A Literature Review on Analysing the Performance of Single Cylinder 4 Stroke Diesel Engine using Blends of Tire Pyrolysis Oil and Diesel

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Abstract- The Purpose of this study is to improve the performance of 4 stroke single cylinder diesel engine with blending of tire pyrolysis oil and diesel. Tire pyrolysis oil is obtained by pyrolysis process of waste tires. Tire pyrolysis oil has a similar properties of diesel like density & Calorific Value. Pyrolysis process involves the chemically decomposes organic materials by heat in the absence of oxygen. An experiment will conduct on 4 stroke DI engine with employing the blends of TPO and diesel. During an experiment readings will be observed. Then an engine performance parameters like brake thermal efficiency, Brake specific fuel consumption, mechanical efficiency etc will be evaluated. In this Experiment, input parameters will be selected that blends of TPO & diesel, variation of injection pressure, and different load conditions.

Keywords – Diesel, Tire pyrolysis oil (TPO), Injection pressure, Engine performance, Blends of TPO & diesel

I. INTRODUCTION

As per current situations concerned with availability of fossil fuel and increasing the demand of vehicles at point of view of transportations, it is necessary to think about it. Also it is noted that prices of petrol and diesel are continuous increases. Day by day increasing the consumption of fossil fuels like petrol and diesel, possibility makes in future that their sources will not available so more. Also today's main problem is the pollution created from vehicles. So, ours effort must be go in that direction which reduces the pollution and also find a suitable alternative for the fossil fuels. .[Sk.Mohammad Younus et al. (2013), Mr. Krunal B Patel et al. (2013)]

As per current scenario, India is a diesel based economy. Diesel consumption is around five times the consumption of petrol. So, to reducing the pollution & achieve a great economical benefit, we have to find suitable alternatives for diesel engine and must be do research work on them.

Tire pyrolysis oil have a similar properties of diesel. It is obtained from waste tires with pyrolysis process. The tire pyrolysis process converts waste tires into potentially recyclable materials such as flammable gas, pyrolysis oil and carbon black. It was determined that the oil production yield of tire pyrolysis process has a maximum at 350°C and decomposes rapidly above 400°C.

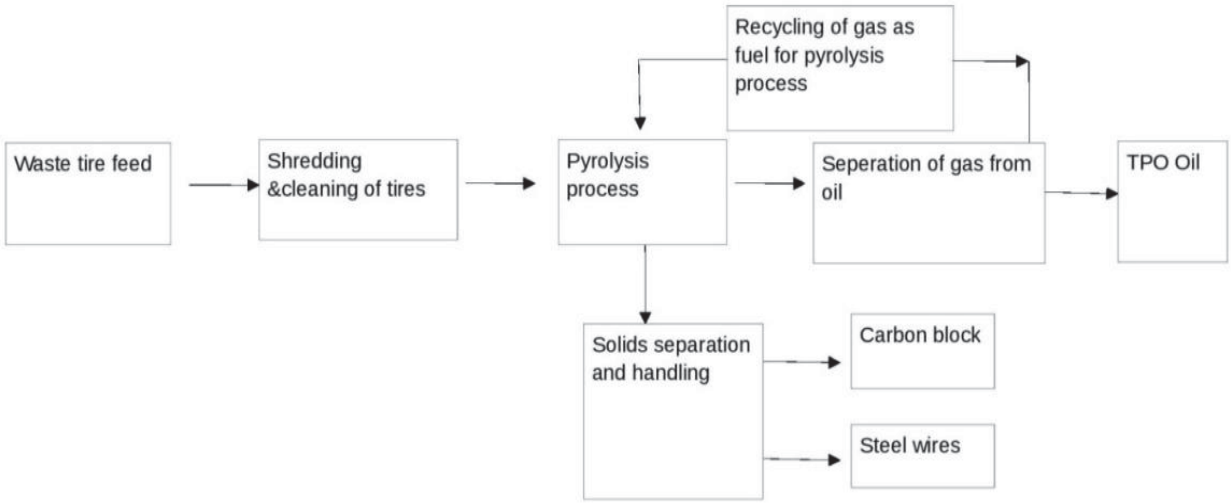

Figure 1: Process to makes of tyre pyrolysis oil

Table 1 Properties of Diesel & Tire pyrolysis oil

Properties (condition)	Unit	TPO	Diesel
Density	Kg/m3	834	799
C.V	Kj/kg	42500	45814
Carbon content	%	84.67	87
Hydrogen content	%	10.44	13
Oxygen content	%	4.17	-
Viscosity @ 40°C	cp	2.69	1-4.11
Flash Point	°C	68	70

II. LITERATURE SURVEY

Rok Vihar et al. (2015)1 A tire pyrolysis oil (TPO) produced from waste tires was tested in a 6-cylinder, compression ignition, turbocharged, 6.9 L heavy-duty engine. Experiments were conducted in two operating modes, with and without intercooler, at two different engine speeds and at various loads. Impact of thermodynamic and engine performance parameters on combustion process were systematically analyzed in terms of cause and effect phenomena through mechanisms initiated by the fuel properties. Results indicate that TPO can be efficiently used in turbocharged non-intercooled CI engines at high loads, which opens its use in power generation.

