Experimental Investigation of Biodiesel with Diesel

Mr. Naveen B
Assistant Professor,
Sahyadri College of Engineering & Management,

Mr. Lawrence J Fernandes
Assistant Professor,
Sahyadri College of Engineering & Management,

Mr. Vikas G
Assistant Professor,
Sahyadri College of Engineering & Management,

Mr. Praveen R
Assistant Professor,
PES Institute of Technology & Management,

Abstract — In the recent past, intensive studies on internal combustion engines has emerged with a view to obtaining higher rate of production of fuels from alternative sources. The increase in alternative fuel investigations is caused by two main factors; a rapid decrease in world petroleum reserves and important environmental concerns originating from exhaust emissions. Fast depletion of the viable alternative fuels. Diesel fuel is largely consumed by the transportation sector. Thermodynamic tests based on the engine performance evaluations have established the feasibility of using vegetable oils. It has been found that vegetable oils hold special promise in this regard, because they can be produced from the plants grown in rural areas. Vegetable oils from crops such as soya bean, peanut, sunflower, rape, palm, coconut, karanja, neem, cotton, mustard, jatropha, linseed and caster have been evaluated in many parts of the world in comparison with other non-edible oils. To solve energy and environmental concerns, the renewable energy with lower environmental pollution impact should be necessary. Hence, it is imperative to look for alternative fuels, which can be produced from the resources that are available within the country. Today, most of the energy demand in India is met by fossil fuels. As India is an agricultural country, there is a wide scope for the production of vegetable oils (both edible and non-edible) from different sources.

Keywords — Soya Bean, Peanut, Sunflower, Rape, Palm, Coconut, Karanja, Neem, Cotton, Mustard, Jatropha, Linseed and Caster

INTRODUCTION:
The internal combustion engine is an engine in which the combustion of a fuel (normally a fossil fuel) occurs with an oxidizer (usually air) in a combustion chamber that is an integral part of the working fluid flow circuit. In an internal combustion engine, the expansion of the high temperature and high pressure gases produced by combustion apply direct force to some component of the engine. This force is transferred to crankshaft through connecting rod, transforming chemical energy into useful mechanical energy. Diesel engines are the best for power plants today because of their high thermal efficiency, good torque characteristics and ability to cater to a wide range of applications. In India, majority of the power plants for heavy transportation, agriculture as well as industries use diesel engines and hence the consumption of diesel is almost six times higher than that of petrol. The cost of diesel is going up in an uncontrollable way and so is the cost of transportation. Costs of transportation affect the price of all commodities and in turn the economic progress of the country. A nation’s development is strongly dependant on the availability of fuels for transportation, agriculture and power generation. Thus, India, like many developing countries faces the major challenge of meeting the high demand for oil. Only by using the renewable sources of fuel with clean combustion, we can reduce emissions and also the dependence on conventional petroleum sources. Therefore, there is a need to stimulate the use of renewable energy sources to increase the rate of economic growth and national development. This is particularly significant for a country like India with plenty of wastelands where plants to produce bio-fuels can be cultivated. This activity also will generate employment for the poor. If the energy need of rural areas can be met by locally available fuels, then the problem of large imports of crude oil can be eased out a little. Fuels suitable for rural applications should have the capability to be used with little processing. Several alternative fuels are being considered for use in engines. The potential alternatives fuels are gaseous fuels and liquid fuels.

In the year 1892, compression ignition engine was introduced by RUDOLFDIESEL (1858-1913) a German engineer born in Paris. Here, compression of air alone to sufficiently high temperature ignited the fuel without the help of ignition systems. Today CI engine is a very important prime mover, being used in buses, trucks, locomotives, tractors, pumping sets and other stationary industrial applications, small and medium electric generation and marine propulsion.

The importance of CI engine is due to:-
I. Its higher thermal efficiency than SI engines
II. CI engines fuels (diesel oils) being less expensive than SI engine fuels (petrol).

