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Impact of Exhaust Gas Recirculation in VCR Engine Fuelled with Pongamia - Biodiesel

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Abstract*: Biodiesel is one of the alternatives which are being widely studied and production of biodiesel is limited by crop land displacement, the Trial examinations are carried on a four stroke Diesel Engine (DE) to inspect the solidness. Exhaust gas recirculation (EGR) is used for control the emission reduction such as NOx, HC & CO. The pongamia oil blended with B20, B40 and B50 of them biodiesel. The biodiesel oils performance are assessed. The performance parameters such as Specific Fuel Consumption (SFC) and Brake Thermal Efficiency (BTE) are calculated. The exhaust emissions such as unburned Hydro-Carbon (HC), oxides of nitrogen (NOx), carbon monoxide (CO), carbon dioxide (co2) and combustion and smoke parameters is discussed in this paper.

Keywords: EGR, Pongamia Pinnata Oil, VCR Engine.

I. INTRODUCTION

Biodiesel is one of the elective fills are used in DE [1]. Due to the highest thermal efficiency in DE despite their disadvantages, the emission of biodiesel causes environmental hazards [2-3]. EGR is used for control the emission reduction such as NOx, HC & CO [4]. Pongamia Pinnata is family of leguminasae is available majorly in Asian countries [5]. Pongamia is semi deciduous, resistant tree it grows about normal tree height with equally wide in range. The oil can separate from the pongamia pinnata because of the trimming of cases and single almond estimated seed [6]. The tree is not required more water and it will be well suited in the sunlight and it has long lateral roots and drought tolerant [10].

II. PROPOSED SYSTEM

The environmental degradation is a major problem in every country. Due to the unburned fuel the emission like nitrogen oxides, carbon monoxide and hydrocarbon [11]. So Exhaust gas recirculation (EGR) is used to control the emission reduction.

III. OBJECTIVE OF THE PAPER

The minimum emission level performance has the optimum running parameters of diesel engines. The dependency on biodiesel fuel is increased. Fossil fuel should be saved for the hazard free environment and future generation.

IV. EXPERIMENTAL SETUP VCR ENGINE

The process of the diesel engine is shown in fig. 1.

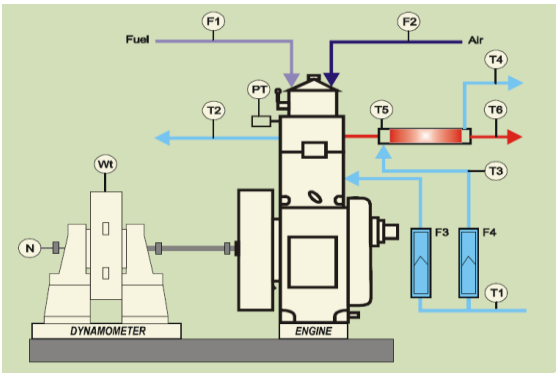

Fig. 1. Working process of diesel engine

The engine hardware setup is represented in fig. 2.

Fig. 2. The engine setup

A. Description

A test set up was created to direct tries with Exhaust gas recirculation (EGR) to evaluate the emission parameters at different operating conditions [12-13].

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B. Specifications

The diesel engine specifications are tabulated in table. I.

Table- I: Engine specifications

Engine	Specifications
No of cylinder	1
No of strokes	4
Engine Make	Kirloskar
Model	TV1
Rated power	5.2 Kw @ 1500 RPM
Compression ratio	17.5:1
Orifice diameter	20 mm
Dynamometer arm length	185 mm

The setup consists of DI diesel Engine; conducted with based software packages for note the readings in proper manner. The readings which carry for basic biodiesel blends B20, B40 and B50 without EGR setup, K- Type (Chromel-Alumel) thermocouple is used for measuring the exhaust gas temperature. Blends B20, B40 and B50 with EGR 20% gas as recirculation.

V. RESULT AND DISCUSSION

The test readings running on B20, 40 and 50 Fuels, so as to research of technique to become better the execution and lessen the discharge qualities. The Diesel engine turned over with no issue and its running smoothly idiom.[8] All the trial were led at steady speed of 1500 rpm with various burdens like 0, 25, 50, 75, 100 kW fluctuating burden conditions for B20, B40, and B50 energizes With various infusion pressure 190 bars with EGR at 20%. The Diesel engine turned over with no issue and it was running smooth.[7].

