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Production of Bio-fuel from Pongamia and its Performance on Ci-engine

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Abstract

India ranks 6th in terms of consumption of energy, which is 3.5% of the total world's commercial energy. The current consumption of diesel in India is about 40m t (40% of the total petroleum product consumption) and is expected to reach 52.32m t by 2006-07 as the demand is growing at a rate 5.6% per annum. Whereas domestic production of crude oil and natural gas will remain around 33.97m t during 2006-07. Hence there will be a huge gap between demand and supply which needs to be met through increasing fuel imports or increasing production of biodiesel through developing biodiesel plantations without sacrificing the food security of the country. Biodiesel is renewable energy resource generated from rehabilitation of waste and degraded lands.

Bio-fuel is a fuel comprising of mono-alkyl esters of long chain fatty acids of vegetable oils or animal fats, which is derived either from plant or animal. Use of bio-fuel requires very little or no modification of engine when blended with diesel up to 20% (B20). Use of biofuel results in substantial reduction of un-burnt hydrocarbons by 30%, carbon monoxide by 20% and particulate matters by 25%. It has almost no sulphur. Besides, it has nearly 10% in-built oxygen, which facilitates combustion and also favorable Cetane number (51). The lower limit for the Cetane number is 46 for good combustion.

1. Introduction

In the present work, Biodiesel is prepared from Honge oil (Pongamia) and used as a fuel in C.I engine. Performance tests will be conducted on a single cylinder four-stroke water-cooled compression ignition engine connected to an eddy current dynamometer with different percentage ethanol and methanol in honge bio-diesel blended with diesel. The performance and combustion characteristics of blends will be evaluated at variable loads at constant rated speed and results will be compared with diesel.

1.1 Bio-fuel Plantations in Wasteland Rehabilitation

As per the various statistical estimates the wastelands in India are ranging from 38.4 m ha to 187 m ha (Table 1). The Govt. of India has identified 146 districts from 19 States in micro planning for rehabilitation of degraded lands. Nearly 83% of India's wastelands are in states of Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Tamil Nadu and UP.

Table 2.1: Comparison of properties of esterified pongamia oil with diesel, Ethanol and Methanol.

Properties	Diesel oil	Pongamia Bio-diesel	Ethanol	Methanol
Density at 300 c. gm/cc	0.830	0.9404	0.789	0.7918
Calorific Value kJ/kg	42500	38996	29700	22700
Kinematic Viscosity at 400c. cSt	3.9	14.7	1.2	1.04
Flash point in oc	56	196	16	12
Fire point in oc	65	206	25	21

Fig. 1

Average seed Yield/Tree

- 5-6 years: 5-10 kg.
- After 10 years: 15-20kg.
- After 20 years: 30-40kg.
- Oil percentage: 30-40 % (seed).

