Performance and Emission Characteristics of Diesel Engine Fuelled with Waste Plastic Bio-Oil/Diesel

M. Venkata Subbaiah, S. Sunil Kumar Reddy, B. Durga Prasad

***Abstract*: *Several methodologies are implemented to regulate the disadvantages of plastic such as non-bio-degradable. The proposed work is explored to design plastics from futuristic bio-degradable materials. At present situation, the waste plastic material is recycled into novel plastic materials by utilizing traditional strategies. Various recycle technologies like carbon sink, Incineration, blast furnace, gasification are exists, but are in main in reducing the plastic wastes. With the reduction of plastics the environmental pollution will also be reduced.* The abundance plastic waste is there and it can be transformed into good-quality oil by using process of pyrolysis. In this work, pyrolysis oil is generated from most regular plastic material as polyethylene materials (LDPE-700), at a temperature ranges of 4000ºC and 6000ºC, respectively. These oils are tested in a diesel engine consists of four-cylinders and the performance characteristics are evaluated with several comparisons.**

Index Terms*: Diesel Engine, *Emissions, Waste plastic pyrolysis oil biodiesel, Performance Evaluation

I. INTRODUCTION

The point of this examination is to exhibit in a sorted out and open way some fundamental learning about the properties and attributes of butanol and its potential usage in the automobile business as bio fuel. The beginning stage is to show its properties, contrasting them and those of regular gas, ethanol, gasohol (a blend of gas and ethanol) and diesel. A depiction of the generation of butanol is surveyed, as it began and as it is today, featuring the generation of bio-butanol. A concise outline is introduced on chemical kinetics of butanol, bringing what scientists and foundations are examining in this field. At last, the use of n-butanol as fluid fuel and the primary ignition parameters are abridged from the perspective of it use in inside burning motors. It is assimilated that on account of CI engines, the preferences are demonstrated fundamentally when one alludes to emissions, conceivably lower when the engine is fuelled with n-butanol-diesel mixes, and as a decent substitute for ethanol-diesel mixes from the perspective of security and parts strength [1] He led investigations on, execution of hydrogen DDF (diesel double fuel)engine with changing states of hydrogen portion to total energy under explicit engine speed and load conditions are discussed as well as evaluated.

Revised Manuscript Received on December 22, 2018.

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Moreover, temperatures on a cylindrical head is observed, and descriptions on various reasons of pre-ignition is happened in hydrogen-DDF engine are led [2] and explored ethanol was blended with neat lemon-grass oil (LGO) and attains diesel fuel mix which are highly impacted of ethanol concentration's during discharge, burning, performance of direct infusion diesel engines. The tested mixes acquire distinctive execution, combustion and emission operating characteristics in contrasted with diesel. The ethanol mixes brought about a high combustion weight and heat discharge rate, consumption of brake explicit fuel and brake thermal efficiency over the diesel and LGO25 (75% good diesel + 25% good lemongrass oil) with a greater NOx & CO2 emissions, with low HC emissions and lower smoke.

Though, the observed values are seen as greater than combustion duration & delay ignition period for LGO25-ethanol mixes than perfect diesel and LGO25 fuels [3]. He explored the sweet orange-oil diesel mixes shows the lower intensity, viscosity, higher calorific value, surface tension over the good diesel fuel. Likewise, from the engine test, the sweet-orange oil diesel-mix showed marginally greater utilization of specific brake fuel, particulate mass number and specific number; be that as it may, the mix decreasing the brake explicit CO outflow somewhat and brake explicit NOX emissions fundamentally compared with that of good diesel. [4] He was exploring the greater impact of combustion specifications on the ignition attributes of vegetable fuel-oil. By utilizing the superior Fuel Ignition Delay-Analyzer, ignition qualities ought to be identified with that of essential reference fuel by developing the cetane number scale.

