A REVIEW ON EXPERIMENTAL INVESTIGATION OF PERFORMANCE AND EMISSION CHARACTERISTICS OF VCR IN CI ENGINE USING ANNONA SQUAMOSA BASED BIODIESEL AS A FUEL

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Abstract-India is one of the top countries with respect to the increasing population. In accordance to its increasing population there is a simultaneous increase in the demand for the non-renewable resources. In order to maintain the biological balance and satisfy the needs of the increasing population a search for the alternative energy sources is must. One such path is the production of renewable resources. Keeping in view the current need of the population the current work was aimed to produce biodegradable, biodiesel obtained for the organic waste, the spent seeds. This source can be a very good utility product as there is no special investment required and additionally it can be a source of waste clearance. Here a pure laboratory protocol has been employed to extract the vegetable oil from the different non edible seeds. Here we are using custard apple seeds for preparing biodiesel.
The custard apple seed oil is characterized by the important properties of biodiesel such as density, flash point, cloud point, pour point and kinematic viscosity, ash content, carbon residue are found out and compared with that of ASTM-biodiesel standards and commercially available diesel. Diesel is the nonrenewable energy source obtained from conventional fuel which are exhaustible today or tomorrow with time. So we need inexhaustible fuel as a biodiesel in future. By producing different blends of biodiesel taking test rig on CI engine plotted graph and performance characteristics. That result shows how the custard apple biodiesel is economical and useful as compared to other sources.

Keywords-Non-edible seeds, Biodiesel, Transesterification process, Properties of biodiesel, testing of engine etc.

I. INTRODUCTION

Biodiesel is one of the alternative fuels usable in any conventional diesel engine with a little or no modification to the engine or fuel system. Increased utilization of renewable biofuels results in significant micro-economic benefits to both the urban and rural sectors. Also it results in a substantial reduction of unburned hydrocarbons, carbon monoxide and particulate matter. A renewable fuel can be derived from vegetable oils, used oils and animal fats. Biodiesel is not the same thing as raw vegetable oil; rather, it is produced by a chemical process which removes the glycerin and converts the oil into methyl esters. Biodiesel can be used in any concentration with petroleum- based diesel fuel with little or no modification to existing diesel engines. These blended fuels are referred to as "biodiesel blends", and include the percentage of biodiesel in the blend, such as B20 (20%), B40 (40%), B60 (60%), B80 (80%).[2].

As such, the situation demands for an alternate source of energy that can be used to overcome the forecasted future energy crisis. In addition to this, if the energy source is clean and renewable, it will reduce the environmental issues as well. In this quest for an alternate and renewable energy resource, scientists have come up with a variety of options among which biodiesel-diesel blends as alternative fuels has become a popular option and is gaining the attention of many researchers. This is because scientists have seen that the properties of biodiesel prepared from vegetable oils are very close to commercial diesel and thus it has a promising future as an alternative fuel for diesel engine. Biodiesel being renewable, biodegradable and green fuel can reduce our dependence on conventional/non-renewable fossil fuels as well as improve environmental quality in metro cities, urban and rural sectors by reducing obnoxious automotive/vehicular emissions. As such biodiesel has the potential to replace petroleum diesel in near future[3].
Generally, biodiesels are fatty acid esters produced from vegetable oils or animal fats through a chemical process known as transesterification. The differences in the composition and properties of biodiesels produced from soybean oil, rapeseed oil, karanja oil, jatropha oil or animal fats, from pure diesel will influence the engine performance, combustion and also the emission characteristics. The low calorific value and high viscosity of bio-fuels again tend to decrease the thermal efficiency. Biodiesel and its blend have larger cetane number than that of diesel, resulting in earlier combustion. Due to this difference in cetane number, the use of biodiesels decreases the ignition delay period compared to pure diesel[1].The higher cetane number and the reduced ignition delay for the biodiesels tend to increase the in cylinder pressure. The higher oxygen content in biodiesels, leading to improved combustion may be another reason

for this. In comparison with conventional diesel fuels, biodiesels promote more complete combustion and thus effectively reduce emissions of particulate matter (PM), carbon monoxide (CO) and smoke. However, the use of biodiesel increases the content of NOx in the combustion products. The simulations predict performance as well as combustion and emission characteristics of the biodiesel fueled engine. Experiments have also been carried out on a double cylinder constant speed direct injection CI engine to evaluate some performance and emission parameters for comparison with the predicted results obtained from using Biodiesel [4].

