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Analysis on Performance Characteristics and Emissions of Diesel Engine using different Blends of Calophyllum Inophyllum, Cotton Seed Oil, Karanja.

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Abstract

Ecological concernment and energy extremity of the planet has led to the quest of feasible alternatives to the non-renewable fuel source, FAME (Fatty Acid Methyl Ester) is biodegradable, ecological, alternative, and safe, environmental friendly which has a high flash point and is also termed as Bio-Diesel. In upcoming years, in most of the regions of the world production and application of biodiesel has extrinsic fame. It is usually produced by the method trans-esterification. In this experiment, biodiesel from Calophyllum Inophyllum oil, Karanja Oil Methyl Ester and Cottonseed Oil has been produced using the trans-esterification process. Engine trail have been executed in water cooled, 4- stroke diesel engine. Investigational analysis has been conducted to study the performance and emission on different biodiesel blends of Cottonseed Oil, Karanja Oil Methyl Ester and Calophyllum Inophyllum oil for unequal injection pressures. From the evaluation of obtained results, it can be deduced that the engine operation process is considerably become better with noteworthy subdual in emissions of the CO and HC.

Keywords:*Bio fuel, Calophyllum Inophyllum, Cotton Seed Oil, Karanja*

1. Introduction

The demand for energy utilization in automobiles and agricultural segment in India has been expanding along with the economic advancement. India is facing difficulties in regard to the fuel necessity for increased transportation pressure and is importing of about 70 % of its petroleum demand. Domestic consumption of mineral diesel in India accounted for approximately 16% of the total imports valued about INR 3.4lakh crores in 2015-16 (PPAC). This indicates the economic stress on the country due to diesel consumption. Since pricing of petroleum products like Diesel, Domestic LPG and kerosene continues to be regulated and subsidized. The subsidy / under recovery on diesel alone accounted for 57.78% of the under recoveries (173,523 crores) during the span of two years.

2.Why Bio-Fuel

Alternative fuels giving guarantee of sustainable advancement with security of supply and lesser ecological implications, are needed. For transport part confronts extra difficulties sufficient energy density and lower pollutant emission potential because their exhaust items are transmitted straightforwardly into the ambient air, which influences human wellbeing. The execution of major project for advancement of bio diesel in India is possible into following favorable conditions.

1) Biodiesel shows perfect diesel characteristics, with none or minor hardware modifications within the engine it shows a probability of it being utilized as substitute.
2) Utilization of biodiesel is useful in decreasing the greenhouse gas emissions.
3) Biodiesel may be manufactured from regional available feedstock resources. Thus advancement of biodiesel industry would fortify local industrialization.
4) Blending it with diesel, it is able to adjust for the decrease in the lubricity in low sulphur content diesel on the grounds that substance is being diminished in diesel fuels, to make them perfect with EURO- IV or higher measures.

3.Literature Review

We know that in village place, where the electric power is supplied for only 3 hours in a day time and 6-8 hours at night time. This is the main reason, which drives me to overlook the biofuels. At whatever point I consider fuel, an image of villages of developing countries overshadowed in darkness, poverty, no planned mechanization, agriculture depending on rain comes

before my eyes. Mainly these petroleum prices are directly proportional to the inflammation rate. As the price of petroleum products increases the daily needs prices also increases.

C K Reddy the thought of utilizing vegetable oil as fuel has been around from the conception of diesel motor. Rudolph diesel, the inventor of the engine that stands his name, experimented with fuels starting from powdered coal to shelled nut oil.

Auld D L et al. Utilized rapeseed oil to study the impacts of utilizing an option Fuel as a part of diesel motors. An examination of the rapeseed oil demonstrated a relationship in the middle of consistency and unsaturated fat chain length. Motor power and torque results utilizing rapeseed oil were like that of diesel fuel. Consequences of the fleeting tests showed further long haul testing was expected to assess motor durability when oil was utilized.

Goering C E et al. studied the characteristic properties of eleven vegetable oils. To determine which oils would be best suited for use as an alternative fuel source. Of the eleven oils tested, corn, rapeseed, sesame, cottonseed, and soybean oils had the most favorable fuel properties.

4.Methodology

Biodiesel which may be delivered from consumable and non- consumable oils which is derived from vegetables, reused vegetable oils and creature fat (Auld D. L.B. L. Bettis and C. L. Peterson 1982) This bio degradable substances can be converted by using trans esterification process by changing over tri-glycerides into unsaturated fats alkyl-esters which is one of best alternative fuel, which may be utilized as a fractional substitute for fossil based diesel. Trans esterification is a reaction in which tri-glycerides exhibit within the raw material vegetable oils with essential alcohols in presence existence of a catalyst, which delivers essential glycerol and esters.

