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Physicochemical properties on Non Edible Crude Oil with Its Performance Analysis on Base Fuel (Diesel Fuel)

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Abstract

Biodiesel is a mixture of fatty acid alkyl esters obtained by the reaction of triglycerides of vegetable or animal origin with alcohol in the presence of a catalyst. In this work the biodiesel has been taken as non edible type in nature. The problems of this oil are attributed to high viscosity, low volatility and polyunsaturated character of vegetable oils. Hence, process of transesterification is found to be effective method of reducing viscosity and eliminating operational and durability problems. The comparative performance on the basis of physicochemical property of biodiesel and base fuel is also presented in this work. The advantages effect of biodiesel as compare of base fuel has been also shown.

Keywords: Biodiesel, No edible Oil, Transterification, Diesel fuel (base fuel).

Introduction:

The yearly reports in pollutants of atmosphere are also in increasing trend, the need is to develop the eco friendly fuel to meet the fossil fuel depletion. These reasons increase the attention towards vegetable oil as an alternate fuel source. Biodiesel is the name of clean burning fuel, produced from domestic renewable resources. It contains no petroleum but it can be blended at any level with petroleum diesel to greater biodiesel blend. It can be used in CI engine with no major modifications. It is simple to use, bio degradable, non toxic and essentially free of sulphur and aromatics [1].Nowadays due to the limited resources of fossil fuels, rising crude oil prices and the increasing concerns for the environment, there has been renewed focus on the vegetable oils and animal fats as an alternative fuel sources. Among the attractive feature of the biodiesel are (i) if it a plant, non petroleum derived and as such its combustion does not increase the current net atmospheric levels of CO2, a green house gas. (ii) it can be domestically produced offering the possibility of reducing petroleum imports, (iii) It is biodegradable (iv) relative to the conventional diesel its combustion products have reduced the levels of particulate matter, UBHC, and CO[2].Plant oil, when blended with fossil diesel or transesterified into biodiesel, does not generally require any engine modification is recommended, however, if the plant oil is useddirectly in neat form, mainly due to higher viscosity of the plant oils compared to fossil diesel which leads to incomplete combustion and coke formation inside the cylinder and in fuel supply systems including the injectors [3]. The fuel properties of biodiesel such as cetane number, heat of combustion, specific gravity, and kinematic viscosity influence the combustion and so the engine performance and emission characteristics because it has different physical and chemical property.

Methodology:

There are several number of non edible seed is use in production of biodiesel. Some are Neem, hemp, castor, Datura-stremonium, kranja, jetropa and pongame.These seeds are use to expelled by using electric oil expeller. There are some important substance also meet in biodiesel which also improve the quality of biodiesel such are methanol, sodium hydroxide (NAOH) and anhydrous sodium sulphate (NA_2SO_4)[4]. The process use to convert non edible oil to biodiesel is shown in figure

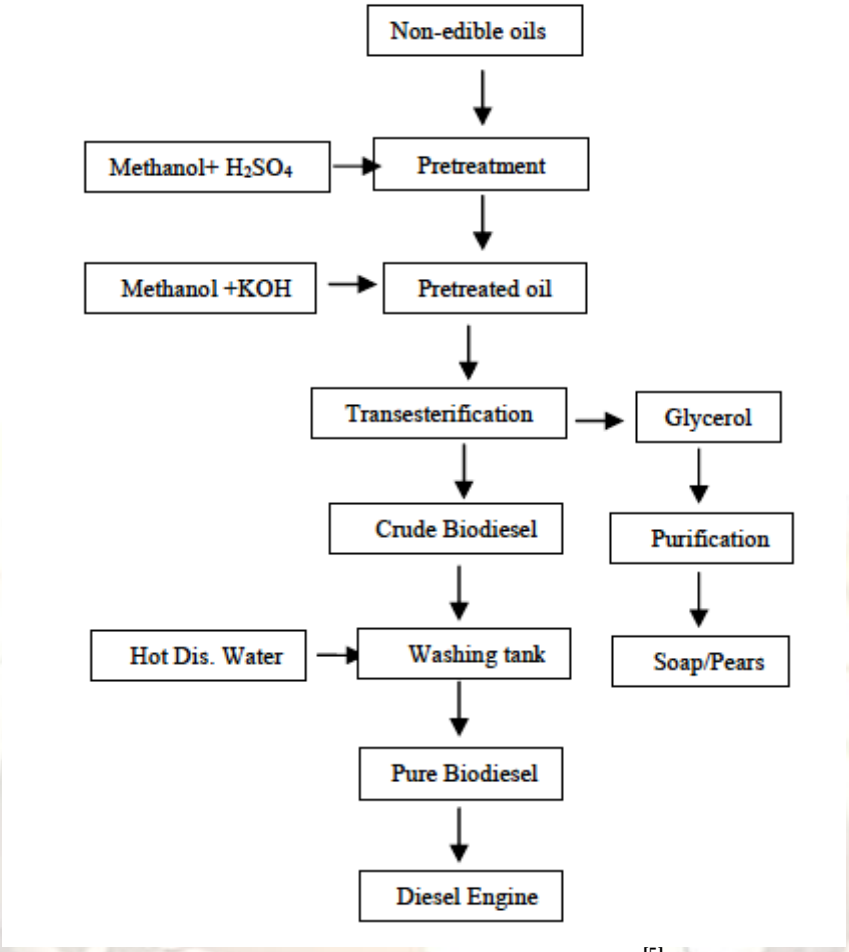

Figure 1 Production process of biodiesel [5]

