Journal of Civil Engineering and Environmental Technology
p-ISSN: 2349-8404; e-ISSN: 2349-879X; Volume 3, Issue 1; January-March, 2016, pp. 86-88

http://www.krishisanskriti.org/Publication.html

Study of Emission from Adulterant Fuel on Environment

Bharat Chandra Pandey[1], Syed Naved Ali[2] and Anamika Paul[3]

[1]M. Tech School of Chemical Engineering Galgotias University
[2,3]School of Chemical Engineering Galgotias University
E-mail: [1]bpandey2070@gmail.com, [2]syedalinaved@gmail.com, [3]anamikasikdhar@gmail.com

Abstract—*Air pollution which is caused by automotive fuel emissions, especially NOx, particulate matter (PM), carbon monoxide CO and unburned hydrocarbons (HC), has been a noteworthy and serious matter for environment. The effects of fuel properties on the emissions and engine performance research have been performed worldwide. In India, ambient air pollution is one of the major factors of hazards to environment and human health. The ambient air pollutants (AAP) such as, volatile organic compounds (VOC's), SO_2, NOx, particulate matter (PM)and polycyclic aromatic hydrocarbon (PAHs) are emitted from the automobile exhausts and industrial activity. Adulteration increases emissions of harmful pollutant from vehicles and worsening urban air pollution that could cause adverse impact on health. Fuel adulteration causes marked effect on the tailpipe emissions of vehicles, as adulterants alter the chemistry of the base fuel rendering its quality inferior to the required commensurate fuel quality for the vehicles. This in turn affects the combustion dynamics inside the combustion chamber of vehicles increasing the emissions of harmful pollutants significantly. Air toxin emissions, such as benzene, depend mostly on fuel composition and catalyst performance. The result showed that addition of kerosene in gasoline results in higher level of emission of hydrocarbons, CO and PM, even in catalyst equipped cars. The emissions of air pollutants was reported due to adulteration of fuels that depend on maintenance of engine, fuel quality, air-fuel ratio, engine speed, load and operating temperature.*

Keywords*: Adulteration, Diesel, Emission, Pollution, Vehicle.*

1. INTRODUCTION

Gasoline is a complex mixture of several hundred of liquid, volatile and inflammable petroleum derived compounds, ranging from C_4 to C_{12} carbon atoms and boiling points in the range of 35–220 ^{0}C.One of the great preoccupations with the gasoline quality is the addition of organic solvents on transportation fuel [1]. The solvents normally used in this adulteration practice are aromatic hydrocarbons, light and heavy aliphatic hydrocarbons as well. In fact, the majority of these compounds are gasoline constituents. Light aliphatic hydrocarbons, when added to gasoline tend to reduce the departure of engine. Aromatic hydrocarbons need more energy to explode [2]. Heavy aliphatic hydrocarbons increase knock, engine wear and increase the probability of more serious consequence. The main consequences of this practice are: fiscal evasion, disloyal competition by fuel price, and potential hazards to the environmental and minor durability of the vehicle combustion motor [3]. 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 [4]. Gasoline is a major transport fuel in India. Adulteration of the fuel at the point of sale and during transportation has become an acute problem in the country. Transport fuels (gasoline and diesel) are often adulterated with other cheaper products or by-product or waste hydrocarbon.

2. CAUSES OF FUEL ADULTERATION

Most developing country governments have not yet established a monitoring regime and system of fines that can act as a strong deterrent to fuel adulteration. There are number of reasons for this, including poor governance, a lack of political will and public awareness, weak regulatory agencies and a shortage or even absence of technical staff and equipment for designing and conducting monitoring [5].The primary factors encouraging the practice of adulteration are the following –

- Existence of differential tax levels amongst the base fuels, intermediate products and byproducts. The adulterants being taxed lower than the base fuels give monetary benefits when mixed with replacing a proportion of the base fuels.
- Differential pricing mechanism of fuels and adulterants and easy availability of adulterants in the market.
- Lack of monitoring and consumers awareness.
- Lack of transparency and uncontrolled regulations in the production-supply and marketing chain for intermediates and by products of refineries.

- Non-availability of mechanism and instruments for spot-checking the quality of fuels.