A.Problem Statement

Now a day's increasing in prices and depletion of fossil fuels, creates very necessary to find out an alternative fuel (biodiesel) from non-edible oil seeds. This paper deals with the Transesterification of non-edible seeds oil (Custard apple, Karanja and Mauha oil) to obtain Fatty Acid Methyl Ester (FAME) or biodiesel by means of methanol in presence of Potassium hydroxide catalyst at 65˚C. The properties of produced biodiesels and their blends for different ratios (B10, B20, B30, B50 and B100) are comparable with each other and ASTM biodiesel standards. The produced biodiesel which is having better properties among three is tested for their use as a substitute fuel for diesel engine. Tests have been conducted on engine for different blends of biodiesel with standard diesel, at an engine speed of 1500 rpm, fixed compression ratio 17.5, fixed injection pressure of 200bar and varying brake power. The performance parameters evaluated includes brake thermal efficiency, brake specific fuel consumption, exhaust gas temperature, Carbon monoxide (CO), carbon dioxide (CO2), Hydrocarbon (HC) and oxides of nitrogen (NOx) emissions against varying Brake Power (BP)[1].In the present work, it is proposed that Experimental investigation of performance and emission characteristics of VCR CI engine using biodiesel instead of fossil fuel. Diesel is the non renewable energy source obtained from conventional fuel which are exhaustible today or tomorrow with time. So we need inexhaustible fuel as a biodiesel in future.

B.Objectives

1. Firstly we will check out, how biodiesel made from non edible sources.
2. After the checking of biodiesel making process from non edible sources we choose suitable non edible sources such as maize, lentils, lemon peel, jujube, spodelia seeds, algae, Annona squamosa etc.
3. These biofuel is used to testing of CI engine at various compression ratio.
4. These are the computerized testing.

C.Scope

Depletion of fossil fuel and serious concern of pollutions from burning of fossil fuels in internal combustion (IC) particularly petrol and diesel engines have led many researchers around the world to find suitable is renewable and because their properties are similar to diesel means that the fuel can be used in diesel engines with no or minor modifications especially with biodiesel–diesel blended fuels. Though 100% biodiesel can be used in diesel engines but the issues of loss of power and torque due to lower calorific value of biodiesel need to be considered. Being renewable, their use in diesel engines can reduce the emission of greenhouse gas CO2. Biodiesel can also reduce other harmful emissions such as carbon monoxide (CO), hydrocarbon [7].

II. BIODIESEL PREPARATION

A.Collection of the Seeds

The custard apple seeds were collected from field of Zhende Nursery, at- kalewadi (Saswad) Tal-Purandar, Dist-Pune and local field of Baramati region.

Fig.1 Custard Apple Seeds

Fig.2 Custard Apple Fruit

B.Sample Preparation

After collection, the seeds were sun dried for a week to remove moisture content. A total of 2 kilograms of dried Custard apple seeds were obtained and ground in mortar and pestle.

C.Extraction of oil (Soxhlet extraction)

A Soxhlet apparatus consisting of a Soxhlet extraction tube, reflux condenser, 500ml round bottomed flask, and heating mantel was used to extract the oil from Custard apple seed sample[6].

D.Procedure

20 grams of fully ripened custard apple seeds were taken and crushed in a mortar and pestle. Filter paper bag were made and the crushed coated seeds were filled in it. Then these bags were placed in the 'extractor' unit of Soxhlet apparatus. 300ml of hexane was taken in the round bottom flask as solvent.Condenser, extractor and the flask were then arranged in a vertical position on a heating mental.The reaction was maintained at 65˚C for number of cycles. The condenser was filled in with water and continuous water supply was maintained throughout the process. The temperature was maintained at 65°C for boiling 3 hours.After 3 hrs. Hexane with the extracted oil was taken out from the flask; and the seed sample was allowed to dry and then weighed. 50 ml of 0.1N NaOH solution was taken in the burette.10 grams of custard

apple seed oil was taken in a conical flaskand added 50ml of Isopropyl alcohol was added into the conical flask. Solution was kept on hot water bath for 2-3 minutes to allow complete dissolution of oil in alcohol.When clear solution was appeared, it was taken for titration.Phenolphthalein indicator (5-6 drops) was added.This solution was titrated against 0.1N NaOH solution until colours turns from yellow colour to permanent pink colour[6].

III.BIODIESEL TRANSESTERIFICATION PROCESS

Take 50ml of custard apple seed oil was taken in a conical flask, and heated up to 60°C. 30ml of methanol and 0.5gms of sodium hydroxide was added as catalyst. The process was run for 90minutes.Then the oil was transferred into separating funnel and allowed for separation.(7-8 hrs.). Then two layers were formed in which upper layer is 'Biodiesel and lower layer is Glycerin'. The glycerin and biodiesel was separated from each other. Then the crude biodiesel was obtained [2].

