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Performance Investigation on DI Diesel Engine by using Different Blends of WPO Blended with MA-Biodiesel along with Nano Additives

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Abstract: ***An attempt was made here for the production and use of waste plastic oil (wpo) oil extracted through pyrolysis and biodiesel from microalgae (MA). The oil extracted by pyrolysis was blended with MA biodiesel and further added with various dosage of zinc oxide nano additive for use in CI engine to measure the combustion, performance and pollution characteristics. The thermal efficiencyof the engine increased by 2.6 % and NOx pollution increased by 5.7 %, HC, CO and Smoke pollutants decreased with the use of MWP oil and microalgae biodiesel ZnO nano additive blend. Also, the use of SCR at the exhaust reduced the NOx emission by 76% when compared to the diesel operation.***

I. INTRODUCTION

As day by day population increasing the demand to the transportation is also increasing as a result there is huge dependency on fossil fuels such as diesel ,petrol, etc…and due to demand the prices are getting hike quarterly in the year and there is talk that depletion in fossil fuels in upcoming decades and even though there are lot demerits using the fossil fuels but people are attracted to it because ease of availability and with our research work we are finding a new alternative fuel mixture which reduces dependency on fossil fuels and its similar in characteristics of diesel and which can be used in CI engines as alternate fuel for diesel and this is produced from by combined mixture of MA-Biodiesel along with Waste plastic oil with no other fuel used in it and when it is used in the CI engine it is showed similar results to the diesel and coming to the pollution it has same emission as compared to diesel and this emissions can be reduced by using SCR technique along with oxygenated additive in it with a specified proportion in it

II. EXTRACTION OF OIL FROM PLASTIC

Waste plastic disposal and excessive use of fossil fuels have caused environment concerns in the world. Both plastics and petroleum derived fuels are hydrocarbons that contain the elements of carbon and hydrogen. The difference between them is that plastic molecules have longer carbon chains than those in LPG, petrol, and diesel fuels. Therefore, it is possible to convert waste plastic into fuels. Waste plastic such as polypropylene, low-density polyethylene, high-density polyethylene, polystyrene is some of the most widely encountered in daily operations which are discarded of after-service to the community. Synthetic polymers are those substances that can take a long time to decompose if merely disposed over to the ecosystem. Waste plastics should, therefore, be converted into usable resources. The numerous waste plastics were thermally cracked at various temperatures and then the oil released was weighed, the residue left after the reaction was over, and the gas produced. It is then compared that which types of plastics can produce higher volumes of fuel. There are a number of ways to manage plastic waste such as incineration, recycling, land-filling and thermal cracking. But this work focuses on thermal cracking of waste plastics in order to transform them into usable resources, since the emission of hazardous gases to the environment is insignificant in this method. The waste can be turned into usable means. Pyrolysis is the action of heating plastic waste in the nonexistence of O_2, a process that reduces the plastic polymers and generates solutions that can be used as fuel. WPO consumed in the present work is mined from varied plastic waste by means of a workroom type pyrolysis component. Raw material was a varied mix of PET items which contains water bottles, shampoo bottles etc., HDPE which includes broken chairs, engine oil containers etc., LDPE which comprises plastic bags, polyvinyl chloride including broken pipes and containers), PP which includes ketchup bottles and stationery and polystyrene that includes general purpose containers and disposable food containers. In this experimental work as exhibited in Fig. 1, where discarded plastic of various group was heat treated in a tubular apparatus of 300mm length × 250 mm dia. at a hotness of 300-350ºC for 60 to 90 minutes. The waste plastic was mildly heated and the fumes arising out of it are converted to get low Sulphur comprised element. Meanwhile the plastic waste is treated in the nonappearance of O_2 at 300 - 350ºC, maximum of the poisonous fumes is scorched.

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The catalyst used in this system (silica of 1% by volume) will evade the creation of all dioxins and Furans (Benzene ring) for refining the kinetics of pyrolysis process.

