Performance Enhancement of Single Cylinder CI Engine using Diesel Blended with Waste Plastic Pyrolysis Oil (PPO) & LPG

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Abstract

As, we already know that there is tremendous use of plastic now a days. So, we can use this 'waste plastic' in a better and useful way as it does not get decomposed easily in environment. We can make fuel by using plastic waste through the pyrolysis process. Plastic waste is used as a raw material hence plastic waste can be recycled by using it in productive way. Waste plastic can be converted into liquid and gaseous fuel. Waste plastic pyrolysis oil fuel can be more reliable and less costly than Diesel if production can be done large economy of scale. The major benefit of this oil is that it doesn't need engine modification hence it can be used in diesel engine. When this fuel (waste plastic pyrolysis oil) is used in engine, the engine emissions are lower which means that it will minimally affect the environment.

Keywords: PPO, Blend, Waste Plastic, CI Engine, LPG

I. INTRODUCTION

Amidst ever decreasing fuel resources and constantly increasing air pollution, the fundamental sustainability of present energy system has been put into question. The present reserve of Petroleum products is slowly dying out, widening the gap between global energy supply and energy consumption. As per 2008, energy used on a global scale is about 142.3 Terawatt-Hour, which is about 39% higher than that of 1990. Moreover, in order to meet the stringent EUROVI standards, automobile manufacturers are compelled to try out emission, more precisely NOx and smoke reduction. As a result a lot of the research studies are now oriented toward finding a cleaner burning fuel with satisfactory combustion and performance signatures. Diesel engine plays a dominant role in the field of power, propulsion and energy. The diesel engine is a type of internal combustion engine; more specifically it is a compression ignition engine, in which the fuel injected by fuel injection system is ignited solely by the high temperature created by compression of the air during the compression stroke. The engine operates on the diesel cycle. Pyrolysis is a thermo chemical decomposition of organic material at elevated temperatures in the absence of oxygen (or any halogen). It involves the simultaneous change of chemical composition and physical phase, and is irreversible. The word is coined from the Greek-derived elements pyro "fire" and lysis "separating". Liquefied petroleum gas or LPG is a byproduct of natural gas processing and petroleum refining. LPG includes several light hydrocarbons whose main distinguishing characteristic is that it can become a liquid when pressurized up to 10 bar. Propane and butane are the most common LPG constituents and, for vehicle use, LPG essentially consists of 70% - 80% propane.

II. EXPERIMENTAL SETUP

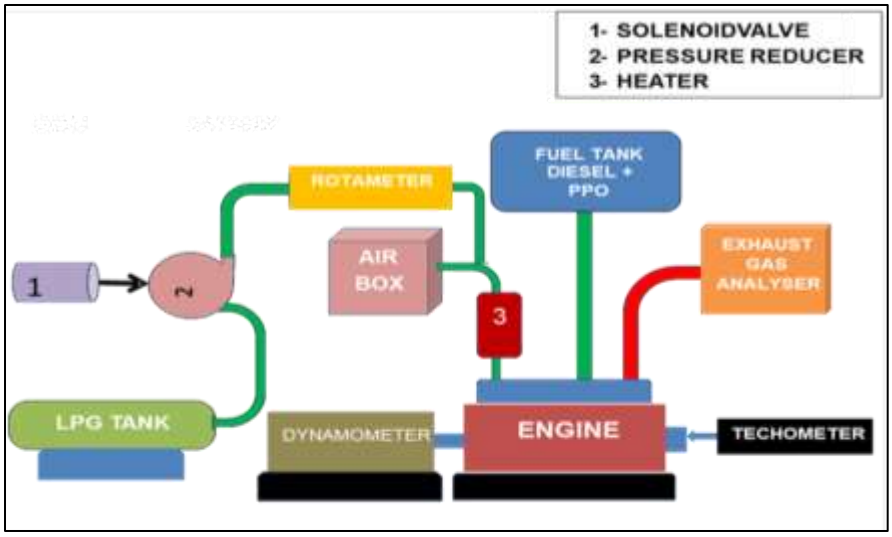

Fig. 1: Schematic Experimental Setup

III. EXPERIMENTAL WORK AND METHODOLOGY

A Single Cylinder, diesel engine is used for the purpose of experimentation. The engine is then coupled to a rope brake dynamometer. Inlet manifold is connected with air box which is also attached with U-tube manometer. Fuel supply to the engine is from the tank via burette in case of diesel + PPO and from Rota meter in case of LPG cylinder. Rota meter is used to measure the fuel consumption of LPG. Necessary provisions are made to measure the flow rates of fuel, air flow to the engine cylinder, rpm of dynamometer, and applying load on drum with help of belt and weight scale, inlet air, inlet gas and exhaust gas temp. Gas analyser used to measure exhaust gas parameters. Thus, after establishing the Experimental Test Set-up, the experimental work towards engine performance evaluation is carried out. The test ring for four stroke single cylinder diesel engine is developed. Engine is to be run for 20 minutes before each sets of reading were taken to get stabilization. The load is set on the dynamometer via weight scale. The engine speed was kept constant for the each set of reading. The engine was tested at the speed of 1400 rpm. The load on the engine was varied from no load to10 kg. Performance and emission parameters were measured.
Following modifications are to be required in the existing engine.