Furthermore, since CI engines fuels have a higher specific gravity than petrol, and since fuel is sold on volume basis (liters) and not on mass basis (kg), more kg of fuel per liter are obtained in purchasing CI engine fuels.

EMISSIONS:

Automobile is a major contribution to air pollution in most of the industrialized nations according to the survey conducted in the present atmosphere. The air we breathe is proven to be unhealthy, the various emission from the automobile exhaust like CO, HC, NOX, particulate matters,
SOOT etc., are highly harmful for human health, apart from that, animals and plants are also facing a negative impact by emission caused by automobiles. Automobile exhaust emission has also actively participation in increasing global warming. Internal combustion engines generate undesirable emissions during the combustion process. In this, both SI and CI engines are equally responsible for the same. The emissions exhausted into the surroundings pollute the atmosphere and causes the following problems

i. Global warming
ii. Acid rain
iii. Smog
iv. Odour
v. Respiratory and Health hazards.

Some alternate fuels are cleaner burning than gasoline and diesel and even produce less tailpipe emission. For example, a light-duty natural gas vehicle can produce 80 present fewer tailpipe emissions than a gasoline vehicle. A light-duty propane vehicle can produces 60 per cent fewer harmful emissions than its gasoline counterpart. Electric Vehicles (EVs) are classified as zero emission vehicles because they produce no tailpipe or evaporative emission: however electricity generation usually creates emissions.

ALTERNATIVE FUELS:
Alternative fuel is any material or substance, other than petroleum, which is consumed to provide energy to power an engine. Alternative fuels are bio-diesel, ethanol, chemically stored electricity, hydrogen, methanol, Natural gas, wood and vegetable oil. The increase in industrialization and materialization of the world led to step rise in the demand of petroleum products. Petroleum based fuels are extracted from earth crust and hence their reserve is limited and are irreplacable. With our present known reserves and the growing rate of fuel consumption, it is feared that they will be exhausted soon. These finite resources of petroleum are highly concentrated in certain regions of the world and have given rise to frequent disruption and uncertainties in its supply and price as well.

According to the estimate of the oil and gas journal, crude oil production is exited to reach a peak somewhere between 2010 and 2015 and from then it is eventually going to decrease. With this, crude oil will be expensive progressively until it becomes unaffordable while enforcing pressure on the import bill and increasing the import. Thus we need to look at other options as far as energy need is concerned.

Alternative propulsion can be categorized into:
Gasoline bio-fuels
- Butane as a direct replacement for gasoline.
- Ethanol or mixture with gasoline.
- Methanol or mixture with gasoline.

Diesel bio-fuels
- Straight vegetable oils.
- Ethanol as mixture with diesel
- Methanol as mixture with diesel.

Gaseous fuels
- Natural gas compressed
- Liquefied Petroleum Gas (LPG)
- Bio-gas

Alternative fuels for IC Engines:
The fuel used in C.I. Engines primarily diesel, which is a petroleum fraction, which lies between kerosene and lubricating oil. Cetane rating is very important factor diesel fuel as it is the measure of auto ignition of the fuel that is supposed to auto ignites inside the combustion chamber due to temperature rise with the compression of air in C.I. engine.

Some of the alternate fuels that can be used in C.I Engines are:

Hydrogen:
It can be produced from water using non-fossil energy sources such as nuclear and solar energy. It is referred as cleanest burning fuel. Hydrogen has an ignition temperature of 585 °C, so duel fuel mode of hydrogen and diesel is suggested. Hydrogen in combustion produces only water and NOX emission whose toxic effects are less in comparison to the obnoxious contents of other fuels. The difficulty in using hydrogen in CI engines is due to its high ignition point. Therefore by addition of ignition improvement additives it can be used as an alternative fuel.

