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NO_X EMISSION CONTROL IN DIRECT INJECTION DIESEL ENGINE USING BIODIESEL WITH EFFECT OF COOLED EXHAUST GAS RECIRCULATION

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Abstract: Bio-diesel is an engine fuel that is created by chemically reacting fatty acids and alcohol. Practically speaking, this usually means combining vegetable oil with methanol or ethanol in the presence of a catalyst (usually sodium hydroxide or potassium hydroxide). Biodiesel is much more suitable for use as an engine fuel than straight vegetable oil for a number of reasons, the most notable one being its lower viscosity. It can be used in any mixture with diesel fuel as it has very similar characteristics for ordinary diesel fuel. In our experimental investigation prickly poppy oil is used to prepare biodiesel. The alcohol used in ethanol and the catalyst used in potassium hydroxide, and then property (density, Viscosity, Calorific Value, Flash point, Fire point)were measured. The produced bio-diesel (PPEE)/diesel fuel blends are used for testing of engine performance and emissions characteristics on a direct injection, single cylinder, and water cooled diesel engine. The test shows that the performance of brake thermal efficiency, brake power increases and specific fuel consumption decreases. The use of biodiesel in diesel engines reduces all of the exhaust emission expect NO_x. The higher temperature in the combustion chamber increases the NO_xemissions.The recirculation of a small percentage of cooled exhaust gases in to the combustion chamber through the intake manifold reduces the cylinder temperature.This leads to a reduction in NO_x emissions and improves the engine brake thermal efficiency.This is an effective method to reduce nitrogen oxides (NO_X) from the engines because it lowers the flame temperature and the oxygen concentration of the working fluid in the combustion chamber.

Key words: Bio diesel (PPEE), Cooled exhaust gas recirculation, Non-edible, Trans-esterification, NO_x Emission.

I.INTRODUCTION

A major problem to be encountered with the more wide spread use of transport vehicles greatly pollute the environment through emissions such as CO_2, CO, NOx, SOx, compounds consisting of organic unburnt or partially burnt HC and particulate emissions[1-6].. This has been the subject of much recent public concern over possible effect on human health, and particularly respiratory disorders in urban environment. Now at this stage think an alternative source of fuel and in term of less pollution. One of those fuels is vegetable oil, animal fat both used vegetable oil and animal fat will definitely act as a substitute for fossils fuel and reduced pollution. But this vegetable oil cannot be safely used in an indirect – injection, naturally aspirated and air cooled engine for long period of time. This problem is related to the high viscosity of Vegetable oil, which causes inadequate atomization and incomplete combustion. A way of reducing the viscosity of the vegetable oil fuel, such as, preheating the oil, Blending or dilution with other fuel, Trans-estrification and thermal cracking. Now we have to chosen trans-esterification method to reduce the viscosity of vegetable oil. In the present investigation Prickly poppy oil is a non edible vegetable oil which has been considered as a potential alternative fuel for C.I engine has been chosen, to find out is suitably for use as fuel oil. Therefore, the main objective of the present study is to decrease the viscosity of Prickly poppy oil by Trans-estrification process. Many research studies have reported that exhaust from bio diesel fuel has higher NOx emissions while HC and PM emissions are significantly lower than operated with diesel fuel. The aim of the present investigation is to reduce NOx emissions using cooled Exhaust gas recirculation.Exhaust gas recirculation (EGR) is one of the most effective technique for reducing NOx emissions in compression ignition engines.In this investigation the cooling of EGR before mixing the intake air is desirable since it will reduce the intake charge temperaturweand the flame temperature, resulting in further reduction in NOx formation. The present work investigates the effect of 20% cooled EGR (parallel flow Heat Exchanger) on the performance and emission characteristics of a biodiesel (prickly poppy methyl esters) fueled engine.This 20% cooled EGR yielded as the optimum engine performance and reduced maximum values of NOx, NO is very maximum and also without much variation in the other emission like CO, CO_2, HC, and SO_2.

II.MATERIAL AND METHODS

The seeds of the white prickly poppy are said to be an excellent source of food for quail and other birds because of their high oil content. Additionally, the oil from the white prickly poppy was used as an alternative fine lubricant. The oil content of white prickly poppy seed to be 25.8%, an amount comparable to that found in soybeans. White prickly poppy is best grown from seed. The fairly large seeds make it a good candidate for direct seeding methods. White prickly poppy

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has been successfully seeded at the Plant Materials Center...It is often found in disturbed areas, along fence rows and railroad tracks, on hills and slopes, and in overgrazed pastures and old fields. White prickly poppies tend to grow in colonie. Prickly Poppy seeds collected are dried in sunlight for a week and the dried seeds are peeled to obtain the kernel for extraction of Prickly Poppy oil by using a Mechanical expeller. Small traces of organic matter, water and other impurities were present in the prickly poppy oil. These can be removed by adding 5% by volume of hexane to the raw oil and stirring it for 15 to 20 minutes at 80˚ C to 90˚C and allowing it to settle for 30 minutes. Since hexane is having low boiling point (68.7˚C), it gets evaporated on heating beyond the boiling point of hexane. The impurities and gum particles that settle down at the bottom can be removed. The remaining oil is the purified oil. The purified oil can be used for Tran's esterification process.

