Waste Plastic Oil As A Diesel Fuel In The Diesel Engine: A Review

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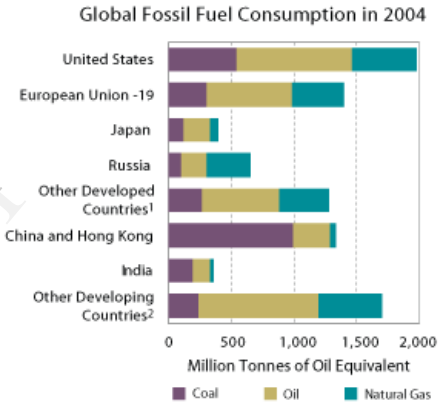
Abstract-:

Environmental degradation and depletion of oil reserves are matters of great concern around the globe. Developing countries like India depend heavily on crude oil import of about 125 Mt per annum (7:1 diesel/gasoline). Diesel being the main transportation fuel in India, finding a suitable fuel alternative to diesel is an urgent need. Waste plastic pyrolysis oil is suitable for compression ignition engines and more attention is focused in India because of its potential to generate large-scale employment and relatively low environmental degradation. Plastics have now become indispensable materials in the modern world and application in the industrial field is continually increasing. The properties of the oil derived from waste plastics were analyzed and found that it has properties similar to that of diesel. Waste plastic oil (WPO) was tested as a fuel in a D.I. diesel engine and its performance characteristics were analysed and compared with diesel fuel (DF) operation. It is observed that the engine could operate with 100% waste plastic oil and can be used as fuel in diesel engines. Engine fueled with waste plastic oil exhibits higher thermal efficiency upto 80% of the full load and the exhaust gas temperature was higher at all loads compared to DF operation. In this review paper we briefly discuss replacement of diesel with waste plastic fuel oil and its effect on the engine performance.

Keywords-Waste plastic oil ,Diesel engine ,Brake thermal efficiency, Engine performance .

Introduction

The growing demand for fuel, ever-increasing prices of energy carriers and the dwindling resources have turned into a major crisis for science and technology.[2] Diesel fuel is regarded as a highly critical fuel in many countries due to its wide applications in heavy duty transport vehicles, rail transportation systems, agricultural machineries and construction equipments.[2] Show in graph 1. The consumption of fossil varies by region and by country. The biggest consumer are the united state, chine and the European union and moderate consumption in india. that means day by day the fuel consumption will be increase.



Also The population of the world increases day by day so facilities of them are also increases. So it is necessary to find the alternative fuel. The properties of the oil derived from waste plastics were analyzed and found that it has properties similar to that of diesel so the waste plastic fuel is use in diesel engine.

Waste plastics their disposal creates large problems for the environment. Waste plastics do not biodegrade in landfills, are not easily recycled, and degrade in quality during the recycling process. Instead of biodegradation, plastics waste goes through photo-degradation and turns into plastic dusts which can enter in the food chain and can cause complex health issues to earth habitants.[4] According to a nationwide survey, conducted in the year 2003, more than 15342.46 T of plastic waste is generated daily in our country, and only 40% wt of the same is recycled, balance 60% wt is not possible to dispose off.[4].If the utilization of plastic is there then will gat advantage like stopping the land pollution and got the a fuel.

Two series of waste plastic cracking. The first series of polymer cracking experiments was carried out in a glass reactor at atmospheric pressure and in a temperature range 350-420°C, the second one in autoclaves under hydrogen pressure (~3-5MPa) in temperature range 380-440°C. The application of catalyst results in lowering of polymers cracking temperature, density of obtained liquid and increased the gas fuel yield.[3] The main problems with the use of neat plastics oil in diesel engines are high smoke levels and relatively low thermal efficiency due to high viscosity and carbon residue as compared to diesel.[1]

Composition and properties of waste plastic oil:

Waste plastic oil is a mixture of C10-C30 organic compounds. Waste plastic oil has lower calorific value and sulphur content compared to diesel. The major process parameters and product yields are given in Table 1.Waste plastic oil gives on weight basis 75% of liquid hydrocarbon, which is a mixture of petrol, diesel and kerosene, 5-10% residual coke and the rest is LPG. The properties of measured waste plastic oil and diesel are compared in Table 1.[1]

Paper 1:[1]

In this paper M. mani et al. investigated the engine performance parameters using diesel, WPO 10, WPO 30, WPO 50, WPO 70 and WPO. The results are compared with DF operation. Show in fig. 1 the cylinder pressure obtained at full load indicates higher value for WPO 10, WPO 30, WPO 50, WPO 70 and WPO compared to DF. Also the ignition delay of WPO-DF blends is considerably longer than that of DF show in fig 2. Ignition delay is defined as the time delay (expressed in crank angle) between the start of injection and start of combustion.