Juan Daniel Martinez et al. (2014)2 A tire pyrolysis liquid (TPL) fuel produced in a continuous auger reactor on pilot scale was blended at 5 vol.% (5TPL) with commercial diesel fuel (100D) and tested in a 4-cylinder, 4-stroke, turbocharged, intercooled, 2.0 L Nissan diesel automotive engine (model M1D) with common-rail injection system. The engine performance and exhaust emissions were obtained for both the 5TPL blend and the commercial diesel

fuel. The fuel did not show significant differences on the combustion pattern; just a slightly longer duration with the TPL blend. The low-volatile fraction of this blend deteriorated the engine performance (in terms of thermal efficiency and fuel economy)

R. Ballesteros et al. (2014) 3 In this paper, two diesel fuels, an animal-fat biodiesel and two diesel blends with the animal-fat biodiesel (50 vol.%) and with a tire pyrolysis liquid (TPL) fuel (5 vol.%) have been tested in a 4-cylinder, 4-stroke, turbocharged, intercooled, 2.0 L Nissan diesel automotive engine (model M1D) with common-rail injection system and diesel oxidation catalyst (DOC). Carbonyl emissions have been analyzed both before and after DOC and specific reactivity of carbonyl profile has been calculated. Results showed, on the one hand, an increase in carbonyl emissions with the biodiesel fraction in the fuel. On the other hand, the addition of TPL to diesel also increased carbonyl emissions.

S.I. Yang et al. (2014)4 This study used the fast pyrolysis method to produce bio-oil from coffee bean residue. The oil was mixed with diesel fuel through emulsification to produce emulsified fuel with varying proportions. A singlecylinder diesel engine connected to a 12-kW power generation system was used as the test system to examine the performance indices of a diesel engine under various loads and rotational speeds when using three fuel mixtures with varying proportions of bio-oil (i.e., CPO (coffee bean residue pyrolysis oil) 0 (100% diesel), CPO 5 (5 vol.% bio-oil/95 vol.% diesel), and CPO 10 (10 vol.% bio-oil/90 vol.% diesel)). According to the results, compared to CPO 0, the addition of CPO 5 and CPO 10 increased the fuel consumed for the same power output.

Jinang M. Patel et al. (2013)5 In their studied the engine (4 cylinder direct injection) performance is measured with applied the blends of tire pyrolysis oil and diesel as proportion of tire pyrolysis oil was 5%, 10% and 15%. A constant speed off 1500rpm was maintained throughout the experiment. The results showed that brake thermal efficiency of the engine was maximum for D10 blend than diesel at same loading conditions. The BSFC was also found to be less for D10 blend compared to diesel. There was no significant increase in exhaust gas temperature for the blends as compared to diesel.

C. Wongkhorsub et al. (2013)6 In this research comparison of the use of pyrolysis oils which are the tire pyrolysis oil, plastic pyrolysis oil and diesel oil in the assessment of engine performance, and feasibility analysis. Pyrolysis oils from waste tire and waste plastic are studied to apply with one cylinder multipurpose agriculture diesel engine. It was found that without engine modification, the tire pyrolysis offers better engine performance whereas the heating value of the plastic pyrolysis oil is higher. The plastic pyrolysis oil could improve performance by modifying engine. The economic analysis shows that the pyrolysis oil is able to replace diesel in terms of engine performance and energy output if the price of pyrolysis oil is not greater than 85% of diesel oil.

Sk.Mohammad Younus et al. (2013)7 In this study test were conducted on four stroke single cylinder diesel engine. An experimental investigations was carried out on the engine by using the tire pyrolysis oil blended with diesel in different proportions such as T10, T20 and T30 to find out the performance parameters and emissions. Also they used the additives during experiment like Ethanol and Ethyl Hexyl Nitrate (EHN). Ethanol was added as 5% and 10% by volume to the diesel-biodiesel blends and Ethyl Hexyl Nitrate(EHN) was added as 0.5% and 1% to the diesel-biodiesel blends. It was observed that the Brake Thermal Efficiency(BTE) increases in proportion to the blend percentage. The CO, HC and NOx emissions are decreased when compared to neat diesel.

