EXPERIMENTAL INVESTIGATION ON 4 –STROKE SINGLE CYLINDER DIESEL ENGINE BLENDED WITH TYRE OIL

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Abstract –

Due to the scarcity of conventional fuels, the crude oil the price was going up day to day and there will be no more conventional fuels in future and also increasing the environmental pollution by the usage of crude oils there is a need for the search of alternative fuel sources for the automobile applications. There are many alternate fuels we already existing like bio-diesel, bio-mass, alcoholic fuels, hydrogen, non-fossil methane and non-fossil gases (like LPG, CNG) and other bio-mass sources which were useful for different applications, out of these bio-diesels are one of the prominent alternative fuel for diesel engines.

Generally bio-diesel is the renewable fuel which is derived by chemically reacting with the sources of bio diesel like vegetable oils, animal oils, plastics, and waste automobile tyres etc. The chemical reaction requires a catalyst usually a strong acid or base such as sulfuric acid, sodium or potassium hydroxide, and produces a new chemical compounds called methyl or ethyl esters of the vegetable crude oil which is called as bio-diesel.

Therefore in the present investigation the oil taken is the tyre pyrolysis oil which was obtained by the pyrolysis of the waste automobile tyres.

Key Words: Waste tyres, Tyre Oil, Blending, Performance

INTRODUCTION:

Now a day's wastes utilization is a major issue to get clean and healthy environment. The production of wastetyres throughout the world is estimated to be 1billion tontines per year. The disposal of solid tyre wastes from human activity is a growing environmental problem for the modern society, especially in developing countries. This polymer solid waste is non-biodegradable because of their complex mixture of very different materials, which include several rubbers, carbon black, steel cord and other organic and inorganic components.

One of the common ways of disposal is land filling, but land filling of used tyres needs a large space because the volume of tyres cannot be compacted. Different recycling processes are being used such as reclaiming, incineration, retreading, grinding etc. but these different recycling processes have some drawbacks. So there is necessary to find the alternative sources for recycling of these tyre wastes. Recycling of solid waste to a useful product is a sustainable approach for the future aspects. One process which has received considerable recent attention is pyrolysis of the tyre to produce oil, gas, and char which has high potential for the other applications. Such as derived oil may be used directly as fuels or added to petroleum feed stocks and it may also be an important source for refined chemicals .The derived gases are useful as fuel; solid char may be used either as smoke less, fuel, carbon black or activated carbon.

Fig.1: Production of tyre oil.

I Engine Specifications:

Table 1

ENGINE	FOUR STROKE SINGLE CYLINDER
MAKE	KIRLOSKAR
FUEL	DIESEL
BORE	87.5 mm
STROKE LENGTH	110 mm
STARTING	CRANKING
WORKING CYCLE	FOUR STROKE
METHOD OF COOLING	WATER COOLED
METHOD OF IGNITION	COMPRESSION IGNITION

II. Blending of Fuels:

Fig 2 : Blending

III VISCOSITY:

The viscosity of different fuel blends are found by using Red Wood viscometer-I

Table:2

S.No	Name of Fuel	Viscosity(stokes
1	Diesel	0.08
2	Tyre oil	0.094
3	B10	0.182
4	B20	0.194
5	B30	0.205

Table:3

Notation	Fuel Quantity (ml)	Bio-Diesel Quantity(ml)	Diesel Quantity (ml)
B10	1000	100	900
B20	1000	200	800
B30	1000	300	700

Fig 3: Blended oils

Fig 4: Engine setup

IV. Flash point and Fire Point

The flash points and fire points of different blended oils can be found out by using pen sky martens flash and fire point apparatus.

V. Calorific Value:

The calorific value of different blended oils are obtained by using Bomb Calorimeter.

VI. WORKING:

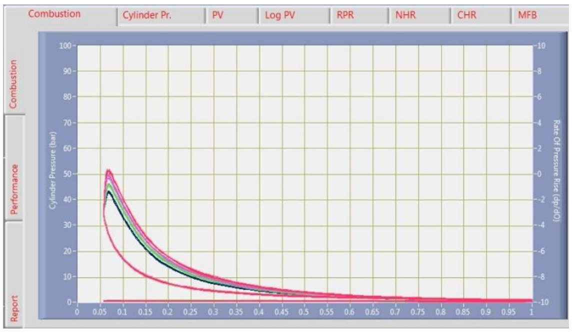
The four stroke diesel (CI) engine operates on diesel cycle. The piston reciprocates inside the cylinder, which is connected to the crankshaft by connecting rod. The valves operated by means of cams and push rods. Water is circulated through the provision made around the cylinder called engine cooling water jackets for cooling purpose. The four strokes taking place are mainly suction, compression, expansion (power stroke) and exhaust strokes.