Distinctive arrangements of temperatures ranges of combustion chamber and injected pressures ought to be examined so as to increase the reliance of ignition characteristics on combustion specifications. Finally, the combustion specifications ought to be related to the unsaturated fatty acids for predicting oil empowering of the ignition characteristics of further veggie-oils [5] This investigation furnishes the utilization of PME as either a substitute fuel or alternate for the diesel may decrease the ozone depleting substances in the meantime the employability in the agricultural fields will be expanded by retaining the movement of the farmer network towards towns or cities for searching of employment. It was seen that the utilization of PME as fuel decreases carbon monoxide to a degree of 8.2% which is contrasted with diesel in the meantime of HC diminished by 8.9% likewise there is impressive

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decrement in oxides of nitrogen elements. There was increment in BSFC of 4.2% and the thermal efficiency minimized by 2.4%.

But, the ecological sustainability and the employability for nearby community and advancement of agriculture inclines towards the PME as a substitute fuel for the power sector, agriculture, transport, etc., [6]. He was seen that has not been examined yet in diesel engines which are greatly utilized for LDPE oil in high mix rates and without requirement of diesel.

In addition, the properties of oil that defines from the pyrolysis of EVA which is not reported for the utilization of EVA oil in diesel engines has not been assessed yet. In the current work, the utilization of EVA and LDPE oils in a diesel engine are assessed and contrasted with the working of diesel fuels.

To achieve this view, describing the oil properties and the combustion of engines, emission and performance a characteristic is studied [7]. Various investigations are carried on study to expand the cetane number by mixing the two fuels which are in distinctive property characteristics as fuel and to enhance the physical properties of specific fuel. This blending will furnish the enhancement in emission characteristics and combustion. In this paper, soybean biodiesel and hazelnut biodiesel is included with an equivalent amounts of diesel fuel. The impact of the new mixed fuel on the combustion, emission and performance characteristics, in a single chamber diesel engine as investigated afterwards. Bio-diesel fuel is utilized in many experiments which are delivered with the technique for trans-esterification. To start NaOH is utilized as a catalyzer and Methanol is utilized as alcohol. The distinctive blends of fuel is named as DHS10 (90% diesel+5% hazelnut methyl ester + 5% soybean methyl ester), DHS30 (70% diesel + 15% hazelnut methyl ester + 15%soybean methyl ester) DHS20 (80% diesel + 10% hazelnut methyl ester + 10% soybean methyl ester) in [8], He was examined on A four stroke single chamber, normally suctioned, a direct injected diesel engine is selected for the simulation work by utilizing the Diesel-RK software.

The impact of two alcoholic parameters is to be specific ethanol and methanol expansions to develop palm stearin biodiesel which is investigated independently and compared. The predicted outcomes demonstrates the lightly utilization of greater brake fuel and thermal efficiency of brake with respect to biodiesel-alcoholic mixes over the good biodiesel products. An attractive minimization of NOx emanations is additionally studied with biodiesel-alcoholic mixes. Moreover, the instantaneous heat discharge rate, PM, ignition delay and smoke emissions [9]. This observation reveals the, canola bio-diesels were generated as per the standards from oxidation stability. Pyrogallol as substance consisted of anti-oxidant which is doped by the dosage of 500ppm into bio-diesel fuel. The critical injection, combustion, emission and performance investigations are performed by considering the diverse parameters, such as fuel line weight, heat discharge rate, start delay, fuel infusion delay, trot of final warmth discharge, ignition portions, engine execution and exhaust outflows in a single cylinder DI based diesel engine [10]

II. EXPERIMENTAL ENGINE SET-UP

Fig.1 Experimental set up of C.I. Engine

Table.1 specification of the engine

Engine	**Single Stroke, Water Cooled, Four Stroke, Kirloskar Diesel Engine (HMTO4) Ltd**
Ignition Type	Compression Ignition
Bore Type	0.0875m
Stroke Range	0.11m
Compression ratio	17.5:1
Speed Range	1500 rpm

The emission and performance specifications of pre-pared diesel fuel mixes (WPPO10, WPPO20, and WPPO30) with waste plastic oil has been examined and contrasted with a diesel fuel at consistent speed ranges for various loads. The experiment analysis is led for various diesel mixes. A schematic diagram of the experimental set up is depicted in Figure.1. The diesel engine is utilized for investigation on a single cylinder, water-cooled, 4-stroke engine. Several parameter specifications of engine are illustrated in Table.1 The engine was loaded with an eddy-current dynamometer; the specific load on dynamometer is investigated by utilizing a strain gauge load sensing elements.

