The Effect of Supercharging on the Performance and Exhaust Gas Emission of Diesel Engine Fueled Of Pyrolysis Oil of Waste Tyre and Diesel Blend

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Abstract--- In the present investigation The effect of supercharging on performance and exhaust gas emission of diesel engine fueled pyrolysis oil and diesel blend. oil taken is tyre pyrolysis oil which was obtained by the waste automobile tyres.in initial stage the test were conducted on Four stroke single cylinder water cooled diesel engine by using diesel at different engine load and at constant engine speed base line data was generated. Further the experimental were carried out on the same engine with same operation parameter at normal atmospheric pressure and different supercharging pressure 1.2bar and 1.5bar.

It was observed that the increasing supercharging pressure, the performance of the engine is gradually improving. Performance parameter like Specific fuel consumption is gradually Reduction with comparison Un-supercharging. Thermal efficiency is gradually increasing and Mechanical efficiency is also gradually increasing. Emission parameter CO, CO2 and HC emission are decreased significantly with supercharging.

I. INTRODUCTION

The energy crisis and environmental degradation are the main problems mankind is facing today. The increasing population on the earth caused over increasing demands of energy. By the year 2100, the world population is expected to be in excess of 12 billion and it is essential that the demand of energy will be increased by five times of what it is now. According to the world energy report, we get around 80% of our energy from conventional fossil fuels like oil (36%), natural gas (21%), and coal (23%). It is well known that the time is not so far when all these sources will be completely exhausted. The alarm bells started ringing as the survey indicates that petroleum will become increasingly scared beyond the present rate of consumption.

There are initiatives to replace gasoline and diesel fuel due to the impact of the fossil fuel crisis, hike in oil price and stringent emission norms. Solution to long term energy problem will come only through research and developments in the field of alternative energy sources, before this is needed for survey on various alternative fuels used in diesel engine by various researches. S.Murugan et al, carried out to evaluate the performance and emission characteristic of single cylinder direct injection diesel engine fuelled by 10%, 30% and 50% blend of tyre pyrolysis oil (TPO) with diesel fuel (DF).Result showed that the brake thermal efficiency of the engine fueled by TPO-DF blend increasing with increasing in blended concentration and higher than diesel .NOx, HC, CO and Smoke emission were found to be higher at higher load [3,.4]. M. Mani et al, conducted performance test on diesel engine by using waste plastic oil as alternate field. The experimental results have showed stable performance with brake "thermal efficiency similar to that of diesel. Carbon dioxide and unburned hydrocarbons were marginally higher than that of the diesel baseline. The toxic gas CO emission of waste plastic oil was higher than diesel. Smoke reduced by about 40% to 50% using waste plastic oil at all loads [5]. G.V.N Kumar et al carried out to experimental investigation on single cylinder 4-stroke diesel engine direct injection by using pyrolysis oil blend in the sense of incensed brake thermal efficiency, decreased brake specific fuel consumption and decreased emission like smoke density, unburned hydrocarbon and carbon monoxide [6].

From the literature, it is concluded that fuels can be used as a substitute for diesel and blending them with diesel proportional can improve performance parameter and reduce emission[7.8], under supercharging condition Brake specific fuel consumption values are decreased for all load to improve performance parameter and reduce exhaust gas emission[1,2].

II. PROPERTIES OF TYRE PYROLYSIS OILAND DIESEL

Table.1 Property of tyre pyrolysis oil

Property	Diesel	Tyre pyrolysis oil
Density(kg/m^3)	0.830	0.9239
Kinematic Viscosity	2.58	3.77
Net Calorific value(MJ/kg)	43.8	38
Flash point,$^\circ$ c	50	43
Fire point,$^\circ$ c	56	50

III. EXPERIMENTAL SETUP AND TECHANICAL METHOD

A. Experimental Setup.

Experiment was performed on single cylinder four stroke water cooled diesel engine. Specifications engine are listed in table 2.Engine load was adjusted by eddy current type water cooled with loading unit dynamometer. Two stage reciprocating compressor has been used for supercharging purpose.