2. Production of Bio-diesel

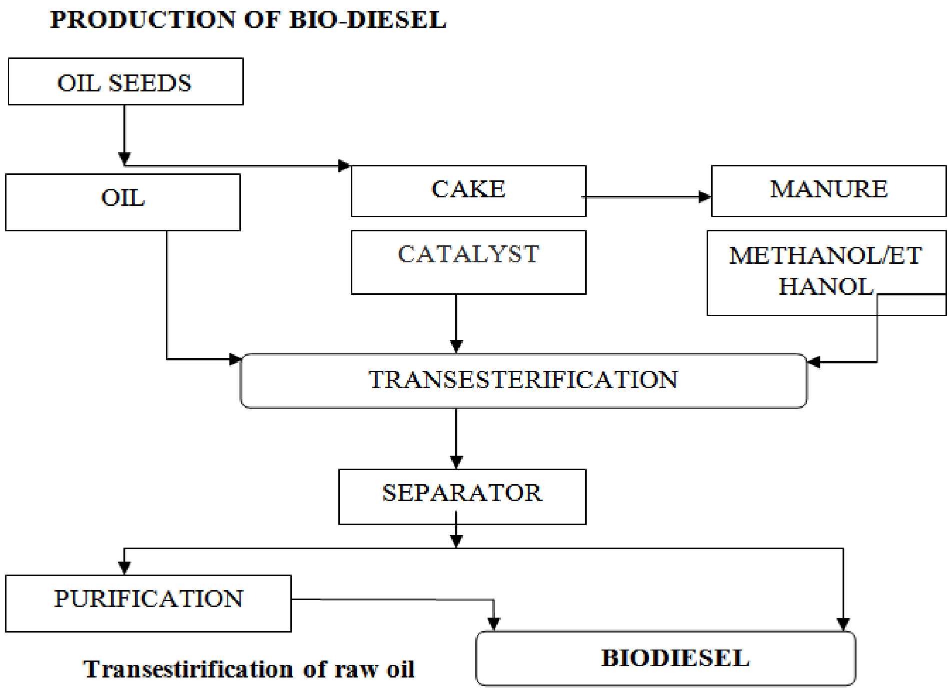

Fig. 2: Extraction of biodiesel.

Figure 3: Transestirification unit.

- Now take 1 liter of sample oil.
- That oil is to be heated up to 55 to 60 c temperature but not exceed 70 c.
- Now take 200 ml of methanol or ethanol in to that add 4.5 grams of KOH.

- Shake that mixture well up to KOH dissolved fully. It will become potassium meth oxide solution.
- Now add that solution to 1 liter sample oil with constant stirring of row oil. Stir up to 10 to 15 minutes.
- Leave that solution to settle down up 8 to 10 hours.
- It will form two distinct layers.
- That upper layer is called Bio-diesel and lower dark and thick layer called glycerol which is used to make soap.

Reaction of transestirification Process

STEP 1:

CH_2–OOC-R HO-CH_2
□ □
CH_2–OOC-R + CH_3OH → OO-CH + R_1-OO-CH_3
□ □
CH_2–OOC-R R_3-COOC-H_2

STEP 2:

CH_2–OH HO- CH_2 R_1-OO-CH_3 □
□
CH_2–OOC-R_2 + CH_3OH → HO- CH + R_2 – COO- CH_3
□ □
R_3-COOC-H_2 R_3-COOC-H_2

STEP 3:

CH_2–OH HO- CH_2 R_1-OO-CH_3
□ □
CH-OH + CH_3OH → HO- CH + R_2 – COO- CH_3
□ □
CH_2–OOC-R_3 HO- CH_2 R_3-COOC-H_2

Separation of glycerol from bio-diesel

Remove that upper layer slowly without disturbing lower layer i.e. Glycerol.

Fig. 4: Separation setup.

Washing of bio-diesel
This step is optional because it depends on colour and some properties but sometimes it is necessary because that separated bio-diesel contain some methanol, to remove that methanol washing is necessary because methanol is soluble in water. After that we have to separate that impurity then will get pure form of bio-diesel. It can be used for automobile purpose.

Fig. 5: Washing unit.

3. Result and Discussion
This Experimental investigations gives the complete information of performance characteristic of C I engine running on different blends of pongamia bio-diesel with different percentages of neat diesel.

The engine was set to run at compression ratio 18:1 and injection pressure of 180 bars and the experiment was conducted for variable loads at constant rated speed. The results are tabulated below and the corresponding graphs have graphs plotted.

