STUDY ON PREPARATION OF BIO-DIESEL BLENDS WITH KARANJA OIL AS A ALTERNATIVE FUEL

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Abstract:
Biodiesel has obtained from vegetable oils that have been considered as a promising alternate fuel. Karanja oil is non edible in nature and is available abundantly in India. An experimental investigation was made to evaluate the performance, emission and combustion characteristics of a diesel engine using different blends of methyl ester of karanja with mineral diesel. The experimental results data were analyzed by using 20% blends of Karanja with 80% diesel by volume and 100% preheated karanja for various parameters like specific fuel consumption, brake thermal efficiency and emission of exhaust gas like CO, CO2, HC and NOx. The brake thermal efficiency and mechanical efficiency were better than mineral diesel for some specific blending ratios under certain loads. The emission characteristics were also studied and levels of carbon dioxide, carbon monoxide, nitric oxide and hydrocarbons were found to be higher than pure diesel. The emissions of smoke, hydro carbon and nitrogen oxides of dual biodiesel blends were higher than that of diesel. But the exhaust gas temperature for dual biodiesel blends was lower than diesel.

Keywords: *Karanja oil, Performance analysis, Biodiesel, Emission analysis*

1.0 Introduction:

The internal combustion engines have become an important part of the fulfilment of the human needs. Propulsion of the world has become impossible without internal combustion engines for the past few decades. Automotive propulsion, the supply of motion to the machinery heavy and decentralized power generation are the chief applications of internal combustion engines. The conventional running of internal combustion demands petroleum products such as Diesel, petrol, Gasoline etc., as fuels. The combustions products and the residues of the engine combustion allowed into the atmosphere are leaving adverse effects on the human health and the environment. Many types of research and are being conducted to find the solution for the reduction of the internal combustion engine pollutants. Biogas can be produced by anaerobic digestion with anaerobic organisms, which digest material inside a closed system, or fermentation of biodegradable materials. Biogas is primarily methane (CH_4) and carbon dioxide (CO_2) and may have small amounts of hydrogen sulphide (H_2S), moisture and siloxanes.

Karanja Oil

Karanja Oil or Pongamia oil is derived from the seeds of the Millettia. Pinnata tree is native to tropical and temperate Asia. Millettia pinnata is native to South and Southeast Asia. Known in various languages as Indian beech, Pongam, Karanja, Honge, Kanuga, and Naktamala, it is now grown all over the world. Typically the plant starts yielding pods from the fifth year on with the yields increasing each year until it stabilizes around the tenth year.

2.0 Literature Review

Melton, R.B. Jr et al (1975) A study was conducted on the feasibility of totally cooling a single-cylinder diesel engine by direct injection of water into the combustion chamber. The term "total cooling" can be taken to mean stabilized cooling at all loads and speeds so as to eliminate need for conventional cooling jackets, cooling fins, or oil spray jets. The engine used was a CLR Direct Injection Diesel with 42.5 cubic inch displacement and a compression ratio of 16:1. Most of the running was at 1800 rpm and 92 psi IMEP.Separate measurements were made of heat rejection to the cylinder head, liner, and crank-case oil to determine more accurately where the cooling effect was being applied. Water injection was by means of a Bosch pump and various pencil-type nozzles installed, adjacent to the fuel injector in the cylinder head. Port injection and port induction were also briefly investigated.

Dennis Y.C Leung, (August 2001) All fuel usage produces air pollutants, causing local and trans-boundary air pollution and acid rain problems. Biodiesel is a clean renewable fuel with properties similar to diesel but produced from renewable resources such as vegetable oils and animal fats. Although this fuel has been developed some two to three decades ago, it is not commonly used, mainly due to the higher production cost involved. Due to the increasing concern on environmental protection, a lot of researches on the usage of this fuel are conducted in recent years. To study the characteristics of this fuel, a special biodiesel fuel is produced using waste cooking oil and animal fat from restaurants as feedstock. Reusing of these wastes has both the benefit of producing a cleaner fuel and waste cycling. Tests of the fuel with different proportions of diesel have been conducted on various diesel engines and the results obtained are encouraging. The environmental benefits and suitability of this fuel to Hong Kong to reduce air pollution problems are discussed based on the assessment results.