Utilization of fuel was observed with a burette (30 ml volumes) and given by stopwatch. Exhaust-gas & water outlet temperatures are estimated with K-type thermocouples. The engines operated with good diesel fuel and heated up. The heated period is assumed to be an end when the engine is come to rated working condition (for example at the point when the temperatures of engine lubricant-oil achieved 60 ± 10◦C).

Working Parameters which includes, brake power, fuel consumption, fuel utilization, brake explicit fuel utilization, and brake thermal efficiency are observed. Emissions, including carbon monoxide (CO), carbon dioxide (CO_2), nitro-gen oxide (NOx) and un-consumed hydro carbon (HC) were estimated by utilizing a gas analyzer. All observations values are recorded. Engine emissions and performance characteristics are exhibited in accordance with engine load. A photograph of the experimental device is depicted in Fig.1.

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III. RESULTS & DISCUSSION

A. BRAKE THERMAL EFFICIENCY.

Several variations in brake-thermal efficiency (BTE), with brake power for various fuels are depicted in Figure.3. Generally, the brake thermal efficiency is maximized based on load increment. As long as load increases brake power increases and fuel consumption increases thereby it increases the break thermal efficiency. In the graph we can observe that B20 gives almost similar brake thermal efficiency compared to conventional diesel. The maximum brake thermal efficiency of diesel is 24.55 and that of B20 is 24.69.

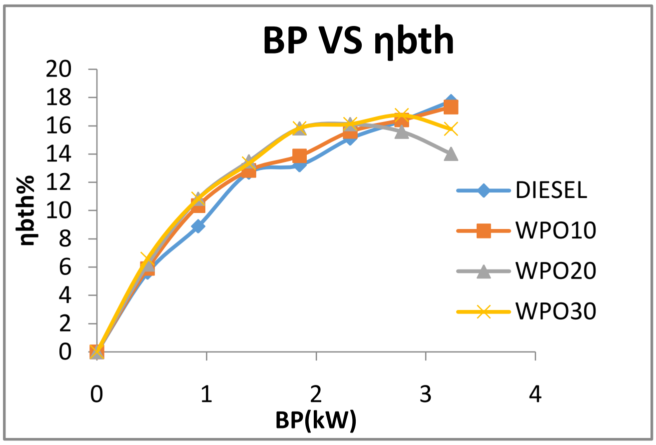

Fig.3. variation of η_{bth} with BP

B. BRAKE SPECIFIC FUEL CONSUMPTION

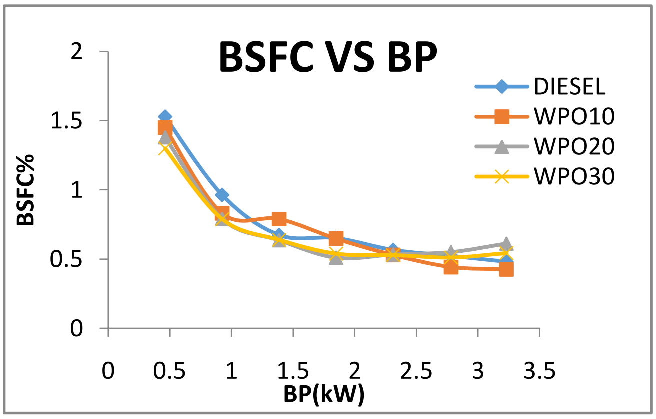

Fig.4. variation of BSFC with BP

Several variations in consumption of brake specific fuel (BSFC), with respect to brake power is depicted in Figure 4. When the applied load increases, automatically specific fuel consumption increases. In the graph we can observe that there are deflections as per criteria, but this happens in varying the load or speed. This experiment was conducted constant speed and varying load condition that is the reason we got deflections in the graph. From the graph we can observe that B20 shows similar performance as conventional diesel. The minimum value of brake specific fuel consumption for diesel is 0.349 and that of diesel is 0.348.

