Bio-Diesel: A Coconut Oil Blend

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***Abstract*—Biofuel is the type of fuel which is being developed using the contemporary process of biology like digestion process of anaerobic and agri-product. The major difference between the biofuels and other types of fuels is in the generation process like in the case of production from the process of fossil fuels like coal, petroleum, etc. Biofuels are generated directly from the various plants and also can be indirectly from the agricultural process and also some commercial processes are also considered. The fixation of the carbon is the major consideration in the case of the renewable fuels, like considering the example of photosynthesis in plants and microalgae.Vegetable oil can also be used in many older diesel engines that do not use common rail or unit injection electronic diesel injection systems. Due to the design of the combustion chambers in indirect injection engines, these are the best engines for use with vegetable oil. This system allows the relatively larger oil molecules more time to burn.The paper considers the new biofuel where the different blends of coconut oil is being used with the diesel and tested for various efficiency and performance testing parameters.**

***Index Terms*—Biofuels, Diesel, Blends, Engine, Vegetable oils, Coconut Oil.**

I. INTRODUCTION

In the world of transportation the different diesel engine are considered as the beast part just because of the torque, robustness in construction and also the fact that the diesel engine can consider any type of oil. The general alternatives used in the diesel engines are like triglycerides like coconut oil where it burns quite rapidly. While the production of the diesel engine the facts like lowered content of acids and viscosity and other different combustion properties for the usage of the refined fuels, the engine also can go for serious damage in the case when the raw oils are used for the longer time span.

The damage in the diesel by the usage of the raw fuels is generally because of the coking and also due to the clogging of the engine parts. Coking means the engine parts filled with the carbon just due to the lack of proper combustion of the fuel. Clogging is the condition when the fuel starts to take a shape of the solid forms or liquid forms and in the case of the coconut oil it gets converted at 22-25 degree temperature. The things are less harming in the case of the winters. The production firms have gone through many preventions for not letting the fuel to be converted in gel forms like using the pre-injection heaters, in majority of the cases the production team uses the different blends of the biofuels which overcomes most of the common issues. The manufacturer sometimes say that the company is not liable for any type of warranty in the case when the engine is considered using the raw oils.

In about 2010 the worldwide production of the biofuel was 105 billion ltrs or 28 billion gallons, where a hike of 17% was recorded as compared to that of in 2009 and also the biofuel usage was around 2.7% of the total transport vehicles. The production of the ethanol reached about 86 billion ltr or 23 billion gallons in year 2010, where the USA and Brazil were at the top in the list for the production with about 90% of the total global production. European union is the largest producer of the biodiesel with a production of about 53% of the total global generation inn about 2010.By the starting of the 2011 the biofuels usage was made general in about 31 different nations and also 29 different states or provinces. The global agency of energy is hoping to achieve a target quarter of worlds demand for vehicle usage by around 2050. The generation of the biofuels have also affected the auto industry, as in Brazil about 79% of total production of the automobiles were made considering the dual fuel usage facility like bioethanol and gasoline [1].

Know a days in the research and practical part the coconut oil is one of the majorly used segment for the generation of the biofuels because of the features like cleanliness, low cost, ease in production, non-toxic and aromatic. The major usage of the coconut oil is for cooking and is also being considered as good for health and used in the products of cosmetics and also for the medication vectors. Other then the above considered usages of the coconut oil it can also be used for the production of the food products like flour, biscuits, pallets of chicken and foods related to fish and the shells and husks of the coconut having higher heating value are generally considered as fuel segment.

The coconut oil can be used as the engine oil in three different ways as under:

 DOI : 10.18231/2454-9150.2019.0553

- Using the coconut oil as the direct substitution of the engine fuel.
- Can be used in additive form with the petro-fuels.
- Can also be used as the base ingredients for the generation of the bio-fuel.

Types of Biofuels

The below enlisted types of fuels can be generated using the first, second, third or even forth generation of the biofuels. Maximum of the fuels can be generated using the two three procedure defined in different generations.

⇒ *biogas*

Biogas is being defined as methane gas which is being generated using the digestion process of anaerobic for organics. The generation of the methane can be done using the waste materials of crops and plants and also using the anaerobic digesters for the production.

