Bharati Vidyapeeth's Institute of Technology

Navi Mumbai

Certificate

This is to certify that, Mr/ Ms. …….
Roll No. …… of fifth Semester of Diploma in Chemical engineering of Baharati Vidyapeeth Institute of Technology Navi Mumbai (Inst.code:0027) has satisfactorily completed the term work in the subject RENEWABLE ENERGY TECHNOLOGIES(22514) for the academic year 20…. to 20…. as prescribed in the MSBTE curriculum.

Place: ……... **Enrollment No. : ……**

Date:……. **Exam. Seat No. : …….**

Sign:

Name:

Subject Teacher **Head of the Department** **Principal**

Seal of Institution

List of experiments and progressive assessment for term work (TW) D-3

Academic Year: 2019-20 **Name of Faculty:**

Course code: CH5I **Subject Code: RET(22514)**

Name of candidate: **Enroll no.** **Roll no.**

Semester: FIFTH **Marks: Max : 25 Min :10**

Sr. No.	Title	Date of performance	Date of submission	Marks	Sign of teacher
1	Identify components and subcomponents of wind turbine.				
2	Assemble /dismantle a small wind turbine.				
3	Identify the parts of the large wind turbine after viewing the relevant video.				
4	To determine the carbon residue of oil by using Caondradson Apparatus /Ramsbottom Apparatus.				
5	To determine the calorific value of given sample by using bomb calorimeter.				
6	To determine of pour point of given fuel.				
7	Determine the cloud point of given sample of fuel.				
8	Determine the viscosity of given sample of fuel.				
9	To determine the calorific value of given sample by using bomb calorimeter.				
10	Determine the acid value of given sample of fuel.				
11	Determine the aniline point of given sample of fuel.				
12	Determine the specific gravity of biofuel.				
Total marks out of 120					
Marks out of 25					

Name and Signature of student Name and Signature of faculty

Experiment 1

Aim: Identify components and subcomponents of wind turbine.

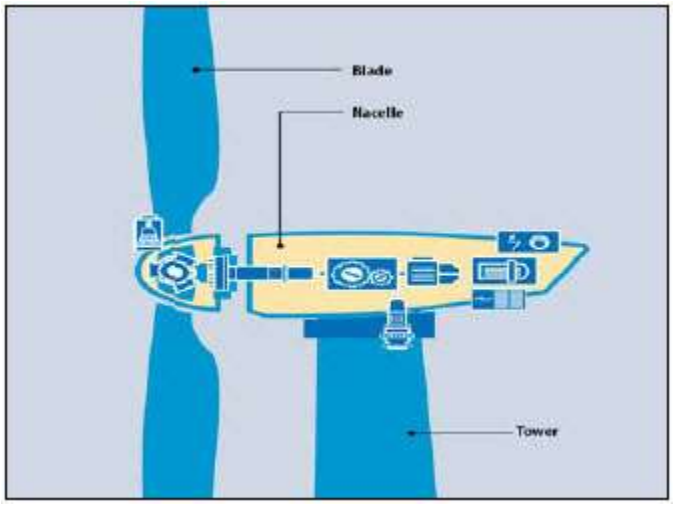
Wind Turbine Components

A wind turbine is a collection of operating systems that convert energy from wind to produce electricity. Utility-scale wind turbines are massive, complex pieces of machinery which come in many sizes and configurations. Wind turbine of concrete.

In simple terms, as shown in **Figure 1**, the major components in a wind turbine consist of:

- a rotor comprising four principal components—the blade, the blade extender, the hub, and the pitch drive system;
- a nacelle, the external shell o structure resting atop the tower containing and housing the controller, gearbox, generator, large bearings, connecting shafts, and electronic components that allow the turbine to monitor changes in wind speed and direction;
- a tower, normally made of rolled steel tube sections that are bolted together to provide the support system for the blades and nacelle; and,
- other components, including transformers, circuit breakers, fiber optic cables, and ground-mounted electrical equipment.[43]

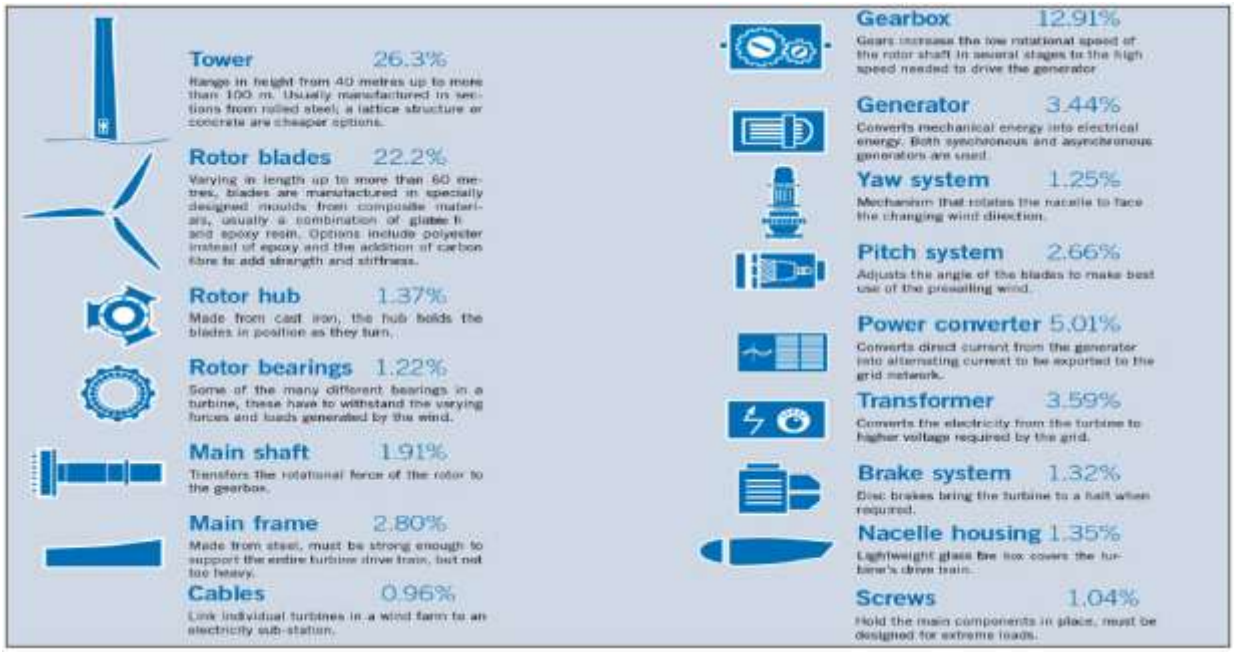
Figure 1. Wind Turbine Overview



Beyond the major components, there are many subcomponents in a wind turbine. The percentages shown in **Figure 2** indicate the costs of the components relative to the overall cost of a turbine. The tower, for example, is over 26% of the total cost of a wind turbine, rotor blades 22%, the gearbox 13%, and the other components 5% or less.