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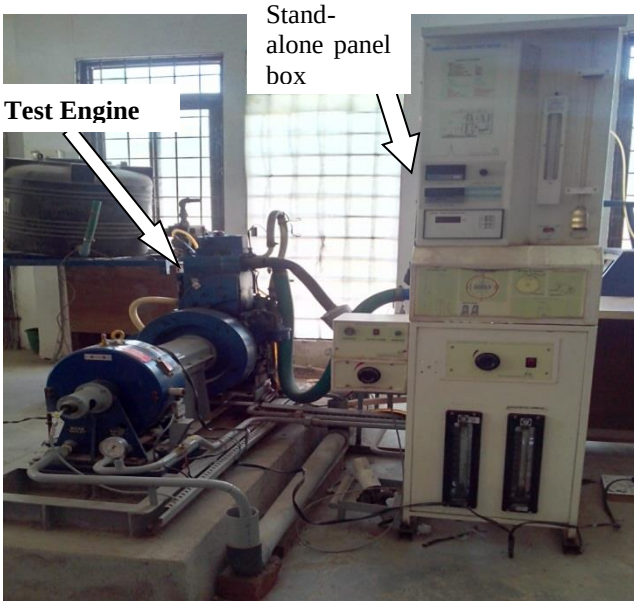

Fig.1 Experiment setup

Table.2 Engine Specification

Engine manufacturer	Apex Innovations (Research Engine test set up)
Engine type	Single cylinder four stroke multi fuel research engine
Number of cylinder	One
Types of cooling	Water cooling
Rated power	3.5kw at 1500 rpm
Bore/stroke	87.5/110mm
Dynamometer	eddy current Type water cooled with loading unit

B. Arrangements used for supercharging:-

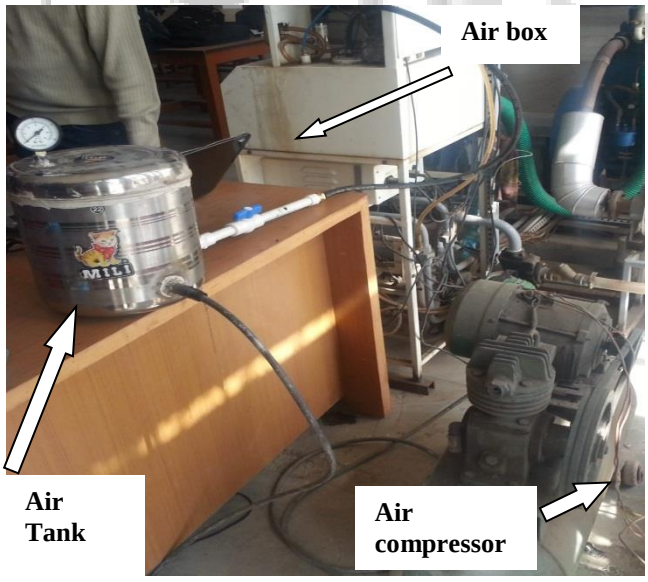

Fig. 2: Arrengement of supercharging

In this arrangement, the compressor (supercharger) is separately driven by External power source (electric motor) as shown in figure2. The compressor is used to increasing an air pressure but the flow of air is not continuous so Air box method is used to continuous air flow rate in our engine. An air tank is connected at the intake of the engine. A water manometer in used to measure the pressure difference between atmosphere and air box.

C. Exhaust Gas Analyzer:-

Fig. 3: Exhaust gas analyzer

IV. Result And Discussion

It's observed with an increase in supercharging pressure, the performance of the engine is gradually improving.

A. Effect of Supercharging on Specific Fuel Consumption:-

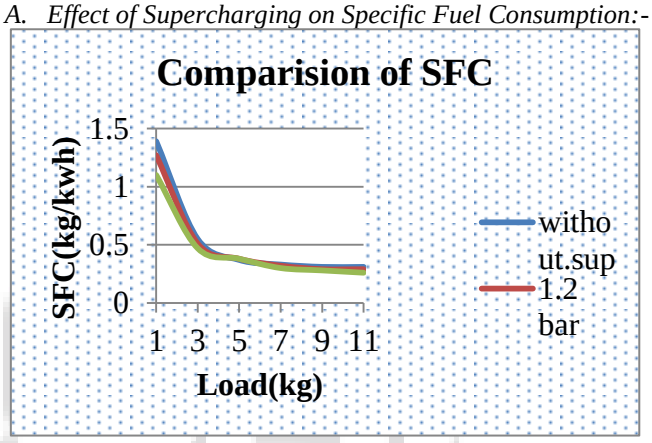

Fig. 4: Variation of Specific Fuel Consumption with load

The Variation of Specific fuel consumption with all Load is shows in fig. no.4 the Effect of the supercharging air pressure at 1.2 bar and 1.5 bar at Specific fuel Consumption (SFC) values Decreasing to diesel at all load condition, The Specific fuel consumption of Supercharging pressure1.5 is decreased compared to 1.2 and bellows atmospheric pressure.