III.PROCEDURE FOR BIODIESEL PREPARATION FROM PRICKLY POPPY OIL BY TRANS-ESTRIFICATION PROCESS

(Single Phase method)

1. Take 500ml Prickly Poppy oil in reactor vessel then Heat the oil to 60^0C.

2. Take 150ml ethanol and 8 gram KOH and Prepared ethnocide mixture.

3. Add ethnocide mixture to oil and Continue heating and stirring Maintain the temperature at 60^0C, Maintain the Rpm at 725 revolution and Give process time of 1hours.

4. Collect a small amount. Check for the completion of reaction and Settled in the settling tank for 6 hours.

5. Check the separation of two layers of diesel and glycerin indicates

6. Transfer the mixture into settling tanks allow the biodiesel on top and glycerin, unreacted oil and impurities at the bottom, Collect the *glycerin.*

7. Wash the biodiesel with water to free from alkaline

8. Dry in hot air oven to get biodiesel free from moisture.

IV.PROPERTIES OF FUELS

Properties	Diesel	Prickly Poppy oil (Mexicana oil)	Prickly Poppy-transtrified oil (Mexicana ethyl ester)
Density (Kg/m3)	840	910	870
Viscosity (Centistoke)	4.59	29.6	10.24
Calorific Value(KJ/Kg)	42500	35433	40834
Flash point (°C)	66	235	170
Fire point(°C)	89	260	210

Table 1 Properties of Diesel, Prickly Poppy oil & Biodiesel (Prickly Poppy-transtrified oil)

V.ENGINE SPECIFICATIONS AND PERFORMANCE TEST PROCEDURE

A. SPECIFICATIONS

Type	4 Stroke vertical single Experiments cylinder direct injection CI engine type
Make	Kirloskar
Power	5.2 KW
BHP	7
Speed	1500 rpm
SFC	0.251 g / Kw- hr
No of Cylinder	1
Cooling	Water cooling
Charging	Natural
Bore	87.5 mm
Stroke	110 mm

Table.2.Engine specifications

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B.PERFORMANCE TEST PROCEDURE:

A single cylinder, naturally aspirated direct injection diesel engine is used for the experimental work. The specifications of the engine are given in Table.2.First the fuel is placed in the tank and necessary things like water flow rate, lubricating oil level etc. are checked, then the engine is started and allowed it to stabilize at no load condition. Note down the time taken for 10cc of fuel flow from the burette using a stop Watch. The voltmeter reading, Ammeter reading, air flow rate, exhausts gas Temperature, cooling water flow rate and coolant outlet temperatures are noted. After taking the readings, the fuel line from the tank should be opened again. Six lamps in a column are switched on and 2 minutes is allowed to the engine to stabilize at a particular load. The above procedures are repeated with 12,18and 24 lamps. Now 20% blend of Bio diesel and 80% Diesel (20%B and 80%D) is placed in the fuel tank. The above procedure is repeated with 40%B and 60%D, 60%B and 40%D, 80%B and20%D, 100%B and 0%D. During this process the engine exhaust gas is divided into two paths, one for the exhaust gas emission measurement and the second for recirculation into the engine. A concentric tubular, parallel flow heat exchanger is fabricated for the cooling of the hot exhaust gases to atmospheric temperature. Exhaust gases released from the engine are filtered and flow through the tubes and are cooled by water in the shell of the heatexchanger.The low temperature exhaust gases are carried to the surge tank and partially filled with silica gel where the moisture is removed. The mass flow rate of the recirculating exhaust gas is measured using a monometer connected with the exhaust gas surge tank. The exhaust gas leaving the surge tank and the fresh air are mixed in the mixing chamber and the mixture is sucked into the engine. Regulators are used to control the quantity of exhaust gases entering into the engine. Finally the lamps are switched off one by one slowly and the engine is stopped.