3. ADULTERATION AND EMISSIONS

Fuel adulteration causes marked effect on the tailpipe emissions of vehicles, as adulterants alter the chemistry of the base fuel rendering its quality inferior to the required commensurate fuel quality for the vehicles [6]. This in turn affects the combustion dynamics inside the combustion chamber of vehicles increasing the emissions of harmful pollutants significantly. In some cases effects of adulteration are indirect; for example, large scale diversion of rationed kerosene subsidized for household use to the diesel sector for mixing with diesel not only hamper engine performance of diesel vehicles, but also deprives the poor of kerosene which can otherwise be used for cooking and as a consequence of lack of availability of subsidized kerosene force the poor to continue to use biomass which expose them to high levels of indoor pollution [7]. Adulterated fuel increases tailpipe emissions of hydrocarbons (HC), carbon monoxide (CO), oxides of nitrogen (NOx) and particulate matter (PM). Air toxin emissions, which fall into the category of unregulated emissions, of primary concern are benzene and poly aromatic hydrocarbons (PAHs), both well known carcinogens [8]. Kerosene is more difficult to burn than gasoline; its addition results in higher levels of HC, CO and PM emissions even from catalyst-equipped cars. The higher sulfur level of kerosene is another issue. The consequences to long term air pollution, quality of life and effect on health are simply ignored [9].

4. MATERIALS AND METHODS

In the research paper of a four-stroke, four-cylinder, water-cooled, spark-ignition engine of brake power 62 kW at rated speed of 4500 rpm was used. Fuels (gasoline and kerosene) were bought from a major oil marketer. For the mixture preparation of gasoline and kerosene, six sets of sample mixture were prepared in 100: 00, 95:5, 85: 15, 75: 25, 65: 35, 55: 45 ratios. Tests of engine performance on pure gasoline (100: 00) were conducted as a basis for comparison. The engine was run on “no load” condition and its speed adjusted to 4500 rpm by adjusting the fuel control valve and the engine was run for at least 15 min. The experiments were done for samples namely: 100: 00, 95:05, 85: 15, 75: 25, 65: 35 and 55: 45 ratios. Gaseous exhaust emissions were measured with the aid of pocket gas TM-portable gas analyzer. During the experiments, the average ambient temperature and atmospheric pressure were recorded as 25°C and 756 mmHg respectively.

5. RESULTS AND DISCUSSION

The variation of carbon monoxide (CO) emissions with different proportion of kerosene by volume in the kerosene - gasoline blends at different load conditions. As the concentration of kerosene in gasoline increases, the value of CO increases, for 5% adulteration it was 16.4% and for 55% mix, the value was 51.6%. This is due to incomplete combustion of fuel owing to higher density and viscosity with poor volatile property of kerosene when compared to pure gasoline. The percentage change of hydrocarbon (HC) emissions due to adulteration of gasoline with kerosene on adulteration with kerosene, HC increases significantly. On 5% adulteration, the percentage increase was 20.6% while that for 55% adulteration was 55.2%. This is due to increase in quenching effect with poor volatility of kerosene when compared to pure gasoline [10]. Kerosene, being a mixture of low volatility, high molecular weight hydrocarbons ($C_{10}H_{22}$ to $C_{16}H_{34}$) than gasoline (C_5H_{12} to C_9H_{34}) is more prone to emit more HC and CO in the exhaust of spark ignition (SI) engine due to less effective combustion. Consequences of incomplete combustion of fuel are increased absorption of heavier HC components in engine oil film which escapes the combustion process. Increased portion of heavier HC components remain in liquid phase and may escapes the combustion process gasoline will cause knocking of the engine [11]. This was noticed when the engine was run with the adulterated fuel in the ratio of 55% kerosene and 45% gasoline there is also possibility of carbon deposits on the spark plug, piston head and valves[12].