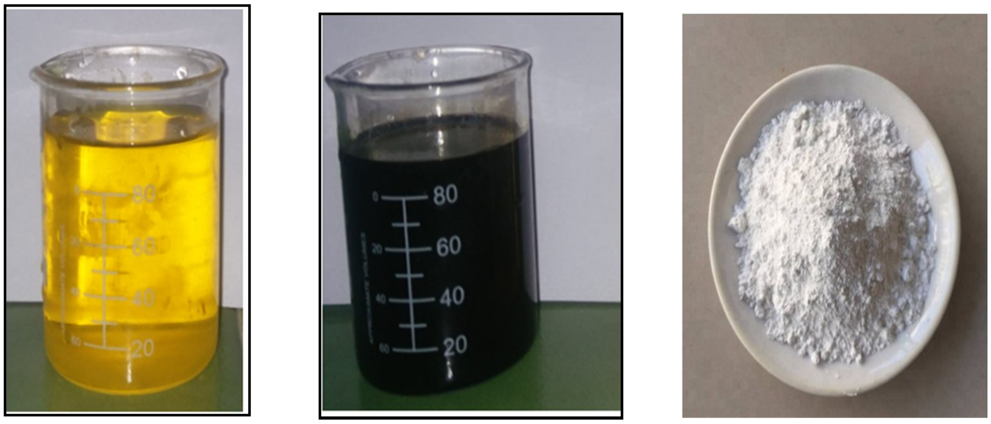


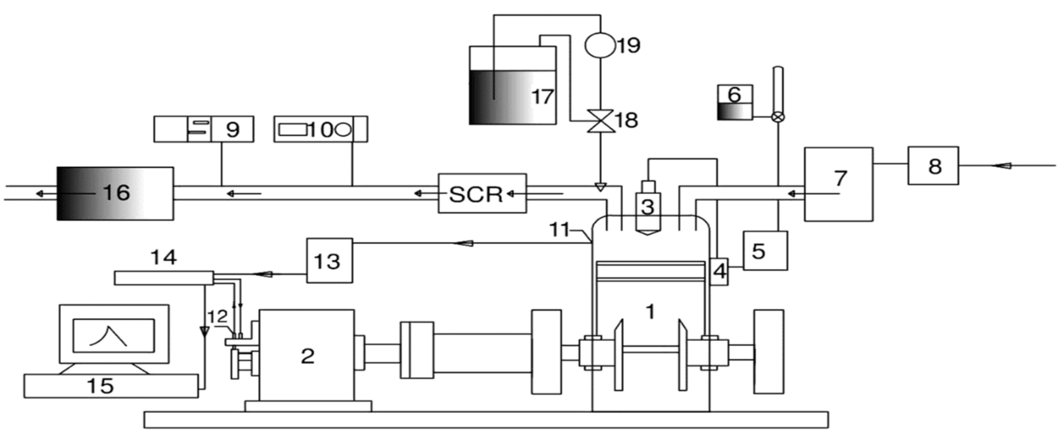
FIG-1 Photographic view of WPO refined oil and ZNA

Later to the pyrolysis process, the high viscosity oil displayed in Fig was distilled to get less viscosity oil as shown in Fig. 1. Distillation setup is shown in Fig.1 Fuel have property similar to Petrol was obtained in the I stage at 104-141°C. At II stage having temperature range of 250°C - 285°C, HSD like fuel were obtained.

A. Steps To Extraction Of Ma-Bio-Diesel

1) Micro algae crude oil is brought from the market
2) Further it is converted into microalgae methyl ester by means of transesterification process
3) During transesterification process the KOH Catalyst mixed along with methanol and this solution is mixed with MA crude oil and stirred at constant temperature in a container until they mix properly and forms as a solution
4) This solution is formed into glycerin and MA-Biodiesel in a container
5) The top layer is MA-Biodiesel and bottom layer is denser glycerin
6) Further this glycerin and MA-Biodiesel is separated and this MA-Biodiesel can be preserved and further used in diesel engines

Photographic image of Ma-Biodiesel



III. EXPERIMENTAL SETUP

1.Kirloskar TV1 Engine	7.Air tank	13.Charge amplifier
2.Eddy current dynamometer	8.Air filter	14.Indimeter
3.Fuel Injector	9.AVL smoke meter	15.Monitor
4.Fuel pump	10.Di-gas analyzer- AVL	16.Drain silencer
5.Fuel filter	11.Transducer-Pressure	17.Urea tank
6.Fuel tank	12.TDC Encoder	18.3-way control valve
		19.Urea solution pump

Schematic diagram of the Experimental test bench with SCR after-treatment setup

Engine Specification

Make & Model	Kirloskar& TV1
Rated Power	5.2 kW @ 1500 rpm
No. of Cylinders	One
Type of Combustion chamber	Hemispherical
Piston type	Shallow bowl
Compression ratio	17.5:1
Rated Speed	1500 rpm
Bore Diameter	87.5 mm
Stroke Length	110 mm
Injection Pressure	220 bar
Timing of fuel injection	20 deg. CA BTDC
Fuel Injection type	Direct
No of nozzle holes	3
Nozzle Hole diameter	0.25mm
Spray cone angle	110
Cubic capacity	661.45 cc
Loading type	Electrical Load
Cooling type	Water cooling
Ignition Type	Compression Ignition

A. Experimentation

First start the engine and allow it to run with pure diesel at constant speed for few minutes, and then start electrical loading from initial load condition to full load condition by step by step and write down the readings of performance, emission and combustion parameters at each load. Now power the engine with different blends of waste plastic oil along with Micro algae Bio-diesel with different dosage of zinc oxide oxygenated nano additive and Finally, the experimental results were analysed and discussed.

