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Experimental Determination of Flash Points of Flammable Liquids

Dr A Rajesh Kanna[1,^]; Purushotham.T[2]; Ashik Ibrahim[3]; Mohammed Sha S[3]; Vishnu G[3]& Livin Devassy[3]

[1,^]Professor & HOD, Department of Petroleum Engineering, LORDS Institute of Engineering & Technology, India.

[2]Associate Professor, Department of Petroleum Engineering, LORDS Institute of Engineering & Technology, India.

[3] B.Tech students, Department of Petroleum Engineering, LORDS Institute of Engineering & Technology, India.

^ Corresponding author email: rajeshkanna@lords.ac.in

Abstract :- *This project takes in to account of flash point of different fuel (petrol, diesel, kerosene) available in the state of Telangana (India).The purpose of this experiment is to determine the flash points of flammable liquids. Flash point is an important safety data for petroleum fuels and derived products during processing, transportation and storage of these materials especially in a high temperature environment. Flash point is an important property of a flammable liquid.*

Keywords: - Combustion, Flash point, Liquids,

I. INTRODUCTION

The flash point of a volatile material is the lowest temperature at which vapors of the material will ignite, given an ignition source. The flash point is defined as the lowest temperature at which a liquid generates flammable vapors which can be ignited in air by a flame above its surface. The flash point is determined experimentally by heating a vessel containing the tester liquid. Good lubricating oil should not volatilize under the working temperatures. Even if some volatilization takes place the vapors formed should not form inflammable mixture with air under the conditions of lubrication. From this point of view, the flash point of lubricating oil is significant

1. Flash point is used in shipping, storage, and handling safety regulations as a classification property to define 'flammable' and 'combustible' materials. Precise definition of the classes is given in each particular regulation.
2. Flash point may indicate the possible presence of highly volatile materials in a relatively non-volatile or non- flammable material.
3. Since the presence of small proportions of highly volatile materials need to be detected, this test shall be the first determination on a received sample

The flash point is a descriptive characteristic that is used to distinguish between flammable liquids, such as petrol, and combustible liquids, such as diesel. The advantages of finding flash point as follows,

The Flash Point of oil may be defined as the minimum temperature to which it must be heated to give off sufficient vapour to ignite momentarily or less than 5 seconds when a flame of standard dimensions (Aprrox. 4 mm) is brought near the surface of the sample for a prescribed rate in an apparatus of specified dimensions. This is detected by the appearance of momentary flash upon the application of small flame over the surface of oil. The Flash Point is defined as closed cup or open cup flash point accordingly as the apparatus for the determination of flash point of sample is provided with a cover to cover the sample cup or not. Whereas the Fire Point of oil may be defined as the minimum temperature to which it must be heated to give off sufficient vapour to ignite for more than 5 seconds when a flame of standard dimensions (Aprrox. 4 mm) is brought near the surface of the sample for a prescribed rate in an apparatus of specified dimensions. The mechanism of the appearance of the flash can be explained in the following manner. Every flammable liquid has a vapour pressure, which is a function of the liquid's temperature. As the temperature increase, the vapour pressure increases, as the vapour pressure increases, the concentration of evaporated flammable liquid in the air increases. Hence, temperature determines the concentration of its vapour in the air to sustain combustion. The flash point of a flammable liquid is the lowest temperature at which there can be enough flammable vapour to ignite, when an ignition source is applied. Oil containing minute quantities of volatile organic substances is liable to flash below the true flash point of the oil. Importance of flash point from view of

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lubricants: Good lubricating oil should not volatilize under the working temperatures. Even if some volatilization takes place, the vapour formed should not form inflammable mixture with air under the condition of lubrication. From this point of view, the flash point of lubricating oil is of vital importance. Lubricating oil selected for the job should have a flash point which is reasonably above its working temperature. This insures the safety against the fire hazards during the storage, transport and use of the lubricating oil. This test is immense importance for illuminating and lubricating Oils. This helps in detecting the highly volatile constituents of the oils. If they are highly volatile at ordinary temperature, the issuing vapors may cause fire hazards. So to ensure safety, certain minimum temperatures are laid down for fuels and Lubricating Oils below which they should not give off adequate vapors to make them burn.

