EFFECT OF COMPOSITE NANOMATERIAL AS FUEL ADDITIVE FOR EMISSION REDUCTION

Kalpana G. Joshi¹, S. B. Bajaj² and Sumedh S. Ingle³

¹Research Scholar, Department of Physics, Dr. B. A. M. U., Aurangabad, India
²Lecturer, Department of Electrical Engineering, Sanjivani KBP Polytechnic, Kopargaon, India
³Associate Professor, Department of Physics, JES College, Jalna, India

Abstract- India is importing more than 70% of its fuel demand and spend a huge amount of money on fuel. Biodiesel is attaining more important as a smart fuel due to the fast depleting fossil fuel resources and environment concern. Many researchers have proposed various methods on adopting different types of additives to reduce the emissions of diesel engines. Up to now, several metallic nanoadditives including cerium and aluminum have been used. However, the Composite nanomaterials are still unfold as fuel additives. The purpose of current research work is to study emission of Palm and Castor biodiesel with perovskite type composite nanomaterial as an additive. The result shows significant decrease in emission level with use of composite nanomaterial as a fuel additive. The B20 Plam biodiesel without additive and B80 Palm biodiesel with additive shows lower emission level as compare to castor biodiesel with and without nanomaterial.

Keywords- Nox, HC, CO₂, CO, biodiesel, composite nanomaterial etc.

I. INTRODUCTION

Diesel has become an essential part of everybody’s day-to-day life. It is found that diesel causes harmful effects to the environment. To overcome these effects, there is a need to find an alternative fuel like biodiesel. In the biodiesel, it is experienced that it too has some demerits. Addition of nanoparticles with biodiesel gives a good fuel to improve the combustion efficiency, combustion stability as well as reduce harmful emissions [1][2][3][4][5][6]. Emission control is one of the major challenges observed in IC Engines and in the field of automobiles. Various theories have been proposed to reduce emission and still at present research is ongoing to achieve emission control as per zero emission standards all over the world [7][8][9][10][11]. Emission cannot be completely eradicated from automobiles but instead can be minimized to the lowest level. The need to minimize emissions at the lowest level to ensure safety for the public and environment. Nanoparticles have been found to be well efficient in emission control. But some defects are observed in the use of nanoparticles and their nature of reactions. The study reveals that use of nanomaterials as an fuel additive reduces emission of CI engine [11][12][14][15][16][17][18][20].

In the present research work the biodiesel derived from palm, castor biodiesel and combination of palm and castor biodiesel with additives of perovskite type composite nanomaterial (BNN) are used to evaluate the emission level of diesel engine.

II. EXPERIMENTAL SETUP

The Schematic Diagram of Experimental Setup is shown in figure no.1 which consist of a single cylinder, vertical, 4-stroke cycle, single acting, totally enclosed, water-cooled, high speed compression ignition engine. The engine was coupled to an Eddy Current Dynamometer through universal coupling. The engine and the dynamometer were mounted on a common bed made from Iron C-Channel which was bolted to the cement foundation. The engine was loaded by means of
electrical dynamometer i.e., by means of excitation current to the dynamometer coil. The emissions were measured with smoke meter and exhaust gas analyser attached to exhaust system of engine.

**III. EXPERIMENTATION**

Experimentation was carried out in two parts. i.e. synthesis of perovskite type composite nanomaterial and Experimentation on CI engine. Firstly, Composite nanomaterial of perovskite type is synthesized by conventional solid state method [7]. Then it is mixed with the blend as per 2 gram per liter. XRD and SEM of the BNN material was carried out. XRD shows sharp single peaks. This indicates the single phase nature of the sample with cubic structure. Secondly, before experimentation, DOE (Design of experiment) was carried out by Taguchi method and accordingly the biodiesel and its blends were selected [13]. Bio-diesel (B100) and its blends B20, B40, B60, B80 & additive were used to test the engine at different engine loads (0N, 30N, 60N, 90N and 120N) at constant speed of 1500 rpm. At each load, the engine was stabilized for 10 minutes and then measurement parameters were recorded. The pressure of diesel injector was maintained 195 bar. On every loading the emissions were measured.

**IV. RESULT AND DISCUSSION**

After obtaining the observations and results of different parameters using castor and palm oil biodiesel as fuel and perovskite composite nanomaterial (BNN) as an fuel additive, the various graphs were obtained to compare emission characteristics of the engine as shown in figure no. 2, figure no. 3, figure no. 4. and figure no.5.
The variation of HC is shown in figure no.2. The graph indicates that HC emission for B20 Palm biodiesel blend without additive and B80 (P+A) shows minimum emission level with respect to load as per the DOE. The less HC emission for B80 (P+A) signifies lower carbon combustion activation temperature due to oxidation catalyst and thus enhances hydro carbon oxidation, promoting complete combustion.

Figure no.3 indicates variations of CO emission, where B20 blend of palm biodiesel without additive shows CO emission less this is because of complete combustion of fuel. Also B80 (P+A) shows less CO emission, this due to oxygen content in nanomaterial additive which enhances complete combustion. The variation of CO$_2$ is shown in figure no. 4 which indicates that the results obtained are inline with the results of CO emission.

The variation of NOx is shown in figure no.5. Among all blends, B20 palm biodiesel blend without additive shows less NOx emission as load at B20 (P) is less as compared to other blends without additives. On other hand B80 (P+A) with BNN shows less NOx this due to high thermal stability of BNN, it maintains less combustion temperature in the cylinder of engine hence reduce NOx level obtained.

V. CONCLUSION

The experimentation and analysis of various biodiesel with and without BNN (composite Nanomaterial) as fuel additive, reveals that B20(P) and B80(P+A) shows less emission level as compare to other blends with respective to load applied. Hence it can be concluded that composite nanomaterial can be used as an additive in diesel – biodiesel blend to enhance the combustion of fuel and to reduce the emission level to satisfy the stringent emission norms and also to save the environment from getting polluted.

VI. ABBREVIATION

BNN – Barium Nickel Niobium oxide  
B20(P) – Palm Biodiesel 20% + Diesel 80%  
B40(C) – Castor Biodiesel 40% + Diesel 60%  
B60(P+C) – Palm Biodiesel 60% + Castor Biodiesel 40%  
B80(P+A) – Palm Biodiesel 80% + Diesel 20% + BNN nanomaterial additive  
B100(C+A) – Castor Biodiesel 100% + BNN nanomaterial additive
NOx – Nitrogen oxide (ppm)
CO – Carbon Monoxide (%) 
CO2 – Carbon dioxide (%)
HC – Hydro Carbon (ppm)

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