⇒ *Syngas*

Syngas is the combination of the CO and hydrogen and many other hydrocarbons, in the generation process the biomass are partially combusted with a mixture of oxygen so that the mixture is not converted into the CO2 and H2O. For the partial combustion the dried biomass is being used and also considered as ptrolysed.

⇒ *Ethanol*

The fermentation of the sugar is being used for the production of the ethanol and also for the production of the propanol and butanol for which the micro organism and enzymes are being used, in the biological process other then sugar for the production starches and even the cellulos can be used.

⇒ *Other bioalcohols*

For the production of the methanol currently the renewable sources are being used, and in the coming days the generation of methanol may be transferred to biomass like biomethanol. The consideration of the production of the methanol using the biomass is technically possible but the things are just kept on hold due the issue considered by Jacob S., Gibbs and Brinsley about the stability of the generation economically. The economy of methanol is just the alternate for the economy of the hydrogen for which the natural gasses are used for production.

II. LITERATURE REVIEW

The mole ratio of methanol to oil, catalyst amount, reaction temperature and reaction time on yield of biodiesel is explained by [2]. Biodiesel is prepared by using NaOH catalyst with the mixture of soybean oil and rapeseed oil. A co-solvent hexane was added into the reactant to decrease the operational temperature to 55^0C. The yield of biodiesel was nearly 94% in 2 hours at molar ratio 5:1 and amount 0.8 wt % catalyst.

Rubber seed (Heveabrasiliensis) produces unsaturated oil that has little value and is often not recovered but could be effectively used to produce biodiesel [3]. An indigenous feedstock, kusum not reported earlier, has been successfully used for biodiesel synthesis with high yield of 95% through acid esterification followed by alkaline transesterification. Alcohol to oil molar ratio of 10:1, 50 ± 0.5 °C, 1% v/v H_2SO_4 and 1 h reaction time permitted the reduction of initial acid value (AV) from 21.30 mg KOH/g to <1 and thus high yield after alkaline transesterification. Optimum conditions for alkaline transesterification reaction were: 8:1 molar ratio, 0.7% (w/w) catalyst, 1 h and 50 ± 0.5 °C [4].

Ferric sulphate shows good activity to catalysed the FFA in WCO; it can be easily separated, reused and is low in cost. Two step processes provides simple and economic method for biodiesel production as compared to the acid catalysed process. But long reaction time and low recovery of catalyst are the disadvantages of the two- step process. In order to overcome these disadvantages, [5], used supercritical methanol in the preparation of biodiesel from WCO. The conversion time is very less and separation occurs easily due to the non- catalytic nature of the process [9].

About 49.5% conversion was obtained with WCO: canola oil blend at 1:1 [6]. Biodiesel produced from waste soybean oil gives highest yield of 72.7% at 1:1 molar ratio. The yield of biodiesel also varies according to the alcohol type used. 1-butanol < ethanol <methanol [7] is the order to increase the yield of biodiesel. Mixture of three vegetable oils including jatropha, roselle and coconut oils and WCO was used for biodiesel preparation using alkali catalysed transesterification at different ratio of vegetable oils to WCO.

[8], examine the fact of production of biodieselfrom the mixture of alkali- catalysed transesterification by these oils (vegetable oil and used cooking oil). Vegetable oils, including jatropha, roselle and coconut oils are the three kinds which are tested.The examination and optimization of the effect of cooking oil content in oil feedstock (used cooking oil/vegetable oil ratios of 0.03-0.2 v/v) on methyl ester is done. The gas chromatography (GC) determined the response of methyl ester content from each reaction condition. The ratio of most favourable used cooking oil/vegetable oil is 0.03 v/v for all the three kinds of oil feedstock. With this same ratio, the specification of methyl ester content is higher than the minimum set for Thai biodiesel (B100) from all the three kinds of biodiesel. The limit of measured properties of Vegetable oils, including jatropha, roselle and coconut oils biodiesel products must be in limit which is given by Thai standards, in which the lower viscosity of biodiesel produced from coconut-used cooking oil mixture is not included.

