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Comparative Assessment of Thermal, Emission and Combustion for Biodiesel Extracted from Waste Cottonseed Cooking Oil with a Mixture of Waste Palm Oil and Waste Cottonseed Oil Biodiesel

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Abstract:
The effect of price of fossile fuels impact on world economy as well as fossile fuels are responsible for greenhouse emissions and to overcome all such issues the biodiesel is a very good as alternative fuel option and the country like India where large quantities of edible and non-edibles oil/seeds are available so bulk amounts of biodiesel production are possible. The present work focuses on the thermal, emission and combustion results of waste cotton seed biodiesel (WCOBD) blended in 10 and 20% by volume with diesel for compression ratio 17 at 1500 RPM engine speed and with the same constrain engine operated for mixture of waste palm oil and waste cottonseed oil biodiesel (W(C+P)BD) blend with diesel and results of both biodiesels are compared.

Intoduction:

Substantial increase in the demand of petroleum fuel raised the concerns about the environment and its supply. This led to the search of alternative fuels for its utilization in Internal Combustion (IC) engines. Research in the field of sustainable alternative fuels still faces challenges because of complexities such as higher cost of production, feasibility of utilization in existing engines etc. Global vehicular transportation is mainly dependent on liquid fuels like gasoline and diesel, primarily produced from crude oil. Bio-generated fuels such as alcohols and biodiesels have emerged as major players for IC engine applications. Biodiesel is favoured as sustainable diesel engine fuel with overall lower greenhouse gas (GHG) emission compared to mineral diesel. Lower aromatic content, inherent oxygen content, lower sulfur concentration and particulate matter (PM) emission etc. are some of the advantages of biodiesel over mineral diesel. Biodiesel is derived from transesterification of triglycerides present in straight vegetable oil (SVO), waste cooking oil (WCO) and animal fats etc. which mainly comprised fatty acid alkyl esters. B.K.Venkann et al [1] conducted experimentation using as fuel mixture of biodiesel extracted from rice bran oil with diesel in par portion 10 % to 50% by volume with diesel. Results show with 30 blending of biodiesel with diesel gives better results. K. Muralidharan et al [2] performed experimentation on a singled cylinder 4 stroke variables CR multi fueled engine, when it is fueled with wasted cooking oils methyl ester and its 20%, 40%, 60% and 80% mixes with diesels (on the volume basis) are examined as well as compared with the standard diesel at CR 18:1, 19:1, 20:1, 21:1 and 22:1. Shiv Kumar Sharma at el [3] carried out experimentation for six blends of biodiesel with diesel to evaluate performance characteristics and the major conclusion drawn is that due to high viscosity and density with low calorific value of biodiesel with some optimum value of blending biodiesel can become good alternative fuel. Abdullah Al-Ghafisst al [4] focused on effect of injection pressure on thermal performance and emission characteristics using 10, 20 and 30 % blending of waste cooking oil with diesel at 17. 5 compression ratio and injection pressure of 200, 225 and 250 bar. Haseeb Yaqoob et al [5] conducted detailed review on waste cooking oil biodiesel considering various parameters for emission, thermal and combustion performance of compression ignition engine to consider technically, economically, environmentally impact. Hoi Nguyen Xa et al [6] conducted experimentation to collect biodiesel from waste cooking oil using catalyst and run the engine using biodiesel blended with commercial diesel and compare results with commercial diesel operated engine to evaluate thermal and emission performance characteristics. Lochan Kendra Devkota et al [7] performed experimentation with 5, 10 15 and 20 % blending of biodiesel obtained from waste cooking oil with diesel at 17.5 compression ratio with 1500 engine speed. From FTIR results it was confirmed that both biodiesel and conventional diesel have the same functional group of C–H. Presence of C=O in biodiesel helps in complete combustion which is advantage over diesel. Nikul Patel et al [8] reviewed the findings reported by different researchers have been

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summarized to portrait the use of non-edible seeds for the production, mathematical model and application of bio-diesel. Nikul Patel et al [9] focused on production and thermal performance of various non-edible oils.

Experimentation

In the present research work is divided into two parts: 1) Extraction of biodiesel from waste PAM cooking oil and waste cotton seed oil 2) Experimentation in single cylinder diesel engine by blending biodiesel in 10 and 20 % extracted from WCOBD and W(C+P) BD of proposition with diesel.

