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Full Length Article

Assessment of Alternative Fuel Performance: Emission and Efficiency Analysis of Diesel-Tyre Pyrolysis Oil Blends

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ABSTRACT
As we all know the due to the scarcity of conventional fuels and the Crude oil, the price of the conventional fuel is going up day by day and there Will no more conventional fuel in future and it is also Increasing the environmental pollution by the usage Of crude oil .And by using biofuels also we are consuming the natural products Therefore in the investigation the oil taken will pyrolysis oil which will be obtained by the Pyrolysis of the waste of automobile tire , and by this the disposal of waste rubber are Becoming the threat to the environment will also be Solved. By this investigation we can not only solve the shortage of crude oil but also can reuse the waste automobile tires, in the initial stage the test will be conducted on four Strokes single cylinder diesel engine by using diesel.
Experimental investigation will be carried out on the same engine by changing the crank angle and by using the tire pyrolysis oil blended with Diesel in Different proportions such as T10, T20 and T30, to Find out the performance parameters, by changing the inlet pressures as 200 bar, 220 bar and 240 at different load condition for each inlet pressure 6, 9 & 12, with crank angle 23deg standard. After performing the experiment the performance characteristics would be determined.

Keywords:
Tire Pyrolysis Oil, Diesel Engine, Alternative Fuel, Waste Tire Recycling, Biofuel Blends, Compression Ignition Engine, Fuel Injection Pressure, Crank Angle, Engine Performance, Emission Characteristics, Waste Rubber Management, Pyrolysis Process, Sustainable Energy, CI Engine, Fuel Blending, Renewable Energy, Thermal Efficiency, Brake Specific Fuel Consumption, Environmental Pollution Reduction, Waste-to-Energy Technology.

INTRODUCTION:

The internal combustion engines have become an important part of the fulfillment of the human needs. Automotive propulsion, the supply of motion to the machinery heavy and decentralized power generation are the chief applications of internal combustion engines. The conventional running of internal combustion Demands petroleum products such as Diesel, petrol, Gasoline etc., as fuels. The combustions products and the residues of the engine combustion allowed into the atmosphere are leaving adverse effects on the human health and the environment. Many types of research and are being conducted to find the solution for the reduction of the internal combustion engine pollutants.

The fossil fuels using in the internal combustion engines are non-renewable and are high impact on a country's economy.

Research reports say that the oil that is being drilled out of the earth would exhaust within few decades. This shows the world is the requirement of fuels that are renewable and can be in digenously produced in a country to save the economy. The internal combustion engines have become an important part of the fulfillment of needs. The conventional running of internal combustion demands petroleum products such as Diesel, petrol, Gasoline etc., as fuels. The combustions products and the residues of the engine combustion allowed into the atmosphere are leaving adverse effects on the human health and the environment.

Many types of research and are being conducted to find the solution for the reduction of the internal combustion engine pollutants.

TYRE PYROLYSIS OIL

Pyrolysis oil is the end product of waste tire and plastic pyrolysis, the oil is wide used as industrial fuel to substitute furnace oil or industrial diesel. … The pyrolysis oil is extracted from waste tire or waste plastic by our pyrolysis plant, the pyrolysis plant is a machine converts waste tire to oil.

METHODS OF WASTE TYRE RECYCLIN

Waste tires are recycled in different ways which are:

1. Retreading
2. Landfills
3. using as construction Materials
4. Incarnations
5. Tire Derived Fuel

Retreads manufacturing process designed to extend the lifespan of worn out tires. The old tread is removed and a new tread is applied to the bare casing using specialized tools. This procedure is regularly carried out in airplane tires as they are worn out very frequently and the necessity for

Those to be in good condition .On an average

4.5 gallons of oil are saved through this process compared to manufacture of a new tire. In case of commercial vehicles, the savings can go up to 12.5gallonsofoil.

Land filling is the most common way of disposing waste tires, accounting upto53% of the total waste tire generated. But it has a serious impact on land usage, fertility of land and is a potential hazard as it is prone to fires. Tires are very difficult to extinguish when they catch fire. Citing these many countries has banned this form of disposal of waste tires.

Incineration and TDF are two wastes to energy technologies that are available for the treatment of

Waste tires. In incineration, energy recovery systems are used to recover the energy. TDF or tire derived fuel the energy remains in a liquid form that can be used in combustors, IC engine etc.

The importance of finding use for waste tires can be deduced from the fact that we produce nearly

1 billion waste tires each year. The composition of passenger vehicle tires is approximately 85% carbon, 10–15% fabric materials and 0.9–1.25% sulfur.