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III. OBJECTIVES

The objective of this project is as follows:-

1. To prepare the blends.
2. To find out the properties of blends using different test.
3. To run the IC Engine test rig on C (Coconut Oil) blends.
4. To find out performance parameters of engine run on different blends.
5. To compare the results with published data.

IV. RESEARCH METHODOLOGY

A clean bio fuel frequently usable is Coconut oil, which is comparatively cheap from all other bio oils and easy to extracts. Coconut oil also poses an aromatic and toxic quality. This oil can also be used in cooking, as well as spreads, in healthy food items and also in beauty products, and as a medication vector.The residual coconut can be used to make flour, biscuits, chicken balls and fish feed, while the envelopes, which havehigh calorific value, constitute an effective dry fuel, making the coconut coconut one of the most useful nuts [11].

As engine fuel, coconut oil can be used in three ways:

⇒ Direct alternate for petroleum diesel.
⇒ An addition to bio- diesel or petroleum diesel.

The oil characteristics comprises the substance and substantial properties of the oil like as calorific value, density, viscosity, flash point and fire point, cetane number, FFA, moisture and specific gravity. A general understanding of the several properties of waste cooking oil is essential to read their Implications in engine use, storage, handling and safety.

A. Prepare Blends

The preparation and analysis of test fuel were carried out at the department of mechanical engineering IC Engine lab Technocrats Institute of Technology Bhopal. A total three test fuels were selected for this investigation.

The test fuels selected were

⇒ 100% diesel oil

Fig. 1: Pure diesel Oil.

⇒ 10 C + 90% Diesel

Fig. 2: Coconut Oil blend (10% coconut oil + 90% Diesel).

⇒ 20 C + 80 % Diesel

Fig. 3: Coconut Oil blend (20% coconut oil + 80% Diesel).

The above three blend are receive at TIT bhopal. All blended proportion was volume based. The blended fuels did not contain any water molecule.

B. Synthesis of Biodiesel from Coconut Oil

For the transesterification [12] of coconut oil, the following steps were being followed in this work First 200 ml methanol was mixed with 150 ml (1 N) NaOH. As this is an exothermic reaction, so the mixture would get hot. Such solution is popularly known as sodium methoxide, which is so powerful base and have harmful character for skin of humans. So, higher degree of cautions should be needed to ignore skin irritation during methoxide producing.

Next, sodium methoxide was added with 1 litre of coconut oil, which was preheated about 65°C. Then the mixture was shaken then hanged for 5 minutes and give a look in the truth. After that, the mixture was left for 24 hours (it's longer, better). To obtain information about the composition of the state and the style, the combination of the bathroom elements and sofas is distinguished. The higher clear layer is composed of 100% biodiesel and concentrated lower layer from glycerine. The heaviest layer is followed by gravity by centrifugation. In this case, if you

 DOI : 10.18231/2454-9150.2019.0553

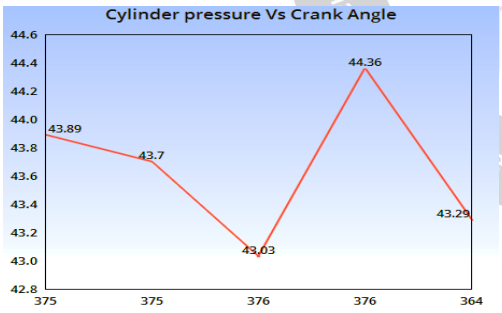
are in the kitchen area you will find impurities; it is in an ideal place for sofas. This thin layer consists of soap and other impurities. Then the biodiesel has been washed with distilled water in order to remove waste and a dry wash has been done by air-stone.

Biodiesel processed in the above process output contains moisture (evaporation at the temperature of 100°C), methanol (vaporization at the temperature of 60°C) and generally found in some soaps. If the level of soaps is low enough in between of 300-500 ppm. From the solution of soaps the soluble methanol can be separated by the evaporation process and solution of methanol will generally can be separated by passing it through dry process of direct recycling back to its reaction. Solution of Methanol acts as a co- solvent for soaps in biodiesel, this can be concluded that at higher soap levels the soap will impulsive as a thick sludge when the methanol is eliminated from it. In other way we can say that heating to the biodiesel at temperature more than of 100 °C can stand as a reason of elimination of methanol and moisture both.