A. Performance characteristics

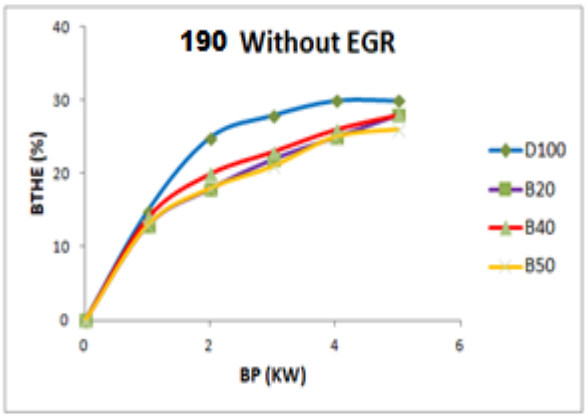

Fig. 3. Pressure 190 bar without EGR – break power thermal efficiency

Without EGR the pressure 190 bar for BTE with brake power efficiency is shown in fig. 3. EGR decreases the combustion its decrease the burning rate, the forming outermost brake thermal efficiency without EGR at 190 bars of pongamia oil B20 is 29.5% respectively, against diesel which is 31.4% due to due to dilution of the charge inside the burning chamber. The BTHE where decreased by 1.9% compare to the diesel with B20 blend of the effectiveness is nearer to diesel its gives approximate the better execution concerning other blends.[9]

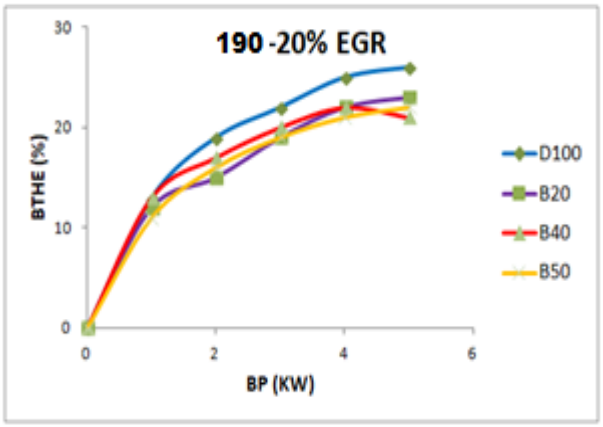

Fig. 4. Pressure 190 bar with EGR at 20% - break power thermal efficiency

Without EGR the pressure bar 20% for brake power brake thermal efficiency is shown in fig. 4.The overwhelming weakening impact of EGR the brake control with the mix B20, B40 and B50 mixes were marginally increment the fuel utilization from 20%, 22%, and 23%. Its measure the fuel utilization as compared with diesel reading its slightly decrease 2.4% expanding because of the EGR condition as played out the higher thermal efficiency. In combustion chamber brings about proficiency drop.

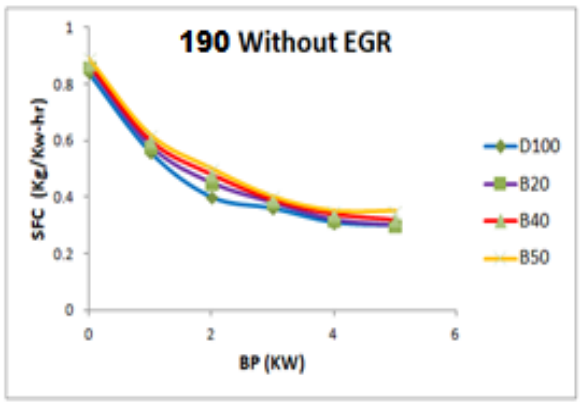

Fig. 5. Pressure 190 bar without EGR-brake power with SFC.