The typical percentages of the rubber mix are 55% synthetic rubber (poly butadiene) and 45% natural rubber (latex) in passenger vehicle tires. Thus, the abundant organic matter (OM) contents of tires can be converted into useful products for energy sources.

Pyrolysis is one of the methods to derive alternative fuels, in which organic substances are converted into useful energy. One of the methods to derive alternative fuels is pyrolysis in which waste substances are converted into useful energy. Pyrolysis is a thermo Chemical conversion process in which an irreversible chemical change is caused by the action of heat in absence of oxygen. This process yields value added products such as fuels or chemicals in the form of solid, liquid or gas.

Without oxygen, the process splits the chemical bonds and leaves

The energy stored in the organic substance. The main advantages of pyrolysis include compactness, simple equipment, low pressure operation, negligible waste product and high energy conversion efficiency of the order of 83%. The oil obtained after pyrolysis is termed as Tire Pyrolysis Oil (TPO).

Pyrolysis of tires yield liquid Fuel, gases, carbon black and steel wires. Tire Pyrolysis Oil can be directly used as fuel in Combustors and IC engines .Al though using in such systems is effective, the complex composition Poses huge challenges for use of TPO as a combustion fuel .Presence of Phenolic, and PAH compounds leads to high emissions and high maintenance cost. To address the drawbacks of using TPO, in this investigation vacuum distillation technique was used .TPO was distilled and separated in temperature ranges of 170 -190 0C, 190 -

210 0C, 210 –

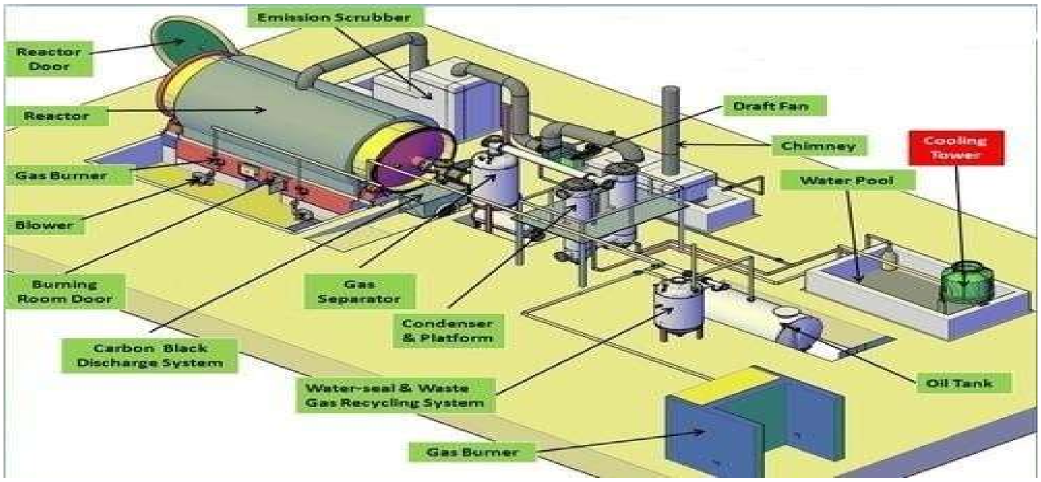
2300Cand 230 -2700C.Not only this technique separated the TPO according to its composition, but also made it a cleaner fuel by removing all the sulfur content present in TPO. Test showed that the distillate had no sulfur content. Instead of wasting the high boiling point substances that Remained in the flask, it has been tried to be used as base stock for manufacturing lubricants.

LITERATURE REVIEW:

The disposal of used tires from automotive vehicles becomes in exhaustible. Though many disposal methods are available to dispose of the waste automobile tires, still the problem persists. Pyrolysis of a substance offers value added products such as pyrolysis oil, pyrolysis gas, and char. It is also reported as pyrolysis oil, pyrolysis gas, and char. It is also reported that TPO has properties similar to those of diesel fuel. One TPO has properties

Similar to those of diesel fuel. One common way of disposal for these waste tires is land filling. It was surveyed that tires are bulky, and 75% of the space at re occupies is void, so the land filling of waste tires has several difficulties [3]. In this study, a batch type fixed bed fire tube heating pyrolysis system has been designed and fabricated for liquid production from scrap tires of rickshaws, bicycles, and trucks. The scrap tires were pyrolysis in an internally heated batch type fixed bed fire tube heating reactor system.

The products were liquid, char, and gases. The maximum liquid and char yield were 52 and 35 wt. %, for bicycle and rickshaw, respectively. For truck tires, the liquid and char yield were maximum 60 and 23 wt. %, respectively. The heat value of liquid of rickshaw and truck tires was found of 41 and 40.7 MJ/kg.



