A REVIEW ON EXPERIMENTAL INVESTIGATION ON THE PERFORMANCE OF AN ENGINE OPERATED WITH MULTI FUEL BLENDS OF BIODIESELS MADE BY ANIMAL FAT & MAHUA OIL, ETHANOL & DIESEL

Mr. Ashish Dubey[1], Prof. A. D. Pitale[2]

[1]Student, IV semester M. Tech (Heat power engineering), [2]Asst. Professor Mechanical Engineering Department, G. H. Raisoni College of Engineering, Nagpur.440016 (India)

ABSTRACT

The term ''biodiesel'' defines a ''fuel comprised of mono-alkyl esters of long-chain fatty acids derived from vegetable oils or animal fats, designated ''B100'' as formulated in the biodiesel standard ASTM D6751 with the European biodiesel standard EN 14214 referring to fatty acid methyl esters (FAME) as fuel [1]. This fuel is obtained from an oil or fat by a transesterification reaction with glycerol as co-product. It may be argued that, when produced with methanol/ethanol as alcohol component, the carbon atoms in biodiesel are only approximately 95% ''bio''. The reason is that methanol, although it can be obtained from renewable resources, is most commonly derived from non-renewable natural gas. In the case of ethyl esters, biodiesel is completely ''bio'' as ethanol is commonly derived from renewable resources such as corn and sugarcane.

Keywords: Animal Fats Oil, Blends, Ethanol, Mahua Oil, Ttransesterification

I. INTRODUCTION

Energy is defined as the ability to do work. Energy is one of the major inputs for the economic development of any country. Energy is the prime mover of economic growth and is vital to the sustenance of a modern economy. Future economic growth crucially depends on the long-term availability of energy from sources that are affordable, accessible and environmental friendly. India ranks sixth in the world in total energy consumption and needs to accelerate the development of the sector to meet its growth aspirations. The country, though rich in coal and abundantly endowed with renewable energy in the form of solar, wind, hydro and bio-energy has very small hydrocarbon reserves (0.4% of the world's reserve). India, like many other developing countries, is a net importer of energy, more than 25 percent of primary energy needs being met through imports mainly in the form of crude oil and natural gas. The rising oil import bill has been the focus of serious concerns due to the pressure it has placed on scarce foreign exchange resources and is also largely responsible for energy supply shortages. The sub-optimal consumption of commercial energy adversely affects the productive sectors, which in turn hampers economic growth. [2]

It is well known that transport is almost totally dependent on fossil fuels particularly petroleum based fuels such as gasoline, diesel fuel and liquefied petroleum gas etc. The liberalization of our economy has brought all around economic and social development in our country with corresponding growth in associated activities. This

has resulted in an exponential rise in the demand for all forms of energy including petroleum products. The steep increase in the consumption of petroleum products from 3.5 MMT in 1950 - 51 to 96.44 MMT in 1999 - 2000 and further projected increase to 110 MMT in 2001 - 2002 and 150 MMT in 2006 - 2007 demands immediate focus on the imperativeness of an unreserved adoption of demand management measures. [3]

II. ENERGY SOURCES

Energy sources can be classified into several types based on the following criteria:

- Primary and Secondary energy sources
- Commercial and Non commercial energy sources
- Renewable and Non-Renewable energy sources

2.1 Primary and Secondary Energy Sources

Primary energy sources are those that are either found or stored in nature. Common primary energy sources are coal, oil, natural gas, and biomass (such as wood). Other primary energy sources available include nuclear energy from radioactive substances, thermal energy stored in earth's interior, and potential energy due to energy sources; for example coal, oil or gas converted into steam and electricity. Primary energy can also be used directly. Some energy sources have non-energy uses, for example coal.