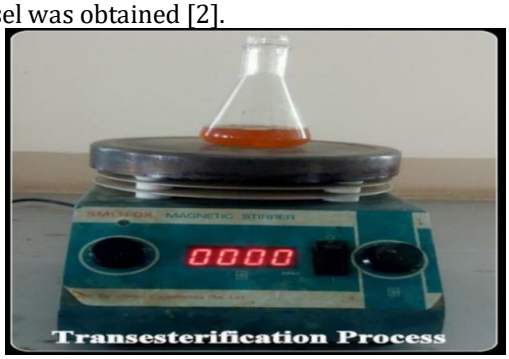

Fig.2 Transesterification Process[3]

IV.BIODIESEL PROPERTIES

A.Viscosity

Kinematic viscosity is the resistance offered by one layer of fluid over another layer. The viscosity is important in determining optimum handling storage, and operational conditions. Fuel must have suitable flow characteristics to ensure that an adequate supply reaches injectors at different operating temperatures. High viscosity can cause fuel flow problems and lead to stall out.

B.Density

A hydrometer is the instrument used to measure the specific gravity (relative density) of biodiesel. That is the ratio of the density of water. The hydrometer is made of glass and consists of a cylindrical stem and bulb weighed with mercury or lead shot to make it float upright. The hydrometer contains a paper scale inside the stem, so that the specific gravity can be read directly.

C.Flash Point

The lowest temperature at which the vapour of a combustible fuel can be made to ignite momentarily in air is identified as the flash point and correlates to ignitibility of fuel. Low flash point can indicate residual methanol remaining from the conversion process. The flash point is often used as a descriptive characteristic of liquid fuel and it is also used to characterize the fire hazards of liquids. "Flash point" refers to both flammable liquids and combustible liquids.

D.Fire point

The lowest temperature at which the vapour of a combustible fuel will continue to burn for at least 5 seconds after ignition by an open flame.At the flash point, a lower temperature a substance will ignite briefly,but vapour might not be produced at a rate to sustain the fire.

E.Calorific Value

The calorific value is the energy released in the form of heat when an hydrocarbon (fuel) undergoes complete combustion with oxygen under standard conditions. The chemical reaction is typically a hydrocarbon reacting with oxygen to form carbon dioxide, water and heat. The obtained calorific value is in range of ASTM biodiesel standards.

F.Cloud point

In the petroleum industry, cloud point refers to the temperature below witch wax in diesel or biowax in biodiesel forms a cloudy appearance. The presence of solidified waxes thickens the oil and clogs fuel filters and injectors in engines.

G.Pour point

The pour point of a liquid is the temperature below witch the liquid loses its flow characteristics. In crude oil high pour point is generally associated with a high paraffin contains.

TABLE I.PROPERTIES OF BIODIESEL (B80)

Sr.No	Properties	Units	Biodiesel Custard apple	Biodiesel Standard value
1	Kinematic viscosity@40°c	Centi-stokes	4.75	1.9-6.0
2	Density	Kg/m^3	910	870-910
3	Flash point	°C	90	130
4	Calorific value	KJ/Kg K	37510.8	37000 to 42500
5	Cloud point	°C	7	-3 to 12
6	Pour point	°C	9	-15 to 10

V.RESULT AND DISCUSSIONS

From the properties of biodiesel at different blends Custard apple has better readings shows.Custard Apple Seeds gives more amount of biodiesel than other non edible seeds. According changing of blends the properties of biodiesel changes. After that Checking properties of biodiesel take testing on CI engine. From the testing of CI engine find out its performance characteristics and emission characteristics.

V.FUTURE SCOPE

Biodiesel being more viscous than diesel may require frequent cleaning of engine components use of preheated biodiesel blends in engine may be studied. Biodiesel if used for longer time in engines cause corrosive effects studies on engine wear and corrosion due to the use of biodiesel must be carried out. Biodiesel combustion causes higher combustion and exhaust temperature. Studies must be carried out suitable engine modifications resulting in low

temperature biodiesel combustion. It must be required to improve the cold weather operation.

VI.CONCLUSIONS

In this project, we have studied the objective of Biodiesel by using the various process. From this project we have find out the new oil from the non edible seeds, 'Annona squamosa' (custard apple).We got up to 180ml of oil from custard apple seeds.We conclude that the oil from the soxhlet extraction process is more.Beacause of the mechanical extraction process has more losses. We conclude that the oil from the soxhlet extraction process is more.Beacause of the mechanical extraction process has more losses.

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