1) **Extraction of Waste Cooking Cotton seed Biodiesel (WCOBD) and Waste Cooking Palm seed Biodiesel (WPAMBD)**

The waste cooking oil of 250ml is heated at 60 ^{0}C to remove moisture content in heating mantle. After which NaOH is added into 160 ml of methanol and heated separately. In the next process after 15 minutes both solutions are mix in a beaker. There afterwards the mixture is stirred (800-1000 RPM) and continues for about 25-30 minutes, then after 30 minutes the mixture is transferred into a separating flask and shake thoroughly and allow the mixture the mixture to get settle down for 24 hrs at room temperature so the glycerine and crude biodiesel get separated. After which collect the biodiesel in separate conical flask and add amount of water into the conical flask and shake thoroughly and leave the conical flask to settle and removes the water.

Fig. 1 Raw PAM oil, Waste Cooking PAM oil and Biodiesel extracted from Waste Cooking PAM oil

Fig. 2 Raw Cotton Seed Oil, Waste Cooking Cotton Seed Oil and Biodiesel extracted from Waste Cotton Seed Oil

2) Experimentation in Single Cylinder Diesel Engine by Blending Biodiesel in 10 and 20 % Extracted from WCOBD And W(C+P) BD of Proposition with Diesel.

A schematic drawing of the experimental setup including the necessary measuring devices was shown in Fig. 3. An AC generator 4.5 kW maximum power was directly coupled to determine the engine brake power where external controllable electric load bank with variable loads was used. The present study was carried out to investigate the performance and exhaust emissions of a diesel engine fuelled WCOBD and W(C+P) BD blended conventional diesel fuel as a 10 and 20% as volume in single cylinder compression ignition with five loading conditions (no load, 25%, 50%, 75% and 100%). The engine had been equipped to measure fuel consumption and engine speed. The engine received air through an air box fitted with an orifice for measuring the air consumption. A pressure differential meter was used to measure the difference in pressure between the two. In the present work engine speed and compression ratio are maintained at 1500RPM and 17 respectively

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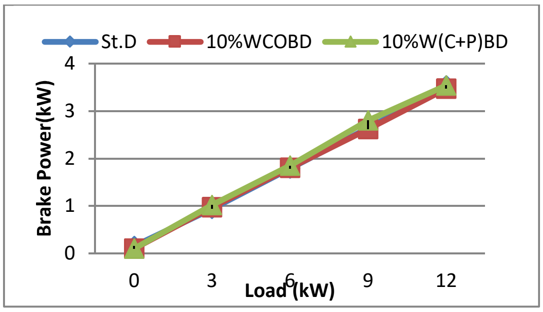
Fig 3 Experimental Set up

Result and Discussion

The experimentation is carried out on single cylinder diesel engine using WCOBD and W(C+P) BD blended conventional diesel fuel as a 10 and 20% as volume and results are obtained for thermal, emission and combustion.



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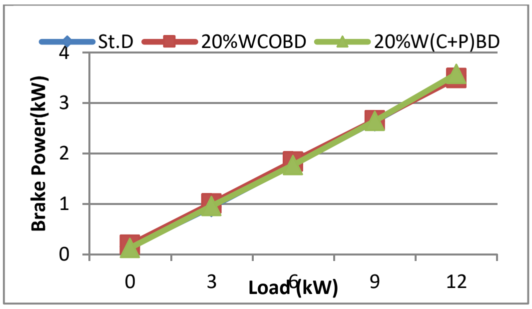

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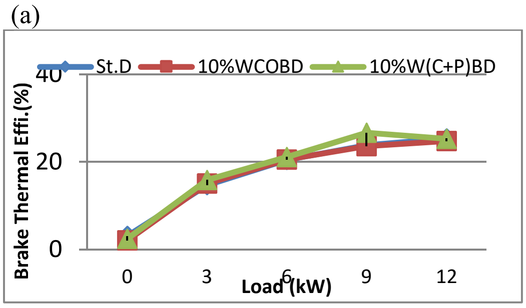

