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Performance Analysis of Pongamia (Karanj Oil) as Fuel in Diesel Engine

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Abstract--- *The experimental outcomes on a diesel engine with numerous emission performances of fuels primarily based on pongamia pinnata oil as compared with diesel gasoline. Fuels utilized in experimental research have been combinations of pongamia pinnata methyl ester and diesel in exclusive proportions: 80% diesel - 20% PPME,60%diesel-40% PPME, 40% diesel - 60% PPME, 20% diesel gas- 80% PPME, 100% PPME and 100% diesel as (reference). The project had focused on the use of fuels derived from pongamia pinnata oil on the prevailing kirloskar AV1 engines. Fuel related properties were reviewed and as compared with the ones of traditional diesel fuel. The effect of use of biofuel on engine emissions from biodiesel and diesel fuels were as compared, paying unique interest to the maximum enormous emissions which include Hydro carbons, carbon monoxide, nitric oxides and particulates be counted.*

Keywords--- *Karanj Oil, Bio Diesel, Diesel Engine.*

I. INTRODUCTION

I.C engines are devices that produce work from the products of combustion because the operating fluid rather than as a warmth switch medium. To supply work, the combustion is done that produces high pressure products that may be accelerated via a piston. This result in the formation of pollution.[1-5]

There are three types of I.C engines were in use (1) the spark ignition engine, which is used mostly in vehicles; (2) the diesel engine, which is used in huge cars and business systems (3) the gas turbine, that is used in aircraft because of its high power/weight ratio and is also used for stationary power technology.]6-9]

All these engines were an important source of atmospheric pollutants. Vehicles were fundamental sources of CO, unburned HC, and NOx. Likely more than any other combustion devices, the layout of vehicle had been guided by way of the requirements to reduce pollution. At the same time as extensive development has been made in emission discount, vehicles remain essential sources of air pollution. Diesel engines are notorious for the black smoke they emit. Gas turbine emits soot additionally. These systems also emit unburned hydrocarbons, carbon monoxide, and nitrogenoxides in huge portions.[10-14]

Bio Diesel

Bio fuel is the call for a ramification of ester-based oxygenated fuels derived from natural, renewable organic sources consisting of vegetable oil.[15]

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Bio diesel is,

- Replacement fuel in diesel engine.
- Alternative fuel for diesel engine.

Source of Bio Diesel

1. EDIBLE PLANTS:

Soybean oil, cotton seeds oil, sunflower oil.

2. NON EDIBLE PLANTS:

Jatrophacurcas, Karanj (Pongamia pinnata), Sal, Neem tree

3. Animal Fats.
4. Recycled Cooking Grease.

II. MOLECULER STRUCTURE OF BIO DIESEL

Fat and oils have the atomic structure demonstrated. It comprising of three unsaturated fats affixes joined to a glycerol body and bringing about the supposed triglyceride of unsaturated fats. The immersed or unsaturated hydrocarbon chains R1, R2 or R3 in addition to the carboxylic gathering COO make the entire structure out of every unsaturated fatty acid.[16-21]

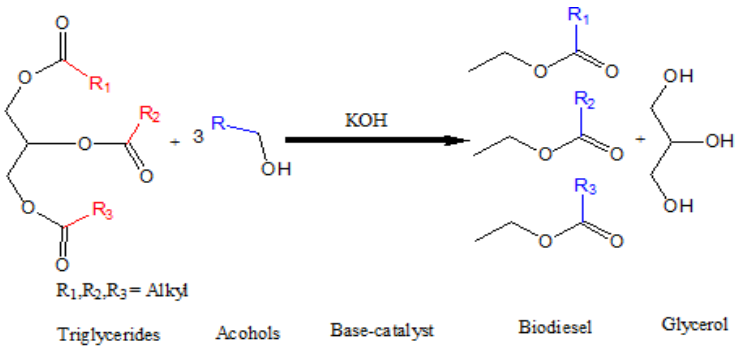

Fig.1: Structure of Bio Diesel

Production of Bio Diesel

Vegetable oils are chemically complicated esters of fatty acids. These are the fat obviously present in oil seeds, and referred to as tri-glycerides of fatty acids. The molecular weight of those tri-glycerides is about 800 kg/m^{3}or higher. Because of their heavy molecular weight those fats have more viscosity causing primary problems of their use as fuels in CI engines.[22-25]

