

PERFORMANCE OF C.I. ENGINE WITH ALTERNATIVE GREEN FUEL

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ABSTRACT

Biodiesel production is a modern and technological area for researchers due to constant increase in the prices of petroleum diesel and environmental advantages. This report presents a review of the alternative technological methods that could be used to produce this fuel. Biodiesel from karanja oil was produced by alkali catalyzed trans-esterification process. Performance of CI engine using karanja biodiesel blending with diesel and with various blending ratios has been evaluated. The engine performance studies were conducted with an eddy current dynamometer-diesel engine set up. Parameters like speed of engine, fuel consumption and torque were measured at different loads for pure diesel and various combinations of dual fuel. Brake power, brake specific fuel consumption and brake thermal efficiency were calculated. The test results indicate that the dual fuel combination of more than B15 can be used in the diesel engines without making any engine modifications. Also the cost of dual fuel can be considerably reduced than pure diesel

I INTRODUCTION

With the increasing demand on the use of fossil fuels, a stronger threat to clean environment is being posed as the burning of fossil fuels is associated with emissions like CO₂, CO, SO_x, NO_x and particulate matter, which are currently the dominant global source of emissions. These emissions are major causes of air pollution and hence of the environment. Despite this, fossil fuels continue as the major conventional energy source in meeting the fast increasing world energy demand. If this continues, it will further deteriorate the environment. Hence, there are efforts around the globe to protect the environment from further deterioration. Harmful exhaust emissions from engines, rapid increase in the prices of petroleum products and uncertainties of their supply, have jointly created renewed interest among researchers to search for suitable alternative fuels. Compressed natural gas, propane, hydrogen, and alcohol-based substances (gasohol, ethanol, methanol, and other neat alcohols) all have their proponents. Although these fuels burn somewhat cleaner than gasoline, the use of all of them involves extensive modification of the engine. The ideal alternative fuel will be one which an engine would burn much more cleanly than conventional gasoline-powered IC engines without much modification of existing engines. Vegetable oils have considerable potential to be considered as appropriate alternate as they possess fuel properties similar to that of diesel. Moreover, review of the literature revealed that with the use of vegetable oils as fuel in diesel engines, harmful exhaust emissions, particularly HC, smoke and CO are considerably reduced as compared to diesel. The major problem associated with direct use of vegetable oils is their high viscosity. One possible method to overcome the problem of higher viscosity is transesterification of potential oils to produce esters of respective oils. Most of the esterified oils tried in diesel engines were soybean,

sunflower, safflower, and rapeseed. These oils are essentially edible oils in the Indian context and use of biodiesels from these oils as substitute to diesel fuel may lead to a concept of self-sufficiency in vegetable oil production, which India has not attained yet. With abundance of forest and tree borne non-edible oils being available in our country, not many attempts have been made to use esters of these non-edible oils as substitute for diesel. Karanja (*Pongamia glabra*) is one such forest-based tree-borne non-edible oils with a production potential of 135,000 million tonnes.

II MAKING OF BIODIESEL

What is biodiesel?

Methyl ester obtained by transesterification of vegetable oil is an alternative fuel called biodiesel. Biodiesel is alternative substitute and additives to diesel. Biodiesel are produced from oil seed, crop plant such karanja, mahua, neem, cottonseed which can easily be grown on wasteland .Among all seed plant, karanja is promising one for availability of raw material for feedstock of production of biodiesel. Biodiesel is renewable source, bio-degradable, non toxic and free from sulphur, no contain of petroleum.

2.1 Transesterification

Transesterification is the kind of organic reaction where alcohol group in ester are substituted .In this process, alcohol are used except water. This process is used to reduce try glyceride and alcohol reacts with vegetable oil fat gives ester and glycerol.

Transesterification process helps to minimize the viscosity of vegetable oil .The process of removal of glycerol and fatty acid from vegetable oil in the presence of catalyst called esterification, this esterifies vegetable oil called bio-diesel.