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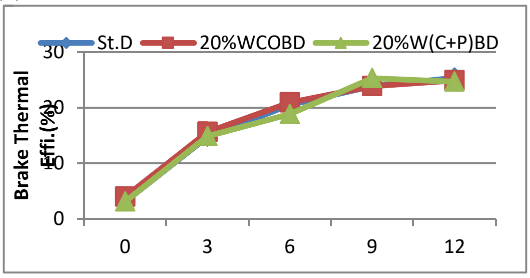

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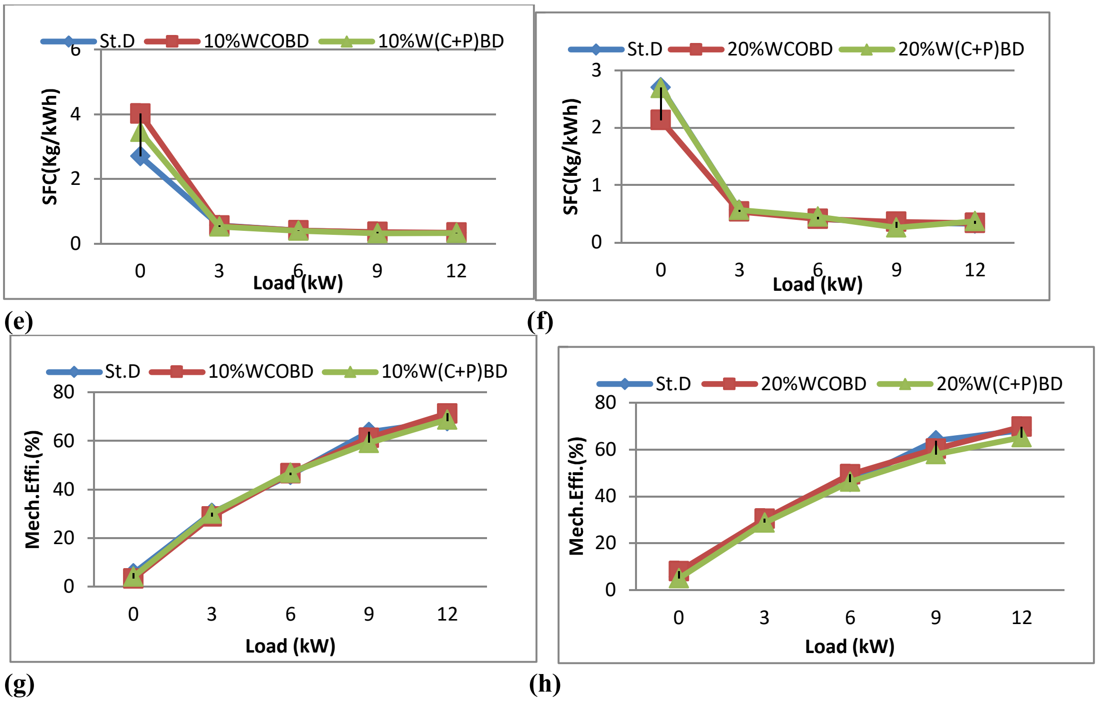
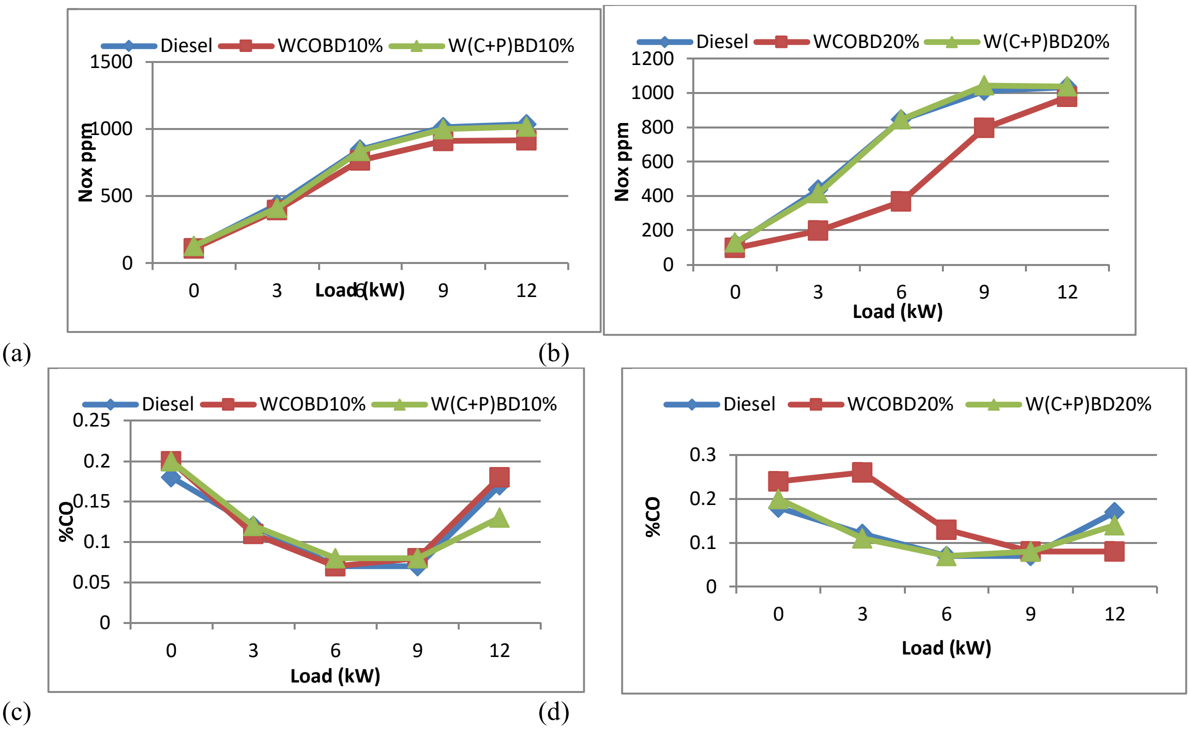