Without EGR the pressure 190 bar for brake power with brake thermal efficiency is shown in fig. 5. The higher SFC to decrease the value from 0.85 to 0.39 Kg/Kw-hr is shown in diesel. The blend of pongamia biodiesel from selected B20,B40 and B50 shows the reading nearest to the diesel readings from the average of 0.86 for starting fuel consumption to decrease the level of approximately 0.35 to 0.4 Kg/Kw-hr. The pressure 190 bar as chosen for specific fuel consumption without EGR as mentioned.

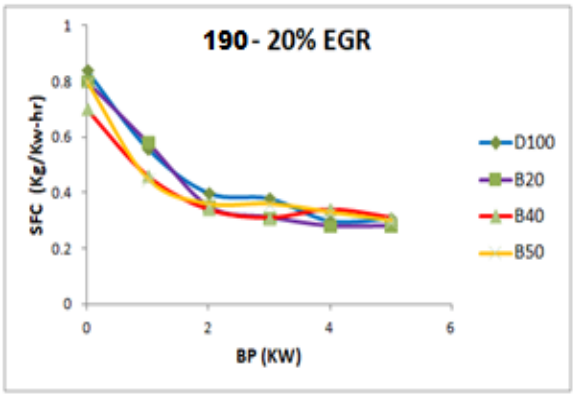

Fig. 6.pressure 190 bar with EGR at 20% brake power specific fuel consumption

Fig.6. pressure 190 bar with EGR at 20% brake power with specific fuel consumption various blends conditions. Diesel with EGR at 20% shows the higher SFC to decrease the value from 0.8 to 0.4 Kg/Kw-hr. The blend of pongamia biodiesel with EGR at 20% from selected B20, B40 and B50 shows the reading nearest to the diesel readings from the average of 0.85 for starting fuel consumption to decrease the level of approximately 0.45 Kg/Kw-hr.

B. Emission characteristics

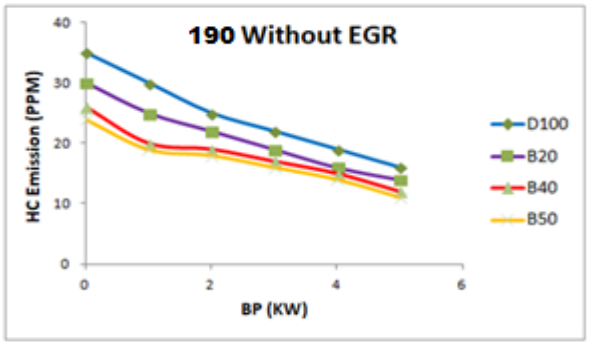

Fig. 7.pressure 190 bar without EGR for unbrunt hydrocarbon with brake power

Fig.7. pressure 190 bar without EGR for unbrunt hydrocarbon with brake power the reading are noted for the pongamia biodiesel with diffrent blend conditions for the standard diesel properties. The unburnt HC emissions is noted that the value decreased from the range 35PPM to 20PPM for diesel and the various blends condition for pongamia which decerese the percentage of blends. The reduction of emission as noted without EGR setup, the diesel is less HC as compared with all the blends.

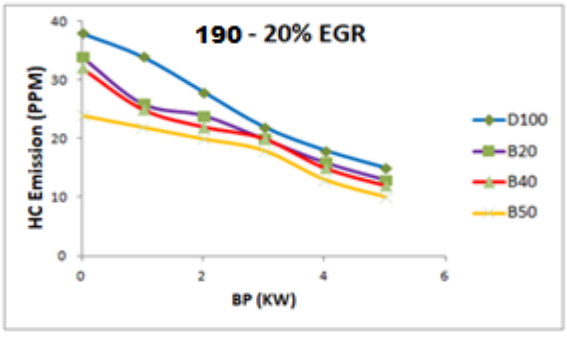

Fig. 8.Pressure 190 bar with EGR at 20% for Unbrunt hydrocarbon with brake power.

Fig. 8. shows the Pressure 190 bar with EGR at 20% for Unbrunt hydrocarbon with brake power readings are noted for the diesel and pongamia biodiesel. Large amout hydrocarbon in biodiesel slightly differ the ranges compare to the pressure without EGR are high as contrasted and 20% of EGR are 38PPM to 25 PPM. The EGR at 20%, unburnt gas with the deceresed temparature in the pongamia biodiesel at heap condition.