Figure 2. Wind Turbine Components

Contribution of main parts as a percentage of overall costs based on a REpower MM92 Turbine



Nacelle

The nacelle contains the key components of the wind turbine, including the gearbox, and the electrical generator. Service personnel may enter the nacelle from the tower of the turbine. To the left of the nacelle we have the wind turbine rotor, i.e. the rotor blades and the hub. The nacelle contains the key components of the wind turbine, including the gearbox, and the electrical generator. Service personnel may enter the nacelle from the tower of the turbine. To the left of the nacelle we have the wind turbine rotor, i.e. the rotor blades and the hub

Rotor blades

The rotor blades capture the wind and transfer its power to the rotor hub. On a modern 1000 kW wind turbine each rotor blade measures about 27 metres (80 ft.) in length and is designed much like a wing of an aeroplane.

Hub

The hub of the rotor is attached to the low speed shaft of the wind turbine.

Low speed shaft

The low speed shaft of the wind turbine connects the rotor hub to the gearbox. On a modern 1000 kW wind turbine the rotor rotates relatively slowly, about 19 to 30 revolutions per minute (RPM). The shaft contains pipes for the hydraulics system to enable the aerodynamic brakes to operate.

Ydraulics system

The hydraulics system is used to reset the aerodynamic brakes of the wind turbine.

Gearbox

The gearbox has the low speed shaft to the left. It makes the high speed shaft to the right turn approximately 50 times faster than the low speed shaft.

High speed shaft rotates

The high speed shaft rotates with approximately. 1,500 revolutions per minute (RPM) and drives the electrical generator. It is equipped with an emergency mechanical disc brake. The mechanical brake is used in case of failure of the aerodynamic brake, or when the turbine is being serviced.

Electrical generator

The electrical generator is usually a so-called induction generator or asynchronous generator. On a modern wind turbine the maximum electric power is usually between 600 and 3000 kilowatts (kW).

Yaw mechanism

The yaw mechanism uses electrical motors to turn the nacelle with the rotor against the wind. The yaw mechanism is operated by the electronic controller which senses the wind direction using the wind vane. The picture shows the turbine yawing. Normally, the turbine will yaw only a few degrees at a time, when the wind changes its direction.

Electronic controller

The electronic controller contains a computer which continuously monitors the condition of the wind turbine and controls the yaw mechanism. In case of any malfunction, (e.g. overheating of the gearbox or the generator), it automatically stops the wind turbine and calls the turbine operator's computer via a telephone modem link.