Fig 4 (a,b,c,d,e,f) Performance Characteristics for 10 and 20 % Blending of WCOBD and W(C+P) BD

Fig 4 (a,b,c,d,e,f,g,h) shows effect of WCOBD blending and mixing of WCOBD and WPAMBD in equal proportion with diesel. It is clear that in case of 10 and 20 % of W(C+P) BD blending with diesel gives better results individual blending of WCOBD, but compare to 10 % in case of 20 % blending thermal performance is better than WCOBD but slightly affected with 20 % blending of mixture of two biodiesels.



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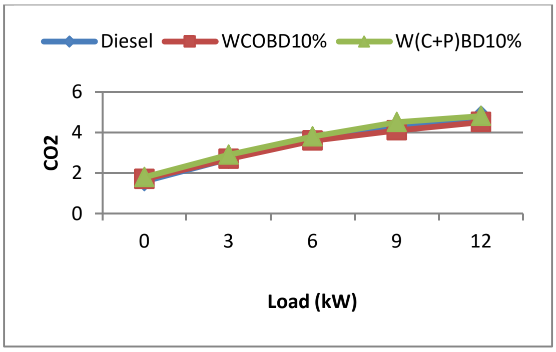

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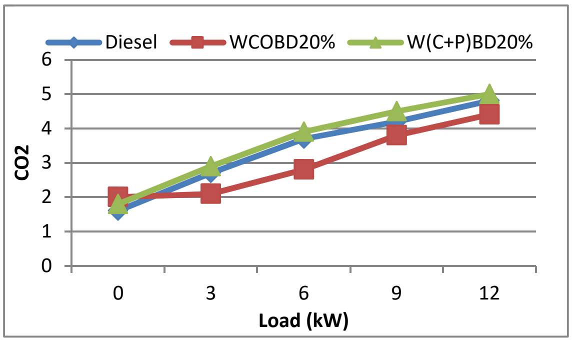
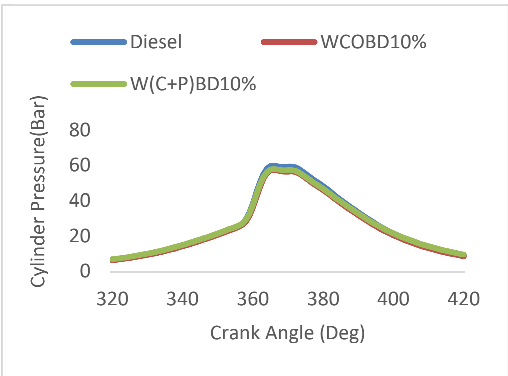


(f)

Fig 5 (a,b,c,d,e,f) Emission Characteristics for 10 and 20 % Blending of WCOBD and W(C+P) BD

Fig 5 represents emission characteristics of WCOBD and W(C+P) BD blending with diesel. Fig 5 (a,b) indicates that NO_X emission is more in case of 20 % W(C+P) BD while CO emission reduces with blending from 10 to 20 % in case of W(C+P) BD but again CO_2 emission increases with % blending of mixture of biodiesel compare to individual WCOBD.