Papagiannakis, R.G et al (February 2003), During the last years a great effort has been made to reduce pollutant emissions from direct injection (DI) diesel engines. Towards this, engineers have proposed various solutions, one of which is the use of gaseous fuels as a supplement for liquid diesel fuel. These engines, which use conventional diesel fuel and gaseous fuel, are referred to as dual fuel engines. The main aspiration from the usage of dual fuel (liquid and gaseous one) combustion systems is mainly to reduce particulate emissions and nitrogen oxides. One of the gaseous fuels used is natural gas, which has a relatively high auto ignition temperature and moreover is an economical and clean burning fuel. The high auto ignition temperature of natural gas is a serious advantage against other gaseous fuels since the compression ratio of most conventional DI diesel engines can be maintained. Moreover the combustion of natural gas produces practically no particulates since natural gas contains less dissolved impurities (e.g. sulfur compounds).The present contribution is mainly concerned, with an experimental investigation of the characteristics of dual fuel operation when liquid diesel is partially replaced with natural gas under ambient intake temperature in a DI diesel engine. Results are given revealing the effect of liquid fuel percentage replacement by natural gas on engine performance and emissions.

Rahul Chandra et al (2013) An experimental investigation was carried out on a single cylinder compression ignition engine to find out the emissions variation

with change in amount substitution of Compressed Natural gas under duel fuel mode with diesel as pilot fuel. The emissions such as CO, NOx, CO2 & UBHC values were compared with that of normal diesel and at various substitutions of CNG. CNG was sent into the engine through induction in various percentages such as 2.5, 5,7.5,9 lpms. The NOX emissions at different brake powers. As shown the NOx emissions decreases with increase in the CNG substitution in the diesel. At peak load the decrease in the NOx was detected as 15.2%. The trend of emission. The HC emissions at different brake powers. As shown the HC emissions increases with decrease in the CNG substitution in the diesel. At peak load the in the HC was detected as 12.2%. The CO emissions at different brake powers. As shown the CO emissions with in the CNG substitution in the diesel. At peak load the in the CO was detected as 20%. The volumetric efficiency is been decreasing with increasing substitution of CNG. This is because of the lower density gas is obstructing the air inflow.

Mudssar M. Bagwan et al (2015) to study effect of exhaust gas recirculation system on engine performance and emission. EGR system is designed and then fabricated by considering specification of engine. Single cylinder four stroke computerised diesel engine is selected for design. Theoretical study is carried out to design EGR system. At successful completion of design work it is expected that developed EGR system will work effectively.

Rajesh Kumar, B et al (2016) Iso-butanol is a second generation biofuel that has the potential to improve energy security and mitigate harmful pollutants in reciprocating engines. The present study investigates the effect of iso-butanol addition to diesel fuel on performance and emissions of a single cylinder direct-injection diesel engine with exhaust gas recirculation (EGR). For this objective, four iso-butanol/diesel blends containing 10%, 20%, 30%, and 40% were prepared by volume basis and tested in the engine under three EGR rates: 10% to 30% (at increments of 10%) with the combination of two injection timings: 23 and 21 crank angle (CA) before top dead center (bTDC). Experimental results showed that the combination of 30% EGR rate, 40% iso-butanol addition (ISB40) and retarded injection timing by 2 CA bTDC simultaneously reduced NOx emissions from 1284 to 749 ppm and smoke opacity from 20.7% to 1.9% with a slight drop in performance. It was found that higher iso-butanol/diesel blends require higher EGR levels to attain optimum levels of smoke and NOx emissions. Both hydrocarbon (HC) and carbon-monoxide (CO) emissions presented an increasing trend at escalating EGR rates.

3.0 EXPERIMENTALMETHODOLOY AND EXPERIMNTAL SETUP

According to the objectives of the present work motioned in the chapter 2 the experimental setup need to have the following additional provisions apart from the basic functions of a basic engine test rig.