Comparison with different blends for mechanical efficiency

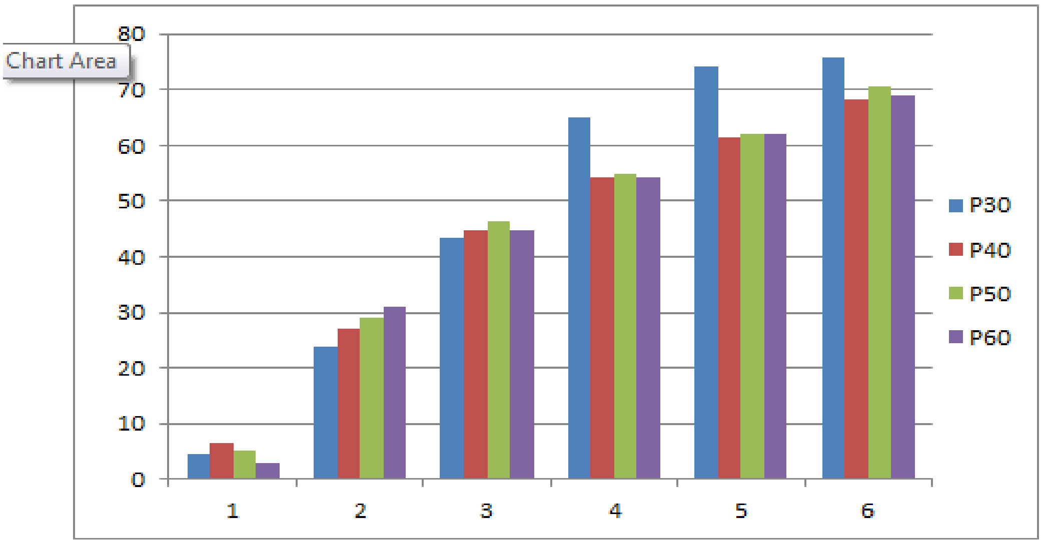

Fig. 6

Table 10.1: Comparison of bio- fuel and standard petroleum diesel.

Property	Bio-fuel	Petroleum diesel
Viscosity (cp) (30°C)52.6	5.51	3.60
Specific gravity (15°C/4°C	0.917	0.841
Solidfying Point (°C)	2.0	0.14
Cetane Value	51.0	47.8
Flash Point (°C)	110	80
Carbon Residue (%)	0.64	0.05
Distillation (°C)	284 to 295	350
Sulfur (%)	0.132 to 0.16	1.0
Acid Value	1.0 to 38.2	
Saponification Value	188 to 198	
Iodine Value	90.8 to 112.5	
Refractive Index (30°C)	1.47	

4. Conclusion

The major fatty acids in Pongamia pinnata crude oil were palmic acid, stearic acid, lenoleic acid, ecosenoic acid observed. The oil extracts exhibited good physic chemical properties and could be used as a biodiesel feedstock and industrial application. The way of reducing the biodiesel production costs is to use less expensive feedstock containing fatty acids. Such ac non edible oils waste vegetable oils, animal fats and byproducts of refining oil. With no competing food uses, this characteristic turns attention to Pongamia pinnata which grows in tropical and subtropical climates across the world. The productions of biodiesel from these oils provide a valuable local, regional and national benefit. To develop biodiesel into an economically important option in India. It is required to work on biological innovations to increase the yield and minimize the gestation period of pongamia pinnata tree.

The Mech Eff, IP for P30,P40, P50 is very close to diesel at low and slightly higher than diesel at higher load.P30,P40 are higher than diesel whereas P60 higher than diesel at higher load. The SFC for all the blends is higher however P20 is closer to diesel. The air fuel ratio of pure diesel is lower than biodiesel and their blend. The BMEP for P20 is closer to neat diesel. The BThE of P20 and P40 are higher than neat diesel.

The IP for P60D40,P20D80 and P30D70 are very close to diesel. The Sfc for P10 is slightly less than pure diesel.

Hence from the above experimental it is concluded that Biodiesel blend with diesel gives IThE and Mech.Eff are higher to compare to diesel but SFC biodiesel blend is higher than diesel.

Reference

[1] John.B.Heywood, Internal combustion Engine fundamentals.(The McGraw Hill Book Co:1988)
[2] V.Ganesan, Internal combustion engines. (The McGraw-Hill Pvt Ltd,2011)
[3] E.T.Puttaiah, Professor, Department of P.G Studies & Research center in Environmental Science,Kuvempu University, Shimoga, Karnataka , India
[4] C.Venkataramana Reddy, Guru Nanak Institute of Technology, Ibrahimpatnam, R.R.District-501506, Hyderabad, Andra Pradesh India.
[5] www.wikipedia.com
[6] www.biodiselfuelonline.com
[7] www.biodisel.org
[8] www.scribd.com.