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A Review on Performance of the IC Engine Using Alternative Fuels

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Abstract--- *The internal combustion (IC) engine is a heat engine that converts chemical energy into mechanical energy, usually made available on a rotating output shaft. Chemical energy of the fuel is first converted to thermal energy by means of combustion or oxidation with air inside the engine. This thermal energy raises the temperature and pressure of the gases within the engine, and the high pressure gas then expands against the mechanisms of the engine. This expansion is converted by the mechanical linkages of the engine to a rotating crankshaft, which is the output of the engine. The crankshaft, in turn, is connected to a transmission and/or power train to transmit the rotating mechanical energy to the desired final use. For engines this will often be the propulsion of a vehicle. Previous work has concentrated on the engine performance using the different alternative fuel for a particular time period. This period considered for testing the engine performance cannot be compared with actual running of the for the specified life of Automobile. From the published literature it is clearly observed that the effect of using alternative fuel on the design and life and the efficiency on IC engine parts like combustion chamber, liner, piston, piston rings are not addressed. Here an attempt is made to design and develop IC engine parts that are most suitable for alternate fuels that last longer without affecting the performance of the Engine. Some of the results presented are the indication of the scope for considering this research work to be done in detail.*

Keywords--- *Alternative Fuel, Combustion chamber, Piston and Piston Rings, Cylinder Liner 1.*

I. INTRODUCTION

1.1. Internal Combustion Engines

Internal combustion engines are seen every day in automobiles, trucks, and buses. The name internal combustion refers also to gas turbines except that the name is usually applied to reciprocating internal combustion (I.C.) engines like the ones found in everyday automobiles. There are basically two types of I.C. ignition engines, those which need a spark plug, and those that rely on compression of a fluid. Spark ignition engines take a mixture of fuel and air, compress it, and ignite it using a spark plug. Fig 1 shows a piston and some of its basic components. The name `reciprocating' is given because of the motion that the crank mechanism goes through. The piston- cylinder engine is basically a crank-slider mechanism, where the slider is the piston in this case. The piston is moved up and down by the rotary motion of the two arms or links. The crankshaft rotates which makes the two links rotate. The piston is encapsulated within a combustion chamber. The bore is the diameter of the chamber. The valves on top represent induction and exhaust valve necessary for the intake of an air-fuel mixture and exhaust of chamber residuals

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1.1.1 Parts of the Engine Block

- Cylinder – the part of the engine block where the combustion takes place.
- Piston – a plunger with rings that fit against the inside cylinder walls and prevent air from leaking past
- Connecting rod – connects the piston to the crankshaft. Fastened by the wrist pin
- Crankshaft – shaft with offsets to which the connecting rods are attached

1.2. Alternative Fuel

The large increase in number of automobiles in recent years has resulted in great demand for petroleum products. With crude oil reserves estimated to last only for few decades, there has been an active search for alternate fuels. The depletion of crude oil would cause a major impact on the transportation sector. Of the various alternate fuels under consideration, biodiesel, derived from vegetable oils, is the most promising alternative fuel to conventional diesel fuel (derived from fossil fuels; hereafter just "diesel") due to the following reasons

- Biodiesel can be used in existing engines without any modifications.
- Biodiesel is made entirely from vegetable sources; it does not contain any sulfur, aromatic hydrocarbons, metals or crude oil residues.
- Biodiesel is an oxygenated fuel; emissions of carbon monoxide and soot tend to be reduced compared to conventional diesel fuel.
- Unlike fossil fuels, the use of biodiesel does not contribute to global warming as CO2 emitted is once again absorbed by the plants grown for vegetable oil/biodiesel production. Thus CO2 balance is maintained.
- The Occupational Safety and Health Administration classify biodiesel as a non-flammable liquid.
- The use of biodiesel can extend the life of diesel engines because it is more lubricating than petroleum diesel fuel.
- Biodiesel is produced from renewable vegetable oils/animal fats and hence improves fuel or energy security and economy independence.