Production of Tire Pyrolysis Oil

Tire Pyrolysis Oil used for this research work was obtained from a pilot plant located in the city of Rourkela. The schematic illustration of the plant is given in fig. The plant is a rotary type, pyrolysis reactor. The dimensions of the reactor are approximately
6.6 m in length; diameter is 2.8 m and has a capacity of 10 tons per batch. The reactor is rotated with the help of electrical motors. Initially it is fired up with waste wood and then coal is used to keep it burning. In the plant, shredded tires are fed into the reactor
.The front end of the reactor has a door with fasteners and can be opened or closed by Unlocking or locking the fasteners respectively. The other end of the reactor is connected to a sealing element and a flexible connection. The volatile vapor which is formed during pyrolysis passes through the oil separator where heavy oil is separated by gravity and collected in an oil tank. A damper is provided at the outlet of the oil separator that connects to a series of water- cooled pipes. The volatile gases pass through these condenser pipes where the light fractions are converted into liquid. A cooling tower is used to bring the temperature of coolant near atmospheric temperature. The whole setup and its accessories are operated by motor and pumps with the help of a control panel. The initial temperature at which volatile evaporevolve is 1600C.

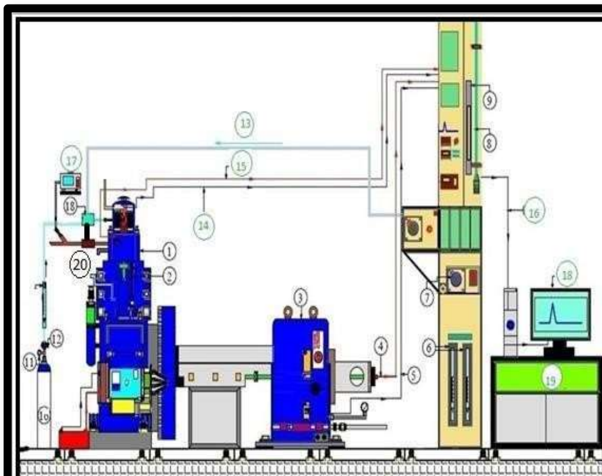
EXPERIMENTAL SETUP:

According to objectives of the present work motioned in the
experimental setup needs to have the following
additional provisions apart from the basic functions
of a basic engine test rig.

Variable compression ratio.

Variable injection pressure.

Provision to induce gaseous fuel as the present experiment requires TPO to induce in the combustion chamber.
Compatibility to work on bio-fuels.
Exhaust gas Re-circulation
To determine the performance at the various running conditions The following measurement provisions are needed.
Measurement of fuel consumption.



1. Engine 2.Variable Compression Ratio lever 3.Eddy Current Dynamometer 4.Crank Angle encoder 5. Load Sensor 6.Rota Meter 7.Loading Unit 8. Burette 9.U-tube Manometer 10.CNG Cylinder 11.CNG Flow Meter 12.Mixing Chamber 13.Ambient Air 14.FuelLine pressure sensor 15.Cylinder pressure sensor Line 16. NI -6270 USB Multi function line 17.Exhaust Gas Analyzer 18.Computer 19.Computer table 20. Exhaust Gas Recirculation

Measurement and regulation of the gas flow. Measurement of temperature at various points of fuel and gas. Measurement of load. Measurement of airflow

Fig1: Block Diagram of experimental Setup

Fig.2: Over all engine set up

EXPERIMNTAL METHODOLOGY

To reach the objectives of the research work and to obtain the outcomes that explain the behavior of the engine the experimental methodology is designed as below.

The engine is run under normal diesel and tyre pyrolysis oil combinations T10, T20 and T30 and the values of the outcomes are noted.

The above-mentioned combinations of fuels are run under variant injection pressures of 200Bar, 220Bar and 240bar.

After setting the injection pressure the load is applied on the engine and the values of the outcomes are noted.