VI.RESULT AND DISCUSSION

A.PERFORMANCE CHARACTERISTICS WITH 20% COOLED EGR

Fig.1 shows Brake thermal efficiency increases with the increase of brake power with EGR. Here also the brake thermal efficiency decreases on increasing the percentage of blends but the decreases is very nominal. It is also seen that for lower percentage of blending, BTE is somewhat constant load while for higher blends, it increase

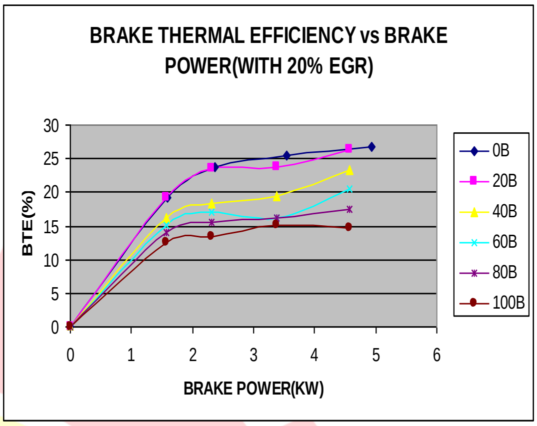

Figure.1

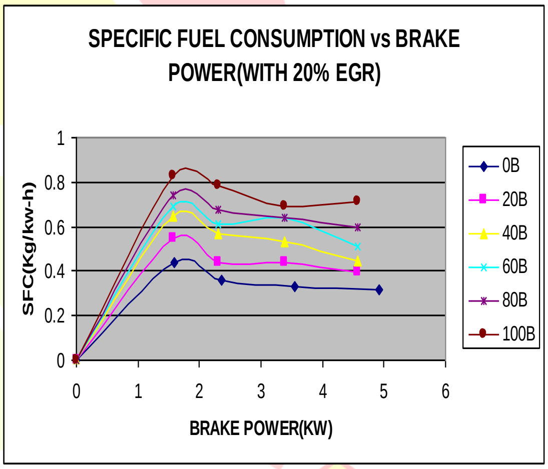

Figure.2

Fig.2 shows that the specific fuel consumption with EGR decreases with the increase of brake power. There is a nominal decrease in the value of the specific fuel consumption on increasing the blending percentage.

B.EMISSION CHARACTERISTICS WITH 20% COOLED EGR

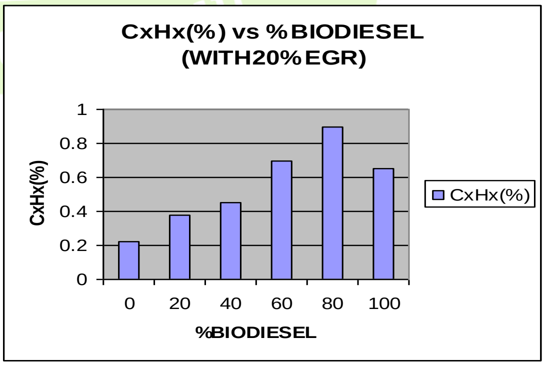

Figure.3

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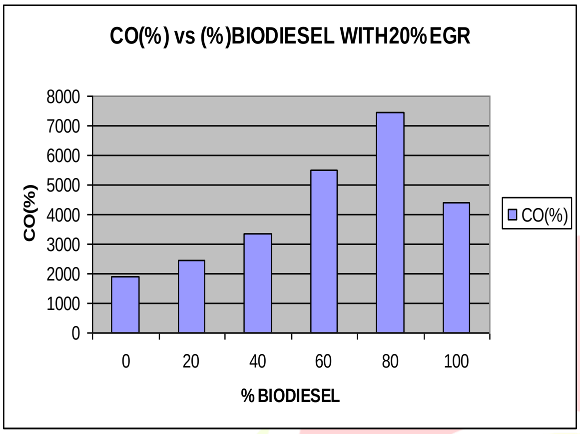

Figure.4

Fig.3, Fig.4, shows the comparison of HC and CO at various blending proportions and with 20% EGR it is seen that HC and CO increases with the increasing blending percentage and then starts' decreasing this emission is at 100% bio-diesel.