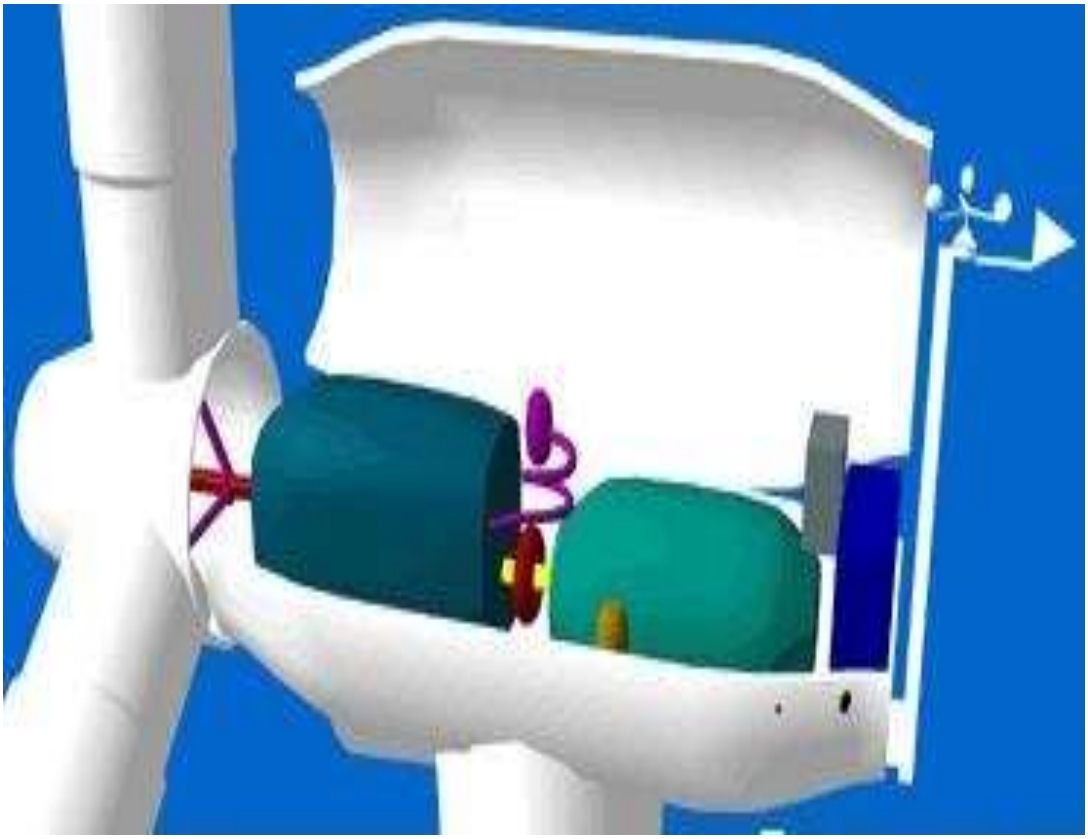
Cooling unit

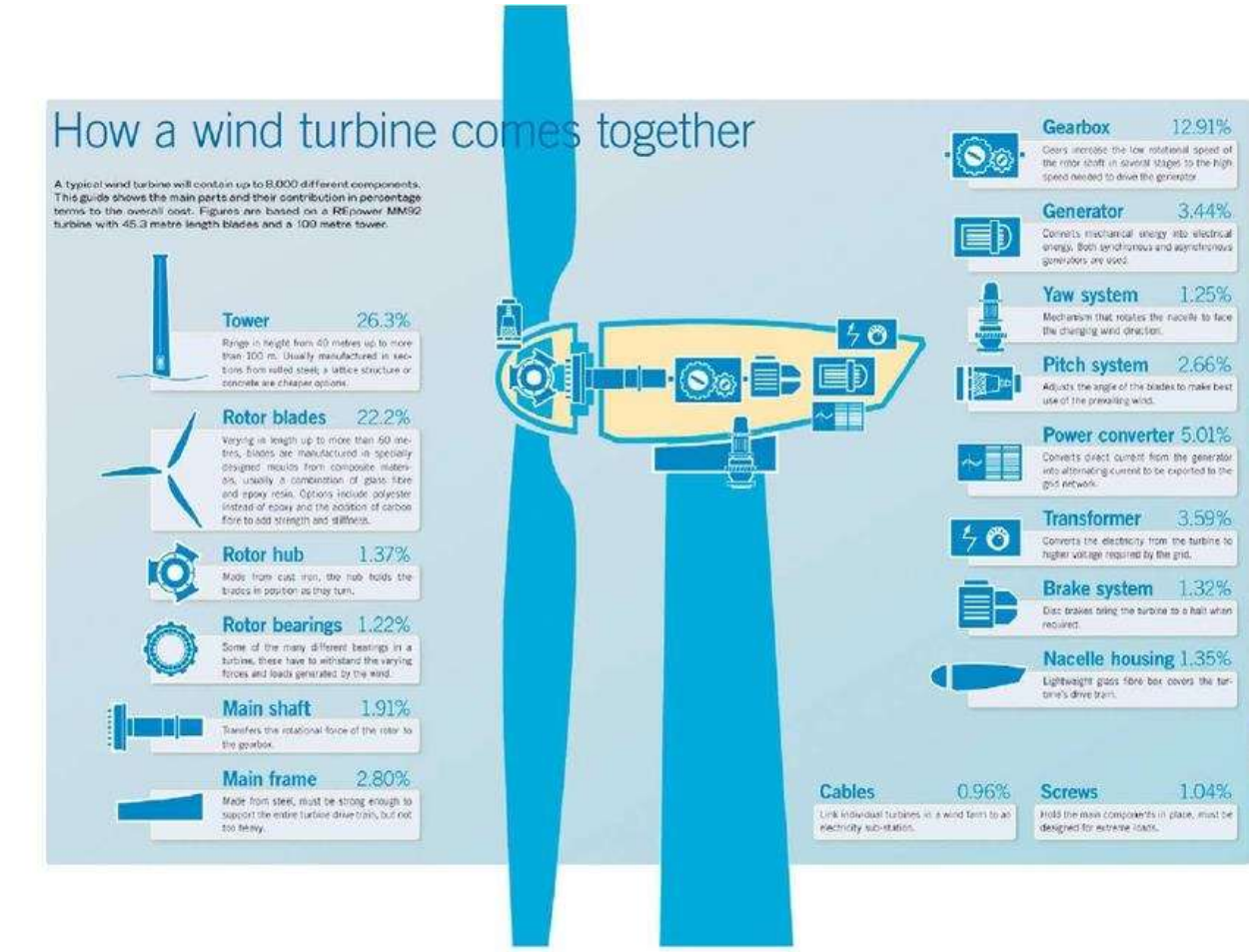
The cooling unit contains an electric fan which is used to cool the electrical generator. In addition, it contains an oil cooling unit which is used to cool the oil in the gearbox. Some turbines have water-cooled generators.

Anemometer and the wind wane

The anemometer and the wind wane are used to measure the speed and the direction of the wind. The electronic signals from the anemometer are used by the wind turbine's electronic controller to start the wind turbine when the wind speed reaches approximately 5 metres per second (10 knots). The computers stops the wind turbine automatically if the wind speed exceeds 25 metres

per second (50 knots) in order to protect the turbine and its surroundings. The wind vane signals are used by the wind turbine's electronic controller to turn the wind turbine against the wind, using the yaw mechanism.





Identify the parts of large wind turbine

1.- ----------

2.- ----------

3. .----------

4. .----------

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10. .----------

11. .----------

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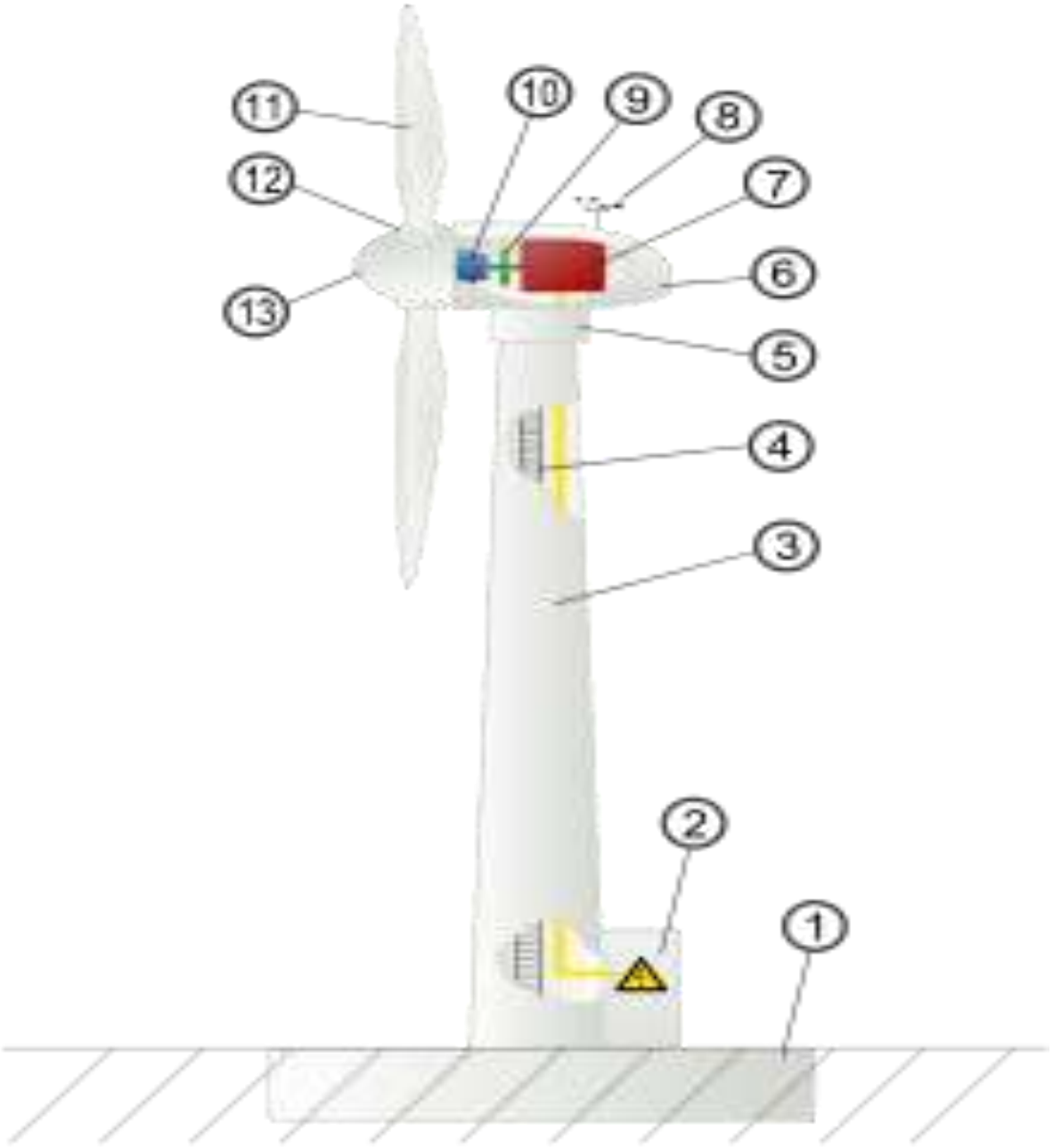
13. .----------



C(4)	P(4)	A(2)	TOTAL	SIGN

Experiment 2

Aim: Assemble/dismantle a small wind turbine.