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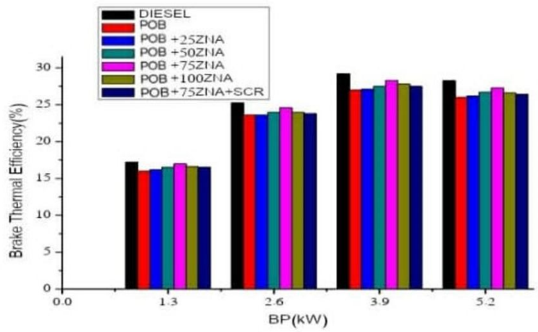
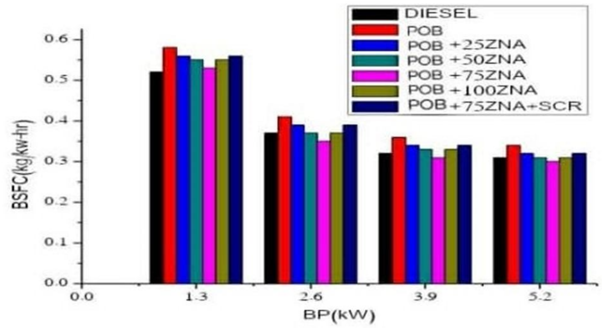
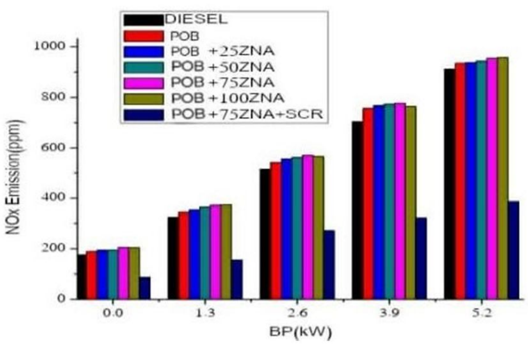
IV. RESULTS AND DISCUSSION



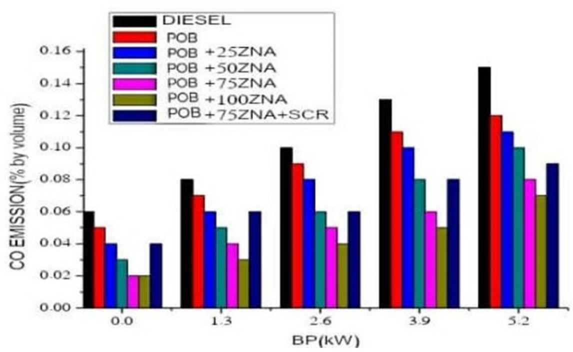
Variation in BTE



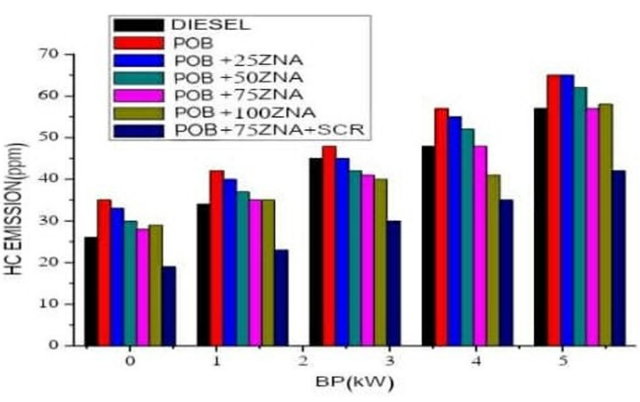
Variation in BSFC



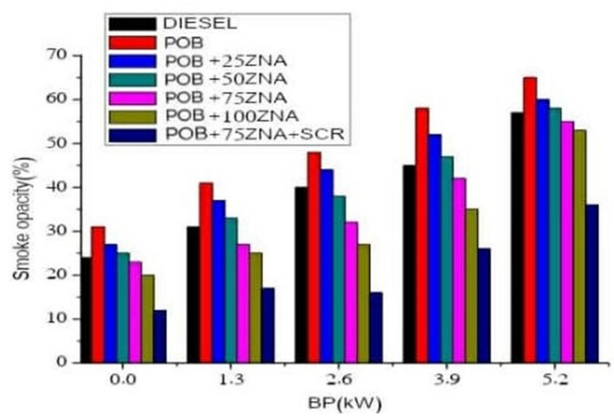
Variation in NOx Emissions



Variation in CO Emissions



Variation in HC Emissions



Variation in Smoke Emissions

V. CONCLUSION

Plastic is a versatile material as it has both merits and demerits and one of the major impact of plastic to the environment is its decomposition period which takes decades to decompose and here is the best solution by converting waste plastic to oil and our research sheds light on with wonder full solution by combination of Wpo with Ma biodiesel along with nano additives with out any usage of fossil fuels which propels the engine.