1. Variable compression ratio.
2. Variable injection pressure.
3. Provision to induce gaseous fuel as the present experiment requires CNG to induce in the combustion chamber.
4. Compatibility to work on bio-fuels.
5. Exhaust gas Re-circulation

Experimental Set-up

The present experimental set up has all the provisions that are mentioned in the above requirements.

Each of the equipments and systems in the test rig is as mentioned below;

Fig.3.1: Overall engine set up

4.0 oil preparation:

Karanja Oil:

Karanja oil is derives from the seeds of Pongamia pinnata tree, is common throughout India. Karanja is a legume tree that grown to about 15-25 meters in height with a large canopy which spreads equally wide. Flowering starts generally after 3- 4 years

Karanja Oil Extraction:

Karanja seeds were collected from local market. Two methods were adopted for extraction of karanja oil from kernel. By mechanical extraction method these karanja seeds were mechanically processed by using mechanical Expeller to extract oil followed by filtration.

Karanja oil is toxic and having disagreeable taste and odor due to flavonoid constituents. Oil made from the seeds has been used as lamp oil, in soap making, and as a lubricant. Karanja oil is composed of the following fatty acids listed in Table

FATTY ACID % IN KARANGA OIL

Sl.No	Fatty Acid	%
1	Palmitic	3.7-7.9
2	Stearic	2.4-8.9
3	Oleic	44.5-71.3
4	Linoleic	10.8-18.3
5	Lignoceric	1.1-3.5
6	Eicosenoic	9.5-12.4
7	Arachidic	2.2-4.7
8	Behenic	4.2-5.3

Karanja Tree, Seeds and Oil

Apparatus used for Karanja oil extraction

Experiments were conducted by using 20% of blended vegetable oils i.e. 20% filtered karanja vegetable oil mixed with 80% diesel by volume. The other form was preheated filtered karanja vegetable oil after analyzing its fuel properties.

PROPERTIES OF KARANJA OIL:

Fuel Blend	Calorific Value (Mj/Kg)	Flash Point (0 C)	Fire Point (0 C)	Kinematic Viscosity (cSt) at 400 C	Specific gravity
Diesel	43.40	64	75	2.9	0.828
Karanja Oil	38.0	210	219	28.3	0.914
10% of karanja oil blend	42.80	83	90	3.94	0.838
20% of karanja oil blend	42.20	112	120	8.0	0.841

Preheated oil at 1300 C	38.00	-	-	4.2	0.835

The Physical and Chemical properties of Karanja oil and its blends used for the engine testing were determined according to ASTM methods at the Renewable Energy Laboratory of Odisha University of Agriculture and Technology (OUAT), Bhubaneswar. The various instrument used for determining the properties were Hydrometer for density, Red wood Viscometer for Kinetic viscosity, Pensky-Martens closed cup tester for flash point and Bomb Calorimeter for Calorific Value etc are shown

Effect of Temperature on Viscosity of Karanja Oil:

The kinematic viscosity of karanja oil was found 28.3 cSt at 400 C, which was not acceptable for a diesel engine. The higher viscosity of karnja will leads to oil ring sticking, thickening of lubricating oil, causes an increased mechanical stress on fuel and injection pumps and impacts the fuel delivery characteristics as a result incomplete fuel combustion and carbon deposition on the valve seat and injector which caused chocking of injectors

Conclusions

The significant conclusions are drawn after the analysis of the results of the four cases. The effect on the various performance parameters such as Brake thermal efficiency, volumetric efficiency and BSFC, emissions such as oxides of carbon, oxides of Nitrogen, un-used Oxygen and un-burnt hydrocarbons are measured and compared on running conditions of various Karanja blends in Diesel, CNG induction proportions into the engine, varying fuel injection pressures and compression ratios are to the grounds are given as below.

- The blends of karanja in the diesel under standard conditions have shown distinct performances at various loads, B20 has stood best of all the other blends with the brake thermal efficiency and BSFC equal to that of pure diesel.
- Majority of blends under majority of running conditions have shown least effect on the emissions except on the oxides of Nitrogen.
- The variation of injection pressures has shown a significant effect on all the performance parameters. The fall in the performance is noted under the increasing injection pressures, all the performance parameters are affected by the injection pressures.

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