Note: Watch the relevant video carefully and identify , how to assemble/dismantle the various parts of small wind turbine and write the answers of given questions.

Video source:- https://www.youtube.com/watch?v=0dVJIwbwAWY

Questions:

1. How is high speed shaft rotates?
2. Write about anemometer and the wind wane.
3. What are nacelle?

Answers:

C(4)	P(4)	A(2)	TOTAL	SIGN

Experiment 3

Aim: Identify the parts of the large wind turbine after viewing the relevant video.

Note: Watch the relevant video carefully and identify the parts of the large wind turbine and answers the questions given below.

Video source:- https://www.youtube.com/watch?v=3xiFiNGCn3s

Questions:

1. How is high speed shaft rotates?
2. Write about anemometer and the wind wane.
3. What are nacelle?

Answers:

C(4)	P(4)	A(2)	TOTAL	SIGN

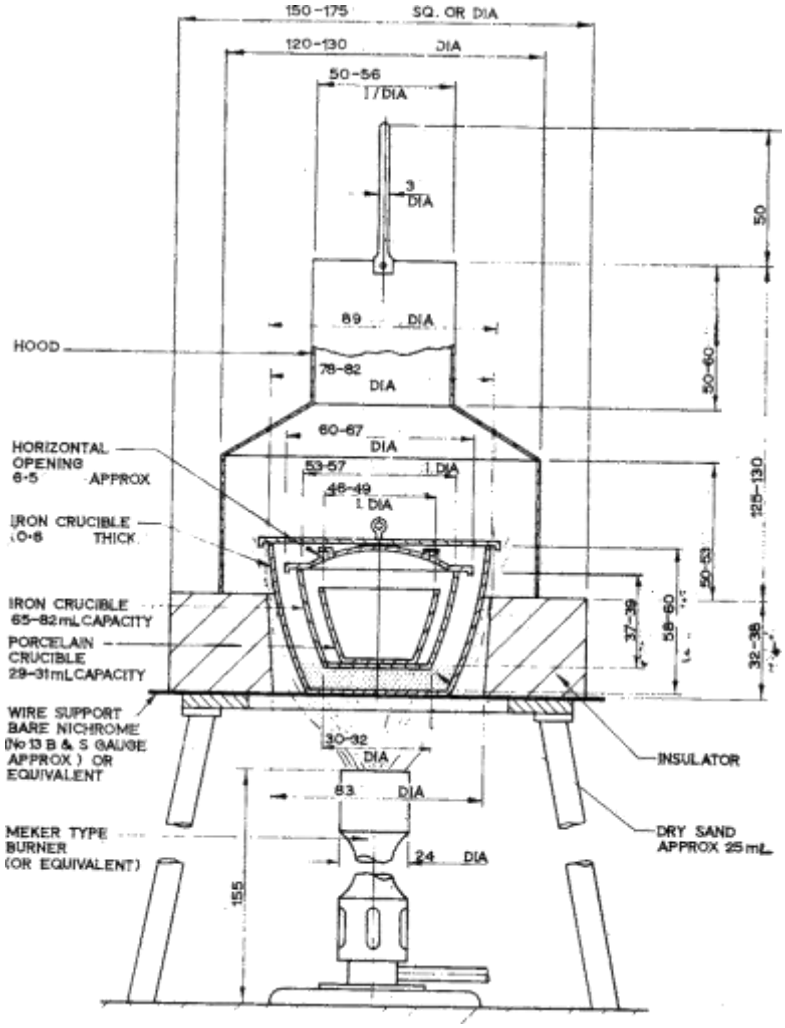
Experiment 4

Aim: To determine the carbon residue of oil by using Caondradson Apparatus/Ramsbottom Apparatus.

Theory:

This test method covers the determination of the amount of carbon residue left after evaporation and pyrolysis of an oil, and is intended to provide some indication of relative coke-forming propensities. This test method is generally applicable to relatively nonvolatile petroleum products which partially decompose on distillation at atmospheric pressure. Petroleum products containing ash-forming constituents as determined by Test Method D 482 or IP Method 4 will have an erroneously high carbon residue, depending upon the amount of ash formed.

Apparatus: Caondradson Apparatus



Summary of Test Method

A weighed quantity of sample is placed in a crucible and subjected to destructive distillation. The residue undergoes cracking and coking reactions during a fixed period of severe heating. At the end of the specified heating period, the test crucible containing the carbonaceous residue is cooled in a desiccator and weighed. The residue remaining is calculated as a percentage of the original sample, and reported as Conradson carbon residue.

Procedure:

Shake thoroughly the sample to be tested, first heating to 50° 6 10°C for 0.5 h when necessary to reduce its viscosity. Immediately following the heating and shaking, filter test portion through a 100 mesh screen. Weigh to the nearest 5 mg a 10-g sample of the oil to be tested, free of moisture and other suspended matter, into a tared porcelain or silica crucible containing two glass beads about 2.5 mm in diameter. Place this crucible in the center of the Skidmore crucible. Level the sand in the large sheet-iron crucible and set the Skidmore crucible on it in the exact center of the iron crucible. Apply covers to both the Skidmore and the iron crucible, the one on the latter fitting loosely to allow free exit to the vapors as formed.

On a suitable stand or ring, place the bare Nichrome wire triangle and on it the insulator. Next center the sheet-iron crucible in the insulator with its bottom resting on top of the triangle, and cover the whole with the sheet-iron hood in order to distribute the heat uniformly during the process.

Apply heat with a high, strong flame from the Meker-type gas burner, so that the pre-ignition period will be 10 6 1.5 min (a shorter time can start the distillation so rapidly as to cause foaming or too high a flame). When smoke appears above the chimney, immediately move or tilt the burner so that the gas flame plays on the sides of the crucible for the purpose of igniting the vapors. Then remove the heat temporarily, and before replacing adjust by screwing down the pinch-cock on the gas tubing so that the ignited vapors burn uniformly with the flame above the chimney but not above the wire bridge. Heat can be increased, if necessary, when the flame does not show above the chimney. The period of burning the vapors shall be 13 6 1 min. If it is found impossible to meet the requirements for both flame and burning time, the requirement for burning time is the more important.