Biogas:
The biogas can be used in CI engines as a duel fuel and improve engine performance. The biogas can be introduced in the engine with air during induction smoke and small quantity of diesel towards the end of compression to initiate the combustion of gas air mixture. The reduction of diesel in the engine would reduce the smoke in the engine exhaust and power would be brought up to full rating by the introduction of gaseous fuel into the intake air when biogas in used, as fuel external means is required to initiate combustion. Biogas is produced by the degradation of biological matter by the anaerobic bacteria’s in the absence of free oxygen. Biogas is mainly used in rural areas to run small stationary engines in duel fuel mode. Cow dung when subjected to the action of micro-organisms in closed tank under anaerobic conditions, undergoes fermentations. As a result go bar gas is produced, this mixture of methane, carbon dioxide and minute quantities of other gases.

Vegetable Oil:
Vegetable oils have a promising future as diesel substitute. The lot of work is going on in different countries on different types of vegetable oils, which can be used in those countries as per availabilities. Vegetable oils have better ignition qualities than light alcohols, their cetane number over 30. Vegetable oil is mainly of two types edible and non-edible oils. Edible oils are those, which are used for cooking purpose some of them are sunflower oils, palm oils, peanut oil, linseed oil, coconut oil, rapeseed oil etc. non edible oils, which are used for some specific purposes, like medicine, dyes etc. Some of these are neem oil, honge oil, jatropha oil etc.
Alcohols:
Alcohols have been used as engine fuels for long. Both ethanol as well as methanol is now used as an automobile fuels. Alcohols have high-knocking rating, due to which they especially methanol, have been in racing car engines. Besides, methanol is also safer than petrol in the event of accidental fire, since it burns cooler. However there are few disadvantages:

Flame if methanol fire is difficult to be seen in daylight, due to which it may not be detected immediately.

Methanol contains about half the energy than petrol per litres, which means lesser kilometer per liter, due to which the fuel tank for larger size has to be used to keep the same range as that with diesel.

Corrosion of rubber, magnesium and aluminum parts occur to higher ethanol percentages.

Ethanol is electrically conducting, whereas petrol is insulating effectively. This can cause problems with some electric fuel pumps and fuel tank sensors.

Compressed Natural Gas (CNG):
CNG has distinct technical, economic and ecological advantage over conventional fuels, which makes it an excellent automotive fuel. CNG has higher auto ignition temperature so a duel fuel mode of operation could be used with the diesel as pilot fuel. The natural gas is composed of methane, ethane, and propane. CNG is stored in specially designed cylinders under pressure because CNG basically is a natural gas which compressed by a compressor so that more energy can be packed in a cylinder for storage.

Synthetic Hydrocarbons:
The use of these fuels is more concerned with power generation than IC engines. This is because transportation of coal from coalfield to the point of uses it differently and costly whereas the gas or liquid from coal is easier to transport several processes are available to convert coal into liquid and gaseous fuels. Some of these are coal gasification and coal liquefaction.

Objectives of Paper:
From the literature view it came to know that so many authors done so many researches on different biodiesels. And they extracted individually and carried experiment for single biodiesel blends, and thereafter they compare the results of different blends and gave the conclusion. But here in this report the performance and emission characteristics on CI engine comparison work carried out for different Biodiesels. For the comparison particularly choose and familiar Biodiesels they are PONGAMIA Biodiesel and SIMAROUBA Biodiesel. This work mainly carried with two things for study, Performance and Emission characteristics, for different Biodiesels of their blends and Different loads conditions.

Some objectives behind the work:
- Optimization of process for maximum biodiesel production.
- Determine fuel properties of selected biodiesels.
- Determine the properties of different blends of biodiesel derived from different sources.
- Test is conducted by varying load and maintaining constant speed.
- Performance analysis of a C.I engine using Pongamia and Simarouba biodiesels and diesel as fuel.
- Comparison of emission parameter of a C.I engine using both pure commercial diesel and Pongamia and Simarouba biodiesel blends.

Why Pongamia pinnata?: Due to pressure on edible oils like groundnut, rapeseed, mustard and soybean etc. non-edible oil of jatropha curcas and karanja (Pongamia pinnata) are evaluated as diesel fuel extender. Pongamia pinnata is a species of family Leguminasae, native in tropical and temperate Asia including part of India, China, Japan, Malaysia, Australia. Commonly it is called as karanja (in MS), pongam (in Gujarat).