The engine is tested in various parameters with different blends and with different loads and finally concluding by comparing optimum mixture i.e-POB+75ZNA+SCR at Peak load condition with Diesel

A. BTE is comparatively low when compared with diesel at full load condition
B. BSFC is comparatively high when compared with diesel at full load condition
C. NOx emission is very low at peak load conditions due to addition of SCR
D. CO emissions are high when compared to NOx at peak load condition
E. HC and Smoke emissions are low in this mixture at peak load condition when compared to Diesel

Finally, we can conclude that PLASTIC OIL BI0DIESEL (POB)+75ZNA+SCR is the optimum blend that can used in the Di-diesel engines which reduces the dependency on fossil fuels and reduced in emissions when compared to diesel.

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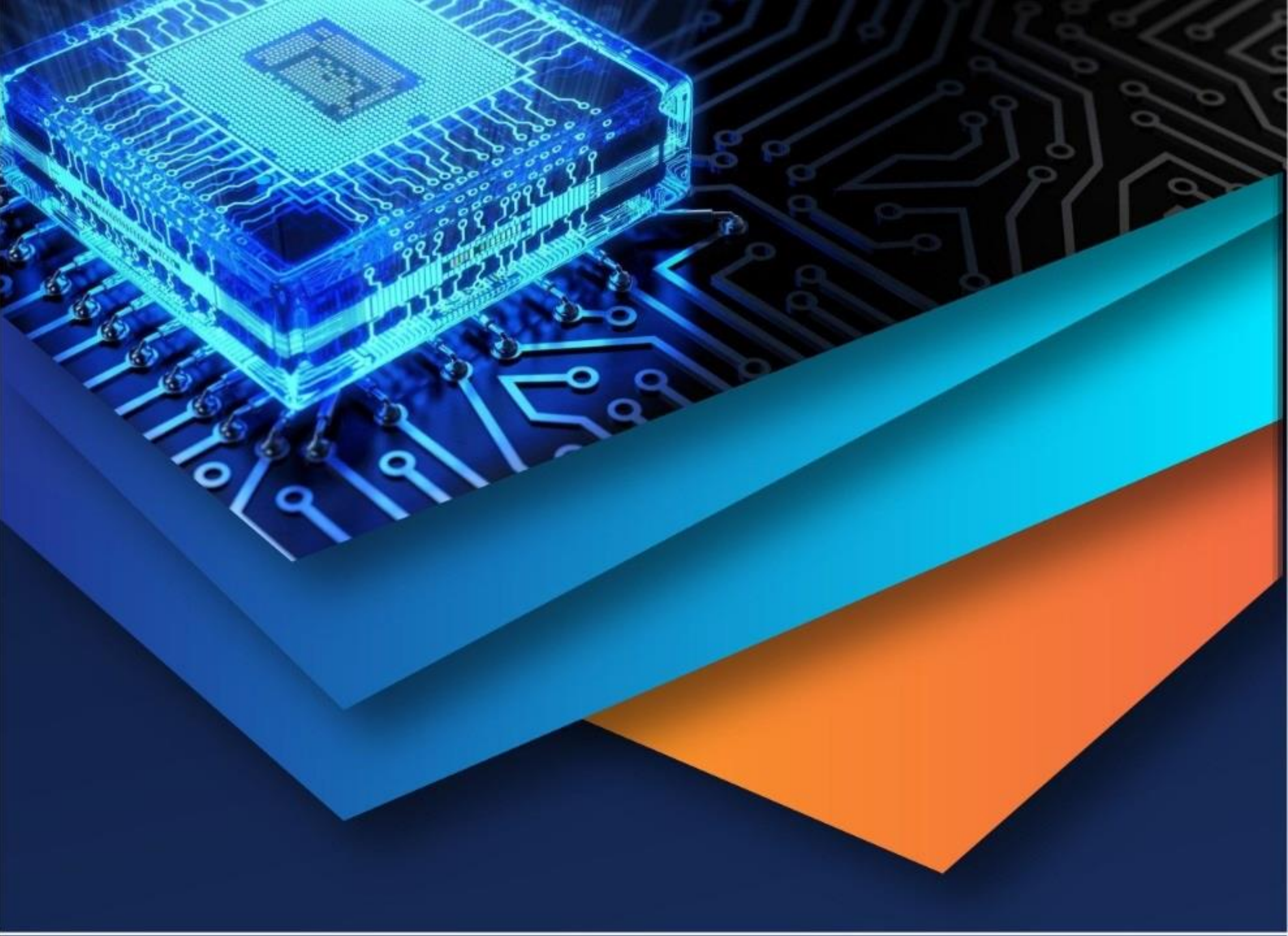

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