When the vapors cease to burn and no further blue smoke can be observed, readjust the burner and hold the heat as at the beginning so as to make the bottom and lower part of the sheet-iron crucible a cherry red, and maintain for exactly 7 min. The total period of heating shall be 30 6 2 min, which constitutes an additional limitation on the tolerances for the pre-ignition and burning periods. There should be no difficulty in carrying out the test exactly as directed with the gas burner of the type named, using city gas (20 to 40 MJ/m^3), with the top of the burner about 50 mm below the bottom of the crucible. The time periods shall be observed with whatever burner and gas is used.

Remove the burner and allow the apparatus to cool until no smoke appears, and then remove the cover of the Skidmore crucible (about 15 min). Remove the porcelain or silica crucible with heated tongs, place in the desiccator, cool, and weigh. Calculate the percentage of carbon residue on the original sample.

Calculation-Calculate the carbon residue of the sample or of the

10 % distillation residue as follows:

Carbon residue 5 ~*A* 3 100!/*W*

where:

A = mass of carbon residue, g, and *W* = mass of sample, g.

Questions:

1) What are constituents of crude oil?

2) Explain in short Distillation of crude oil.

3) Explain the various Waste Treatments methods used in refineries.

Answers:

C(4)	P(4)	A(2)	TOTAL	SIGN

Experiment 5

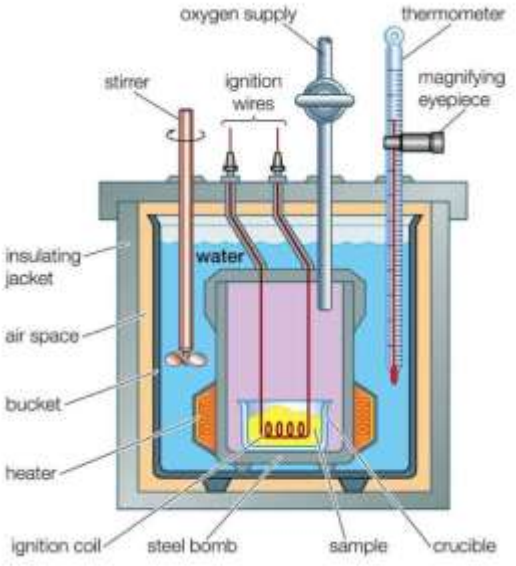
Aim :To determine the calorific value of given sample by using bomb calorimeter.

THEORY:
The determination of the calorific value of fuels is carried out in specially designed calorimeter. The type of calorimeter used will depends on the type of fuel under test.

In the case of solid and some liquid fuels the calorific value is usually determined in a bomb calorimeter.In the case of gaseous and some liquids fuels the calorific value is determined in a gas calorimeter.

APPARATUS:
Bomb calorimeter, crucible

THE BOMB CALORIMETER
In this type of calorimeter a small quantity of the fuel under test is burnt at constant volume in a high-pressure container. Hence the name bomb calorimeter. Oxygen isadmitted to the bomb under pressure in order that the fuel may be burnt. The energy liberated is measured and hence the calorific value of the fuel determined.One such bomb calorimeter is shown



DESCRIPTION OF APPARATUS
The apparatus consists of a thick stainless steel wall, high-pressure cylinder into the top of which is introduced a non-return, oxygen admission value and a pressure release value.The calorimeter is mounted in a water container. In this mount there are registers for the feet of the bomb and also electrical constant in the base of the bomb. Electrical power isfed to the mount through lead-covered wire from a plug and socket. The can is itself mounted in another outer can, which serves as a heat insulator. Into the base of the outer can is set a wooden plat-form which serves as

a register for the can.The apparatus is covered by cone plate into which is set a stirrer. This stirrer spring-loaded and is horse-shoe shaped round the bomb. The cover plate is also pierced by a hole through which is inserted a thermometer, usually a Beckmann Thermometer.

PROCEEDURE:

An empty crucible was weighed and approximately 0.7g wood pellets was put into it. The crucible was reweighed to ensure the correct amount of oil. The crucible with the oil was positioned in the seating in the bomb cover. A suitable piece-of ignition wire was attached across the terminals making sure it touched the wood pellets surface.15 ml of distilled water was poured into the base of the bomb, and the bomb assembled carefully. The bomb was then charged with oxygen to 25 atmospheres and tested underwater for leaks. The calorimeter vessel was weighed and 2400 ml of water was added and reweighed to determine the correctly weight of water.The calorimeter vessel was positioned in the water filled jacket and the bomb was set in place in the calorimeter vessel. The water jacket provides a sensible constant temperature environment.The stirrer, Beckmann thermometer and electrical leads were connected and stirring gear was set in motion.The thermometer readings were observed at one minute intervals for a preliminary period of five minutes and then the firing circuit was completed.

The thermometer readings were continued at one minute intervals until the maximum temperature was attained. The temperature was observed further for five minutes at one minute intervals.The apparatus was dismantled and checked whether combustion had been completed.

TABLE OF RESULTS:

Table 2-1: Calorific values (HHV in MJ/kg) of oven dry tree components of softwoods (Singh and Kostecky 1986)

Species	Stump	Stem	Treetop	Bark	Foliage	Branches	Mean
White Spruce							
Black Spruce							
Jack Pine							
Eastern White cedar							
Tamarack							
Balsam fir							
Mean							
Standard Deviation							

Note that MJ/kg and GJ/MT are equivalent units, i.e. 1 MJ/kg = 1 GJ/MT

Table 2-2: Calorific values (HHV in MJ/kg) of oven dry tree components of hardwoods ((Singh and Kostecky 1986)

Species	Stump	Stem	Treetop	Bark	Foliage	Branches	Mean
Aspen							
Balsam poplar							
White birch							
Manitoba maple							
Mean							
Standard Deviation							

Note that MJ/kg and GJ/MT are equivalent units, i.e. 1 MJ/kg = 1 GJ/MT

Calculations:-

$Wf * Q = (Ww + Wa)\ (\Delta T)^0C * 4.2$
Where Wf (Kg) is the weight of fuel,
Q(KJ/Kg) is the calorific value,
Ww g is the weight of water in the calorimeter vessel,
Wa Kg is the water equivalent of the apparatus(0.482 Kg).