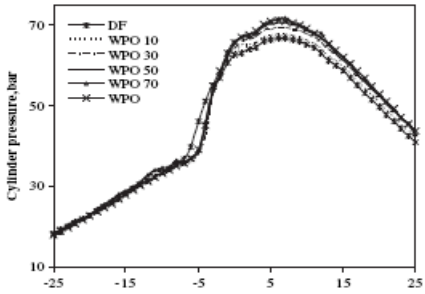


Fig 1. Variation of cylinder pressure with crank angle

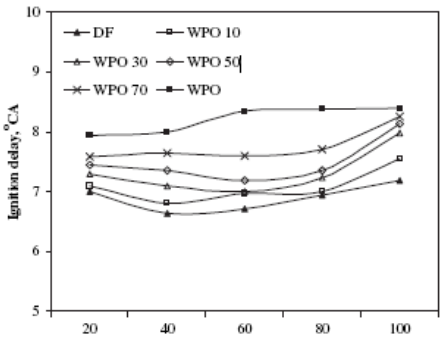


Fig. 2. Variation of ignition delay with load.

The variation of cylinder peak pressure show in fig.3. and Heat release rate with load for tested fuels at different loads is shown in Fig. 4. The cylinder peak pressure and Heat release rate for the WPO-DF blends is higher than DF at higher loads

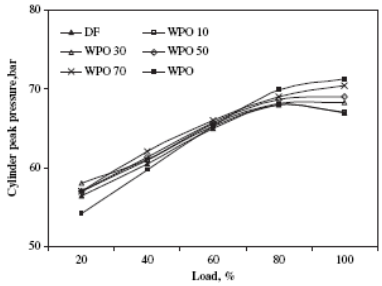


Fig 3. Variation of cylinder peak pressure with load

Table 1: comparision of WPO,Diesel

Sr. No.	Properties	WPO	Diesel
1	Colour	Pale black	Orange
2	Specific Gravity at 30 °C	0.8355	0.84 to o.88
3	Gross Calorific Value (kJ/kg)	44340	46500
4	Kinematic Viscosity, cSt @ 40 °C	2.52	2.0
5	Cetane number	51	55
6	Sulphur Content (%)	<0.002	<0.035
7	Flash Point °C	42	50
8	Fire Point °C	45	56
9	Pour Point °C	< 7	6

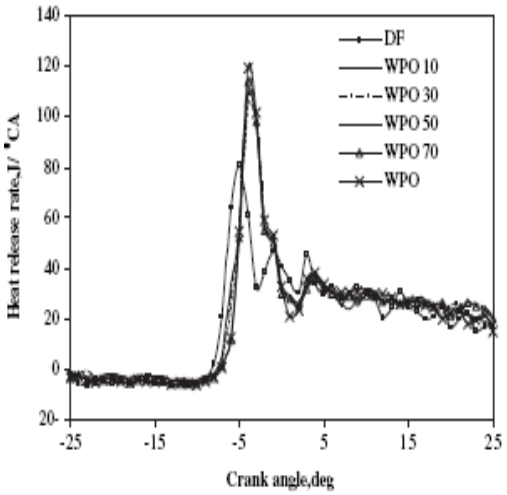


Fig 4. Variation of heat release rate with crank angle

The brake thermal efficiency is lower for the WPO-DF blends than diesel so in fig 5. The brake thermal efficiency of WPO is higher than that of DF upto 80% of full load, beyond which the brake thermal efficiency of DF is marginally higher.

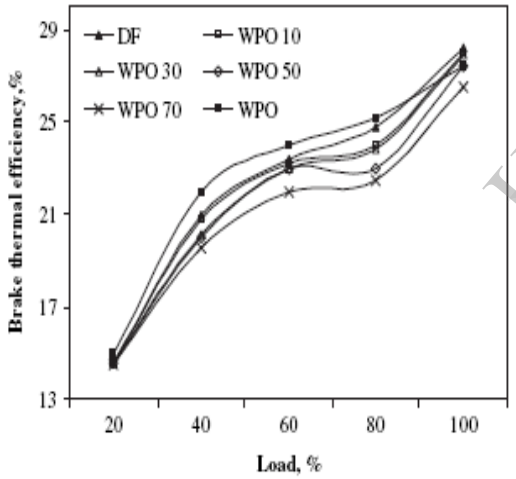


Fig 5. Variation of brake thermal efficiency with load.

