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BIODIESEL AN ALTERNATIVE FUEL: A REVIEW

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ABSTRACT

The increasing industrialization and motorization of the world has led to a increasing demand of an petroleum products. Hence it is necessary to search the alternative biofuels such as environment friendly. There are various types of raw materials are used for production of biodiesel such as Jatropha, Karanja, Moha, Undi, Castor, Jojoba, Cottonseed etc. An non-edible oil seeds and various vegetable oils including Palm oil, Soya bean oil, Sunflower oil, Rapeseed oil and waste vegetable oils. It can be used in diesel engine with no modifications. It is simple to use biodegradable, nontoxic and having low emissions. In India, edible vegetable oils are in short supply and India needs to import 45% of total requirements (600,000 tons) per year, to bridge the gap. Used cooking oil is practically not available, as it is used till the end due to shortage. In many developed countries vegetable oilsare in excess of their local requirements of edible oils. They have to dispose of these oils and converting these to Biodiesel as fuel is best option for them for disposal.

Keywords- *Biodiesel, Emissions, Esterification, Transesterification process, BSFC(Brake Specific Fuel Consumption).*

I. INTRODUCTION

Energy is the basic need for economic development of any country. The single largest source of energy in India is coal and after that comes is petroleum, about two third of petroleum products imported from OPEC (Oil and Petroleum Exporting Countries). In India energy consumption is increasing at rapid rate due to rapid industrialization, transportation, mechanization and motorization. At present, India is the sixth biggest country in the world and second highest country after china in Asia in terms of energy demand. India is totally dependent on foreign countries for petroleum products it is imported from other countries due to rapid rise in petroleum prices the Indian economy becomes insecure from energy demand. The Government of India estimates that, the requirement of petrol is expected to grow from approximately 7 million tons in 2001 to 10 million tons in 2006 and 12.5 million tons in 2012 and the ratio is increases day by day. Similarly, the demand for diesel is likely to touch the level of about 52 million tons in 2006, 66 million tons in 2012 and 78.11 million tons in 2016. Coal is the most important & abundant fossil fuel in India and itsatisfies 55% of India's energy

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need. Thirty per cent of commercial energy requirements are met by petroleum products, nearly 7.5 per cent by natural gas and 3.5 per cent by primary electricity. A large population of India in the rural areas depends on traditional sources of energy such as firewood, animal dung and biomass. The usage of such sources of energy is estimated at around approximately 47 per cent of total primary energy use.

Biodiesel is the product one gets when organically derived oil such as vegetable oil or animal fat chemically reacts with an alcohol to produce a fatty acid alkyl ester. It has become an interesting alternative to be used in diesel engine, because it has similar properties to the traditional fossil diesel fuel and substitute conventional fuel with none or very minor engine modification. One of the attractive features of biodiesel is its biodegradability and being more environmental friendly than the fossil fuels. Emissions such as total hydro carbons and CO are usually found to significantly low with biodiesel as compared to petroleum diesel. This may be due to more complete combustion caused by the increased oxygen content in the flame coming from the biodiesel molecules It is always recommended to produce biodiesel use waste edibles oil or non-edibles oil such as jatropha, caster, pongamia pinnata, rubber seed and mango. India, hence introduction of biodiesel both as a diesel substitute and for blending with diesel is an essential need. Mainly, biodiesel is being produced by the crops like sunflower, soybean, mustard oil etc. in many parts of the world. As the nation is facing a shortage of edible oils, it would not be feasible to produce biodiesel by edible oils. Biodiesel is nothing but fatty acid methyl or ethyl esters made from edible and non-edible oils and animal fats. It contains no petroleum, but it can be blended at any level with petroleum diesel to create a biodiesel blend or can be used in its pure form.

II. LITERATURE REVIEW

R. K. Singh et al. [1] In this study they have focused on preparation of biodiesel from jatropha by using Esterification and Transesterification process. In this paper author done comparison of experimental and theoretical values of important chemical properties like acid value, saponification value and iodine value etc. They find that calorific value of biodiesel is lower than diesel and viscosity, flash point and fire point is higher than diesel. The comparison is shown in below table,

Table No. 1 Comparison of Fuel Properties

Sr. No.	Property	Units	Jatropha oil	Jatropha oil methyl ester	Diesel	ASTM D-6751
1.	Density at 15^0C	Kg/m^3	918	880	850	875-900
2.	Viscosity at 40^0C	mm^2/sec	3545	4.84	2.60	1.9-6.0
3.	Flash point	^{0}C	186	162	70	>130
4.	Water content	%	5	Nil	0.02	<0.03
5.	Ash content	%	0.7	Nil	0.01	<0.02
6.	Carbon residue	%	0.3	0.024	0.17	-
7.	Acid value	mg KOH/g	11.0	0.24	0.35	<0.8