Blends of Biodiesel:
Blends of biodiesel and conventional hydrocarbon-based diesel are products most commonly distributed for use in the retail diesel fuel marketplace. Much of the world uses a system known as the "B" factor to state the amount of biodiesel in any fuel mix. 100% biodiesel is referred to as B100, While 20% biodiesel, 80% Diesel is labelled B20, 40% biodiesel, 60% Diesel is labelled B40, 60% biodiesel, 40% Diesel is labelled B60, 80% biodiesel, 20% Diesel is labelled B80.
The variation of fuel consumption with brake power for different blends of biodiesel and neat diesel are shown in above figure at constant speed. It was observed that consumption of fuel increases with the increase of brake power. The diesel fuel consumption was less in all load conditions due to the high calorific value of diesel than the biodiesel blends.

For B20 pongamia biodiesel blend fuel consumption was slightly approaching neat diesel fuel.

The specific fuel consumption for Simarouba biodiesel blends are showing less. But the blends of Pongamia biodiesel are near to commercial diesel.

All blends of Simarouba biodiesel are showing less production of the Monoxide gas. The hydrocarbon emission of B20 and B60 Simarouba biodiesel and B40 and B80 Pongamia biodiesels are showing results as less production of HC emissions. Simarouba B20 and B80 blends and Pongamia B40 and B60 producing more NOx emission.

So it can conclude that can promote the production and usage of both biodiesels as substitute fuels.

### PROJECT ANALYSIS:

The major advantage of using Pongamia and Simarouba seeds as a primary raw material is that it is highly economical. The Pongamia and Simarouba seeds which plenty available in nature, then there is no problem of raw materials. The Pongamia and Simarouba seeds are available 3 months in a year, and we can store the seeds as long time. Country like India there so many types of seeds available in nature, in that as comparably Pongamia and Simarouba

### RESULTS AND DISCUSSION:

<table>
<thead>
<tr>
<th>Properties</th>
<th>Pongamia Biodiesel</th>
<th>Simarouba Biodiesel</th>
<th>Diesel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific Gravity at (at 15°C)</td>
<td>0.899</td>
<td>0.875</td>
<td>0.834</td>
</tr>
<tr>
<td>Calorific Value (kJ/kg)</td>
<td>38119</td>
<td>38233</td>
<td>42707</td>
</tr>
</tbody>
</table>

**Graph number 1: Variation of fuel consumption with brake power for B80 blend of both biodiesels**

**Graph number 2: Variation of BSFC with brake power for B80 blend of both biodiesels**

**Variation of BSFC with brake power for B80 blend of both biodiesels**

The variation of brake specific fuel consumption with brake power for different blends of pongamia and simarouba biodiesels and neat diesel are shown in above figures at constant speed. From graph it is observed that the specific fuel consumptions decreased with the increase of brake power. The specific fuel consumption of biodiesel blends is higher than the neat diesel in all load conditions due to high viscosity of the biodiesel blends. The specific fuel consumption for Simarouba biodiesel blends are showing less. But the blends of Pongamia biodiesel are near to commercial diesel.

### CONCLUSIONS:

Experiment was conducted on single cylinder four stroke water cooled diesel engine by using diesel and different blends of Pongamia and Simarouba biodiesels. Here experimental study of performance and emission for Pongamia and Simarouba biodiesels is compared with diesel fuel on diesel engine.

**The study led to the following conclusions:**

It was observed that with the increase of the load brake thermal efficiency increase in all cases. All Simarouba biodiesel blends are showing good results for Brake thermal efficiency. BTE characteristics of B20 blend of both biodiesels are approaching diesel characteristics. And it is near to Pongamia biodiesel with some 5% variation.

### REFERENCE

[9]. Somashetty S S, et, al, “Production of Biodiesel from Simarouba Seeds and Performance Test on Single Cylinder Compression...