Wf =
Ww =
Wa =
Total weight of crucible and fuel = Wf + Ww =
$\Delta T = 26.43^0C - 23.57^0C = 2.86^0C$

$$Q = \frac{(Ww + Wa)\ (\Delta T)^0C * 4.2}{Wf}$$

Q =

Q =

PRECAUTIONS

In the experiment it should be ensured that the ignition wire is properly wired to the leads and also makes contact with the fuel (diesel)
Extreme caution is taken while working with water and the completely electrical apparatus.
The calorimeter was tested for leaks to prevent "wetting" the fuel.
Maximum attention is required to ensure simultaneous firing and timing

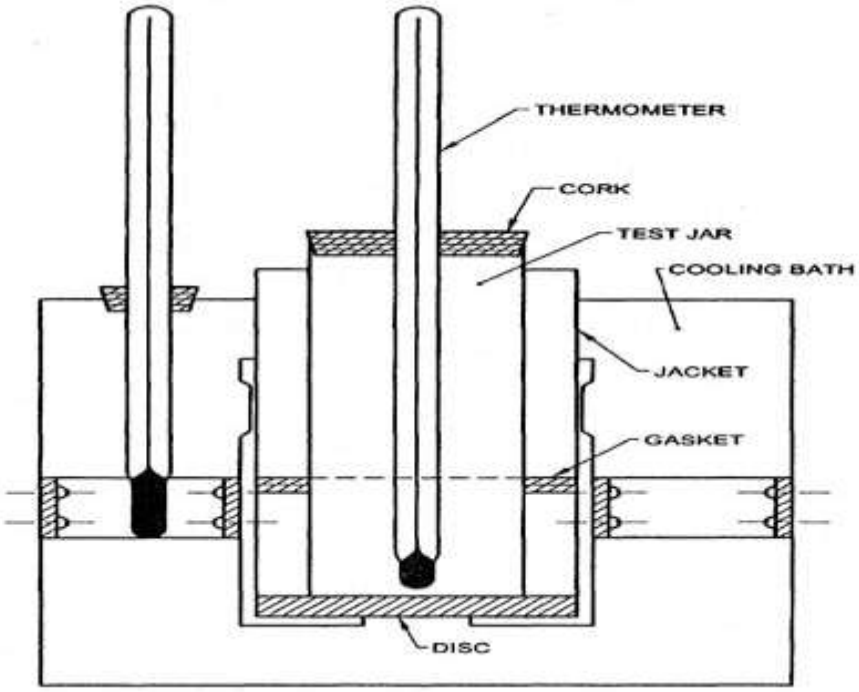
Experiment 6

Aim: To determine of pour point of given fuel.

Apparatus : pour point apparatus, thermometer.

Procedure :

1. fill the jar with sample oil
2. put thermometer in cork
3. keep the jar in cooling bath
4. keep cork to the jar
5. Initially oil will start to crystalline at lower temperature .
6. Take out jar and fill it.
7. If the sample flow keeps it again in the ball and reduce temperature.
8. Repeat the procedure until sample does not flow. When it is fitted and kept horizontally for 5 sec.s.



Result: **Pour point of given sample is _____**

C(4)	P(4)	A(2)	TOTAL	SIGN

Experiment 7

Aim: Determine the cloud point of given sample of fuel.

Apparatus: given fuel sample , thermometer , beaker , cooling bath , testing jar , cork etc.

Procedure:

1. Take cooled sample of fuel to be tested to a temperature at least 25^0C about the approximate cloud point.
2. Remove moisture present by filtration , if any , through any linthless filter paper until the fuel was perfectly clear.
3. Then pour the clean fuel into the test jar upto the level marked.
4. Adjust the position of cork carrying the test thermometer so that the cork fits tightly.
5. Thermometer and jar were co-axial and thermometer bulb was heating at the bottom of jar.
6. Then place the ring gasket around the test jar one inch from the bottom.
7. The disk gasket and inside the gasket should be clear and dry.
8. Insert the test jar in the jacket and maintain the temperature of cooling bath at 30-35 ^{0}C and put jacket containing test jar in the cooling bath.
9. After every 2^0C fall in temperature , remove the test jar from the jacket quickly , but without disturbing the fuel.
10. Inspect for the cloud and replace in the jacket.
11. The complete operation shall not require more than three seconds.
12. Repeat the procedure till inspection revels distinct cloudiness in the bottom of the test jar.
13. Record the readings.

Result: Cloud point of given sample of fuel is =---

Questions:

1) What is cloud point?

2) What is the significance of cloud point determination?

Answers:

_____

_____

_____

_____

C(4)	P(4)	A(2)	TOTAL	SIGN

Experiment 8

AIM: - Determination of viscosity of fuel by Red Wood Viscometer.

CHEMICALS- Given sample of fuel, suitable organic solvent like CCl4, ether, petroleum spirit or benzene.

APPARATUS: - Red Wood viscometer ,stop watch, Kohlrausch flask, thermometer, filter paper

THEORY:

Viscosity is the property of a fluid that determines its resistance to flow. It is an indicator of flow ability of a lubricating oil; the lowest the viscosity, greater the flow ability. It is mainly due to the forces of cohesion between the molecules of lubricating oil.

Absolute Viscosity may be defined as "the tangential force per unit area which is required to maintain a unit velocity gradient between two parallel layers. It is denoted by □(eta). Its Unit in CGS system is poise and its dimensions are ML-1T-1.

Viscosity Index: Viscosity generally decreases with increase in temperature. The maintenance of viscosity over the range of temperature is called the viscosity Index (V.I)

A relatively small change/no change in viscosity with temperature is indicated by high viscosity index whereas low viscosity index shows relatively large change in viscosity with temperature

Note: There is a direct correlation between molecular structure of lubricating oil with its viscosity and viscosity index. A high viscosity index is exhibited by those lubricating oils which have linear or rod like shape molecules with high molecular weight. This is due to the greater intermolecular forces of attraction Effect of temperature on viscosity of lubricating oil is inversely proportional to the temperature i.e. with increase of temperature,

Viscosity decreases. This is due to the decrease in intermolecular attraction

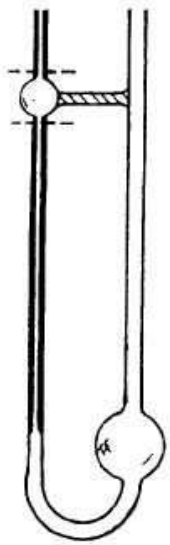
At higher temperature, oil must have sufficient viscosity to carry loads. Hence heavier oils are used at higher temperature. Similarly, light oils are used at low ambient temperature

Effects of pressure on viscosity Lubricating oils are subjected to extreme pressure at the interphase between gears and rolling element. At such higher pressure, viscosity of lubricating oil increases considerably. Viscosity helps in selecting good lubricating oil

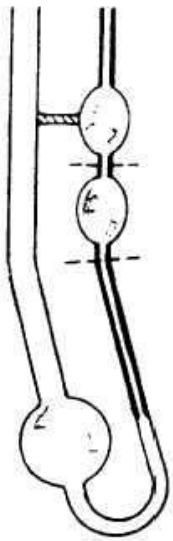
PROCEDURE: -

1. Select the appropriate viscometer, either Redwood viscometer No.1 or 2 depending up on the nature of fuel.
2. Clean the viscometer cup properly with the help of suitable solvent e.g. CCl4, ether, petroleum spirit or benzene and dry it to remove any traces of solvent.
3. Level the viscometer with the help of leveling screws.
4. Fill the outer bath with water.
5. Place the ball valve on the jet to close it and pour the test oil into the cup up to the tip of indicator.

