International Refereed Journal of Engineering and Science (IRJES)
ISSN (Online) 2319-183X, (Print) 2319-1821
Volume 6, Issue 3 (March 2017), PP.18- 21

Determination of Aniline Point of Petroleum Samples

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ABSTRACT:– Aniline point is the minimum temperature for a complete mixing of aniline and materials such as gasoline; used in some specifications to indicate the aromatic content of oils and to calculate approximate heat of combustion.

Keywords: – Aniline point, Aromaticity, Cetane number, Miscibility.

I. INTRODUCTION

In Determination of aniline point is a test to evaluate base oils that are used in oil mud. The test indicates if oil is likely to damage elastomers (rubber compounds) that come in contact with the oil. The aniline point is called the "aniline point temperature," which is the lowest temperature (°F or °C) at which equal volumes of aniline ($C_6H_5NH_2$) and the oil form a single phase. Aniline point of oil gives an indication of the possible tendency of deterioration of oil when it comes into contact with packing ,rubber sealing etc. in general oils with a high aromatic content are more detrimental to rubber products than those with a low aromatic content. The relative aromatic content of an oil is indicated by its anilinepoint and oils with a high aromatic content have a low aniline point and vice versa. The higher theaniline point of the oil ,the more desirable it is for drilling fluid usage. In our experiment, 5 ml aniline and5ml diesel were taken in a test tube provided with thermometer and heat was given until both aniline and diesel become completely miscible. The aniline point of diesel was found at the temperature of 94°C.

By definition, the aniline point is the lowest temperature at which equal volume of aniline and oil are completely miscible (clear). This method is suitable for transparent liquid samples having an initial boiling point above room temperature and where the aniline point is below the bubble point and above the solidification point of the aniline sample mixture. The procedure is useful in characterizing pure hydrocarbons. The lower the aniline point, the greater the solvency or reactivity of the oil, which in turn gives an indication of the oils aromaticity. Paraffinic hydrocarbons have higher aniline points than aromatic types (Mair & Willingham 1936; Rossini 1937). For instance, for an aromatic oil with a 75%aromatic content, the aniline point would be between 32.2° and 48.9°C; for a naphthenic type containing 40% aromatic structures, it would be between 65.6° and 76.7°C; and for a paraffinic oil with a15% aromatic content it would be between 93.3° and 126.7°C.In a homologous series, the aniline point for mixtures of hydrocarbons such as diesel oils and mineral oils serves as a guideline for judging the aromatic hydrocarbon content of oil and for comparing oil. Aniline being an aromatic compound freely mixes with aromatics; so a low aniline point indicates a low diesel index. Aniline point also predicts the amount of carbon present in the aromatics , as given by the formula:

$\%C_A = 1039.4n\ d_{20} - 470.4d_{20} - 0.567AP\ (°C) - 1104.42;$ (1)

Where, n_d^{20}=refractive index at 20°C

d_{20} =density at 20°C

Diesel index is a measure of ignition quality of fuel

1.1 DIESEL

In Petroleum diesel, also called petrol, diesel, or fossil diesel is the most common type of diesel fuel. It is produced from the fractional distillation of crude oil between 200 °C (392 °F) and 350 °C (662 °F) at atmospheric pressure, resulting in a mixture of carbon chains that typically contain between 8 and 21 carbon atoms per molecule [2].

1.2 PETROL

Gasoline also known as petrol outside North America is a transparent, petroleum-derived liquid that is used primarily as a fuel in internal combustion engines. It consists mostly of organic compounds obtained by the fractional distillation of petroleum, enhanced with a variety of additives. On average, a 42-gallon barrel of crude oil (159 L) yields about 19 US gallons (72 L) of gasoline when processed in an oil refinery, though this varies based on the crude oil source's assay

1.3 KEROSENE

Kerosene, also known as paraffin, lamp oil and coal oil (an obsolete term), is a combustible hydrocarbon liquid which is derived from petroleum, widely used as a fuel in industry as well as households. Kerosene is widely used to power jet engines of aircraft (jet fuel) and some rocket engines, and is also commonly used as a cooking and lighting fuel and for fire toys such as poi. In parts of Asia, where the price of kerosene is subsidized, it fuels outboard motors on small fishing boats.World total kerosene consumption for all purposes is equivalent to about 1.2 million barrels per day [1].

1.4 JET FUEL

Jet fuel, aviation turbine fuel (ATF), or avtur, is a type of aviation fuel designed for use in aircraft powered by gas-turbine engines. It is colorless to straw-colored in appearance. The most commonly used fuels for commercial aviation are Jet A and Jet A-1, which are produced to a standardized international specification. The only other jet fuel commonly used in civilian turbine-engine powered aviation is Jet B, which is used for its enhanced cold-weather performance. Jet fuel is a mixture of a large number of different hydrocarbons. The range of their sizes (molecular weights or carbon numbers) is defined by the requirements for the product, such as the freezing or smoke point. Kerosene-type jet fuel (including Jet A and Jet A-1) has a carbon number distribution between about 8 and 16 (carbon atoms per molecule); wide-cut or naphtha-type jet fuel (including Jet B), between about 5 and 15 [2].