Mr. Krunal B Patel et al. (2013)8 They carried out an experiment on single cylinder diesel engine. They blended the tire pyrolysis oil with diesel as proportion of 5 % tire pyrolysis oil. They conclude that blending of pyrolysis oil with diesel helps to reduce the fuel consumption. For that input parameters are taken as injection timing, injection pressure, compression ratio, and load are taken as variable. For this they used taguchi method for minimal number of experiments and get a optimal experimental L25 orthogonal arrays. At the end of experiment they concluded that 220 injection timing, injection pressure 200 bar, compression ratio 16 and engine load 3 kg are optimum parameter for lowest break specific fuel consumption.

Og˘uzhan Dog˘an et al. (2012)9 The aim of the present study is to evaluate the effect of tire-derived fuel (TDF) on engine performance and exhaust emissions in a diesel engine. For this aim, the raw tire derived pyrolytic oil was refined and six test fuels, TDF10 (contains 10% tire derived fuel and 90% diesel fuel in volume basis), TDF30, TDF50, TDF70, TDF90 and neat diesel fuel, were prepared to test in a diesel engine. Tests were performed in a single cylinder, four stroke, unmodified, and naturally aspirated DI high speed diesel engine at full load and four engine speeds (1400 rpm, 2000 rpm, 2600 rpm, and 3200 rpm) by using six test fuels. The experimental test results showed that the DI diesel engine can run with the TDF fuel blends up to TDF90. In addition, TDF fuel content in the fuel blends does not have a significant impact on the engine output torque, the engine power, brake specific fuel consumption (BSFC) and brake thermal efficiency (BTE) with respect to those of the reference diesel fuel.

Mr. Dhananjay H Joshi et al. (2012)10 An experimental has been carried out for pyrolysis oil blended with diesel used in single cylinder diesel engine. In this study, the effects of parameters like. load, blend proportion and injection pressure are taken as variable for optimization. taguchi method of optimization was used in this

experiment. The results of the taguchi experiment identifies that 5% blend ratio, injection pressure 180 bar and engine load 20kg are optimum parameter setting for highest mechanical efficiency. Engine performance is mostly influenced by engine load and is least influenced by injection pressure.

III. SCOPE OF FUTURE WORK

An experiment will be occur on four stroke single cylinder diesel engine with supplying blends of tire pyrolysis oil and diesel. During this injection pressure and loads will also change. Tire pyrolysis oil has a similar properties of diesel. Engine performance parameters like brake thermal efficiency, brake specific fuel consumption, mechanical efficiency will be analyze.

REFERENCES

[1] Rok Vihar et al. "Combustion characteristics of tire pyrolysis oil in turbo charged compression ignition engine" Science direct Fuel 150 (2015) 226–235

[2] Juan Daniel Martinez et al. "Performance and emissions of an automotive diesel engine using a tire pyrolysis liquid blend" Science direct Fuel 115 (2014) 490–499

[3] R. Ballesteros et al. "Carbonyl emission and toxicity profile of diesel blends with an animal-fat biodiesel and a tire pyrolysis liquid fuel" Science direct Chemosphere 96 (2014) 155–166

[4] S.I. Yang et al. "Application of biomass fast pyrolysis part II: The effects that bio-pyrolysis oil has on the performance of diesel engines" Science direct Energy xxx (2014) 1e9

[5] Jinang M. Patel et al. "Performance studies of Tire Pyrolysis Oil blends with Diesel Fuel " (IJEAT) ISSN: 2249 – 8958, Volume-3, Issue-2, December 2013

[6] C. Wongkhorsub et al. "A Comparison of the Use of Pyrolysis Oils in Diesel Engine" Scientific Journal-July 2013

[7] Sk.Mohammad Younus et al. "Performance and Emissions Characterstics of Diesel Engine Fueled With Tyre Pyrolysis Oil&Diesel Blends with Additives" IJESI- Volume 2 Issue 5 ǁ May. 2013

[8] Mr. Krunal B Patel et al. "Parametric Optimization of Single Cylinder Diesel Engine for Pyrolysis Oil and Diesel Blend for Specific Fuel Consumption Using Taguchi Method" (IOSR-JMCE) e-ISSN: 2278-1684 Volume 6, Issue 1 (Mar. - Apr. 2013)

[9] Og˘uzhan Dog˘an et al. "The effect of tire derived fuel/diesel fuel blends utilization on diesel engine performance and emissions" Science direct Fuel 95 (2012) 340–346

[10] Mr. Dhananjay H Joshi et al. "Parametric optimization of single cylinder diesel engine for pyrolysis oil & diesel blend for mechanical efficiency using taguchi method" (IJERT) Vol. 1 Issue 4, June - 2012 ISSN: 2278-0181