Paper 2:[2]
In this paper Pouya Mohammadi et al. investigated the Engine performance parameters such as brake power (Pb), brake mean effective pressure (bmep), brake specific fuel consumption (bsfc), brake thermal efficiency (bte) and brake fuel conversion efficiency (bfce) were calculated and formulated in the literature .[4,21,22]

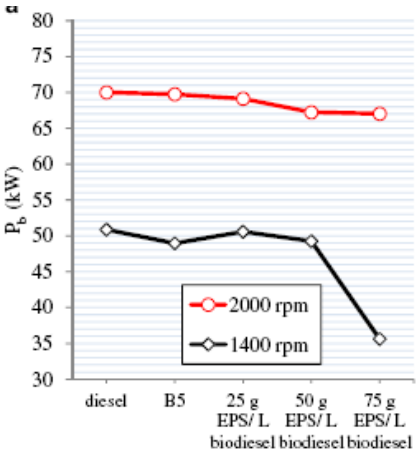


Fig. 6. Pb Vs speed at full load

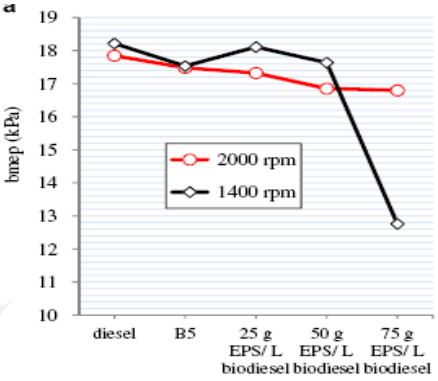


Fig. 7. Bmep Vs speed at full load

Brake power will increase with speed. at full load and the maximum speed of 2000 rpm, brake power increase by o.36,1.26,3.95,4.26% show in fig 6, Brake mean effective pressure increase 2.07,2.95,5.60,5.89% show in fig 7 and Brake specific fuel consumption decrease 1.3,7.4,8.5,9.1% show in fig 8 for the EPS contents of 0, 25, 50 and 75 g/L biodiesel, respectively.

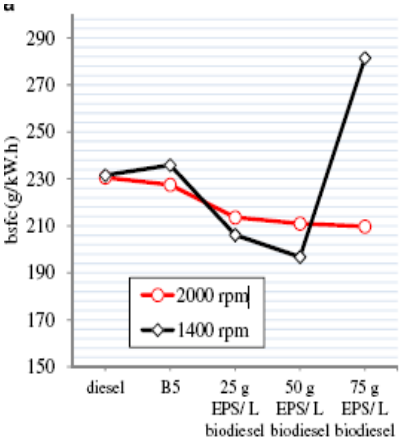


Fig. 8. bsfc Vs speed at full load

Show in fig 9 Brake thermal efficiency remained almost constant at all speed levels. By adding 25, 50 and 75 g EPS/L biodiesel. bte was enhanced by 8.4, 9.8 and 10.4%, respectively at the speed of 2000 rpm and full load operation condition