1.5 BIO DIESEL

Biodiesel refers to a vegetable oil - or animal fat-based diesel fuel consisting of long-chain alkyl (methyl, ethyl, or propyl) esters. Biodiesel is typically made by chemically reacting lipids (e.g., vegetable oil, soybean oil, animal fat (tallow) with an alcohol producing fatty acid esters.

Biodiesel is meant to be used in standard diesel engines and is thus distinct from the vegetable and waste oils used to fuel *converted* diesel engines. Biodiesel can be used alone, or blended with petrodiesel in any proportions. Biodiesel blends can also be used as heating oil.

II. EQUIPMENT USED

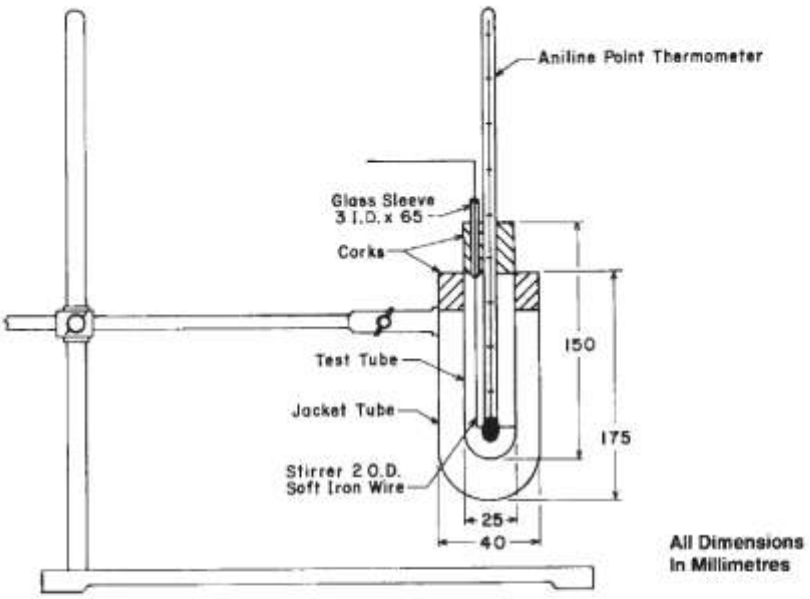

Fig. 1: Aniline Point Apparatus

The apparatus consist of the following:

1. Test Tube, approximately 25 mm in diameter and 150 mm in length, made of heat-resistant glass.
2. Jacket, approximately 37 to 42 mm in diameter and 175 mm in length, made of heat-resistant glass.
3. Stirrer, manually operated, metal, approximately 2 mm in diameter (14 B&S gage) metal wire concentric ring shall be at the bottom, having a diameter of approximately 19 mm. The length of the stirrer to a right-angle bend shall be approximately 200 mm. The right-angle bend shall be approximately 55 mm long. A glass sleeve approximately 65 mm in length of 3-mm inside diameter shall be used as a guide for the stirrer. Any suitable mechanical device for operating the stirrer as specified is an approved alternative for the manual operation [4].

III. EXPERIMENTAL PROCEDURE

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. 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 this temperature, and not the temperature of separation of small amounts of material, is the minimum equilibrium solution temperature.

IV. OBSERVATIONS

SL.NO:	SAMPLE	VOLUME OF SAMPLE TAKEN(ml)	VOLUME OF ANILINE TAKEN (ml)	ANILINE POINT (^{0} C)
1.	Diesel	5	5	71
2.	Petrol	5	5	65
3.	Kerosene	5	5	74
4.	Jet fuel	5	5	80
5.	Bio diesel	5	5	59.5

V. RESULTS

Aniline point of diesel = 71°C
Aniline point of petrol = 65°C
Aniline point of kerosene = 74°C
Aniline point of jet fuel = 80°C
Aniline point of bio diesel = 59.5°C

VI. CONCLUSION

Specified volumes of aniline and sample, or aniline and sample plus *n*-heptane, are placed in a tube and mixed mechanically. The mixture is heated at a controlled rate until the two phases become miscible. The mixture is then cooled at a controlled rate and the temperature at which two phases separate is recorded as the aniline point or mixed aniline point.

VII. ACKNOWLEDGEMENTS

I am immensely grateful to Dr. A. Rajesh Kanna, Professor & HOD of Petroleum Department, for providing me valuable suggestions and helping in drafting and preparation of manuscript with necessary information during my project work. I am immensely indebted to my mentor Mr. Nagaraju, Assistant Professor whose guidance and expertise has helped me immensely during the tenure of my project. I am also expressing my deep sense of gratitude to Mr. Srikant, Associate Professor who helped us to complete our project work.

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