STUDY OF ADULTERATION IN TRANSPORTATION FUEL

[1]BHARAT CHANDRA PANDEY, [2]SYED NAVED ALI , [3]ANAMIKA PAUL

[1,2,3]School of chemical engineering (Galgotias university) Greater Noida
E-mail: [1]bpandey2070@gmail.com, [2]syedalinaved@gmail.com,[3]anamika.sikdar@gmail.com

Abstract- Kerosene is common adulterant which is used for mixing with diesel and petrol. Five fuel-adulterant mixtures in different proportions by volume were prepared and individually tested for density and kinematic viscosity. In this research paper the mixtures were administered to transportation vehicles and the tail pipe exhaust emission was tested for opacity value. The variation in density did not observe at different level of adulteration so to find out the adulteration density test is not sufficient even at higher adulteration. The value of kinematic viscosity decreases at higher level of adulteration Considerable decrease in kinematic viscosity, a departure from prescribed viscosity, was noted at higher adulteration level. In small level of adulterant the value of opacity also decreases which can be observed by opacity meter. The density test is not sufficient for testing of adulteration in transportation vehicles. The value of opacity and kinematic viscosity can show result diesel adulteration test parameters.

Keywords- Adulteration, Diesel, Kerosen**e**, Petrol, Transportation

I. INTRODUCTION

Adulteration is defined as the illegal or unauthorized introduction of foreign substance into gasoline or similar substance, with the result that the product does not conform to the requirements and specifications of the product. The foreign substances are also called adulterants, which when introduced alter and degrade the quality of the base transport fuels Transport fuels (gasoline and diesel) are often adulterated with other cheaper products or by-product or waste hydrocarbon stream for monetary gains. Some of the effects of adulteration are outlined below :-

(i) Mal-functioning of the engine, failure of components, safety problems etc. The problem gets further magnified for high performance modern engines.
(ii) Increased tailpipe emissions of hydrocarbons (HC), carbon monoxide (CO), oxides of nitrogen (NOx), particulate matter (PM) can also cause increased emissions of air toxin substances.
(iii) Adulteration of fuel can cause health problems directly in the form of increased tailpipe emissions of harmful and sometimes carcinogenic pollutants. While indirectly in the form of diversion of kerosene to the automobile sector for adulteration, thus prompting the use of biomass as domestic fuel which in turn leads to health problems of various types due to indoor air pollution. It may be noted that all forms of adulteration are not harmful to public health. Some adulterants increase emission of harmful pollutants significantly, whereas others have little or no effect on air quality.
(iv) Significant loss of tax revenue: Various estimates have been made of the extent of financial loss to the national GDP (Gross Domestic Product), as well as the oil companies as a result of diversion of kerosene, which is mixed with petrol and diesel.

Types of fuel adulteration

• Blending of lubricants into kerosene as a substitute for diesel.
• Blending of kerosene into petrol.
• Blending of kerosene into diesel and
• Blending of used lubricants into diesel.

The urban metropolis growth is associated with increasing number of automobiles to meet chiefly public conveyance and goods transport. Kathmandu city is no exception to this phenomenon. The vehicle models on road range from old to the recent and their traffic is a source among others to urban air pollution.Automobile fuel adulteration is a clandestine and profit oriented operation. Adulteration of diesel by mixing kerosene is a common and widespread practice. Many vehicles seldom maintained properly run on adulterated fuels. An assessment of the extent of emission, represented by opacity value and fuel quality tests with varied composition of fuel (diesel) and adulterant (kerosene) proportions in diesel was the focus of the study. The objectives of the study were to assess the of usefulness of density and kinematic viscosity tests applied to different proportional mixtures of fuel and adulterant and also to assess variation in opacity value (k-value) of emission from combustion of adulterated diesel (kerosene in diesel) consequent to the extent of adulteration.

II. MATERIAL AND METHODS

Procurement of pure diesel

The diesel (20 liters) was procured from petrol filling station. The purity was ensured by testing density and kinematic viscosity and comparing the values obtained with respective prescribed values. The adulterant used was kerosene (5 liters) procured from a local government source.

Preparation of custom proportions mixture of fuel and adulterant

Diesel and kerosene was mixed in volume by volume in six different proportions (100:0, 90:10, 80:20, 70:30, 60:40 and 50:50; volume by volume mixture preparation). The final volume of the prepared fuel-adulterant mixture was 1 liters and this mixture was subjected for testing emissions separately for percent opacity value (k-value).