Fig 3;OIL&TPO

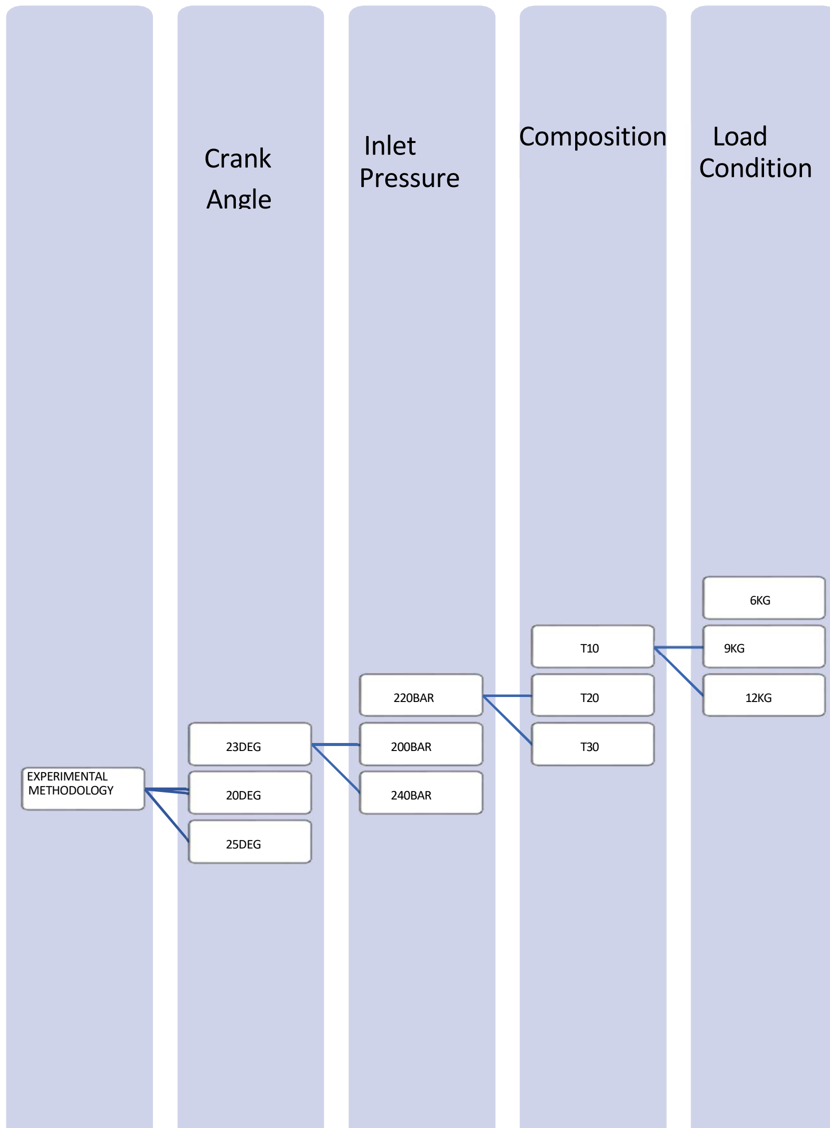


Fig.4: Tree diagram demonstrating the experimental flow As from the above chart the experimental methodology for their search work is explained

The detailed methodology is in such a way that at standard crank angle (23 degree) whole experiment is performed, once the crank angle is set then on the same crank angle three inlet pressure conditions are taken into consideration (i.e.220 bar,200 bar, 240 bar),after adjusting the inlet pressure at one inlet pressure (i.e.at 220 bar) we are taking three fuel compositions i.e. T10=90%DIESEL&10%TPOwhichmeans10 0ml of tire pyrolysis oil is mixed with 900ml diesel , T20=80%DIESEL & 20%TPO which means 200ml of tire pyrolysis oil is mixed with 800ml of diesel, T30= 70%DIESEL & 30%TPO which means300ml of tire pyrolysis oil is mixed with700ml of diesel in this manner all the combinations are made. After preparing the compositions the further experiment is performed, as of further procedure at each composition load are applied ontheenginei.e.6kg, 9kg and full load condition 12kg and the values of outcomes are noted. .After performing the experiment the calculations are done and based on the calculations performance and combustion characteristics are determined .After performing The experiment the crank the same procedure is followed as mentioned above and the calculations are done based on the readings.

Results and Discussions

Effect of Tire pyrolysis Oil for IC Engine

After going through all the experimental procedure and conducting numerous iterations as per the experimental methodology as mentioned in the chapter3, significant results are drawn and presented that are exposed in the present chapter. The presentations of the results are done in a classified manner of steps for the better sympathetic of the behavior of the Investigation engine at all experimental conditions. The Case wise presentation is given as;

The main base of the experiment is the tirepyrolysisoil.Inthecase1theperformance-of the tire pyrolysis oil at various combinations with diesel and at various load conditions is presented at constant injection pressure.

Brake thermal efficiency (BTE) BTE V/S BP

BTE is a main performance parameter of a CI engine it assesses the suitability of a specific running condition. The graph 4.1 shows the BTE of the Engine at several substitutions of TPO in diesel & compared with that of BTE for pure diesel.

