cooling medium.
5. At each thermometer reading of one degree centigrade, remove the jar from the jacket quickly but without disturbing the oil, inspect the material for cloud, and replace the jar, this complete operation shall not take more than 3 sec.
6. If the sample does not show a cloud when it has been cooled 10 °C place the jar and jacket in another bath maintained at a temp of -15 °C to -18 °C.
7. If the sample does not show a cloud when it has been cooled to -7 °C. Place the jar and jacket in another bath maintained at a temp. Of -32 °C to -35 °C.

8. When an inspection of the sample first reveals a distinct cloudiness or haze at the bottom of the jar, record the reading of the thermometer as the cloud point after correcting the thermometer errors if necessary.

POUR POINT:

1. The sample has cooled enough to allow the formation of the crystals.
2. Maintain the bath temp at -1 °C to 2 °C.
3. Support the jacket and jar in a vertical position in the bath so that not more than 25mm projects from the cooling medium.
4. Beginning at a temp 12 °C above the expected pour point, at each thermometer reading which is a multiple of 3 °C remove the jar from the jacket carefully, and tilt it just enough to see whether the oil will move and the replace it, this complete operation shall not take more than 3 sec.
5. As soon as the sample ceases to flow when the jar is titled, hold the jar in horizontal position for exactly 5 sec.
6. If the sample shows any movement replace the jar in the jacket and cool down the sample for another 3 °C. If the oil shows no movement during the 5 sec, record the reading of the thermometer.
7. Add 3 °C to the temp recorded above and corrected for thermometer errors if necessary, and note down the result as the pour point.

OBSERVATIONS:

OIL	CLOUD POINT(°C)	POUR POINT (°C)

PRECAUTIONS:

1. The disc, the gasket, and jacket shall be kept clean and dry.
2. Don't disturb the mass of sample nor don't permit the thermometer to shift in the sample. Any disturbance of the spongy network of crystals will lead to false results.

RESULTS:

For a given sample of oil, the cloud & pour points are _____ and _____ respectively.



POUR POINT AND CLOUD POINT APPARATUS

EXPERIMENT-3

AIM OF THE EXPERIMENT: To determine the Flash point and Fire point of the given sample of oil using Pensky Marten's apparatus.

APPARATUS REQUIRED:

1. Pensky Marten's apparatus.
2. Thermometer

SAMPLE REQUIRED: Fuel oil

THEORY:

This method determines the closed cup and open cup flash and fire points of petroleum products and mixtures to ascertain whether they give off inflammable vapours below a certain temperature.

FLASH POINT: It is the lowest temperature of the oil at which application of test flame causes the vapour above the sample to ignite with a distinct flash inside the cup.

FIRE POINT: It is the lowest temperature of the oil, at which, application of test flame causes burning for a period of about five seconds.

DESCRIPTIONS:

The apparatus consists of a brass cup and cover fitted with shutter mechanism without shutter mechanism (open cup), test flame arrangement, hand stirrer (closed cup), thermometer socket, etc., heated with energy regulator, a thermometer socket made of copper.

PROCEDURE:

1. Clean the oil cup thoroughly and fill the oil cup with the sample oil to be tested up to the mark.
2. Insert the thermometer into the oil cup through a provision, which measures the rise of oil temp.
3. Using the Energy regulator, control; the power supply given to the heater and rate of heating.
4. The oil is heated slowly when temp of oil rises; it is checked for the flash point for every one-degree rise in temp.

5. After determining the flash point, the heating shall be further continued. The temp. at which time of flame application which causes burning for a period at least 5 seconds shall be recorded as the fire point.
6. Repeat the experiment 2 to 3 times with fresh sample of the same oil.
7. Take the average value of flash and fire points.

OBSERVATIONS:

Sample oil	Flash point (°C)	Fire point (°C)

RESULT:

The flash point is observed at -----°C.

The fire point is observed at-----°C.