III. TRANSESTERIFICATION

The fatty acid triglycerides themselves are esters of fatty acids and the chemical splitting up of the heavy molecules, giving rise to simpler esters, is referred to as Transesterification. The triglycerides are reacted with a appropriate alcohol (Methyl, Ethyl, or others) in the presence of a catalyst under a controlled temperature for a given

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length of time. The very last products are alkyl esters and glycerin. The Alkyl esters, having favorable properties as fuels for use in CI engines, are the principle product and the glycerin, is a spinoff.

Reaction

Triglycerides+free fatty acids + alcohol➔ alkyl esters + Glycerol

Properties of Bio Diesel

S.NO	FUEL PROPERTIES	DIESEL	BIO DIESEL
1.	Fuel standard	ASTM D 975	ASTM D 6751
2.	Kinematic viscosity at 40°c	1.3-4.1	1.9-6.0
3.	Density at 15^0c (kg/m^3)	848	878
4.	Boiling point °C	188 to 343	182 to 338
5.	Flash point °C	60 to 80	100 to 170
6.	Cloud point °C	-15 to 5	-3 to 2
7.	Pour point °C	-35 to -15	-15 to 16

IV. PONGAMIA PINNATA (KARANJA) OIL AS BIO FUEL

Renewable powers made by the estrification of vegetable oils can be utilized as a substitute for or as an added substance to mineral diesel powers. Such powers are named as biodiesel. Bio diesel is obtained by changing unsaturated fat into mono-alkyl esters by transestrification. Esters got from karanja oil and methyl liquor have acronym as PME (pongamia pinnata oil Methyl Ester). PME (Biodiesel) and its mixes with petroleum based diesel fuel can be utilized as a part of diesel engine with no huge changes to the engines.

The upsides of biodiesel (PME) over petroleum diesel fuel are enhanced lubricity, a higher blaze point, lower lethality and bio degradability. Since biodiesel is oxygenated, burning is more finished and delivers less hurtful discharge and poisons (particulate matter, hydrocarbons, carbon monoxide).

It grows about 16 to 18 meter in height with a huge cover which spreads equally huge. The leaves were gentle in early hot season and mature to a sleek, deep green as the season passes. Flowering starts after4 to 5 years. Cropping of nuts and a single almond sized seeds occur by 4 to 6 years and yield around9 to 90 kg of seed. The yield per hectare is about 900 to 9000 kg. As according to statistics this oil yield about 135000 million tonesperyear and just 6% is being utilized. The thick lateral and long faucet roots make it suitable to live in drought condition.

Preparation of Pongamia

Pongamia+ Methanol + H_2SO_4➔

Bio-fuel + glycerin

Step 1:

Methanol = 200ml + H_2SO_4 = 20ml Titrating in 1000ml conical flask.

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Step 2:

Pongamia pinnata oil= 500ml, reacting with mixture of H_2SO_4 and methanol. Keep the conical flask in Shaker for 1hrs with maintaining 45ºC.

Step 3:

After the shaking the sedimentation process is done by separating funnel.

V. EXPERIMENTAL SETUP

The prevailing examine changed into carried out to analyse the performance and emission characteristics of Pongamia methyl esters in a stationary single cylinder diesel engine and to compare it with diesel fuel.