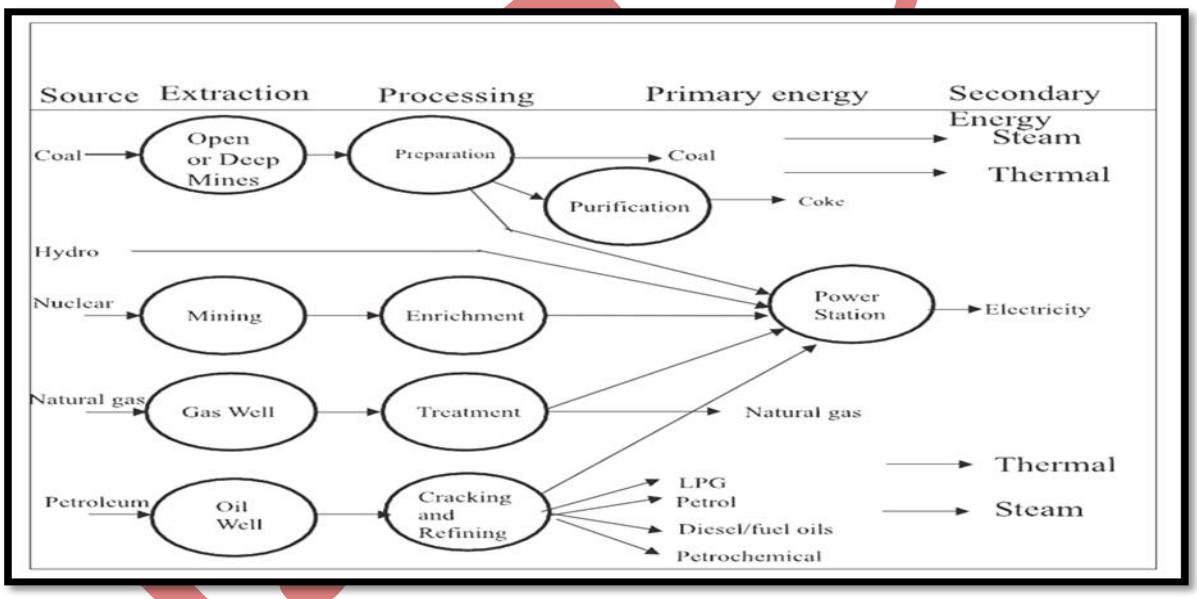
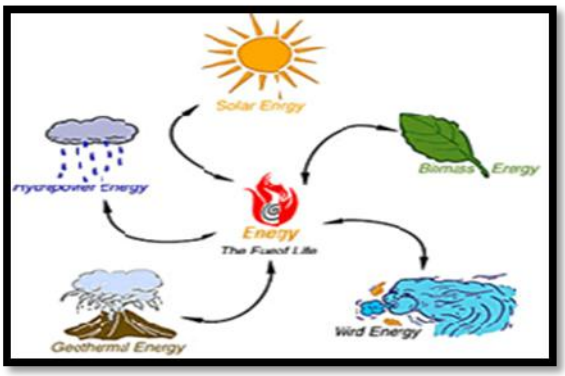


Fig.1 Primary and Secondary Energy Sources

2.2 Renewable and Non-Renewable Energy Sources

Renewable energy is energy obtained from sources that are essentially inexhaustible. Examples of renewable resources include wind power, solar power, geothermal energy, tidal power and hydroelectric power (see figure 2(a) & (b). The most important feature of renewable energy is that it can be harnessed without the release of harmful pollutants. Non-renewable energy is the conventional fossil fuels such as coal, oil and gas, which are likely to deplete with time. The most important feature of renewable energy is that it can be

harnessed without the release of harmful pollutants. Non-renewable energy is the conventional fossil fuels such as coal, oil and gas, which are likely to deplete with time Fig. 2(b).