A lot of research work has been carried out using vegetable oil both in its neat form and modified form. Studies have shown that the usage of vegetable oils in neat form is possible but not preferable. The high viscosity of vegetable oils and the low volatility affects the atomization and spray pattern of fuel, leading to incomplete combustion and severe carbon deposits, injector choking and piston ring sticking. Methods such as blending with.

A large number of studies on performance, combustion and emission using raw vegetable oils and methyl/ethyl esters of sunflower oil, rice bran oil, palm oil, mahua oil, jatropha oil, karanja oil, soybean oil, rapeseed oil and rubber seed oil have been carried out on Compression Ignition(CI) engines. The purpose of this paper is to review previous studies that look into the effect of bio-diesel on CI engine from the viewpoint of performance, combustion and emissions.

II. PRODUCTION OF BIODIESEL

Vegetable oils are chemically complex esters of fatty acids. These are the fats naturally present in oil seeds, and known as tri-glycerides of fatty acids. The molecular weight of these tri-glycerides would be of order of 800

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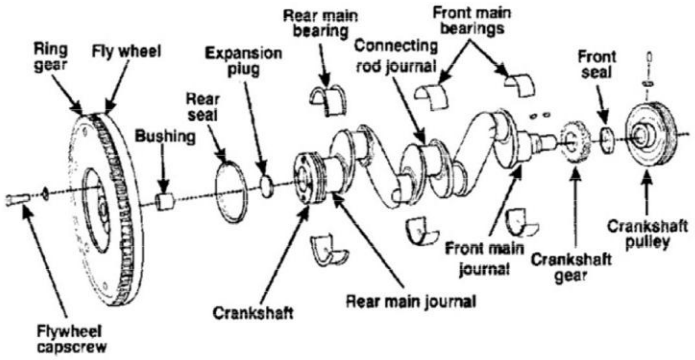
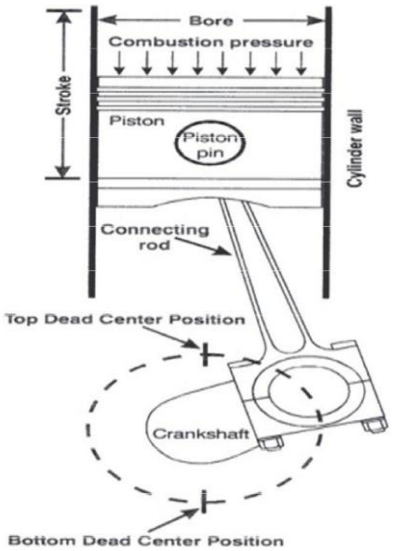
kg/m3or more. Because of their high molecular weights these fats have high viscosity causing major problems in their use as fuels in CI engines. These molecules have to be split into simpler molecules so that they have viscosity and other properties comparable to standard diesel oils. Modifying the vegetable oils (to make them lighter) can be achieved in many ways, including; Pyrolysis, Micro emulsification, Dilution and Transesterification. Among these, transesterification is the most commonly used commercial process to produce clean and environmentally friendly light vegetable oil fuel i.e. biodiesel.

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 known as Transesterification. The triglycerides are reacted with a suitable alcohol (Methyl, Ethyl, or others) in the presence of a catalyst under a controlled temperature for a given length of time. The final products are Alkyl esters and Glycerin. The Alkyl esters, having favorable properties as fuels for use in CI engines, are the main product and the Glycerin, is a by-product.