4.1 Cottonseed Oil Methyl Ester Production

The procedure trans esterification of cottonseed oil was performed by using the catalyst of 5 g potassium hydroxide and 200 ml methyl liquor for each 1L (G. R. KannanK. Rajasekhar Reddy and Velmathi 2006-2009). To begin with, the cottonseed oil was heated to around 700C in a reactor then; the catalyst was blended with methyl alcohol to disintegrate and added to the heated cottonseed oil in the reactor. After that blend was blended for 1 hour at an temperature of about 700C, it was exchanged to another container and the partition of the glycerol layer was permitted. Once the glycerol layer was settled down, the methyl ester layer framed at the upper piece of the compartment was exchanged to another vessel. Thereafter, a washing procedure was completed to evacuate some un reacted rest of methanol and catalyst utilizing refined water and the blown air. At that point, a distillation procedure at around 1100 C was employed for evacuating water contained in the esterified cottonseed oil. At the last moment the produced cottonseed oil methyl ester was left to cool down (R. Anand 2006-2009)

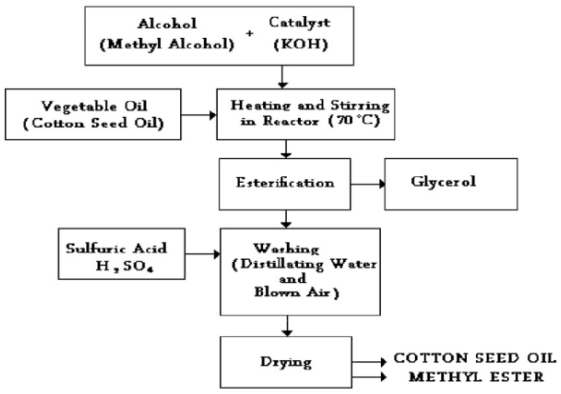

Fig.1 Flow chart of COME

4.2Calophyllum Inophyllum Production

The oil is initially warmed to 50ºC and then 0.7% (by wt. of oil) sulphuric acid is to be added in oil and methyl alcohol about 1:6 molar proportion (by molar mass of oil) is added. Methyl alcohol is added in excess quantity to accelerate the reaction. This reaction was continuing with stirring at 650 rpm and temperature was controlled at 55-57ºC for 90 min. The fatty ester is isolated after regular cooling (P. L. Naik and D. C. Katpatal 2013). At second level, the isolated oil from the isolating funnel needs to experience trans esterification. Meth- oxide (methanol + sodium hydroxide) is added in the above ester and it is heated to 65°C The same temperature is kept for 2 hr. with connected stirring and after that, it undergoes natural cooling for 8 hr. Glycerol will be stored at the bottom of the flask, and it is isolated out by a separating pipe. The remainders in the flask is the esterified vegetable oil (biodiesel) (S. Patil 2013).

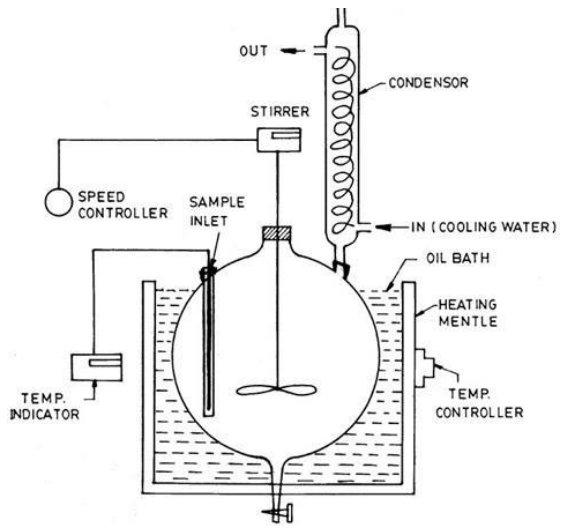

Fig.2 Experimental set up for trans esterification of Honne and Karanja Crude oil

4.3 Karanja Production

The trans esterification procedure is the reaction of triglyceride (fat/oil) with an alcohol in the vicinity of acidic, alkaline or lipase as a catalyst to form mono

alkyl ester that is biodiesel and glycerol. However the vicinity of strong acid or base quickens the transformation. It is accounted that alkaline catalyzed trans esterification is quickest and require basic set up hence, in current study the oil of pongamia pinnata were trans esterified with methyl alcohol in presence of strong alkaline catalyst like sodium hydroxide or potassium hydroxide in a batch type trans esterification reactor.