6. CONCLUSION

An experimental investigation has been carried out to evaluate the effect of kerosene-doped gasoline on the engine-out emissions and performance of gasoline powered engine. The experimental results showed that the engine-out emissions increase with the increase concentration of kerosene in the blend. The analyses gave increase ranging from 16.4 – 51.6% for CO and 20.6 -55.2% for HC. To curb fuel adulteration, oil companies should carryout filter paper test, density checks, blue dyeing of kerosene. Oil companies and government agencies should carryout surprise and regular inspections of retail outlets with mobile laboratories. Heavy penalty on sale of adulterated fuels should be enforced in order to discourage fuel adulteration. The main conclusions of adulteration of kerosene in petrol are:-

I. Kerosene is more difficult to burn than gasoline and this result in higher levels of HC and CO.
II. High sulphur contents of the kerosene can deactivate the catalyst and lowers the conversion of engine out pollutants. Adulterants alter the chemistry of the base fuel rendering its quality inferior to the required commensurate fuel quality for the vehicles. This in turn affects the combustion dynamics inside the combustion chamber of vehicles increasing the emissions of harmful pollutants significantly.
III. Adulteration increases emission of harmful pollutants from vehicles & worsening urban air pollution that would cause adverse effect on human health. Also Adulteration increases tailpipe emissions of

hazardous pollutants causing air borne diseases & green house gases.

IV. Diversion of PDS kerosene for doping in gasoline is mainly observed in auto rickshaws and trucks for monitory gains by their drivers or owners. Along with loss of government revenue, environmental impact due to continuous worsening of air quality is at alarming level.

V. The transportation sector is a major source of air pollution. It contributes to harmful exhaust emissions, such as green house gases, CO, oxides of sulphur and nitrogen, unburned hydrocarbons and PM emissions.

VI. Air pollution caused by adulterated fuel emissions, especially NOx, CO, unburned hydrocarbons (HC), and particulate matter (PM) has been a noteworthy matter.

REFERENCES

[1] Biswas D, R. R. Evaluation of Adulterated Petrol-Fuels. Indian Chem Eng. J., 43(4), 314 – 317, (2001).

[2] Igbafe AI, O. M. Ambient Air Monitoring for Carbonmonoxide from Engine Emission in Benin City. Nigeria, Afr. J. Sci. Technology, 1(2), 208 – 212, (2005).

[3] Mohan D, A. A., Singh RS Standardization for automotive Exhaust pollution. J. Inst. Eng(Some issues in Indian perspective), 39-43, (2006).

[4] Yadar, S. R. Estimation of petrol and diesel adulteration with kerosene and assessment of usefulness of selected automobile fuel quality test parameters. International Journal of Environmental Science and Technology, Vol 1, No. 4, 253-255, (2005).

[5] Muralikrisha MVS, K. K., Venkata RD. Studies on Exhaust Emissions of catalytic coated spark ignition Engine with adulterated gasoline. J. Environ. Sci. Eng 48(2), 97-10, (2006).

[6] Kamil. Experimental study on adulterated gasoline and diesel fuels. India Chem, 23-28, (2008).

[7] Wieldman L.S.M. et.al. ‘Adulteration Detection of Brazilian Gasoline Samples by Statistical Analysis’, Elsevier Fuel-84, p. 467-473, (2005).

[8] D. Biswas and R. Ray, Evaluation of Adulterated Petrol-Fuels, Indian Chem. J., 43(4), 314-317 (2001).

[9] S. Sinha and V. Shivgotra, Environmental Monitoring of Adulterated Gasoline with Kerosene and their Assessment at Exhaust Level, J. Environ. Biol., 33, 729-734 (2012).

[10] M. Muralikrisha, K. Kishor and R. Venkata, Studies on Exhaust Emissions of Catalytic Coated Spark Ignition Engine with Adulterated Gasoline, J. Environ. Sci. Engg., 48(2), 97-102 (2006).

[11] S. Kalligeros, F. Zannikos, S. Stournas, E. Lois and G. Anastopoulos, Impact of using Automotive Diesel Fuel Adulterated with Heating Diesel on the Performance of a Stationary Diesel Engine, J. Energy Conversion and Management, 3(4), 68-75 (2004).

[12] M. Kamil, N. Sardar and M. Y. Ansari, Experimental Study of Adulterated Gasoline & Diesel Fuels, Indian Chem. Engg. J., 89(1), 23-28 (2008).

[13] C. Osueke and I. Ofondu, Fuel Adulteration in Nigeria & Its Consequences, Int. J. Mechanical & Mechatronics Engg., 2(4), 34-37 (2011).