FLASH POINT AND FIRE POINT APPARATUS

EXPERIMENT-4

AIM OF THE EXPERIMENTS: To determine the carbon residue of the given sample of lubricating oil/fuel.

APPARATUS REQUIRED:

1. Carbon residue (Conradson) apparatus
2. Analytical balance with Weight box

SAMPLE REQUIRED: Fuel oil

THEORY:

Most of the lubricant oils are containing high percentage of carbon in combined form and fuels containing less percentage of carbon in combined form. On heating, they decompose depositing a certain amount of carbon. The deposition of such carbon in machine is intolerable, particularly in internal combustion engines and air compressors. A good lubricant should deposit least amount of the carbon in use.

PROCEDURE:

1. The weighed porcelain or silica crucible with approximately 2 grams of sample is placed in the centre of skid more crucible.
2. The skid more crucible is provided with lid, having a small tube type opening for the escape of volatile matter.
3. The combination is then placed in wrought iron crucible covered with chimney shaped iron hood.
4. The wrought iron crucible is heated slowly till flame appears. Slow heating continues for 5 minutes more.
5. Finally, strong heating is done for about 15 minutes till vapours of all volatile matter are burnt completely.
6. Apparatus is then allowed to cool and weight of residue left is determined.
7. The result is expressed as percentage of the original weight of oil taken.

OBSERVATIONS:

1. Weight of the crucible $w_1 =$ gms
2. Weight of the crucible with oil $w_2 =$ gms

3. Weight of crucible with residue $w_3 =$ gms

Percentage of carbon residue = (weight of residue/original weight of sample) *100

$$= [(w_3-w_1)/ (w_2-w_1)] *100$$

RESULT:

The percentage of carbon present in given sample of lubricating oil is _____%



CONRADSON APPARATUS

EXPERIMENT-5

AIM OF THE EXPERIMENT: To determine the Smoke point of a given oil using Smoke point apparatus.

APPARATUS REQUIRED:

1. Smoke point apparatus
2. Thermometer

SAMPLE REQUIRED: Fuel oil

THEORY:

The smoke point, also referred to as the burning point, is the temperature at which an oil or fat begins to produce a continuous bluish smoke that becomes clearly visible, dependent upon specific and defined conditions. The smoke point of oil is the temperature at which the oil starts to smoke. ... The smoke point of oil is important because no one wants to burn their oil. Smoke point is related to the hydrocarbon composition of kerosene - it is highest with paraffin's, considerably lower with naphthenic and very much lower with aromatics. The smoke point is also an indication of the tendency to smoke when the flame is smaller than the maximum stipulated size.

PROCEDURE:

1. A 126 mm long dried wick is soaked in the sample and placed in the wick tube of the candle.
2. A 10-20 ml of prepared sample is introduced at room temp into the dry candle.
3. The wick tube is placed in the candle firmly with taking care of the candle air vent is free from fuel. A new clean, sharp razor is used to cut the wick at the face of the holder and remove wisps and frayed ends.
4. T he candle is lighted and the wick adjusted so that the flame is approximately 10mm high with 5min.
5. After burning, the candle raised until a smoke tail appears, then the candle is lowered slowly through several stages of flame appear once.
6. The maximum height of flame that can be achieved without smoking is determined to the nearest 0.5mm.

7. The candle is removed from the lamp arise with heptanes and purged with air to make ready for re-use.

RESULT:

In this experiment we have to record the height of the flame, when we raise the candle until a smoky tail appears then lower the flame slowly until the smoky tail disappears.

To eliminate errors due to parallax, the eye of the observer shall be slightly to one side of the centreline, so that a reflected image of the flame is seen on the scale on one side of the central vertical white line. We have recorded the following records;

CALCULATIONS:

For kerosene:

Record of height in mm (1) = x mm

Record of height in mm (2) = y mm

Record of height in mm (3) = z mm

The avg of records = $(x+y+z)/3$ mm

Smoking tendency = $320/\text{smoke point}$

DISCUSSION:

From the above experiment we have to find the smoking tendency of the given oil is ___.