The dynamometer is fixed to the engine flywheel and are mounted on a M.S channel frame and further mounted on vibro mounts. Panel board is used to fix burette with a three way lock, digital temperature indicator with selector switch, digital RPM indicator and U-tube manometer.

1. Digital temperature indicator to measure different temperatures sensed by respective thermocouples.
2. Digital RPM indicator to measure the speed of the engine
3. A manifold burette is provided to measure the rate of fuel consumed while running the engine.
4. Hart ridge smoke meter is provided to measure the smoke density at different loading conditions.
5. Exhaust gas or multi gas analyzer is provided to measure the exhaust emissions.

Fig 5: Smoke meter

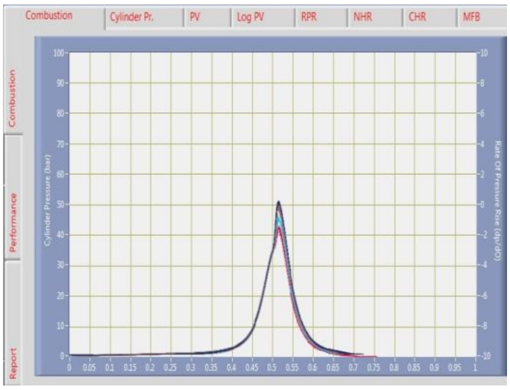
Fig 6: Exhaust gas Analyzer



Trends showing the rate of pressure rise at different loads

These graphs are obtained from IC engine Combustion Software when the engine is connected to computer and also when the engine is in running condition.

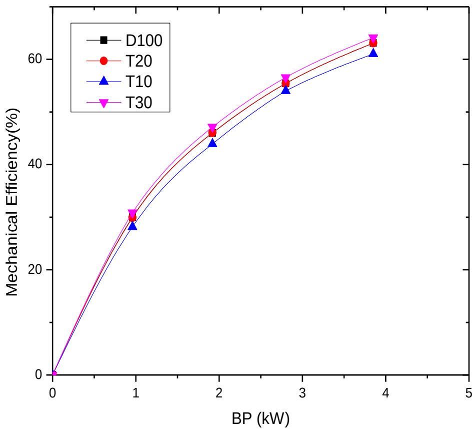
Trends showing the combustion process at different loads



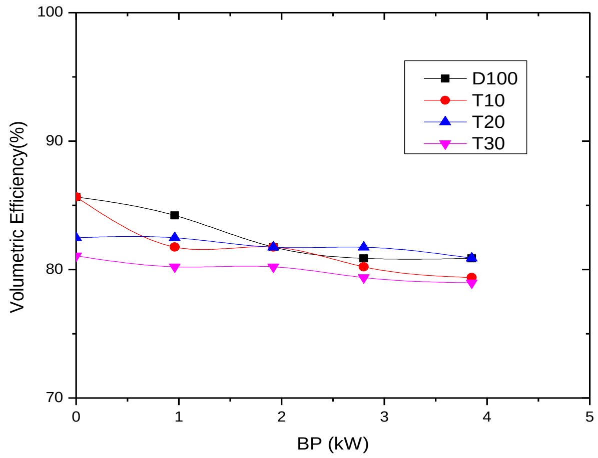
On x-axis -------crank angle
On y-axis ------ pressure

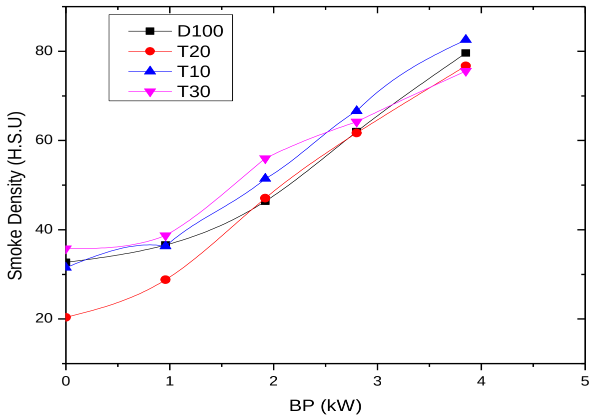
VII. Performance curves:

Engine is made to run at constant speed 1500 r.p.m. By using different oil blends the load on the engine is gradually increased manually .At every load and for every blend time taken for fuel consumption is noted. The indicated power is obtained by drawing a graph between BP and Mfc. With this the η_{mech} is obtained. The below graph is drawn by taking Bp on X-axis and η_{mech} on Y-axis.



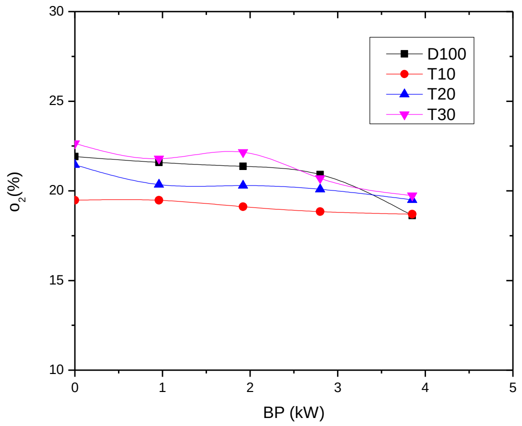
Here the Volume of air actually entering at different loads and at different blends are noted by making the engine to rotate at constant speed.Swept volume remains constant as the engine is at constant speed.The below graph is drawn for comparing the amount the amount of air entered for different brake powers.



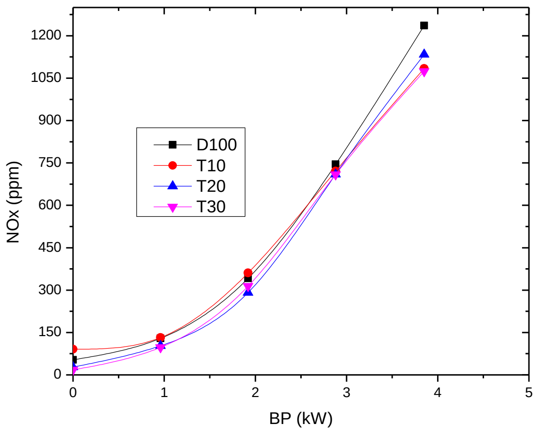


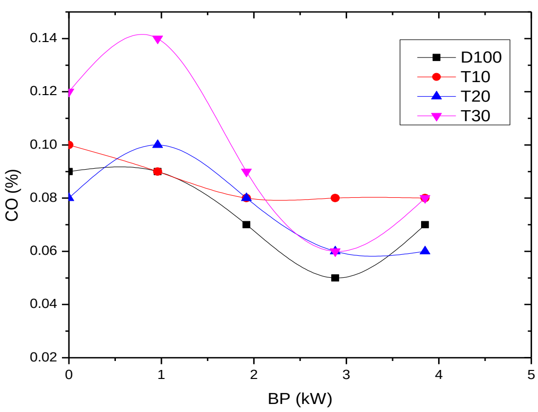
Here the engine exhaust system system is connected to smoke meter for obtaining the smoke density in exhaust gases at different loads and at different blends.A graph is drawn by taking BP on X-axis and Smoke density on Y-axis.With this graph we can get the Max. smoke density .

Here the engine exhaust system system is connected to Exhaust Gas Analyser for obtaining the % of O_2 in exhaust gases at different loads and at different blends.A graph is drawn by taking BP on X-axis and % of O_2 on Y-axis.With this graph we can get the information on % of O_2.



Here the engine exhaust system system is connected to Exhaust Gas Analyser for obtaining the NO_x in exhaust gases at different loads and at different blends.A graph is drawn by taking BP on X-axis and NO_x on Y-axis.With this graph we can get the information on NO_x.





Here the engine exhaust system system is connected to Exhaust Gas Analyser for obtaining the % of CO in exhaust gases at different loads and at different blends.A graph is drawn by taking BP on X-axis and CO on Y-axis.With this graph we can get the information on CO.

From the above graphs it is observed that B20 is having high performance and for this we are adding ignition improver hexanol-1 and again performance is calculated.