B. Effect of Supercharging on Thermal efficiency:-

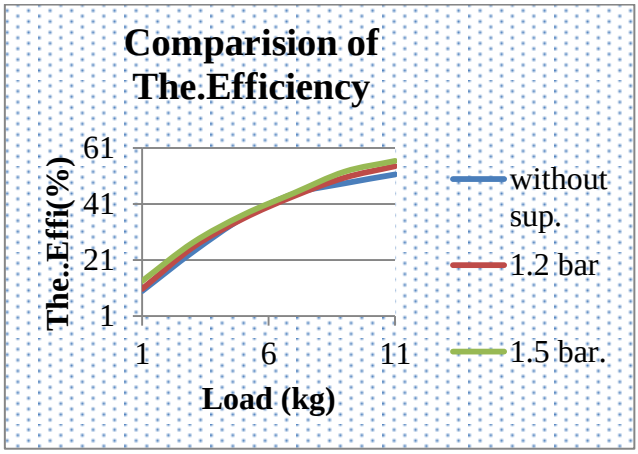

Fig. 5: Variation of Thermal efficiency with load

The variation of Thermal efficiency with all load is shows in Fig. no.5 the Effect of the supercharging air pressure at 1.2 bar and 1.5 bar at Thermal efficiency values

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is Increasing to diesel at all load condition, The thermal efficiency of Supercharging pressure1.5 is increased compared to 1.2 and bellows atmospheric pressure.

C. Effect of Supercharging on Air mass flow rate:-

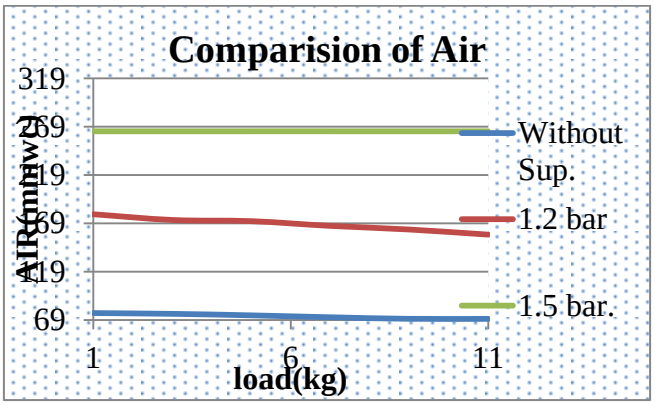

Fig. 6: Variation of Air mass with load

The variation of air mass flow with all load is shows in Fig.no..6 the Effect of the supercharging air pressure at 1.2 bar and 1.5 bar at air mass flow is gradually values is Increasing to diesel at un supercharging all load condition.

D. Effect of Supercharging on carbon monoxide:-

The variation of CO Emission with all load is shows in Fig no.7 From the it is observed that as the load increasing the CO emission Decreasing. At full load condition the co emission obtained are0.16%, 0.12%, 0.07%, 0.06%, 0.05%, 0.04%, 0.03% for diesel. The minimum values of Carbon monoxide emission is 0.03% at 1.5bar supercharging pressure.