To prepare biodiesel from pongamia crude oil first sodium hydroxide was added in to the methyl alcohol so as to form sodium Methoxide and at the same time oil was heated in a separate vessel of tranesterifaction reactor and it is subjected to heating and stirring. At the point when temperature of oil came to at 60oC then sodium Methoxide was mixed in to the oil and reaction mixture was stirred for one and half hour. After reaction completion, there action mixture was moved in separating funnel. The mixture of glycerol and methyl ester was permitted to settle for 8hours. In the wake of settling for 8 hours glycerol and methyl esters was isolated manually. The methyl ester was the washed with heated water to uproot hints of sodium hydroxide polluting influence. The washed biodiesel then refined to evacuate moisture and final good quality biodiesel was subjected for chemical analysis.

5. Properties of Biofuels

Table 1 Physical-chemical Properties of Biofuels

Properties	Unit	Diesel	Honne Oil	Karanja Oil	Cotton Oil
Density	gm/cc	0.84	0.895	0.865	0.85
Viscosity (at 40 0c)	cst	2.5	4.43	4.78	4.35
Calorific Value	KJ/kg	43,560	39,650	38,540	39,648
Specific Gravity		0.84	0.9	0.925	0.91
Flash Point	0c	52	173	225	207
Fire Point	0c	61	181	236	219

Table 2 Blending percentage of fuel

Notation	Fuel Quantity (Liter)	Bio-Diesel Quantity(ml)			Diesel Quantity (ml)
		Honne	Karanja	Cotton	
O1	1	300	400	-	300
O2	1	100	500	-	400
O3	1	200	600	-	200
O4	1	300	-	400	300
O5	1	100	-	500	400
O6	1	200	-	600	200

6. Experimental Setup

The experiment is completed at constant rated speed, comparing the performance of C.I engine by varying its Injection pressure on Diesel and Using Different Blends of Calophyllum, Inophyllum, Cotton Seed Oil & Karanja. The specimens are arranged by utilizing 1000 ml measuring container and a graduated test tube.

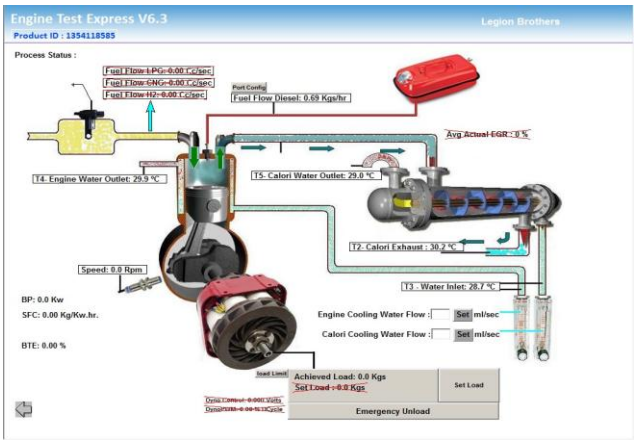

Fig.3 Schematic Diagram of the Experimental Set-up.

7. Result and Discussion

7.1 Brake Thermal Efficiency

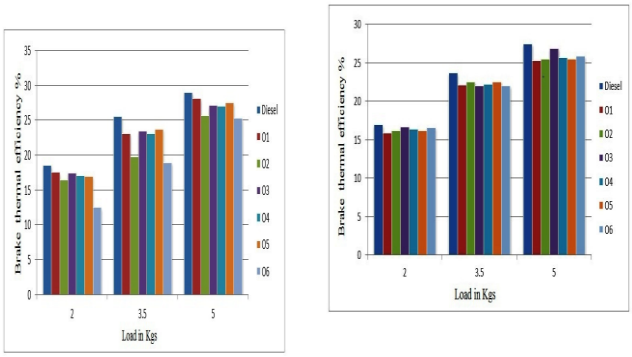

Fig.4 Brake thermal efficiency VS load for Injection Pressure180 bar and 220 bar respectively

Above graph displays the variation of brake thermal efficiency versus load for Injection Pressure 180bar and 220 bar respectively. It is found that the brake thermal efficiency is steadily increased with the increases in load. The thermal efficiencies of biodiesel fuel blends are reducing with comparison to diesel fuel. This is mainly because of the lower heating value and inferior combustion of the Bio fuels.