VIII. CONCLUSIONS:

The experimental tests are conducted on 4-stroke, single cylinder, water cooled and direct injection diesel engine by using tyre pyrolysis oil blends of B10, B20 and B30, pure diesel at constant speed of 1500 rpm. From the first set of results it can be conclude that the blend B20 has given the better performance in the sense of brake thermal efficiency, specific fuel consumption and emission parameters. No engine seizing, injector blocking was found during the entire operation while the engine running with different blends of tyre pyrolysis oil and diesel. So B20 can be used as alternative fuel and we can save 20% of diesel that we are importing and increase the economy. In the second stage again the test is conducted on the engine by taking the blend B20 along with the addition of ignition improver 1-hexanol in the quantity of 5ml (B20D79.5H5) and 10ml (B20D79H10) at the same operating conditions. Among these two compositions the one B20D79H10 has given the better performance in the following parameters.

- Brake thermal efficiency is observed as the BP increases there is considerable increase in the BTE. The BTE of diesel at full load is 32.82% while the blends of B20 is 32.97%, B20D79.5H5 is 32.45%, B20D79H10 is 33.09%, among the three the maximum BTE is 33.09% which is obtained for B20D79H10. The BTE of tyre oil is increases up to 0.364% and 0.823% as compared with te fuels of optimum blend and diesel at full load condition.
- Brake specific fuel consumption is observed that as the load increases the fuel consumption decreases, the minimum fuel consumption is for B20D79H10 is 0.249 as to that of B20 is 0.256 at full load condition. The BSFC of after adding ignition improver of tyre oil is decreases up to 2.7% and 4.23% are compared with optimum blend (B20) and diesel at full load condition.
- Smoke density is observed that smoke is higher for optimum blend at full load conditions

compared to ignition improver blends. At full load condition the smoke density obtained are 79.6 HSU, 76.72 HSU, 86.22 HSU and 87.14 HSU for the fuels of diesel, B20, B20D79.5H5 and B20D79H10. It is observed that smoke is increases for tyre oil blends at full load conditions as compared to optimum blend. The smoke density of after adding ignition improver of tyre oil is increases up to 13.58% and 9.47% as compared with optimum blend (B20) and diesel at full load condition.

- Carbon monoxide is observed that is interesting to note that the engine emits more CO for diesel as compared to tyre oil blends under all loading conditions. The CO concentration is decreases for the blends of B20D79.5H5 and B20D79H10 for all loading conditions. At full load condition the CO emission obtained are 0.07%, 0.06%, 0.05% and 0.05% for the fuels of diesel, B20, B20D79.5H5 and B20D79H10 respectively. The carbon monoxide of after adding ignition improver of tyre oil is decreases up to 16.66% and 28.5% as compared with optimum blend (B20) and diesel at full load condition.
- Unburned hydrocarbons are observed that the HC emission variation for different blends is indicated. At full load condition the unburned hydrocarbons are obtained 58ppm, 27ppm, 53ppm and 56ppm for the fuels of diesel, B20, B20D79.5H5 and B20D79H10 respectively. The unburned hydrocarbons of after adding ignition improver of tyre oil decreases up to 3.44% as compared to diesel at full load condition.
- The NO_x emission for all the fuels tested followed an increasing trend with respect to load. At full load condition the NOx emissions obtained are 1236ppm, 1134ppm, 1192ppm and 1020ppm for the fuels of diesel, B20, B20d79.5H5 and B20D79H10 respectively. The oxide of nitrogen of after adding ignition improver of tyre oil is decreases up to 10.05% and 17.48% as compared with optimum blend (B20) and diesel at full load condition.
- It is reveals that the as load increases the unused oxygen decreases. At full load condition the unused oxygen obtained are 18.62%, 19.50%, 15.97% and 14.91% for the fuels of diesel, B20, B20D79.5H5 and B20D79H10 respectively. The unused oxygen of after adding ignition improver of tyre oil is decreases up to 23.53% and 19.92% as compared with optimum blend (B20) and diesel at full load condition.

From all the above discussion it can be concluded that the tyre oil can be used as an alternative fuel in the diesel engines

In near future the method of solid waste management is to be focused for the economic development of nation to avoid dependence on conventional fuels by converting waste tyres into tyres oil.

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