2.2 Procedure

- 1) Take vegetable oil.
- 2) Clean it through muslin cloth to remove impurities if any.
- 3) Pour the oil in transesterification vessel.
- 4) Heat the oil up to 55-58⁰c temperature.
- 5) Stir the oil slowly.
- 6) Add methanol about 200-250 ml per liter of oil by maintaining above temperature and stirring speed.
- 7) Maintain the same temperature and speed up to one hour to achieve complete trans-esterification.
- 8) After one hour pour the material in suitable semi transparent vessel.
- 9) Keep it at room temperature for 4-6 hrs. Setting down of the glycerin.
- 10) Take out upper yellowish biodiesel from lower thick brownish glycerin by siphon pump or other suitable means.
- 11) Add 1:1 proportion of water for washing of biodiesel followed by inserting stone of bubble generator at the bottom of the vessel.
- 12) Near about two to three washing of 4-5 hrs. Should be given so that PH of biodiesel ranged from 6.5 to 7.5.
- 13) Siphon off the upper washed biodiesel from lower whitish washed water carefully.
- 14) Heat biodiesel at 110⁰c temperature for 10-15 min. to remove the excess moisture in it.
- 15) After cooling, biodiesel is ready to use in any diesel engine.

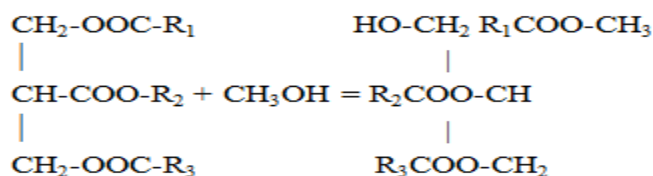
2.3 Chemical Reaction

In transesterification of vegetable oil, triglyceride reacts with three molecule of alcohol in presence of catalyst to produce ester and glycerol. The total process is sequence of three consecutive reactions, in which di and mono-glyceride are formed as intermediate .Transesterification is reversible reaction thus excess alcohol are used to increase the yield of alkyl ester and allow its phase separation from glycerol formed. In this process, catalyst(strong acid or base) are added , chemical reaction are accelerated, vegetable oil having more cetane number ,so it needed esterifies to improve physical and chemical properties , so due to physical property and chemical property. It helps to obtain good combustion characteristics in vegetable oil, so that unburnt HC reduces in exhaust , more one importance of ester are it contain more oxygen and low carbon than diesel.

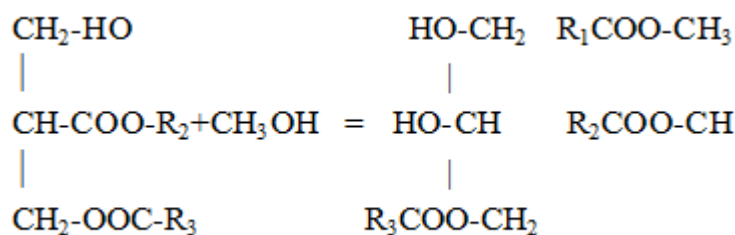
Conversion of vegetable oil to biodiesel is effected by several parameters namely

1. Time of reaction
2. Reactant ratio (molar ratio of OH to vegetable oil)
3. Type of catalyst
4. Amount of catalyst
5. Temperature of reaction.

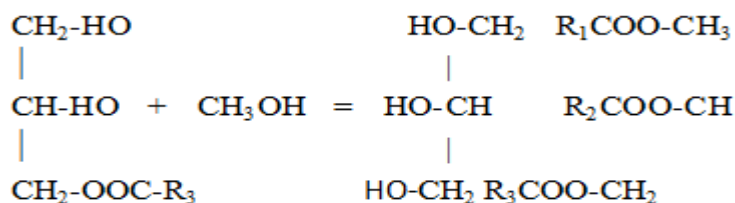
STEP 1



STEP 2



STEP 3



(Triglyceride) (Methanol) (Glycerol) (Ester)