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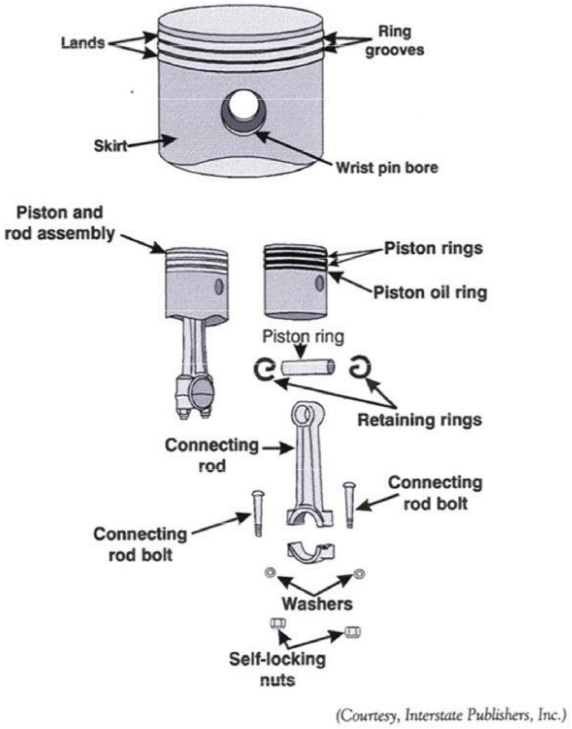

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III. LITERATURE SURVEY

Wang Wenzhong, HU Yuanzhong, WANG Hui & LIU Yuchuan[1] they have found that Piston and piston ring lubrication is a factor that strongly affects the performance of the reciprocating internal combustion engine. Their work is based on a unified numerical ap- proach assuming that the pressure distribution obeys Reynolds equation in hydrodynamic lubrication regions while in asperities contact regions, the contact pressure can be obtained through the so-called reduced Reynolds equation.

Arka Ghosh [2] has worked on the essentials of combustion chamber, their design, influence in combustion process, timing, etc. They emphasize research on newer designs requirement for combustion chambers.

Balvinder Budania1and Virender Bishnoi [3] developed „A New Concept of I.C. Engine with Homogeneous Combustion in a Porous Medium". They have proposed a new combustion concept that fulfils all requirements to perform homogeneous combustion in I.C. engines using the Porous Medium Combustion Engine, called "PM - engine".

S. Jaichandar and K. Annamalai [4], have discussed the effect of use of biodiesel fuel on engine power, fuel consumption and thermal efficiency are collected and analyzed with that of conventional diesel fuel.

Maro JELIĆ and Neven NINIĆ [5], have discussed the „Analysis of Internal Combustion Engine Thermodynamic Using the Second Law of Thermodynamic". They applyed the numerical simulations in modeling the ICE engine processes together with the analysis by the second law of thermodynamics, they got a very potent tool for better insight and optimization of spark- and compression-ignition engines achieving lower fuel consumption and lower emissions.

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IV. Outcome Of Literature Survey And Scope For Present Work

Previous work has concentrated on the engine performance using the different alternative fuel and from the published literature it is clearly observed that the effect of using alternative fuel on the design and life and the efficiency on IC engine parts like combustion chamber, piston, piston rings are not addressed.

It is observed that by using the alternative fuel gum or wax is formed in the fuel tank after long period. This wax will mix with he fuel and effect the IC engine performance. This problem is not exist in the regular fuel (diesel).

- Using Alternative fuel, the Combustion chamber redesign that includes the position of injector and valve is to be optimized.

V. Methodology

- Performance and the operation characteristics of the IC engine choosen is conducted with desired and results are plotted.
- The above procedure is repeated with the most efficient alternative fuel and the results are plotted and compared
- In both the cases the study on effect of fuel on the behaviour/performance of the combustion chamber, piston, piston rings, cylinder wall are carried out.
- The performance study of the above includes tribological and geometrical behaviour like wear and tear, cylinder liner, ovality of cylinder liner.

VI. Expected Outcomes

- The wear and tear of piston rings and liner is expected to be more when compared with the engine using Diesel as a fuel. This leads to more fuel consumption and may demand for reboring of cylinder at the early stages.
- The above situation demands for newer material for piston, piston rings, liner which are compatible for Alternative fuel.

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