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George Anastopoulos et al. [2] They have used the two stage transesterification process with sodium hydroxide as a catalyst for producing biodiesel due to 2 stage transesterification process obtain the biodiesel with high purity. Optimised reaction conditions for one stage transesterification process were 12:1 molar ratio of ethanol to oil, the addition of 1% NaOH catalyst, A 80^0 C temperature and about 2.5 hr reaction time. Two stage transesterification process improves the results obtained in single stage transesterification and improvement is about 16% as compared to single stage transesterification. The properties such as density, viscosity of ethyl ester were similar to diesel and flash point is higher so it is easy to handle & storage.

Mushatq Ahmad et al. [3] They suggested that Sunflower is one potential source for biodiesel production. The production of biodiesel and detailed taxonomic is very high in sunflower. The oil of the species has low content of saturated fatty acid and is suitable source for biodiesel production. Transesterification of crude oil of the species was carry out at 60^0 C and molar ratio 1:6. The properties of the biodiesel are checked and compared with ASTM. It having emissions are very low so it is environment friendly.

Kazi Mostafijur Rahman et al. [4] They have prepared the biodiesel by using jatropha oil. Firstly oil is combined with methanol in the presence of catalyst and this mixture is allowed to settle down for several hours. After equilibrium conditions the layer of biodiesel and glycerine are separate out. Then check the parameters and properties of biodiesel and compared with diesel and found that, Calorific value of biodiesel is same as that of diesel. They also check the performance of B50 biodiesel on diesel engine and found that brake thermal efficiency and brake power is greater than diesel. BSFC of biodiesel is less than diesel. The emissions of Co_2 are less than diesel as a results reducing greenhouse effect on our environment.

Hossain A.B.M.S. et al. [5] They have focused on production of biodiesel from waste oil to reduce cost of biodiesel. Alcohols are used such as methanol, ethanol and butanol. From this they have found that,

1. Increasing methanol to oil molar ratio increases the yield of biodiesel production.
2. The reaction is carried out by using 0.5% NaOH, 1:1 oil to alcohol molar ratio for 2hr they found that methanol gave the best yield followed by ethanol and butanol.
3. Two hours of mixing time gave better yield when compared with 6hr and gave 71.2%.
4. The lowest viscosity was found in 1:1 oil to methanol ratio following 6hr shaking time.

From above remarks it is conclude that it was effective to produce good quality of biodiesel from waste oil.

Hemant Y. Shrirame et al. [6] They have explained that, In developing countries like India there is more scope for production of biodiesel from vegetable oils. Vegetable oils are a renewable and having more inexhaustible source of energy with an energetic content nearly similar to diesel fuel.The biodiesel is burn more effectively and they reduce emissions of the carbon monoxide, hydrocarbon, oxides of nitrogen and smoke than diesel fuel. Biodiesel can be used alone or it will be blended with petroleum diesel fuel at any ratio. The most commonly blend is used such as B20 (i.e. 20% of biodiesel and 80% petroleum diesel).

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P. Sreenivas et al. [7] They have produced the biodiesel from castor oil and check the properties of an biodiesel such as viscosity, cetane number, flash point, fire point, density, calorific value etc. And these properties are compared with ASTM (American Society Of Testing & Materials) and Indian Biodiesel standards. They found that viscosity of biodiesel oil is nearer to that of diesel, calorific value of biodiesel is 12% less than that of diesel and it is more lubricating than diesel. Castor oil has viscosity 100 times more than that of diesel. Higher cetane number gives the greater combustibility and short delay interval. Biodiesel have higher flash point so it is safe for transportation and storage purpose.

S. Antony Raja et al. [8] In this paper they have produced the biodiesel by using jatropha oil and they found that alkaline catalysed transesterification process is used for the production of biodiesel on large scale. Author analysed the different parameters such as temperature, time, and reactant ratio catalyst concentration on the biodiesel yield. Flash point of jatropha oil decreases after transesterification due to this improved the volatile characteristics so it is safe to handle. The viscosity of jatropha oil is reduces by transesterification process. The higher cloud point can affect the engine performance and emission adversely under cold climatic conditions.