The step by step processes which are generally use to convert non edible oil to biodiesel are:

Transesterification: The formation of fatty acid methyl esters (FAME) through transesterification of seed oils requires raw oil, 12-16% of methanol & 4-5.5% of sodium hydroxide on mass basis. However, transesterification is an equilibrium reaction in which excess alcohol is required to drive the reaction very close to completion. The vegetable oil was chemically reacted with an alcohol in the presence of a catalyst to produce FAMEs. Glycerol was separated as a by-product of transesterification reaction.One liter crude non edible oil takes and filtered it. Now heated between 110-130°C and to remove the moisture content on it. The transesterification reaction performed at 5.8:1 molar ratio of methanol/crude oil, by using 0.33%, 0.66% and 1.33% (w/w) NAOH as catalyst [4].Trans esterification is a chemical reaction which is shown below in figure

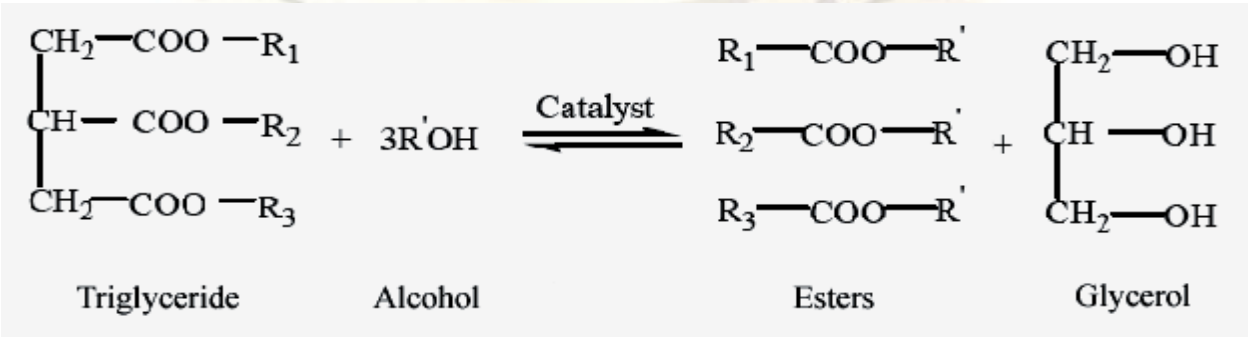

Figure 2 Transesterification process[5]

Purification: As shown in figure 1, the resultant crude biodiesel has some amount of glycerol on it. Before it use pure biodiesel there is requirement to remove glycerol on it. Removing of glycerol on this by using that process is called purification. In purification there are two layers, the upper layer of

biodiesel was purified by distilling the residual methanol at 55-65°C. The remaining catalyst was removed by successive rinsing with distilled water by adding some amount of drops of acetic acid to neutralize the catalyst. The residual canbe eliminated by treatment with anhydrous sodium sulphate (Na2SO4) followed by filtration.Transparent blackish liquid was obtained as the final product [4].

Acid neutralisation method: By the way in this process we use the specific method, in which we do the acid base titration technique. This process is followed the method on ASTM, 2003 on it [6].

Properties of fuels: In a fuel there is most important thing on it which is the property of fuel. There are mainly 2 types of property on any fuel; they are physical, chemical property.The properties of any plant oil depend on the plant variety and conditions of cultivation.

Physiochemical property of a fuel:

Viscosity: Viscosity is a measure of the internal friction or resistance of an oil to flow. As the temperature of oil is increased, its viscosity decreases, and it is, therefore, able to flow more readily. Viscosity is measured on several different scales, including Redwood No. 1 at 100 F, Engler Degrees, Say bolt Seconds, etc., the number of seconds required for 50 ml. of oil to flow out of a standard Redwood viscometer at a definite temperature.Viscosity is the most important property of biodiesel since it affects the operation of the fuel injection equipment, particularly at low temperatures when the increase in viscosity affects the fluidity of the fuel. Biodiesel has a viscosity close to that of Diesel fuels. High viscosity leads to poorer atomization of the fuel spray and less accurate operation of the fuel injectors. A novel process of BD fuel production has been developed by a non-catalytic supercritical methanol method.