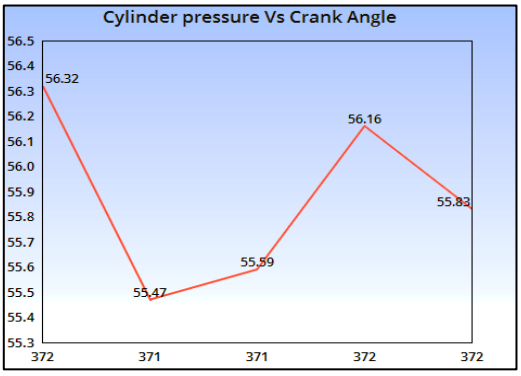
V. RESULT AND DISCUSSION

Specific Gas Const (kJ/kgK) : 1.00, Air Density (kg/m^3) : 1.17, Adiabatic Index : 1.41, Polytrophic Index : 1.26, Number Of Cycles : 10, Cylinder Pressure Reference : 7, Smoothing 2, TDC Reference : 0

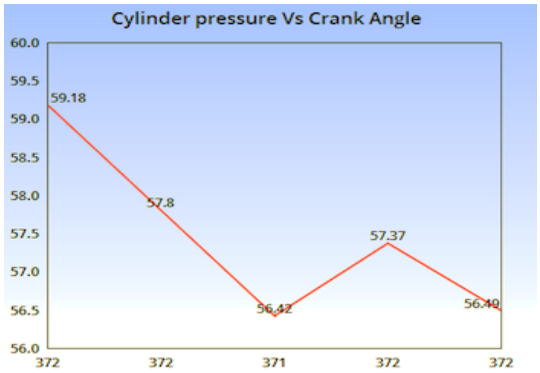
For combustion analyses with paying regards to crank angle a cylindrical pressure is essential and also deep monitoring of engine behaviour is needed. The piezo sensors are used in the effective generation of parameters for combustion.



pure Diesel



10%coconut oil 90% diesel



20%coconut oil 90% diesel

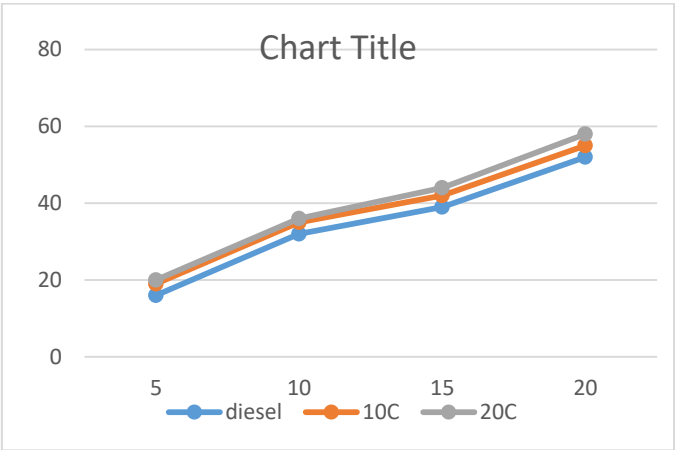
At lower load the peak pressure of 20C is higher than 10 C. In the case when the cetane number for coconut oil is being considered then it is quite for 10% blend of C and for 20%blend of coconut oil which should permit lower delay period for 20% C but the increased viscosity of 20% C, the delay period is quite higher because of lack of good air mixing and atomization because of which the pressure is increased. The fuel viscosity is increased just because of the increased load for the temperature of gas, due to which the atomization is quite enhanced. The cylinder is also increased by increasing the load. The variation of cylinder pressure with crank angle for diesel and C blends with diesel and its different loads in table shown above.

A. *Performance Parameters*

The performance characteristics of the engine are a practical graphical presentation of its performance. They are built from the data obtained during the actual test run on the engine with different mixtures. In this section, some of the important performance features of the CI engines is discussed.