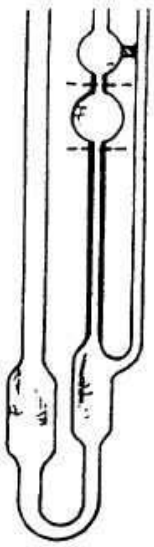
6. Set the viscosity bath at 40^{o}C.
7. Insert a clean thermometer and a stirrer in the cup and cover it with a lid.
8. Heat the water filled in the bath slowly with constant stirring. When the oil in the cup attains a desired temperature, stop the heating.
9. Lift the ball valve and start the stop watch. fuel from the jet flows into the flask.
10. Stop the stop watch when lower meniscus of the oil reaches the 50 ml mark on the neck of receiving flask.
11. Record the time taken for 50 ml of the fuel to collect in the flask.
12. Repeat the experiment for 100^{o}C to get more readings.



OSTWALD



CANNON-FENSKE



UBBELOHDE

OBSERVATIONS AND CALCULATIONS

Sr. No.	**Temperature in ^{0}C**	**Viscosity , t (Redwood seconds)**
1		
2		
3		
4		
5		

Result:

Questions:

1) What is viscosity index?

2) Explain any other method other than redwood viscometer to find viscosity index.

3) Give any five fuels found in market.

4) What are properties of good fuel?

Answers:

C(4)	P(4)	A(2)	TOTAL	SIGN

Experiment 9

Aim :**To determine the calorific value of given sample by using bomb calorimeter.**

THEORY:

The determination of the calorific value of wood chips is carried out in specially designed calorimeter. The type of calorimeter used will depends on the type of fuel under test.

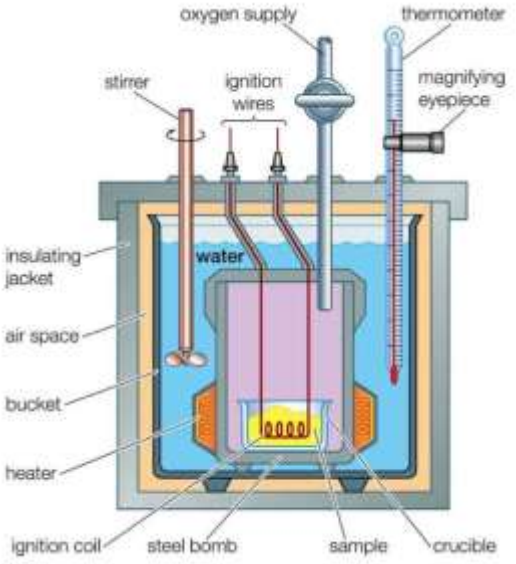
In the case of solid and some liquid fuels the calorific value is usually determined in a bomb calorimeter.In the case of gaseous and some liquids fuels the calorific value is determined in a gas calorimeter.

APPARATUS:

Bomb calorimeter, crucible

THE BOMB CALORIMETER

In this type of calorimeter a small quantity of the fuel under test is burnt at constant volume in a high-pressure container. Hence the name bomb calorimeter. Oxygen isadmitted to the bomb under pressure in order that the fuel may be burnt. The energy liberated is measured and hence the calorific value of the fuel determined.One such bomb calorimeter is shown



DESCRIPTION OF APPARATUS

The apparatus consists of a thick stainless steel wall, high-pressure cylinder into the top of which is introduced a non-return, oxygen admission value and a pressure release value.The calorimeter is mounted in a water container. In this mount there are registers for the feet of the bomb and also electrical constant in the base of the bomb. Electrical power isfed to the mount through lead-covered wire from a plug and socket. The can is itself mounted in another outer can, which serves as a heat insulator. Into the base of the outer can is set a wooden plat-form which serves as

a register for the can.The apparatus is covered by cone plate into which is set a stirrer. This stirrer spring-loaded and is horse-shoe shaped round the bomb. The cover plate is also pierced by a hole through which is inserted a thermometer, usually a Beckmann Thermometer.

PROCEEDURE:

An empty crucible was weighed and approximately 0.7g oil was put into it. The crucible was reweighed to ensure the correct amount of oil. The crucible with the oil was positioned in the seating in the bomb cover. A suitable piece-of ignition wire was attached across the terminals making sure it touched the oil surface.15 ml of distilled water was poured into the base of the bomb, and the bomb assembled carefully. The bomb was then charged with oxygen to 25 atmospheres and tested underwater for leaks. The calorimeter vessel was weighed and 2400 ml of water was added and reweighed to determine the correctly weight of water.The calorimeter vessel was positioned in the water filled jacket and the bomb was set in place in the calorimeter vessel. The water jacket provides a sensible constant temperature environment.The stirrer, Beckmann thermometer and electrical leads were connected and stirring gear was set in motion.The thermometer readings were observed at one minute intervals for a preliminary period of five minutes and then the firing circuit was completed.

The thermometer readings were continued at one minute intervals until the maximum temperature was attained. The temperature was observed further for five minutes at one minute intervals.The apparatus was dismantled and checked whether combustion had been completed.

TABLE OF RESULTS:

TIME /MINUTE	TEMPERATURE/^{O}C
PRELIMINERY PERIOD	
0	
1	
2	
3	
4	
5	
CHIEF PERIOD	
6	
7	
8	
9	
10	
AFTER PERIOD	
11	
12	
13	
14	
15	

Calculations:-

$Wf * Q = (Ww + Wa) (\Delta T)^0C * 4.2$
Where Wf (Kg) is the weight of fuel,
Q(KJ/Kg) is the calorific value,
Ww g is the weight of water in the calorimeter vessel,
Wa Kg is the water equivalent of the apparatus(0.482 Kg).

Wf =
Ww =
Wa =
Total weight of crucible and fuel = $Wf + Ww = 0.7 * 10^{-3} + 0.00741 + 8.11 * 10^{-3}$
$\Delta T = 26.43^0C - 23.57^0C = 2.86^0C$

$$Q = \frac{(Ww + Wa) (\Delta T)^0C * 4.2}{Wf}$$

Q =

Q =

PRECAUTIONS

In the experiment it should be ensured that the ignition wire is properly wired to the leads and also makes contact with the fuel (diesel)

Extreme caution is taken while working with water and the completely electrical apparatus.

The calorimeter was tested for leaks to prevent "wetting" the fuel.

Maximum attention is required to ensure simultaneous firing and timing

CONCLUSION
Due to unavailable material, the experiment could not be carried out. However, from experimental data previously obtained, it is clear that the results of the test are valid and the set objectives have been achieved.

C(4)	P(4)	A(2)	TOTAL	SIGN

EXPERIMENT 10

Aim: Calculate acid value of fuel.