Density: Density is another important property of biodiesel. It is the weight of a unit volume of fluid. Specific gravity is the ratio of the density of a liquid to the density of water. The specific gravity of biodiesels ranges between 0.86 and 0.90. Fuel injection equipment operates on a volume metering system, hence a higher density for biodiesel results in the delivery of a slightly greater mass of fuel.

Cetane number: Cetane number (CN) is based on two compounds, namely hexadecane with a cetane number of 100 and heptamethylnonane with a cetane number of 15. The CN scale also shows that straight chain, saturated hydrocarbons have higher CN compared to branched chain or aromatic compounds of similar molecular weight and number of carbon atoms. The CN of biodiesel is generally higher than that of conventional Diesel. The CN is one of the prime indicators of the quality of Diesel fuel. It relates to the ignition delay time of a fuel upon injection into the combustion chamber. The CN is a measure of the ignition quality of Diesel fuels, and high CN implies short ignition delay. The longer the fatty acid carbon chains and the more saturated the molecules, the higher the CN will be. The CN of biodiesel from animal fats is higher than those from vegetable oils.

Cloud point and pour point: There are two important parameters for low temperature applications of a fuel are cloud point (CP) and pour point (PP). The CP is the temperature at which wax first becomes visible when the fuel is cooled. The PP is the temperature at which the amount of wax out of solution is sufficient to gel the fuel, thus it is the lowest temperature at which the fuel can flow. Biodiesel has higher CP and PP compared to conventional Diesel.

Sulphur contents: The most valuable result is the reduction and absence of percentage of total sulphur contents in biodiesel that will result in reduction of Sox in exhaust gases which is one of the reasons of acid rain. Sulfur content of petro diesel is 20–50 times higher than biodiesels.

Heating value: Heating value or heat of combustion is the amount of heating value\energy released by the combustion of unit values of fuels. This is always taking to high on it.

Flash point: This is the minimum temp. at which the fuel will ignite (flash) on application of an ignition source. Flash point varies inversely with the fuel`s volatility. Minimum flash point temperatures are required for proper safety and handling of diesel fuel. Flash point is the temperature that indicates the overall flammability hazards in the presence of air; higher flash points make for safe handling and storage of biodiesel.

Iodine value: Iodine value is the value of the amount of iodine, measured in grams, adsorbed by 100 g of the given oil. Iodine value is generally used as a measure of the chemical stability properties of different Biodiesel fuels against oxidation. Higher the iodine value, lesser the stability of the Biodiesel. The iodine values of the Biodiesel fuel is considerably low and thereby they are stable.

Latent heat of vaporization: Latent heat of vaporization is the quantity of heat absorbed by a fuel on passing b/w liquid and gaseous phases. The condition under which latent heat of vaporization is measured is the boiling point and atmospheric pressure is 101.4 kpa.

Flammability limits: Minimum and maximum concentrations of vapor on air below and above which the mixture are un ignitable a vapor air below the lower flammable limits is too lean to ignite , which a concentration above the upper flammable limits is too rich to ignite.

Boiling point: The boiling point is that point in which fuel started to boil on it.

Flame visibility: Flame visibility is a degree to which combustion of a substance under various conditions can be seen.

Odor recognition: Degree of smell associated with that fuel that fuel vapors.

Comparative analysis of bio fuel with diesel fuel:

There are fishable comparison on the basis of psychochemical property between biodiesel and diesel fuel are given below

Table: property analysis of both fuels[4-9]

Serial number	Property of fuel with data	Diesel fuel	Biodiesel
1	Viscosity@ 40°C cSt	1.25 to 1.40	3.45 to 5.82
2	Density@15°C Kg/L	0.83	0.86 to 0.90
3	Cetane number	49	45 to 65
4	Cloud point(°C)	-23 to 12.5	-14 to 7
5	Pour point(°C)	6 to 7	-9 to 9
6	Flash point(°C)	47 to 70	95 to 210
7	Sulphur % wt	0.05	0.0008
8	Lower heating value in btu/gal	129050	118170
9	Iodine value	117-143	-
10	Boiling point (°C)	180-340	315-350

Conclusion:

In this paper researcher do Experimental investigations and carried out in a single cylinder diesel engine to examine the suitability of different non edible oil as alternate fuels. Further the performance and emission characteristics of these oils are evaluated and compared with diesel and optimum fuel is determined. From the above investigations, followingconclusions are drawn.

1) The properties viz: density, viscosity, flash point and pour point of non edible oils are higher and cetane value is also higher than the diesel.
2) Viscosity at 40^0C of diesel is very good as compare to biodiesel. Hence preheating of oils is required to attain the smooth flow.

Hence from above conclusions it may be stated that non edible oils with preheating has acceptable performance with lower emissions. Hence these neat oils with preheating can be substituted as fuel for diesel engine without any modification in the diesel engine.

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