7.2 Exhaust Gas Temperature

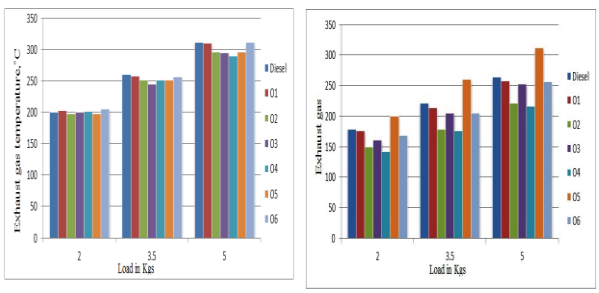

Fig.5 Exhaust gas temperature versus load for Injection Pressure 180bar and 220 bar respectively

Above graph gives the variation of Exhaust gas temperature versus load for Injection Pressure 180bar and 220 bar respectively. The exhaust gas temperature reduces with increase in the bio fuel blend percentage and the values are smaller in comparison to diesel fuel as shown in the graphs. The main reason for lower exhaust gas temperatures for Bio fuels-diesel blends is Lower viscosity. Because lower the viscosity lower the penetration of the fuel into the combustion chamber, which results in the smaller amount of heat is produced.

7.3 Carbon Monoxide Emission

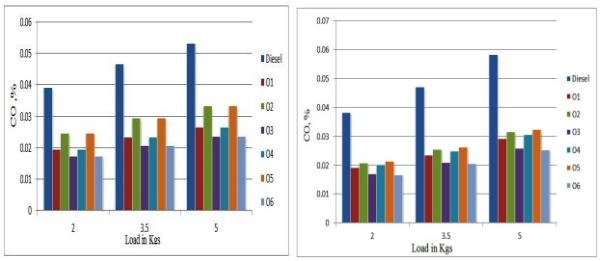

Fig.6 Percentage Carbon Monoxide Vs Load for Injection Pressure 180 bar and 220 bar respectively.

Above graph demonstrates the variations of %CO with load for Injection Pressure 180bar and 220 bar respectively. The emission of carbon monoxide get increases for Injection Pressure of 180bar to the injection Pressure 2200bar .This is because of fuel air mixture fills inside the cylinder is very lean and some

of the mixtures nearer to the wall and crevice volume, the flame will not propagate.

7.4 Hydrocarbon Emission

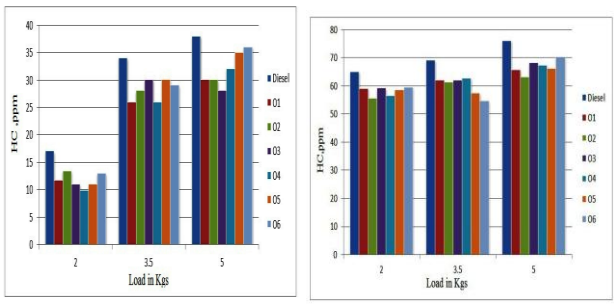

Fig.6 Hydrocarbon VS load for Injection Pressure 180bar and 220 bar respectively.

Above graphs shows the variation of Hydrocarbon opposite of load for Injection Pressure 180bar and 220 bar respectively. The Unburnt hydrocarbon discharge is mainly due to the incomplete combustion. By comparing Injection Pressure 180bar to the emission of hydrocarbon increases for Injection Pressure 220 bars. This is because of two reasons. First one is, the fuel spray doesn't spread deeper in the combustion chamber and second one is gaseous HC's will remain alongside the cylinder wall and the crevice volume and leftUnburnt.

Conclusion

The complete study is based on the exhaust emission and engine performance of Cotton seed oil, Karanja, Honne biodiesel were performed. The following conclusions can be made

1) In biofuel blend O2, BTE was dropped by 13 % compared to 100% Diesel fuel at 180 bars.
2) In biofuel blend O5, BTE was dropped by 11.32 % as compared to 100% Diesel fuel at 180 bars.
3) In terms of BTE O5 is somewhat better than O2 at 180 bars.
4) In biofuel blend O2, BTE was dropped by 15.44 % compared to 100% Diesel fuel at 220 bars.
5) In biofuel blend O5, BTE was dropped by 13.25 % as compared to 100% Diesel fuel at the 220 bars.
6) In terms of BTE O5 is better than O2 at 220 bars.
7) It was observed that with the increase in the blend, exhaust temperature get increased.
8) Emission of NOx found to be increased with the increase in the blending percentage.
9) But, CO and HC found decreased with the increase in the percent of bend.

From the end of work we can deduce that the bio fuels namely cotton seed oil, Karanja and Honne can be used as Alternative fuel. The values of BTE and BSFC are nearer to diesel fuel values. As the overall emissions of biodiesel is less than that of diesel, they are more Eco-friendly. As compared to Honne -Karanja biodiesel, Honne – Cotton seed oil biodiesel is preferred because they show better performance characteristics. From the economy point of view Honne – Cotton seed oil biodiesel has less cost compared to Honne - Karanja, as Cotton seed oil biodiesel is produced from waste Cotton seed.

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