Calculations:

IP-200 BAR,C-ANGLE 23DEG			
X-AXIS	Y-AXIS	Y-AXIS	Y-AXIS
BP	BTE	BTE	BTE
	T10	T20	T30
1.752	14.72294	16.0617	17.6683
2.628	20.98018	22.88793	25.17732
3.504	23.5567	25.69873	28.26927

$$BP=\frac{2\pi NT}{60000}$$

$$BTE=\frac{BP\times3600\times100}{mass\ of\ fuel\times calorific\ value\ of\ fuel}$$

$$BTE\ \frac{BP\times3600\times100}{(Density\times volume)\times calorific\ value\ of\ fuel}$$

$$BTE=\frac{BP\times3600\times100}{(\rho diesel\times vol\ diesel\times cf\ diesel)+(\rho TPO\times vol\ tpo\times cf\ tpo)}$$

Fig.5;1TableBPV/SBTE (INOP-220BAR)

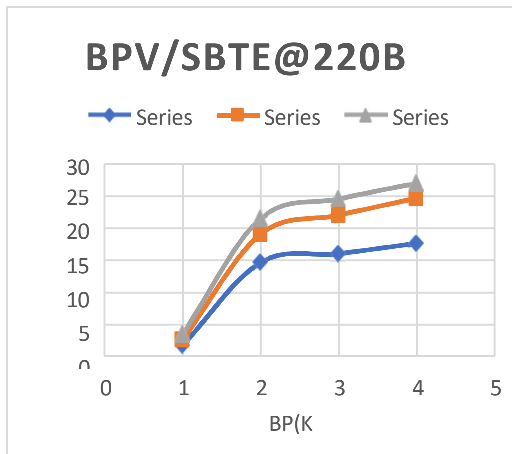


Fig.6; Graph BTEV/SBP(IP-220BAR)

X-AXIS	Y-AXIS	Y-AXIS	Y-AXIS
BP	BTE	BTE	BTE
	T10	T20	T30
1.752	14.72294	16.0617	17.6683
2.628	19.13982	22.08484	24.73561
3.504	21.59364	24.62795	27.09139

Fig.7;.Table BTEV/SBP (IP-200BAR)

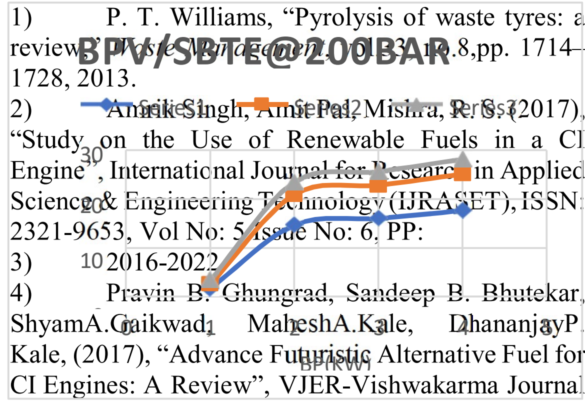


Fig.8; Graph BTEV/SBP (IP-200BAR)

Diesel and top @T30 (top =30%&diesel 70%) gives the close performance to pure diesel with a deviation of 2.2% of break thermal efficiency. Whereas T10 &T20 has somewhat less efficiency in all IP'S.

C-ANGLE 23DEG,IP=220 BAR,			
X-AXIS	Y-AXIS	Y-AXIS	Y-AXIS
BP	BSFC	BSFC	BSFC
	T10	T20	T30
1.752	0.000163	0.000164	0.000163
2.628	0.000125	0.000119	0.000125
3.504	0.000111	0.000107	0.000111

Fig.9; TABLEBSFCV/SBP (IP-220BAR)

CONCLUS ION:

In the presented study, it is found that the distilled tire pyrolysis oil is similar to diesel fuel and able to take place of diesel fuel in small engines.BlendofDTPO30 Gives better results when compared with DTPO 10 & DTPO 20. The following are the conclusion based on the experimental results obtained while operating single cylinder diesel engine with DTPO blends: DPTO 30 blends can also be directly use in diesel engines with some modifications as of inlet opening pressure,

The brake thermal efficiency of DPTO 30 at INOP 240 bar is a bit less than diesel fuel, but at INOP 200 bar it is much lower when compared with diesel fuel.

Specific fuel consumption of DTPO 30 blend is very close to the specific fuel

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6) 220 Bar, DTPO 30is better in SFC. Volumetric efficiency of DTPO 30 blend is somewhat less to volumetric efficiency of

7) diesel, but at 220 bar it is better when compared by other INOP'S i.e. 200bar and 240 bar.

8) So, it is suggested to use DTPO 30 for better performance of the engine.

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