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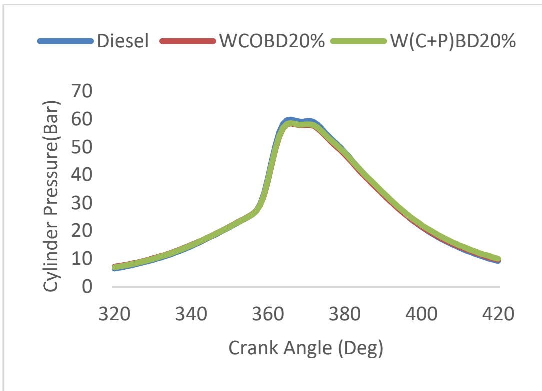

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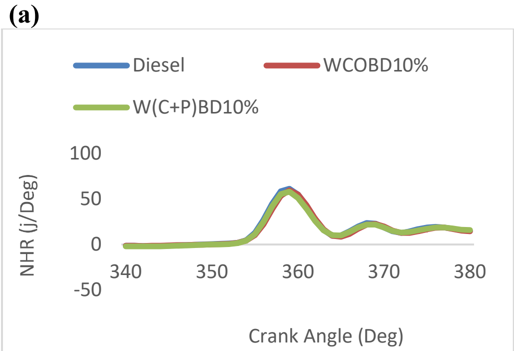

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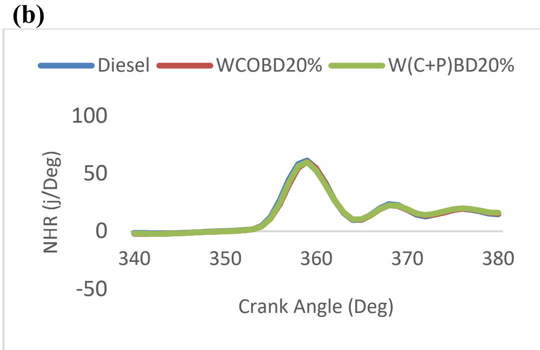

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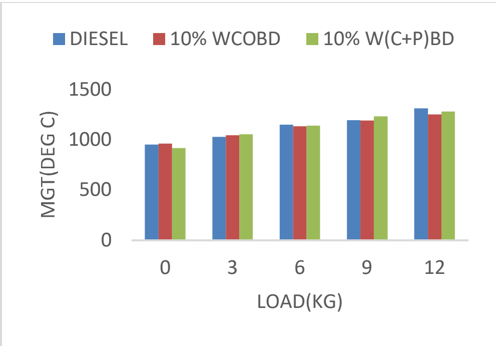

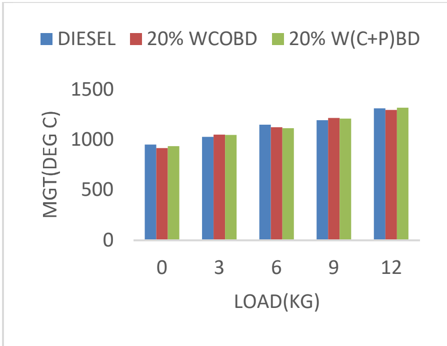

Fig 6 (a,b,c,d,e,f) Combustion Characteristics for 10 and 20 % Blending of WCOBD and W(C+P) BD

Fig 6 includes combustion characteristics of individual bio diesel and mixed biodiesel. Fig 6 (a,b,c,d) indicates that cylinder pressure and net heat release values are high in case of mixture of biodiesel with 20 % blending while Fig 6 (e,f) shows that mean gas temperature values are high for all loads in case of WCOBD compare to W(C+P) BD for 10 and 20 % blending.

Conclusion

The major conclusion of present work is that compare utilization individual biodiesel extracted from waste cooking oil the mixture of biodiesel obtained from two different waste cooking oil gives belter results.

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