III. LABORATORY TESTS

The Laboratory tests conducted were density and kinematic viscosity. Calibrated hydrometers and thermometers were used for density testing and American Society for Testing Materials (ASTM 1953) chart was used to convert the observed density to density at 15 °C. The kinematic viscosity of diesel was estimated by using 'U' type calibrated viscometer and the time to be recorded for viscosity testing was noted with help of calibrated stopwatch**.**

Prerequisite vehicle maintenance work and emission test

Diesel loading vehicles (Make: Tata Mobiles, Model 2010) manufactured between the years of 2000 to 2010 were selected for the tests. The air cleaner filter, oil filter, engine oil were replaced and the setting of valve clearance and the ignition timing was set according to the manufacturer specification. This maintenance work was done for all the six selected vehicles prior to subjecting them to the emission test. The diesel vehicles emission tester RTM430 opacimeter was used which was suitable for testing compression ignition engines. The opacity value (k value) was estimated after administering of each of diesel-kerosene mixture. The requisite conditions to be followed for vehicles to be tested and the specified calibration steps of the emission tester were strictly adhered to as prescribed and specified in the manual of the emission-testing equipment. The density tests conducted for different fuel and adulterant mixtures varied between 0.8460 g/ml to 0.8250 g/ml (Table 1). The Kinematic viscosity reading in centistokes at different adulteration levels showed decreasing trend with the increasing level of adulteration. There was a considerable decrease in the kinematic viscosity at higher adulteration levels. Compared to the prescribed viscosity the departure observed was substantial. The percent opacity value (% k-value) with respect to the tail pipe exhaust emission decreased sharply even with a small amount of adulterant addition; at 10% adulteration level the k-value was 90% (Table 2). The emission test conducted with existing diesel (that is commercially dispensed at automotive fuel pump stations) indicated 25% to 45% kerosene presence in diesel.

IV. DISCUSSION AND CONCLUSION

The tests results of density and kinematic viscosity were compared with corresponding values prescribed as standards by Indian Standard specification for motor gasoline and high speed diesel. The standard prescribed density for diesel fuel is a value-range from 0.82 to 0.86 gm/dl (Indian Standard, Specification for High Speed Diesel, 2000). The observations from the experiment suggested that density was within the prescribed range immaterial of diesel-adulteration level with kerosene (Table 1).The presence of kerosene did not to alter density of diesel appreciably and hence density test for adulteration with kerosene is not useful. The observed variation in opacity with different proportions of adulterant although not sharp, showed a decreasing trend with increasing adulterant presence in diesel. Both kinematic viscosity and percent opacity tests therefore are good indicators in the assessment of kerosene adulteration extent. Compared to the density test, kinematic viscosity test was a better indicator for assessment of adulteration level. An intrinsic intensity modulated fiber optic sensor for determining adulteration of petrol and diesel by kerosene is reported (Sukhdev, 1999).

Table 1. Density and kinematic viscosity of diesel fuel and adulterant kerosene at different proportions

S.No.	Diesel and kerosene ratio	Density @15^{0}C (g/ml)	Kinematic viscosity @40 ^{0}C
1	Pure diesel	0.8456	2.63
2	Prescribed level	0.82-0.86	2-3
3	90:10	0.8460	2.15
4	80:20	0.8410	2.10
5	70:30	0.8360	1.95
6	60:40	0.8330	1.88
7	50:50	0.8250	1.60

Table 2 :Variation in opacity value (% k-value) in diesel fuel according to different fuel and adulterant proportions

S.No	Diesel and kerosene	Mean opacity value
1	Pure diesel	100
2	Existing diesel in fuel tank	76
3	90:10	85
4	80:20	81
5	70:30	79
6	60:40	72
7	50:50	70

Another study pertains to diesel fuel contamination by excitation emission matrix spectral subtraction fluorescence; it is reported that this method is efficacious in the whole range of 0-90%v/ v of various adulterants present in diesel (Digambara, 2001). However, the kinematic viscosity and density tests are considered routine fuel quality test parameters for which prescribed values considered as standard values are available. An attempt to estimate the extent of adulteration (possibly with kerosene) of the existing diesel in the fuel tank of vehicles in terms of emission of was carried out. The emission prescription of opacity percent value for diesel not mixed with kerosene (pure fuel) was considered as 100% and a comparison was made to the emissions from the fuel that existed in the vehicles selected and subjected to the emission tests. However, the vehicle maintenance steps were followed before subjecting to emission test. This experiment gave an estimate of extent of adulteration of diesel dispensed at the diesel filling-stations in the city. The tests indicated a considerable diesel adulteration level, warranting strict compliance and dispensation of fuels of prescribed quality. If neglected, the adulteration level could rise to further higher levels and could be cause for increased ambient air pollution and consequent increased morbidity.

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