1) Adopted for supply of LPG-Air mixture.
2) Installing gas adapter in series with air inlet manifold.
3) Heating solder to heat inlet manifold up to 100oC.
4) LPG conversion kit.

IV. EXPERIMENTAL RESULTS AND DISCUSSION

A. Brake Specific Fuel Consumption:

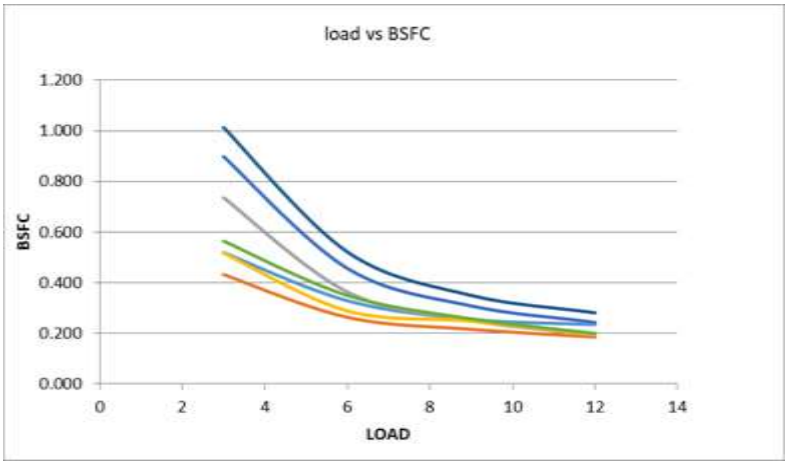

Fig. 2: Variation in Brake Specific Fuel Consumption

B. Brake Thermal Efficiency:

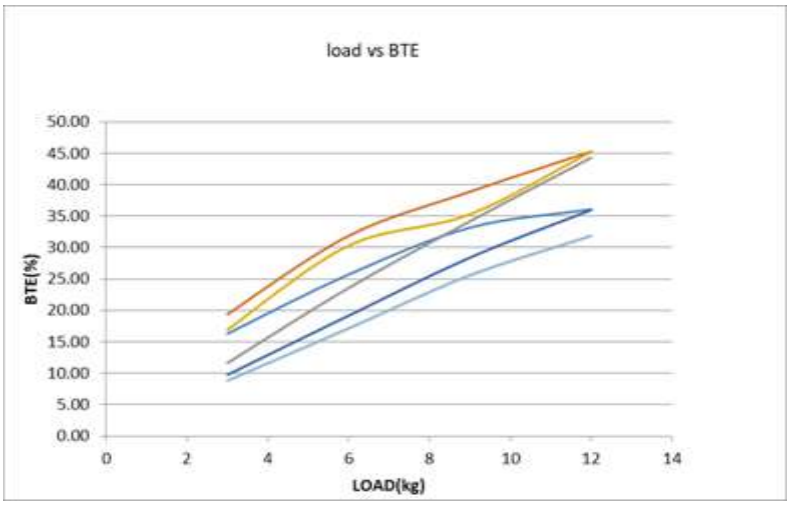

Fig. 3: Variation in Brake Thermal Efficiency with Load

C. CO Emissions:

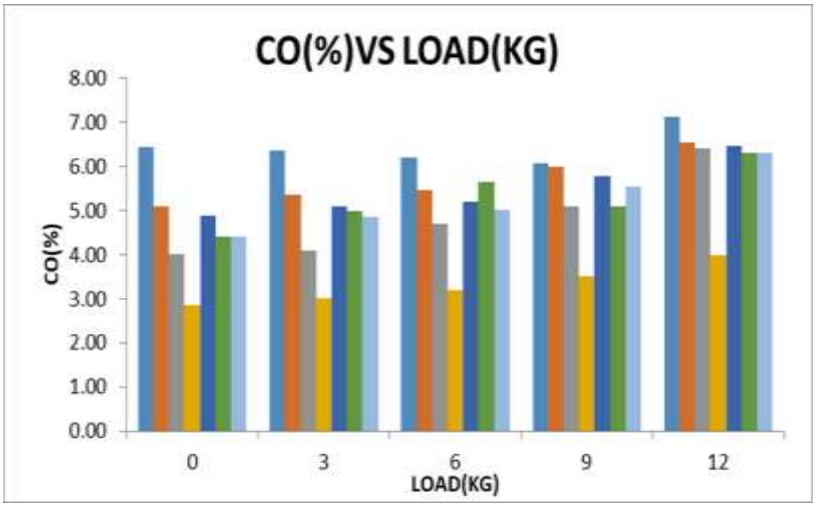

Fig. 4: Variation in CO Emissions with Load

D. HC Emissions:

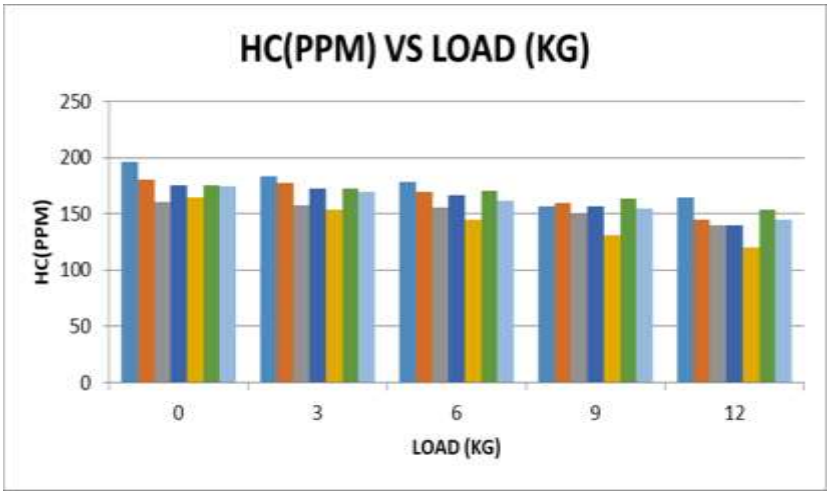

Fig. 5: Variation in HC Emission with Load

E. CO2 Emissions:

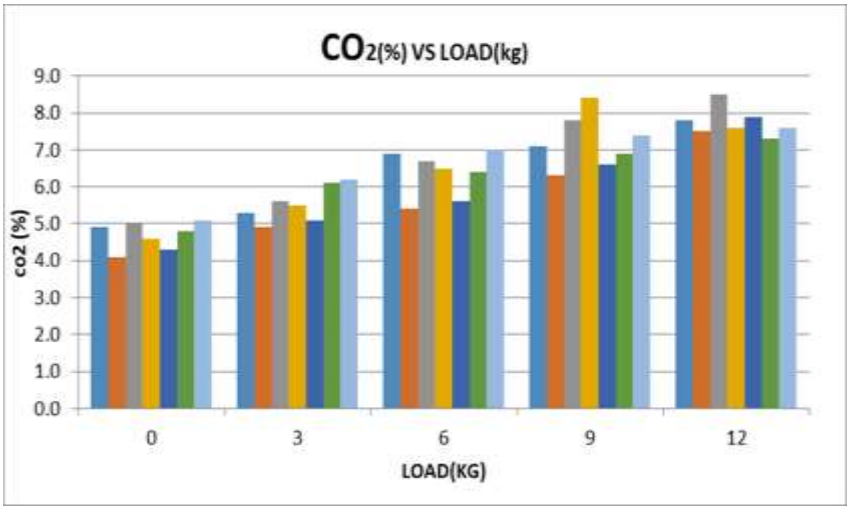