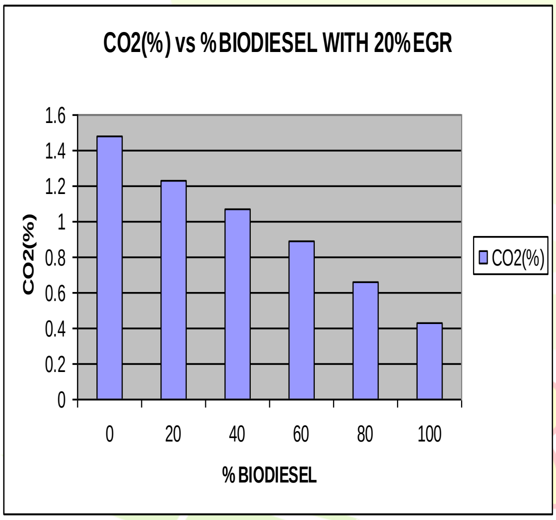

Figure.5

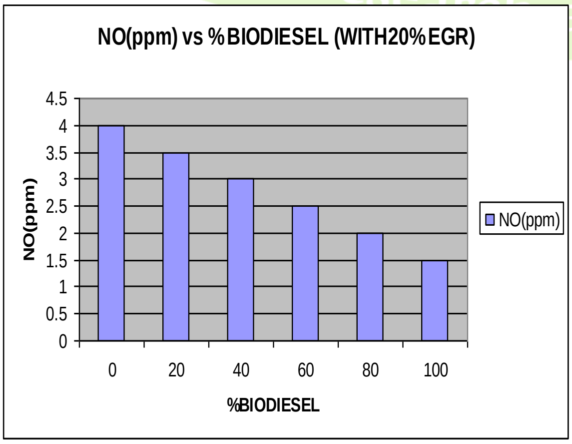

Figure.6

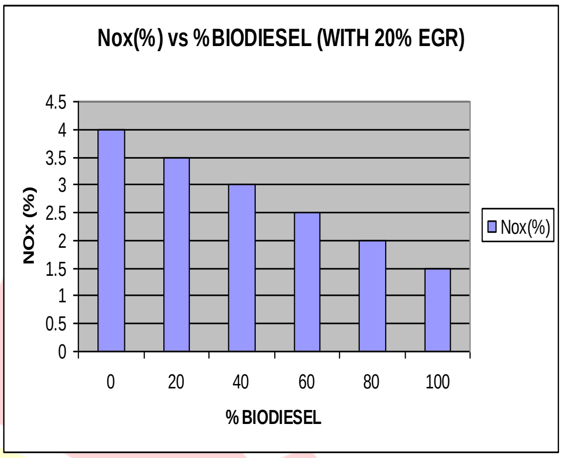

Figure.7

Figure.5,6,7shows the comparison of CO2,NOand NOX at various blending proportions and with20% EGR it is seen that SO2,NO,NOX high at lower blending percentage and then starts decreasing with the increasing blending percentage for the cases.

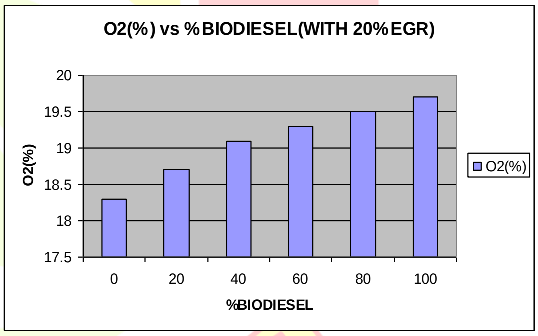

Figure.8

Fig.8 shows the comparison of O2 at various blending proportions and with 20% EGR it is seen that O2 increases with blending and then starts increasing with the increasing blending percentage for the cases.

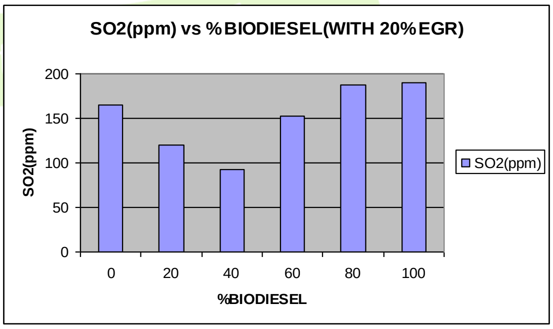

Figure.9

Fig.9 shows the comparison of SO2 at various blending proportions and with 20% EGR it is seen that SO2 decreases to an optimum and then starts increasing with the increasing blending percentage for the cases.

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VII CONCLUSION

The result shows that the decrease in NOx is more effective using cooled gas recirculation. If the exhaust gas is recycled by some other means such as spiral fin Heat exchanger pipes, the operation is called the cold EGR.The heat exchanger pipes reduced the intake charge temperature and, then, the maximum charge temperature in the cycle. The O_2 and CO_2 concentrations in the exhaust gases decreased as a result of using the heat exchanger pipes .The NO_X concentration was reduced due to the effect of the cooled EGR on decreasing the combustion temperature. The above results and discussions show the 20% EGR is better reducing NOX emission. Hence it can be concluded that the emission reduction are taking place on account of the performance but the decrease is only nominal and so in the present trends of energy conservation and environmental preservation," India is one of the largest producers of oil and hence bio-diesel future is really good. It is expected that one day bio-diesel will outcome diesel as a major energy sources for diesel engines.

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