SMOKE POINT APPARATUS

EXPERIMENT-6

AIM OF THE EXPERIMENT: To determine the acid value of a given oil

CHEMICALS REQUIRED:

1. 1N KOH Solution
2. Neutral ethyl alcohol
3. phenolphthalein indicator

APPARATUS REQUIRED:

1. Test tube
2. measuring cylinder
3. watch bath
4. Test tube holder
5. Stirrer

SAMPLE REQUIRED: Fuel oil

PRINCIPLE:

The acid value of lubricating oil is defined as the number of milligrams of potassium hydroxide required to neutralise the free acid present in 1 gm of the oil. The presence of mineral acid presence in lubricating oil is so rare that it is almost necessary to look for it unless the oil is refined in a faulty manner. Free organic acid or acidic bodies are always found in lubricating oil, whether they are pure mineral oil, compound oils with fatty oils. In unused refined petroleum oil, the quantity is in variably negligible. When fatty acids are present on the case of used oils, the acid content should be determined not because it gives any direct evidence of corrosion hazard, but to sound a warning that a corrosion test might be revealing. In good lubricating oil the acid value should be very low (<0.1). Increase in acid value should be taken as an indicator of oxidation of the oil which may lead to gum and sludge formation besides corrosion. The acid value of fatty oils may vary from 0.2 to 50 and it shows the extent of hydrolysis of glycerol ester of the oil.

PROCEDURE:

1.5 gm of oil was weighted out accurately under test into a 250 ml conical flask.

2.50 ml of neutral alcohol was added to it.

3. The flask was heated over a water bath for about 30 minutes.
4. The flask was cooled and added a few drops of phenolphthalein indicator.
5. Then it was titrated with 1N KOH solution until a faint permanent pink colour appeared at the end point.

CHEMICAL REACTION:



TABULATION:

SL.NO	IBR	FBR	DIFFERENCE	REMARKS

CALCULATION:

ACID VALUE = (No of ml of 1N KOH run down/wt. of oil taken in gms) *56

Where 56 represent the amount of KOH in mg present per each ml of 1N KOH solution.

CONCLUSION:

From the above experiment it is found that the acid value of the given oil sample is _____.

EXPERIMENT-7

AIM OF THE EXPERIMENT: To determine the Aniline point of a given lubricating oil.

CHEMICAL REQUIRED:

Aniline

APPARATUS REQUIRED:

1. Test tube
2. Measuring cylinder
3. water bath
4. test tube holder
5. stirrer
6. thermometer

SAMPLE REQUIRED: Fuel oil

THEORY:

Aniline point of oil is defined as the minimum equilibrium temperature for equal volumes of aniline and the oil. In other words, it is the least temp at which the oil is completely miscible with an equal volume of freshly distilled aniline.

Aromatic hydrocarbons have a tendency to dissolve natural and certain types of synthetic rubber. Aniline point of lubricating oil is a measure of its aromatic content and hence it gives an indication of the possible tendency of deterioration of oil when it comes into contact with rubber seals used in the system to prevent leakages. Thus the lower the aniline point of lubricating oil, the more severe will be its attack on the rubber sealing. Obviously a higher aniline point is describing for lubricating oil, because it means that the oil contains lower percentage of aromatic hydrocarbons.

PROCEDURE:

1. 4ml of aniline and diesel oil are taken in a test tube and poured into a boiling tube.
2. A stirrer is used to mix the mixture while it is placed in a hot water bath.
3. The boiling tube is taken out and noticed from time to time after periodic intervals.

4. When the haziness forms over the entire solution leading to a homogeneous colour, the temperature of the solution just at the surface is noted.

RESULT:

The aniline point of diesel was found out to be _____.

CONCLUSION:

Since aromatic dissolve aniline more readily than paraffin's, the higher aniline point lowers the aromatics and higher the paraffin content with high cetane number making the oil suitable for use in diesel engine.

Hence, higher the aniline point betters the diesel oil and the lubricant.