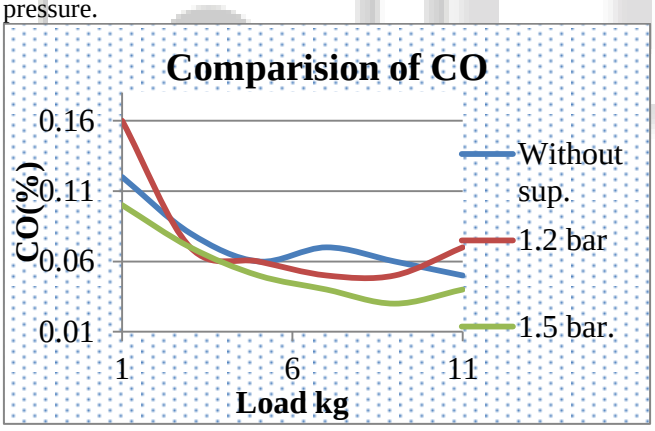

Fig. 7: Variation of carbon monoxide with load

E. Effect of Supercharging on Hydrocarbon:-

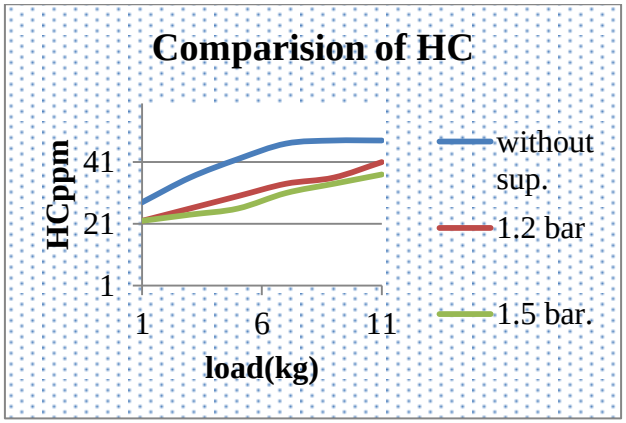

Fig. 8: Variation of Hydrocarbon emission with load

The variation of HC Emission with all load is shows in Fig. no.8 the load increasing the HC emission Decreasing. At full load condition the co emission obtained are 48ppm, 42ppm, 36ppm, 34ppm, 30ppm, 26ppm, 22ppm for diesel, 1.2bar and 1.5bar

F. Effect of Supercharging on carbon dioxide:-

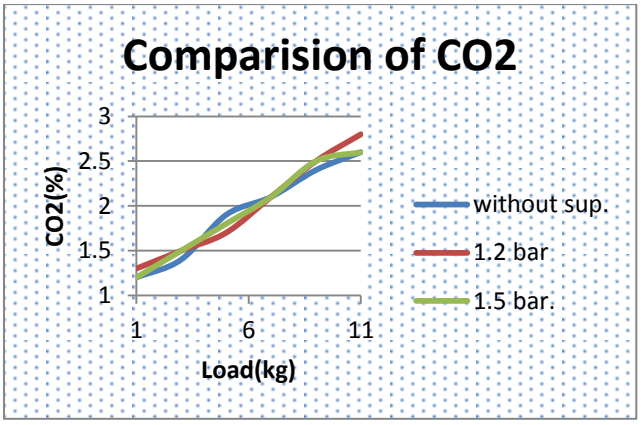

Fig. 9: Variation of Carbon dioxide emission with load

The variation of CO2 Emission with all load is shows in Fig.no.9 the load increasing the Co2 emission Decreasing. At full load condition the CO2 emission obtained are 2.8%,2.6%,2.1%, 1.9%, 1.7%, 1.5%,1.4%, 1.2% for fuel of diesel,1.2bar and 1.5bar supercharging pressure Respectively.

G. Effect of Supercharging on Nitrogen oxide:-

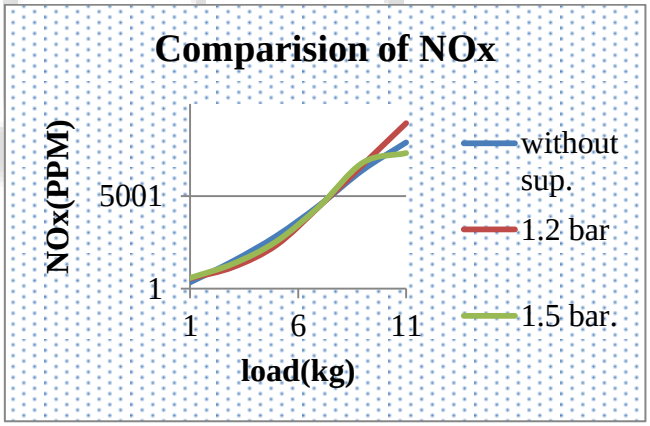

Fig. 10: Variation of Nitrogen oxide emission with load

The variation of NOx Emission with all load is shows in Fig.no.10 the load increasing the NOx emission Increasing .At full load condition the NOx emission obtained are 340ppm,548ppm, 578ppm, 1500ppm,2361ppm,4473ppm, 6427ppm, 7915 ppm, 8957 ppm for diesel fuel.

V. Conclusion

- Using Different supercharging pressure.
- Its observed With an increase in supercharging pressure, the performance of the engine is gradually improving
- Effect of the supercharging air flow rate values increasing to diesel at all load
- SFC (Specific fuel consumption) is gradually Reduction with comparison to without supercharging.

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- Brake thermal efficiency is high with supercharging.
- CO, CO2 and HC emissions are decreased significantly with supercharging when compared with without supercharging.
- it observed With an increase in supercharging pressure, the performance of the engine is gradually improving

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