G. Raju et al. [9] In that paper author compare the engine performance of karanja biodiesel with diesel fuel. They have find out the emission characteristics of biodiesel are better than the diesel. NO_x (Oxides of Nitrogen) emissions, CO (Carbon Monoxide) are lesser in karanja biodiesel than the pure diesel. They have also found Brake Thermal Efficiency is increased due to reducing heat loss with increasing load. Maximum efficiency obtained is 33.74% for B25 (25% of karanja biodiesel and 75% of diesel) and 33.54 for B20 (20% of karanja biodiesel and 80% of diesel).

Hitesh J. Yadav et al. [10] In this study they have prepared biodiesel from karanja oil by using trans esterification process in presence of NaOH as a catalyst and methanol. They have checked performance of biodiesel on diesel engine and also check the properties of biodiesel such as viscosity, density, flash point, fire point and calorific value etc. and they are compared with ASTM and German biodiesel standards. The viscosity of biodiesel is similar to that of diesel and calorific value is about 12% less than diesel fuel.

Mukesh A. Mane [11] In this paper he has studied properties of karanja oil, transesterification process, properties and results of karanja oil as an alternative fuel for diesel engine. He has found that Brake thermal efficiency of karanja oil methyl ester lower than that of diesel fuel. BSFC (Brake Specific Fuel Consumption) is increases with increasing blend proportions as compared to diesel fuel. The volumetric efficiency for diesel and karanja methyl ester blends was constant at different brake power (BP).

R. B. Sharma et al. [12] They have focused on production of Bio-Diesel from waste cooking oil. They have produced the biodiesel by using transesterification process and the reagents are used during this process such as waste cooking oil, methyl alcohol (CH_3OH) and base catalyst (KOH) for accelerating the reaction mixture. It is found that biodiesel yield increases as reaction time increases and it becomes slight constant after 80 min of reaction time. The yield is more for molar ratio 6:1 and 1% catalyst as compared to molar ratio 4.5:1 and 0.75%

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catalyst. It is found that mechanical stirring the yield obtained at 1% of KOH is higher as compared to 0.75% KOH.

P. Venkateswara Rao et al. [13] In this paper they have produced biodiesel by using jatropha oil. For preparing methyl ester i.e. biodiesel they have used Transesterification process with NaOH (Sodium Hydroxide) as a catalyst. The properties of biodiesel are checked and they are compared with pure diesel and jatropha oil. The results are shown in below table,

Table No. 2 Comparison of fuel properties

Sr. No.	Property	Jatropha Oil	Jatropha Oil Methyl Ester	Diesel
1.	Density at 15^0 C (Kg/m^3)	925	878	850
2.	Viscosity at 35^0 C (cst)	484.4	4.76	2.7
3.	Flash Point (^{0} C)	189	162	68
4.	Carbon Residue (%)	0.3	0.03	0.19
5.	Pour Point (^{0} C)	-6	-6	-20
6.	Cetane Number	24	53.8	48

M. Arunkumar et al. [14] They have made their paper on production of biodiesel by using castor seed. They have checked the performance of a diesel engine with various blends such as C10E5 (10% of castor oil, 5% of methanol and 85% of diesel fuel) & C15E5 (15% of castor oil, 5% of methanol and 80% of diesel fuel). From this performance they found that C15E5 have lower value of Nitrogen Oxide (NO), unburned Hydrocarbon than diesel fuel. The brake thermal efficiency and exhaust gas temperature of C15E5 is less as compared to C10E5 and pure diesel. And it also gives the optimum performance.

R. Bhaskar Reddy et al. [15] In this paper author prepared biodiesel from calophyllum inophyllum and analysed various parameters such as BSFC (Brake Specific Fuel Consumption), brake thermal efficiency, indicated thermal efficiency, volumetric efficiency, mechanical efficiency etc. It was observed from graphs,

1. BSFC decreases with increase in injection pressure.
2. Brake thermal efficiency increases with increasing load.
3. Indicated thermal efficiency increases with increasing load.
4. Volumetric efficiency is higher for B50 at 180, 200 and 220 bar.
5. Mechanical efficiency is increases at all injection pressures such as 180, 200 and 220 bar.

III. CONCLUSION

- Day by day energy consumption in India increases and the resources of petroleum products are decreases. Hence it is necessary to find out an alternative fuel.

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- The biodiesel is only one fuel that can be replaced to diesel fuel and it can be used in diesel engine with none or very minor engine modification.
- Biodiesel and diesel fuel blends may prove an alternative option as diesel fuel in the future because they are renewable resources and less polluting.
- The leading crops for production of biodiesel are palm, jatropha, castor, rapeseed etc. The oil extraction from jatropha is more as compared to other seeds. But in India castor seed is widely available and oil extracted from castor is 48%. So it is effectively used for production of biodiesel in India.

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