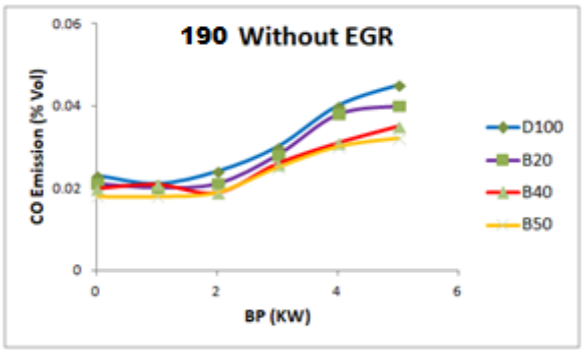

Fig. 9.Pressure 190 bar without EGR - brake power carbon monoxide

Correlation of CO emission is shown in fig. 9. and its depends to the pressure brake power 190 bar. The quality of the blend relies on the CO emission, the most extreme CO emission 0.023 to 0.025 accessibility of O_2 and consistency of fuel. The pongamia Biodiesel blends for 190 bars of the every one of the mixes, The most extreme CO emission as noted for the blend B20, B40 and B60 is range nearest to the diesel value, the volume unadulterated for pongamia blend to the 190 bars pressure.

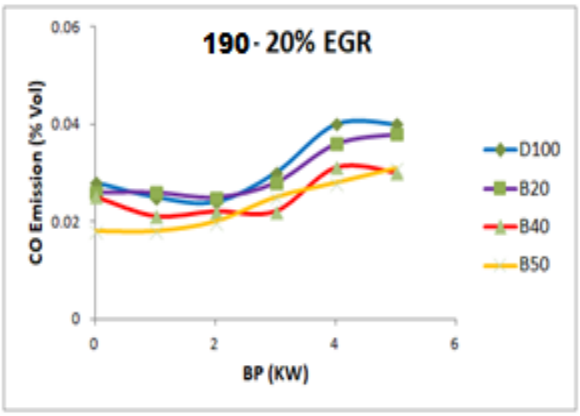

Fig. 10. Pressure 190 bar with EGR at 20% - brake power carbon monoxide

Pressure 190 bar with EGR at 20% for CO with brake power in fig. 10. CO emission relies for the 190 bar pressure with 20& EGR on the quality of the blend, the most extreme CO emission 0.02 to 0.04 accessibility of O_2 and consistency of fuel. The pongamia Biodiesel blends for 190 bars of the every one of the mixes, This is because of reality that high EGR extend at 20% outcomes in diminished the oxygen in ignition process and inadequate burning will in general increment CO discharges. Expanding EGR stream rates at 20% outcomes in ascent of CO discharges.

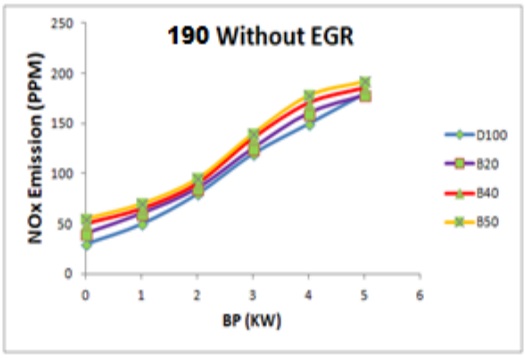

Fig. 11. Pressure 190 bar without EGR for NOX - brake power

The Pressure 190 bar without EGR for NO_X brake power fig. 11. The value of the diesel 150 PPM is obtained. The different blend B20, B40 and B50 are the range 160PPM, 170PPm and 180PPM respectively. The NO_X emission for pressure 190 bars without EGR for the diesel and pongamia biodiesel are increment emanation compare to the diesel.