1.1 FLAMMABLE AND COMUSTIBLE LIQUID

Generally, a flammable liquid is a combustible liquid that can easily catch fire. However, it is not the liquid itself that burns, but the vapor cloud above the liquid that will burn if the vapor's concentration in air is between the lower flammable limit (LFL) and upper flammable limit (UFL) of the liquid at normal room temperatures; flammable liquids can give off enough vapour to form burnable mixtures with air. As a result, they can be a serious fire hazard. Flammable liquid fires burn very fast. They also give off a lot of heat and often clouds of thick, black, toxic smoke. Combustible liquids at temperatures above their flashpoint also release enough vapour to form burnable mixtures with air. Hot combustible liquids can be as serious a fire hazard as flammable liquids. Spray mists of flammable and combustible liquids in air may burn at any temperature if an ignition source is present. The vapours of flammable and combustible liquids are usually invisible. They can be hard to detect unless special instruments are used. Most flammable and combustible liquids flow easily. A small spill can cover a large area of workbench or floor. Burning liquids can flow under doors, down stairs and even into neighboring buildings, spreading fire widely. Materials like wood, cardboard and cloth can easily absorb flammable and combustible liquids. Even after a spill has been cleaned up, a dangerous amount of liquid could still remain in surrounding materials or clothing, giving off hazardous vapours.

Figure 1: The international pictogram for flammable chemicals

1.2 ABEL'S CLOSED CUP FLASH POINT APPRATUS

The Abel's flash point apparatus consists thermometers; stirrer, oil cup, heating vessel and water bath are there. Two thermometers are provided, one for the oil cup in the bush when the stirrer is not in use and another for the water bath. Stirrer is made of brass or gun metal, and consists of a round stem having four blades or vanes silver soldered in place at one end. A collar is fixed on the stem so that when the stem is inserted into the bush from below, it is arrested at a position such that the correct length protrudes into the oil cup. Oil cup is made of brass or gun metal and consists of a cylindrical vessel open at the top and fitted on the outside with a flat circular flange projecting at right angles. Within the cup, fixed through the wall and silver-soldered or brazed in place, there is gauge consisting of a piece of wire bent upwards and terminating in a point. The heating vessel or bath consists of two flat-bottomed cylindrical copper vessels placed coaxially, one inside the other, and soldered at their tops to a flat copper ring, greater in outside diameter than the larger vessel and of smaller inside diameter than the smaller vessel. The space between the two vessels is thus totally enclosed and is used as a water jacket**.**

Figure 1: Abel's closed cup flash point apparatus

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II. PROCEDURE

a) Fill the given sample in such a way that the sample level is exactly up to the mark in the cup.

b) Fix the cup in to the apparatus and cover with lid. Insert thermometer in the thermometer holder given in the cup in such a manner that it will not directly touch the lower bottom of the cup and the paddle stirrer inside the cup. Fill the water bath with the cold water.

c) Close the sliding shutter and light the standard flame. Adjust the size of flame (4mm diameter) with respect to the metal bead.

d) Stir the oil using paddle stirrer.

e) Introduce the flame by opening the shutter and check the appearance of the flash.

f) Now heat the apparatus and set the rate of temperature increase at the rate of 1 to 2 0C per minute. Check the flash point of given sample at the interval of 3 0C rise in the temperature. Discontinue the stirring the sample during the introduction of the test flame.

g) On observing a flash, stop the heating process and allow the temperature to decrease.

h) Check the occurrence of a flash at every 1 0C drop in temperature at which the flash is observed as the flash point of the sample.

Precautions are as follows,

1. Oil should be stirred at regular interval.

2. The flame should be introduced carefully and the flash point should be observed carefully.

III. OBSERVATION

PETROL:-

Sr. No.	Temperature (°C)	Flash observed / not observed
1.	-23	NILL
2.	-29	NILL
3.	-33	NILL
4.	-38	NILL
5.	-43	OBSERVED

DIESEL:

Sr. No.	Temperature (°C)	Flash observed / not observed
1.	28	NILL
2.	34	NILL
3.	40	NILL
4.	46	NILL

5.	52	OBSERVED

KEROSENE:-

Sr. No.	Temperature (°C)	Flash observed / not observed
1.	50	NILL
2.	55	NILL
3.	60	NILL
4.	65	NILL
5.	72	OBSERVED

IV. CONCLUSION

The experiment had given us some knowledge about the flash point and basic operation of an Abel's closed cup flash point apparatus; we also under stood the flash point of different fuel available in the market.

The flash point of petrol, diesel, kerosene are petrol > diesel > kerosene.

Flash point is defined as the lowest temperature of a liquid at which its vapours will form a combustible mixture with air. It is a convenient and reliable classification of the flammability of many substances, there are three main categories;

- Extremely flammable: Flash point below $0^{o}C$
- Highly flammable: Flash point below $21^{o}C$
- Flammable: Flash point below $55^{o}C$

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