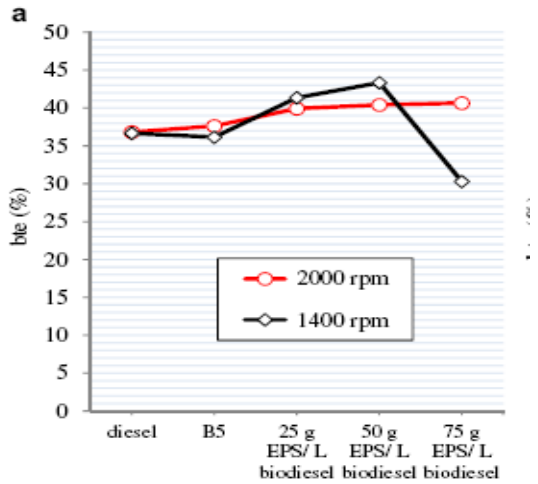


Fig. 9. bte Vs speed at full load

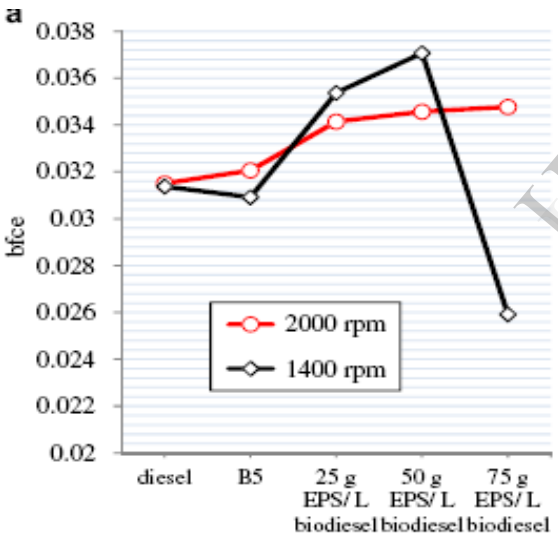


Fig. 10. bfce Vs speed at full load

Show in fig 10 the trend of brake fuel conversion efficiency is similar to that of brake thermal efficiency.

Paper 3:[3]

In this paper Senthilkumar Tamilkolundu et al. investigated Total Fuel Consumption (TFC), Brake Power (BP), Specific Fuel Consumption (SFC) and Brake Thermal Efficiency (□BT) for PVC/diesel oil blend and they are comparison with 50% loading .

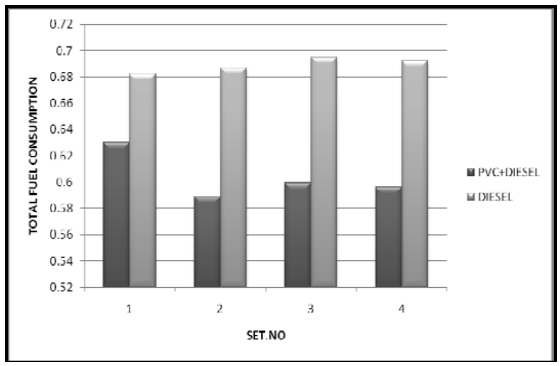


Fig. 11 Comparison of Total Fuel Consumption

The test results show that the Total Fuel Consumption is about 0.69 kg/hr and 0.61 kg/hr for diesel oil and PVC/diesel oilshow in fig 11; Specific Fuel consumption is about 0.37 kg/kWhr and 0.32 kg/kWhr for diesel oil and PVC/diesel oil respectively show 12; Brake thermal efficiency is about 22.5% and 27.4% for diesel oils and PVC/diesel oil respectively show in fig 13.

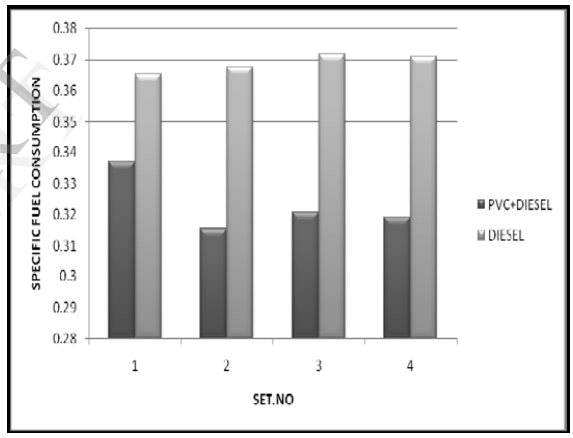


Fig. 12 Comparison of Specific Fuel Consumption

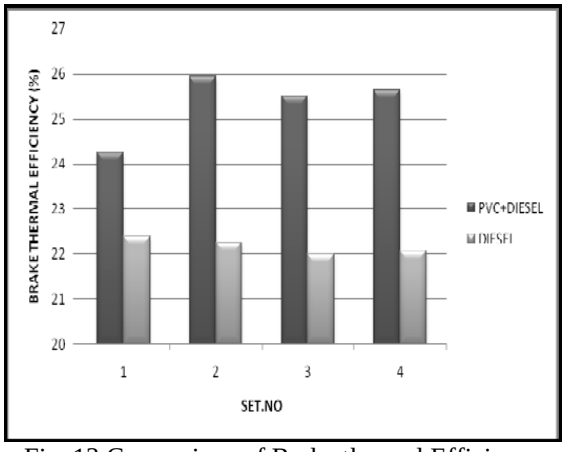


Fig. 13 Comparison of Brake thermal Efficiency

From the Figures, it is observed that the Total Fuel Consumption is reduced by about 11.6 %, Specific Fuel Consumption is reduced by about 13.5% and the increase in Brake thermal Efficiency is about 23%. The results indicate the oil derived from waste plastic can be used as a promising alternate fuel for transportation

Paper 4:[4]

In this paper Mr. Rajesh Guntur et al. investigated total fuel consumption, specific fuel consumption break mean effective pressure and brake thermal efficiency were calculated.

