

QUANTITATIVE ESTIMATION OF AUTOMOBILE EXHAUST EMISSION WITH SPECIFIC REFERENCE TO THE EXTENT OF ADULTERATION

Shiv Ram Yadav⁺, V. Krishna Murthy*, Dhaneswar Mishra⁺, Bibek Baral⁺

⁺ Department of Mechanical Engineering, School of Engineering, Kathmandu University

* Department of Biological Sciences and Environmental Science, Kathmandu University

SUMMARY

Motor fuel adulteration being a clandestine operation has become almost a common practice indulged by the concerned dispensers of lubricants and fuel dealers largely to derive profits. While petrol and diesel are major automobile fuels at present, kerosene is by and large the commonest adulterant that is utilized for mixing since it is available and cheap.

Automotive emission as exhausts from the vehicles emerge in both cases with adulteration and without adulteration of the fuels. However, the emission coming out from vehicles using fuel without adulteration is legal operation where as emission coming out from vehicles using fuel with adulteration is an illegal operation. There has been no verified the variation of emissions consequent to the extent of adulteration, on the life of engine components and on the performance of the automobile engine. The present study was planned to assess the extent of emission quantity, chiefly the carbon monoxide emanation with varied composition of fuels and adulterant (kerosene) proportions both in petrol and diesel automobile fuels.

In the case of petrol fuel, the variation in percentages of the reported emissions namely Carbon monoxide (CO) and Unburnt Hydro-Carbons (UHC) from the combustion of the adulterated fuel (kerosene as an adulterant in petrol) consequent to extent of adulteration in Spark Ignition (S.I.) engine was estimated. In the case of diesel fuels, analysis of the variation of the reported opacity value (K value) from combustion of adulterated fuel (kerosene in diesel) consequent to the extent of adulteration was estimated.

To achieve these objectives, a series of experiments with petrol, diesel fuel and adulterant kerosene was carried out in the recognized laboratories in Kathmandu. The experiment that were conducted to understand the extent of emissions arising out to the adulteration of the fuels estimation of standard parameters was carried out. While density was a common test conducted for pure petrol, diesel and kerosene, density was also estimated for the custom prepared fuel adulterant mixtures (5 different proportions) in case of both diesel and petrol fuels. The other parameters were the Initial Boiling Point (IBP) and Final Boiling Point (FBP), recovery tests for pure petrol and kerosene as well as for the custom prepared fuel adulterant mixtures (5 different proportions).

The emission tests included estimation of % CO, %UHC in ppm for petrol and % k value estimation for the diesel fuel. This was performed as field investigations.

From the series of experiments conducted on pure petrol and mixtures of pure petrol and adulterant (kerosene) of customized proportion, it can be concluded that the density increases with the extent of Kerosene adulteration and the density above the specified range shows the increased extent of adulteration.

Similarly from the distillation test conducted on the same samples it can conclusively be said that the alteration in IBP is suggestive of extent of adulteration. FBP is suggestive of even small extent of adulteration implying that it is a sensitive marker of adulteration. The set of recovery

experiments conclusively suggest that conducting recovery for extent fuel adulteration at 180°C is a sensitive and useful test. So testing recovery is to be a routine parameter and done compulsorily to estimate the extent of fuel adulteration.

The adulteration increases CO and UHC emissions in case of petrol fuel based vehicles. The inference from CO emission set of tests is that it is a good indicator for fuel adulteration testing in normal adulteration levels that we encounter with the majority of vehicles and fuels. This is particularly true with respect to well-maintained vehicles. The level of increase in UHC is maximal at even smaller extent of adulteration. Therefore conclusively it can be inferred that the level adulteration has direct bearing on emission levels of pollutants and under normally encountered adulteration levels the emission of exhaust gases like CO and UHC are considerably high extent.

In case of Diesel fuel, from the set of experiments conducted it can be concluded that there is no appreciable decrease in density due to adulteration. The density noted was in the range of prescribed limit even at higher extent of adulteration. Therefore density is not a good indicator of adulteration. But there is a considerable decrease in kinematic viscosity at higher adulteration level, which is a quite departure from the standard viscosity level prescribed. The % opacity value (k) decreases sharply with even a small amount of adulteration.

The study confirms that continuing the test of kinematic viscosity and opacity value are useful parameters of testing adulteration of diesel fuel.