⇒ Mechanical Efficiency VS Torque

It is observed from figure for lower and normal value of torque is higher for 20% C as the mechanical efficiency compared to diesel and 10% C. All this is the results of fact that the portion of power is needed to be down for 20% C. It has superior value of thickness. The 10% coconut oil has mechanical efficiency lower than 20% C by higher than diesel.



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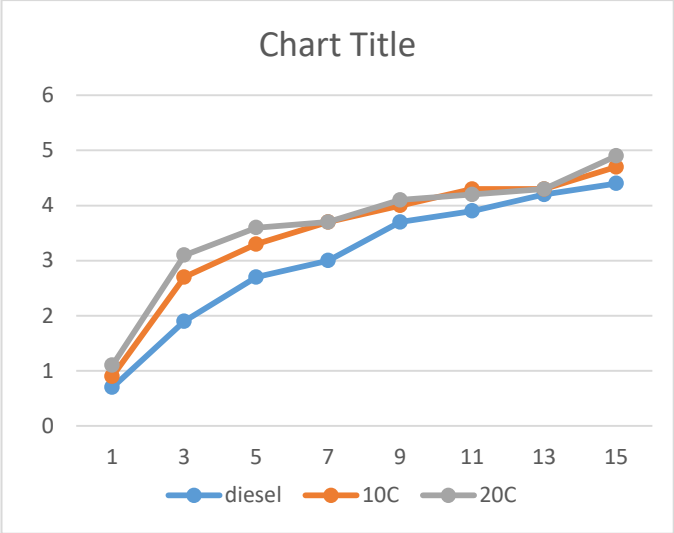
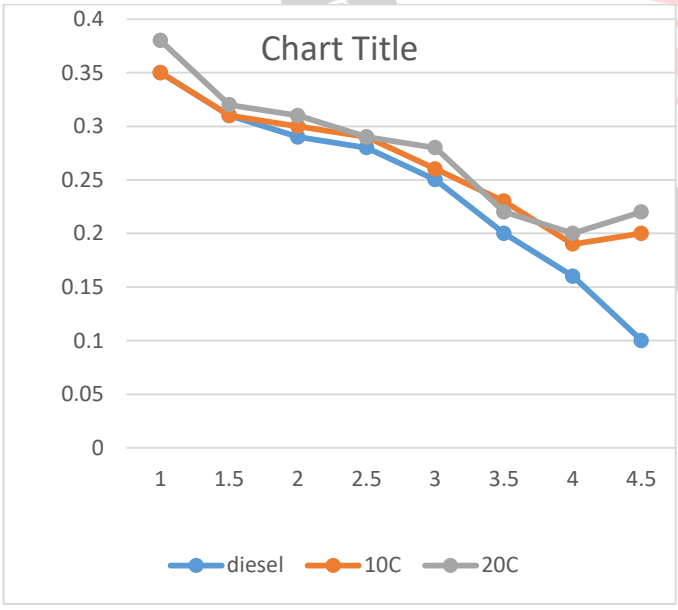
⇒ *Brake Power VS Load:-*

For all blends of fuel the load of engine is directly proportionate to the brake power so produced by engine. In the illustrated fig the explanation of brake power produced by the engine in variant loads starting with constant speed of 1500 r.p.m.



Brake Power VS Specific Fuel Consumption

The particular fuel consumption of numerous C blends and conventional diesel is shown in fig. It is observed that SFC is higher for all C mixtures in comparison diesel with numerous conditions of loading. SFC is 0.37 Kg/ KWh for C 20% blends and 0.33 Kg/KWh for conventional diesel fuel. This is because of high thickness, solidity and less heating value of C blends. Specific fuel consumption is not rational parameter to compare the performance of fuels having different calorific values.



VI. CONCLUSION

The research has been performed on diesel mixtures C0(pure Diesel), C10(10% coconut oil & 90% Diesel) and C20 (20% coconut oil & 80% Diesel) and the subsequent explanations have been derived.We get higher peak pressure for C20 fuel as compare to C10 and pure diesel. The break specific fuel consumption is decreasing with increase in load. BSFC of all blends are almost in equal range. The break thermal efficiency is increases with increase with load.The mechanical efficiency increases with increasing in load.

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 DOI : 10.18231/2454-9150.2019.0553