C. CARBON MONOXIDE (CO% IN VOLUME).

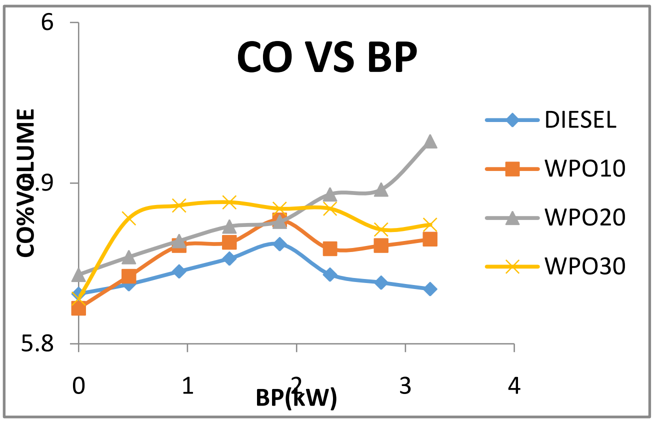

Fig.5. variation of CO with BP

Figure5 compares the carbon monoxide (CO) emissions, with respect to brake power. In general carbon monoxide can be seen in exhaust when there is incomplete burning of fuel. For the obtained pyrolysis oil there is a chance of presence of aromatics. This compound doesn't exhibit complete combustion. This results in excess formation of carbon monoxide in the exhaust for all the blends.

D. CARBON DIOXIDE (CO2).

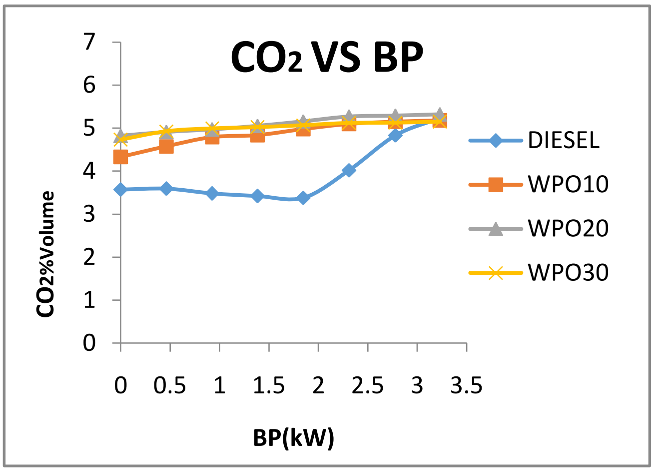

Fig.6. variation of CO_2 with BP

The Variation of carbon dioxide with Biodiesel blends with different brake power is graphically represented in Fig 6. Carbon dioxide can be seen in engine exhaust only when complete combustion takes place in sufficient supply of oxygen. The plastic pyrolysed oil which we are obtained may be in excess of oxygen. This gives excess supply of oxygen which finally liberates large amount of carbon dioxide in the exhaust. In fact carbon dioxide regarded as pollutant inn diesel engine I is a long lived greenhouse gas.