Procedure :

- Weigh accurately 1 gm of fuel sample
- Transfer it to dry 250 ml conical flask.
- Add 75 ml anhydrous ethanol into flask.
- Dissolve fuel into ethanol.
- Fill the burette with 0.01 N KOH solution.
- Cool the solution and add phenolphthalein indicator.
- Titrate it with 0.01 N KOH solution placed in burette till solution turns pink.

Observations:

- Weight of fuel :----------(w) gm
- Solution in Burette : 0.1 N KOH solution
- Solution in Conical Flask : Fuel + Ethanol
- Indicator : phenolphthalein
- End Point : colourless to pink

Observation Table :

Readings	Pilot Reading	Burette Readings in ml			Constant Burette Reading
		I	II	III	
Initial					……X ml
Final					
Difference					

Calculations :

Acid value of fuel = $\frac{56 \times 0.01 \times \text{ml of KOH}}{\text{Weight of fuel}}$ mg of KOH

Acid value of fuel = ---------- mg of KOH.

Result :

Acid value of fuel = ---------- mg of KOH.

Questions

1. What is acid value of plastic material?

2. How the acid value of plastic material is determined?

3. Which polymer is used to determine the acid value?

C(4)	P(4)	A(2)	TOTAL	SIGN

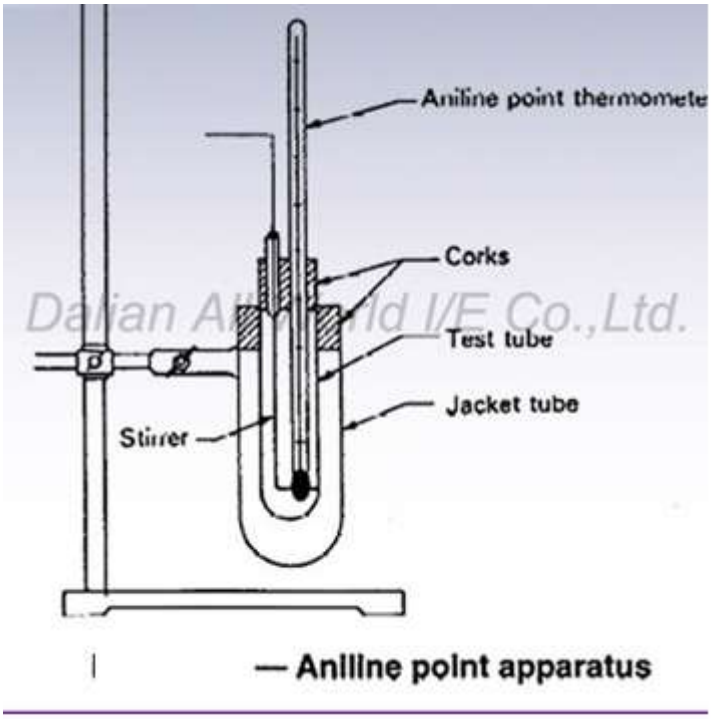
Experiment 11

Aim : To determine aniline point of given sample of fuel.

Theory: The aniline point of an fuel is defined as the minimum temperature at which equal volumes of aniline and fuel are miscible. The value gives an approximation for the content of aromatic compounds in the fuel, since the miscibility of aniline, which is also an aromatic compound suggests the presence of similar (i.e. aromatic) compounds in the fule. The lower the aniline point, the greater is the content of aromatic compounds in the oil as obviously a lower temperature is needed to ensure miscibility. The aniline point serves as a reasonable proxy for aromaticity of oils consisting mostly of saturated hydrocarbons (i.e. alkanes, paraffins) or unsaturated compounds (mostly aromatics). Significant chemical functionalization of the oil (chlorination, sulfonation, etc.) can interfere with the measurement, due to changes to the solvency of the functionalized oil.

Procedure:

1. clean & dry the apparatus
2. take 10ml aniline inside apparatus with stirrer & thermometer
3. Clean and dry the apparatus. Deliver 10 ml of aniline and 10 ml of the dried sample into the test tube fitted with stirrer and thermometer. If the material is too viscous for volumetric transfer, weigh to the nearest 0.01 g a quantity of the sample corresponding to 10 ml at room temperature. Center the thermometer in the test tube so that the immersion mark is at the liquid level, making sure that the thermometer bulb does not touch the side of the tube. Center the test tube in the jacket tube. Stir the mixture rapidly using a 50-mm (2-in.) stroke, avoiding the introduction of air bubbles.
4. If the aniline-sample mixture is not miscible at room temperature, apply heat directly to the jacket tube so that the temperature rises at a rate of 1 to 3°C (2 to 5°F)/min by removing or reducing the heat source until complete miscibility is obtained. Continue stirring and allow the mixture to cool at a rate of 0.5 to 1.0°C (1.0 to 1.8°F)/min. Continue cooling to a temperature of 1 to 2°C (2.0 to 3.5°F) below the first appearance of turbidity, and record as the aniline point the temperature at which the mixture suddenly becomes cloudy throughout (Note A1.1). This temperature, and not the temperature of separation of small amounts of material, is the minimum equilibrium solution temperature.
5. set the thermometer in the test tube so that it is at liquid making sure that they does not touches the side of wall .



— Aniline point apparatus

Result: Aniline point of given sample is_____

QUESTIONS:

1) What is aniline point?

2) What is the significance of aniline point?

3) What is an aromatic compound?

4) What are the uses of aromatic compounds?

5) Give the structural formula of aniline.

Answers:

C(4)	P(4)	A(2)	TOTAL	SIGN

Experiment 12

Aim: Determine the specific gravity of biofuel.

Apparatus: Biofuel , gravity bottole , beaker , weigh balance , etc.

Procedure:

1. Properly clean the specific gravity bottle.
2. Find out the weight of empty specific gravity bottle with stopper.
3. Take 50 ml of given sample of fuel in the specific gravity bottle , place the stopper and find out the weight using balance.
4. Repeat the procedure for two more times to get constant reading.

Observations and Calculations :

1.Observations –

1. Weight of empty specific gravity bottle =----------gm.
2. Volume of specific gravity bottle =----------ml.

2.Observation Table –

Sr.No.	Volume of Biofuel (ml)	Weight of Fuel + Bottle (gm)	Weight of Fuel (gm)	Density of Fuel (gm/ml)
1.				
2.				
3.				

Calculations –

1. Weight of fuel = (Weight of fuel + bottle) – Weight of empty bottle

   =

   =

2. Density of fuel= Weight of fuel / volume of fuel

   =

   =

Result: Specific gravity of given fuel sample is found to be--------

Questions:

1) What is specific gravity?

2) What is the specific gravity of water?

3) What affects specific gravity?

Answers:

_____

_____

_____

_____

_____

_____

_____

_____

C(4)	P(4)	A(2)	TOTAL	SIGN