

Petroleum Products and Test Methods

CRUDE OIL ANALYSIS

- Crude petroleum oil is a mixture of hydrocarbons. The hydrocarbon gases, methane, ethane, propane, and butane, are present in crude oil in its dissolved state.
 - Methane has a high vapor pressure and it escapes from crude oil unless pressure above the vapor pressure is maintained.
 - Usually it separates out from crude oil itself from the well and is collected separately as natural gas and a trace of it may be found in crude oil under atmospheric pressure.
 - Though ethane has a higher vapour pressure than propane and butane, traces of it are usually found in crude oil right from the well.
 - Propane and butane are present in the liquid state at slightly above atmospheric pressure owing to their low vapour pressure and high solubility in crude oil.
 - The propane–butane mixture is separated from crude oil and is used as liquified petroleum gas (LPG).
 - The remaining liquid hydrocarbons can be separated as boiling fractions such as naphtha cut (boiling up to 140°C), kerosene cut (boiling between 140°C and 270°C), gas oil or diesel cut (boiling between 270°C and 350°C), by heating and vaporizing the crude oil by a gradual increase in temperature followed by collection after condensation.

Boiling Point (BP)

Initial Boiling Point (IBP)

- The temperature of vapor giving the first drop of condensate is reported as the initial boiling point (IBP), which may be above or below 0°C depending on the presence of the lowest boiling hydrocarbon in crude.

True Boiling Point (TBP)

- The separation of hydrocarbons can be improved if the vapor and its condensates (reflux) are in intimate contact for some time during distillation and a reproducible distillation analysis is possible. Such a method of distillation is known as true boiling point (TBP) distillation.

Distillation of Crude Oil

- The composition of crude oil varies from well to well and it is essential to have a separate TBP analysis for each batch of oil purchased before refining.
- Hence, the yields of light to heavy fractions will vary from crude to crude.
- A small variation in TBP analysis may have a wide variation in the chemical constituents of the boiling fractions.
- The design of a distillation column of a refinery must be done **judiciously, depending on the availability of the crude oils,** which may have little difference in TBP analysis.
 - Crude oils having wide difference in TBP analysis cannot be distilled in the same column without sacrificing the yields and quality of the products.

Petroleum Products



Domestic Fuels

- **Liquified Petroleum Gas**

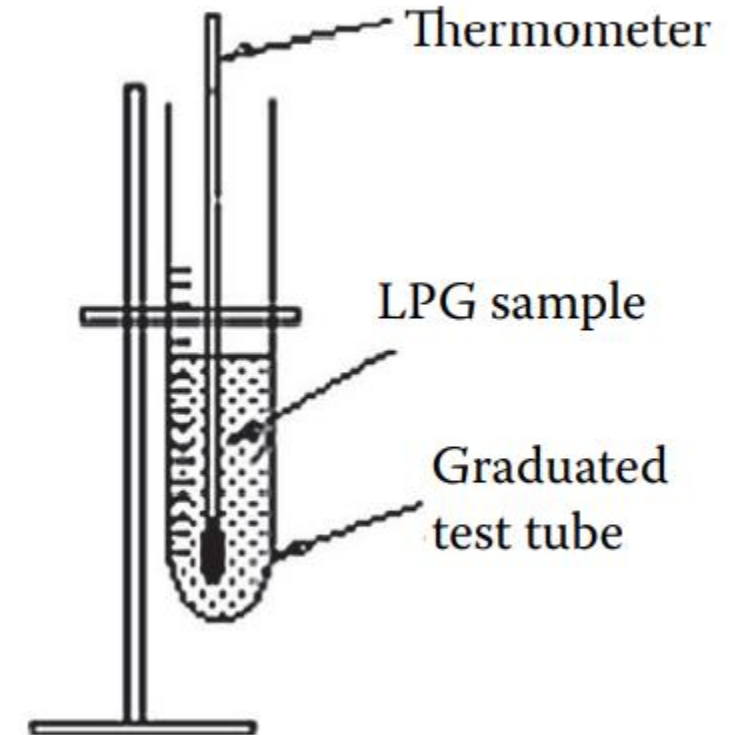
- Liquified petroleum gas (LPG) is a mixture of propane and butane in liquified form at a pressure of about 10–15 atm, depending on the proportion of the components present.
- Gases are odorous and corrosive
 - Raw hydrocarbons gases contain sulfur hydrocarbon such as mercaptans, hydrogen sulfide associated with these gases.
- LPG is tested for its quality by the **Weathering test**