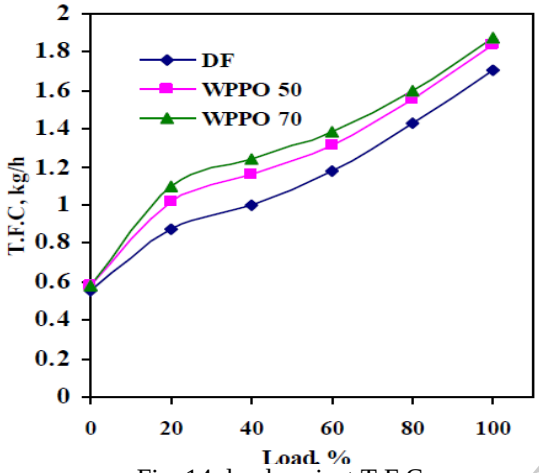


Fig. 14: load against T.F.C

The performance tests were conducted at 1500 rpm with loading of 20,40,60,80, and 100 percent of maximum power.

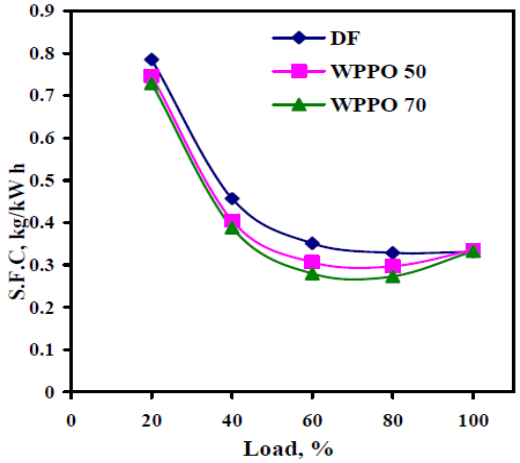


Fig. 15:load against S.F.C

In this paper Three test fuels were used during experiments including neat 100 % diesel fuel and a blend of 50% and 70% with waste plastic pyrolysis oil by volume in the diesel. Total fuel consumption increase show in fig 14 and Brake specific fuel consumption decrease show in fig 15when the load increase. the fuel consumption approximately proportional to the amount of WPPO added to the diesel fuel. At full load, WPPO blends show the specific fuel consumption higher than the load.

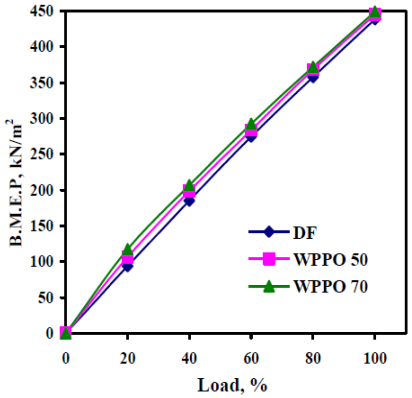


Fig.16. Load against B.M.E.P diesel.

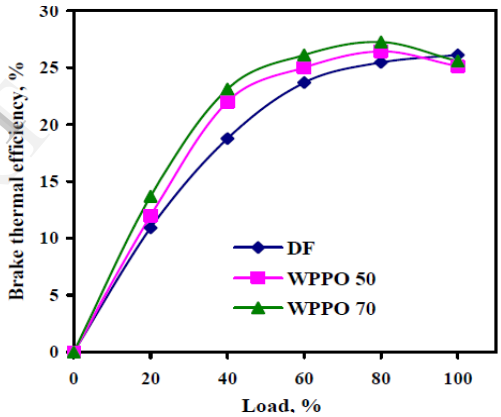


Fig. 17 Load against Brake thermal efficiency

Show in fig. 16 Brake Mean Effective Pressure for pure diesel fuel is less than all the waste plastic pyrolysis oil - diesel blends and show in fig 17. The brake thermal efficiency is high for the WPPO-DF blends than diesel.

Conclusion:

From the review of all above paper it is concluded that the blend of wpo and diesel can directly used in the engine without modification. Also it is concluded that the engine performance is good .The main aim of this paper is to find the best suitable blend of wpo and diesel. Since the viscosity of WPO is high which can be reduced by adding the ethanol in the WPO?

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