Transesterification reaction of triglyceride

2.4 Advantages and Disadvantages of Biodiesel

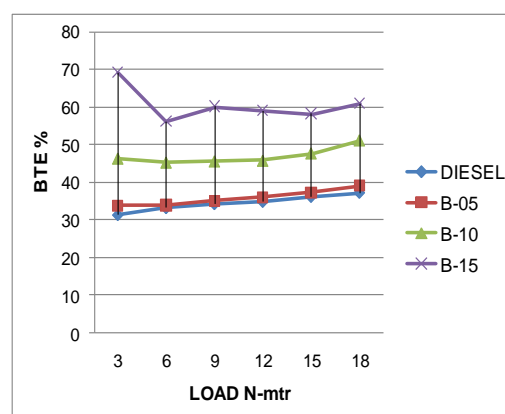
2.4.1 Advantage

- 1) The fuel property of biodiesel such as kinematic viscosity and specific gravity are found within limit of BIS standard.
- 2) Biodiesel can be used as alternate and non conventional fuel to run all type of C.I engine
- 3) Biodiesel have better lubricating property and much higher cetane rating than today's sulphur diesel.
- 4) Bio- diesel addition to fuel to reduce wear and level in high pressure system increases the life of fuel injection pump.
- 5) Calorific value of bio diesel is 37.27 MJ/KG, if 9% lower than petro-diesel.
- 6) Smoke number is considerably reduced by using bio-diesel as a blend.
- 7) Bio- diesel have a better ignition quality, comparable energy content, high density and higher safety due to higher flash point.
- 8) Although Bio diesel heat combustion is slightly lower than petro diesel, there is no engine adjustment necessary and no loss in efficiency.
- 9) It has low emission than petro-diesel.

2.4.2 Disadvantage

- 1) Use of bio-diesel may create problem during winter season.
- 2) Quality of bio-diesel depends upon blend so quality can vary.
- 3) Bio-diesel cannot be used directly in engine because carbon deposits, oil ring striking, lubricating problem, thickening of lubricating oil as a result of contamination by vegetable oil.

III COMPARISON GRAPH BETWEEN DIESEL, B-05%, B-10%, B-15% WITH RESPECTIVE EFFICIENCIES



SR. LOAD NON-m	BP Kw	IP Kw	FP Kw	BSFC Kg/Kw	ISFC Kg/Kw	BME P	IMEP Bar	VE %	BTE 5 %	BTE 10%	BTE 15%	ITE %	ME %	HBP %	HGAS %	HUN %
1	0.48	2.37	1.89	0.13	0.03	0.4	1.96	57	33.8	46.3	69.2	69.8	20.25	69.2	27.12	3.68
2	0.77	2.42	1.65	0.16	0.05	0.8	2.52	71.9	34.0	45.3	55.51	56.2	31.81	55.51	23.67	20.82
3	0.96	1.3	0.34	0.07	0.05	1.2	2.63	86.4	35.1	45.6	59.3	60.12	73.84	59.3	24.53	16.17
4	1.09	2.07	0.98	0.11	0.06	1.6	3.04	87.1	36.1	45.8	58.9	59.01	52.65	58.9	26.72	14.38
5	1.2	1.33	0.13	0.05	0.05	2	3.23	87.6	37.3	47.7	57.67	58.13	90.22	57.67	27	15.33
6	1.46	1.63	0.17	0.04	0.04	2.39	3.46	88.1	39.1	51.1	63.15	61.00	89.57	63.15	28.19	8.66

IV CONCLUSION

Bio-diesel (*karanja oil*) is natural and domestic fuel alternative for diesel engine. It is nontoxic and biodegradable. bio-diesel burn clean which resulting significant reduction of the pollutants that contribute to smog and global warming. No engine modification required to run the engine on bio –diesel. Furthermore shows no significant difference in fuel economy between bio-diesel and bio-diesel blend, petro-diesel performance Experimentation gives the performance of *karanja oil* as bio-diesel equivalent to diesel & thus it can replace the diesel partially or fully.

The cost of biodiesel is less as compared to petro-diesel and it control emission so it is economical to us and eco-friendly which need of present day. The test results indicate that the dual fuel combination of more than B15 can be used in the diesel engines without making any engine modifications. Also the cost of dual fuel can be considerably reduced than pure diesel.

V FUTURE SCOPE

India currently imports about 72% of its petroleum requirements, spending more on foreign exchange. The demand for diesel increased from 28.3 million tonnes to 40 million tonnes. With increasing demand on the use of fossil fuels, stronger threat to clean environment is being posed as burning of fossil fuels is associated with emissions like CO₂, CO, SO_x, NO_x and particulate matter and are currently the dominant global source of emissions. The harmful exhaust emissions from the engines, rapid increase in the prices of petroleum products and uncertainties of their supply have jointly created renewed interest among the researchers to search for suitable alternative fuels.

If we use the bio-diesel instead of diesel in the engine there is no need to make any modification in diesel engine. Also its effect on engine components and exhaust emissions can be analyzed.

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