1. KIRLOSKER AV-1 TYPE ENGINE
2. DYNAMOMETER
3. ELECTRICAL LOADING DEVICE
4. FUEL TANK
5. NDIR HORIBA ANALYZER

S.N	Fuel	Relative density	Kinematic viscosity (cst)	Calorific value (MJ/kg)	Flash point (°C)
1	Karanja oil	0.912	27.84	34.00	205
2	B100	0.876	9.60	36.12	187
3	B20	0.848	3.39	38.28	79
4	B40	0.856	4.63	37.85	81
5	B60	0.864	5.42	37.25	84
6	B80	0.869	6.56	36.47	92
7	Diesel	0.846	2.60	42.21	52

VI. PERFORMANCE AND RESULTS

After completion of bio fuel preparation the fuel will taken into various physical and chemical test, like lower heating volume(MJ/Kg), kinematic viscosity, Relative Density , Flash point(°C) has been tested. Fuels used in experiment were mixtures of pongamiapinnata (karanja oil) methyl ester and diesel in different proportions:

1. Diesel (0% Bio fuel)
2. B20 (20% Bio fuel : 80% Diesel)
3. B40 (40% Bio fuel : 60% Diesel)
4. B60 (60% Bio fuel : 40% Diesel)
5. B80 (80% Bio fuel : 20% Diesel)
6. B100(100% Bio fuel : 0% Diesel)

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VII. PROPERTIES OF KARANJA OIL AND VARIOUS BLENDS EMISSION RESULTS

FUEL: DIESELSPEED: 1500 rpm

ROOM TEMPERATURE: 35°C

% of load	Calc. load Nm	EGT °C	CO % by vol	HC PPM	NO_χ PPM
0		118	0.08	96	323
20	4.71	196	0.06	99	727
40	9.42	210	0.06	100	1350
60	14.13	230	0.04	104	2348
80	18.84	245	0.04	112	3063
100	23.55	256	0.01	133	3678

FUEL: 20% BIO FUEL: 1500 rpm

ROOM TEMPERATURE: 35°C

% of load	Calc. load Nm	EGT °C	CO % by vol	HC PPM	NO_χ PPM
0		176	0.07	114	186
20	4.71	0.08	111	210	0.07
40	9.42	106	226	0.06	105
60	14.13	230	0.05	109	235
80	18.84	0.08	123	529	762

FUEL: 40%: 1500 rpm

ROOM TEMPERATURE: 35°C

% of load	Calc. load Nm	EGT °C	CO % by vol	HC PPM	NO_χ PPM
0		118	0.09	111	526
20	4.71	121	0.1	103	686
40	9.42	123	0.08	98	1354
60	14.13	138	0.06	97	2238
80	18.84	160	0.06	102	3035
100	23.55	191	0.12	120	3694

FUEL: 60%: 1500 rpm

ROOM TEMPERATURE: 35°C

% of load	Calc. load Nm	EGT °C	CO % by vol	HC PPM	NO_χ PPM
0		145	0.1	105	573
20	4.71	127	0.11	98	717
40	9.42	122	0.09	92	1308
60	14.13	137	0.06	91	2328
80	18.84	157	0.07	97	3093
100	23.55	165	0.18	115	3499

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FUEL: 80%: 1500 rpm

ROOM TEMPERATURE: 35ºC

% of load	Calc. load Nm	EGT °C	CO % by vol	HC PPM	NO_χ PPM
0		134	0.11	98	524
20	4.71	124	0.11	91	636
40	9.42	124	0.09	87	1134
60	14.13	136	0.07	85	2224
80	18.84	154	0.08	91	2794
100	23.55	176	0.19	107	3304

FUEL: 100%: 1500 rpm

ROOM TEMPERATURE: 35ºC

% of load	Calc. load Nm	EGT °C	CO % by vol	HC PPM	NO_χ PPM
0		135	0.12	88	465
20	4.71	121	0.13	84	530
40	9.42	123	0.1	79	918
60	14.13	139	0.09	79	1696
80	18.84	152	0.09	82	2413
100	23.55	182	0.18	98	2969

VIII. CONCLUSION

Through this experimental investigation a comparison with various emission of bio-fuel and its blends with diesel (reference fuel) was done successfully. It is a renewable fuel. It has less emission like EGT, CO, HC, NOx, B20, B40 and has better efficiency than diesel.

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