Fig. 6: Variation in CO2 Emissions with Load

F. NOx Emissions:

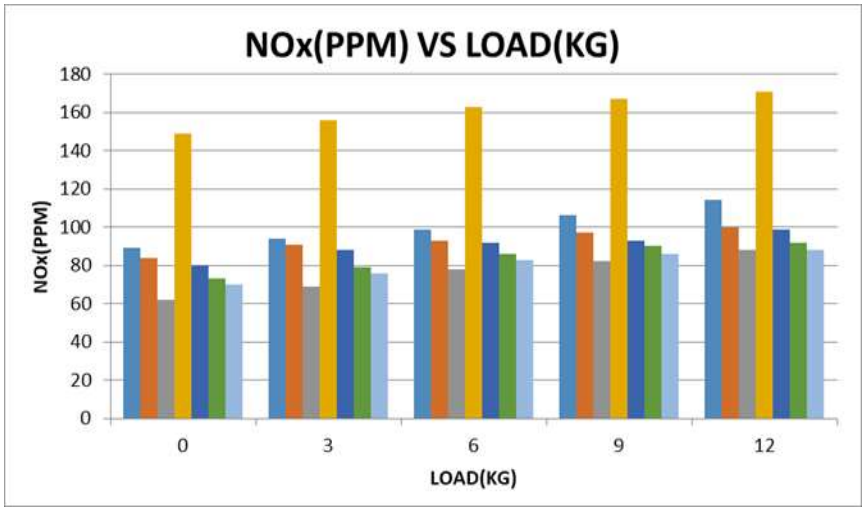

Fig. 7: Load VS Nox

V. CONCLUSION

The present work has attempted to use try-fuel (PPO) blends in a diesel engine and thereby, increase performance of diesel engine, decrease emission and decrease these of fossil fuel. Based on the Experiment and study the following conclusions are drawn:-

1) The performance can be improved by using blending of DIESEL and PPO &LPG. And the brake specific fuel consumption is minimum for Diesel blend with PPO&LPG.
2) And the brake thermal efficiency is maximum for Diesel blend with PPO&LPG. At high load the emission of blending fuel is decrease by increasing the percentage of PPO.

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