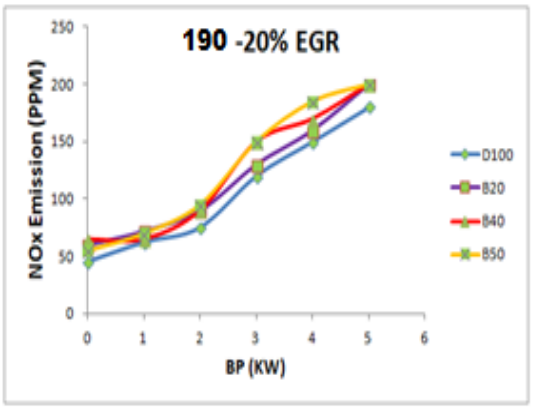

Fig. 12. pressure 190bar and EGR at 20% NO_X - brake power

The EGR at 20% with the pressure 190 bar NO_X with brake power in fig. 12. Diesel compared with the different blends. The value of the diesel 180 PPM is obtained for the pressure 190 bar with EGR 20% level mixes. The different blend B20, B40 and B50 are the range 180PPM, 190PPm and 200PPM respectively. The NO_X emission for pressure 190 bars with EGR 20% mixes shows the dominal level of the diesel and pongamia biodiesel are increment emanation compare to the diesel.

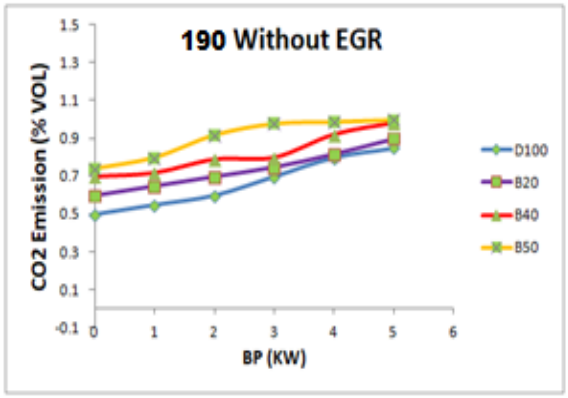

Fig. 13. pressure 190 bar without EGR-brake power carbon dioxide

Fig. 13. Shows the examination of CO2 without EGR for CO2 brake control 190 pressure. The CO2 expanding the break control for rate diminishes. The unadulterated biodiesel in CO2 has the 0.3% and 0.42% against 1.2% and 0.69% of the diesel in 180 bras and 190 bars.

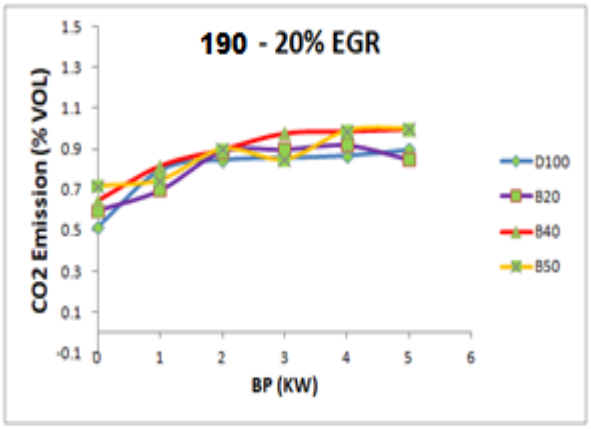

Fig. 14. Pressure 190 bar with EGR at 20% - brake power carbon dioxide

Fig.14 shows EGR with pressure 190 bar at 20% Carbon dioxide with brake power various mixes of pongamia oil and diesel. On account of 20% the CO2 with EGR level outflow was 0.90% volume for biodiesel and 0.85% volume for biodiesel.

VI. CONCLUSION

Pongamia biodiesel can be legitimately utilized in diesel engine with no adjustments. The greatest brake warm proficiency is gotten for 190 bars with 20% pongamia biodiesel contrasted. The EGR at 20% has the high emanation in HC. The biodiesel oxygen content for making the oxygen insufficiency and encouraging total ignition this is due to HC emanation. Emanation of nitrogen oxide (NOx) was expanded for 20% without EGR with 190 bar for pongamia biodiesel. The NOx gets diminished for the expanded EGR level. The 20% of the biodiesel properties are contrast with different mixes. The pongamia biodiesel B20 with 190 bars in EGR at 20% can be utilized and substitute for the fuel for diesel engine with DI with no significant adjustment.

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