E. HC EMISSION

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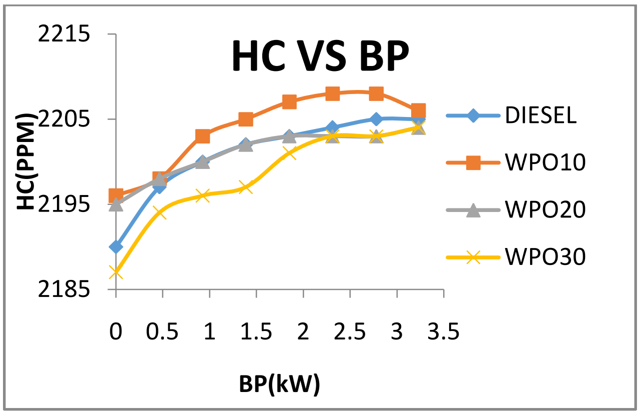

Fig.7. variation of HC with BP

The Variation of unburned hydrocarbon with Biodiesel blends with different brake power is graphically represented in Fig.7. In general hydrocarbons can be seen in engine exhaust when fuel has high cetane number and sufficient combustion doesn't takes place. The cetane number for the pyrolysed fuel is less when compared to conventional diesel hence the extent of combustion increases and emission of hydrocarbons decreases. From the graph these can be seen in the blends of B20 and B30, which shows lower hydrocarbon emission.

F. NOX EMISSION

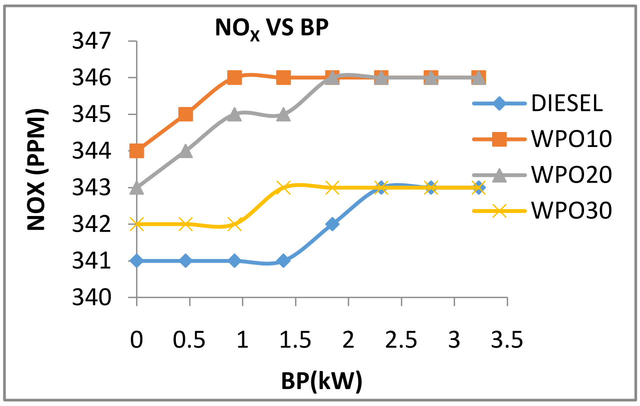

Fig.8. variation of NO_X with BP

The Variation of NOx with plastic oil diesel blends at different brake power is graphically represented in Fig 8. The formation of nitrogen oxides in the exhaust is due to increased engine temperature. But in this case the engine temperature for B20 is equal to conventional diesel and B30 is lesser than diesel. Although engine temperature is less it shown higher nitrogen oxides emission this is due to the reason that pyrolysed fuel has more oxygen content than conventional diesel fuel. This supplies excess oxygen and which results in excess liberation of nitrogen oxides. That is the reason we got excess liberation of nitrogen oxides.

IV. CONCLUSION

Due to larger deposition of plastic wastes in the earth surface pyrolysis process shows better conversion of plastics in to useful hydro carbon fuels like petrol, diesel. On efficiently doing this process the production cost per litre fuel decreases when compared to crude oil refining .Due to increased fuel demand this process shows an alternative way of producing fuel which can able to meet the global fuel demand. The power generated by the plastic oil blend (B20) is equal to the diesel. On absorbing the emission characteristic graphs plastic oil blend shows little bit higher emission values than diesel. The modification in the production like pressure heating the obtained crude form of fuel it is possible to separate better quality of fuel. If the production is done efficiently with specified parameters it is possible to produce better quality fuel this will occupy the place of conventional diesel.

V. FUTURE WORK

Several aspects in the present work still require attention and they are worth mentioning in this section so as to encourage future research. The present study involved the effect of temperature and pressure on the quality and quality of plastic oil. As the future work to maintain the optimum temperature and pressure in the reactor to increases the quantity and quality. Another one of the process parameter is type of quantity of catalyst used in the process. So as a future work, to use different catalyst and its mixing ratio may also changes the quantity and quality of the oil. Above mention the parameter changes may also reduce the production time.
From the present work it is observed that the emission characteristic of plastic oil blends shows more percentage than diesel. So the future work is to investigate emission reduction method. As a future work plastic oil is directly used as an alternative fuel without mixing with diesel or gasoline.

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