Weathering Test Procedure

100 mL of liquid LPG is kept in a test tube with a mercury-in-glass thermometer dipped into it.

of the test Liquid LPG starts vaporizing through the open mouth tube to the atmosphere, causing the temperature to fall rapidly

After 95 mL of liquid is vaporised, the residual liquid temperature is noted. If the temperature is very low (below 0°C), then the proportion of propane in the mixture is more and if it is high (above 2°C), then the proportion of butane will be more.



Weathering test of LPG.

Observations of Weathering Test



For domestic use, the maximum weathering temperature should be 2°C.

Slightly lower than this 2 C temperature may be useful, but the carrying capacity in the cylinder will be reduced.



higher than this temperature should not be acceptable because incomplete vaporisation may occur at a low ambient temperature (e.g., in winter or in hilly places like Darjeeling).

Copper Strip Corrosion Test Procedure

LPG is tested for its corrosive properties by the copper strip corrosion test



a standard polished copper strip is dipped into liquid LPG in a thick-walled small vessel, known as a bomb, kept at a constant temperature, usually 30°C.



After 1 h (or maybe more depending on its end use), the bomb is opened and the copper strip is removed and compared its brightness of surface against a set of standard copper strips indicating different degrees of corrosion as ASTM 1, 1a, 1b, 2, 2a, etc.

Copper Strip Corrosion Test DEMO



Domestic Fuels

- KEROSENE

- Kerosene or superior kerosene oil (SKO) is another domestic fuel mainly used for lighting or lamp oil. It is also used as a domestic stove oil.
- It is a petroleum product that boils in the range of 140°C–280°C and is available from crude petroleum oil.
- It is heavier than naphtha or petrol (motor spirit, MS), but lighter than diesel oil.
- The major properties of kerosene that determine its burning quality are the smoke point and the flash point.

Smoke Point Test

The smoke point is determined as the height of the flame (in millimeters) produced by this oil in the wick of a stove or a lamp without forming any smoke. The greater the smoke point, the better the burning quality.

Domestic kerosene should have a smoke point of 20 mm (minimum).



Smoke is produced mainly due to the presence of carbon and heavy hydrocarbon particles in the flue gas. The presence of aromatic hydrocarbons contributes carbon atoms when burnt. In the refinery, aromatic hydrocarbons are removed by extraction to a desirable extent so that the smoke point becomes greater or near 20 mm.

This is measured in a standard testing apparatus consisting of a standard lamp with a wick of specified dimension and mass. In this apparatus, a mirror is provided to position the flame in the center such that the straight height of the flame can be measured in a graduated scale.

Flash Point Test Procedure

The flash point is defined as the temperature of the oil at which it momentarily flashes in the presence of air and igniting source.



The temperature of the oil in the bath is measured by a thermometer. The oil is heated at the rate of 5°C – 6°C per minute and a standard flame is introduced every 30 sec.



The temperature at which a momentary flash occurs is noted as the flash point.

Char Point and Bloom

Char point is defined as the coke and ash left on the wick after complete burning of the oil.

- For domestic kerosene, the maximum amount of char allowed is 20 mg/kg of oil burnt.
- If the oil contains more aromatics, more organic char may be found.

Bloom is the darkness produced by the flame of the oil while burning in a standard glass.

- The bloom should not be darker than a standard brightness desired in a lamp.

Distillation Test of Kerosene

- ASTM distillation of kerosene is carried out under atmospheric conditions.
- Finished kerosene must be at least 20% distilled at 200°C or lower and the final boiling point (FBP) should be no more than 300°C.
 - Kerosene that is too light is dangerous for use in a domestic kerosene stove as explosion may occur owing to the presence of a very light boiling fraction especially in the range of naphtha.
 - The presence of too heavy boiling fractions in kerosene will make it a poorly burning fuel.

Sulfur Content and Corrosion

- Domestic kerosene must not have a sulfur content of more than 0.25% by weight.
 - A corrosion test of kerosene is also carried out using the copper strip corrosion method.
 - Corrosiveness of oil will damage the storage tanks, stove containers, pipelines for transportation, etc.