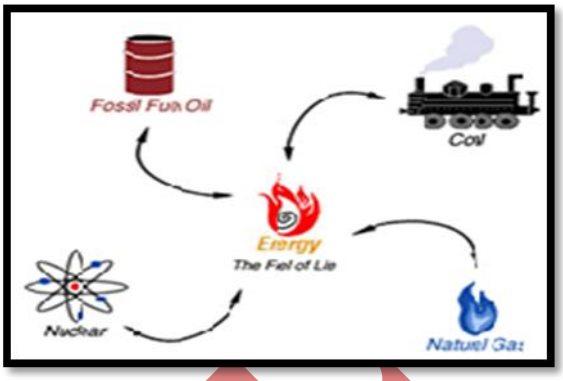


Fig. 2(a) Renewable Energy Sources **Fig. 2(b) Non-Renewable Energy Sources**

The major sources of the world's energy needs are petroleum, coal and natural gases which are fossil-derived and non renewable. The world, at large, depends on petroleum as the energy source for the transportation sector. Scarcity of traditional petroleum fuels, its over-dependence by nations, increasing emissions of combustion generated pollutants and their increasing costs have made renewable energy sources more attractive. The world petroleum reserves are finite in nature and declining fast, the production of oil will eventually slow down. Way back in 18th century, the petrol and diesel engines were discovered. Till then, the most conventional fuels used are gasoline and diesel. But there are some disadvantages of fossil fuel that are listed below:

- The fossil fuels are of Non renewable type
- Fossil fuels produce CO2 and other emission from combustion sources which results in greenhouse effect
- Price hike for fossil fuels is rapid
- The Govt. is dependent on gulf nations for supply of fossil fuels.

As the study [4] conducted, 20% biodiesel combusting internal diesel engines discharge polluted matters 20% less, carbon monoxide 12% less, fine dust 12% less, NOX 2% more, SOX 20% less, aromatic chemicals 13% less than those of diesel fuel. The reason for NOX incremental is that, again, more oxygen amount than diesel fuel. For biodiesel usage practice for agricultural tractor [5], more biodiesel fuel, about 30 to 40%, for tractor operation such as tilling and ploughing was needed than light oil. The biodiesel is produced by mahua oil which is widely available in India and neighbouring countries. The mahua oil comes in the category of non edible vegetable oils [6], mahua oil has an estimated annual production potential of 181 thousand tons in India [7]. Mahua trees are grown in drought prone areas and are abundant in several parts of India. Use of mahua oil methyl ester (MEMO) as the renewable substitute fuel for diesel will reduce the diesel consumption. The biodiesel is also produced by animal fats. In Korea, about 400 thousand tons of animal-fats are produced annually that can be transformed to biodiesel of 315 thousand kl. Cow fats and swine fats are the main resource for animal-fats biodiesel production. Animal-fats biodiesel yielding in USA is about 450 million litres in 2008 that was taking up 20% of total biodiesel production amount. Biodiesel can be a alternative fuel for heating fuel in the hot air heater for greenhouse heating.

III. PRODUCTION OF BIODIESEL

The production of biodiesel by transesterification process can be shown as:

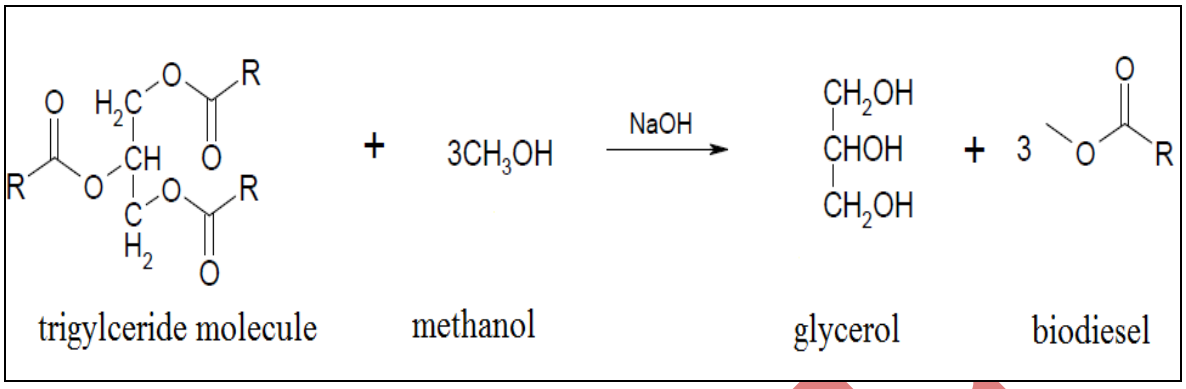


Fig. 3 Transesterification process

3.1 Biodiesel production from animal fat

Biodiesel is produced from the triacylglycerol-containing material by means of a transesterification reaction. In this process, alcohol (methanol/ethanol) and animal fats are mixed in the molar ratio of 6:1, heated at 60-650C for 1hr and the ambient pressure in the presence of catalyst such as NaOH/KOH. Before that, animal fat gets heated up to 105-1100C so that it will be converted into fat oil then in the separate flat bottom flask, alcohol and NaOH/KOH (2% of fat)are mixed exothermic reaction take place. This mixer is then added to heated fat and keep it at 60-650C for 1hr. After this, it is poured into a bottle so that biodiesel and glycerol get separated as shown [8].

3.2 Biodiesel production from mahua oil

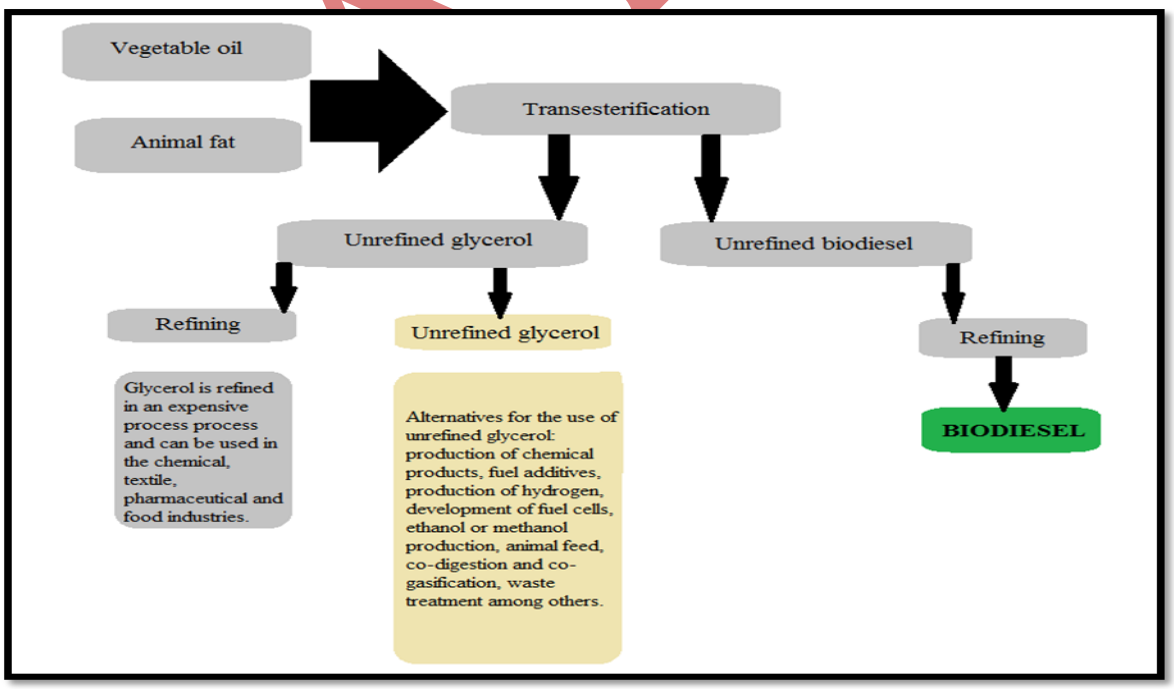


Fig. 4 The Flow Diagram Of Process of Biodiesel Product And Uses Of Glycerol.

Mahua oil methyl ester (MOME) was prepared by using alkali catalyst as sodium methoxide by transesterification process. In the transesterification reaction excess of ethanol is used to cause fast reaction and high degree of conversion [9]. The transesterification requires an alkali catalyst such as NaOH, or KOH which are preferred due to their low cost and large availability. Although the ester is the major product, desired recovery of glycerol is important because of its industrial uses [10-11].

IV. EXPERIMENTAL SET-UP

Experimental set-up for the use of biodiesel in diesel engine can be shown in the following figure:

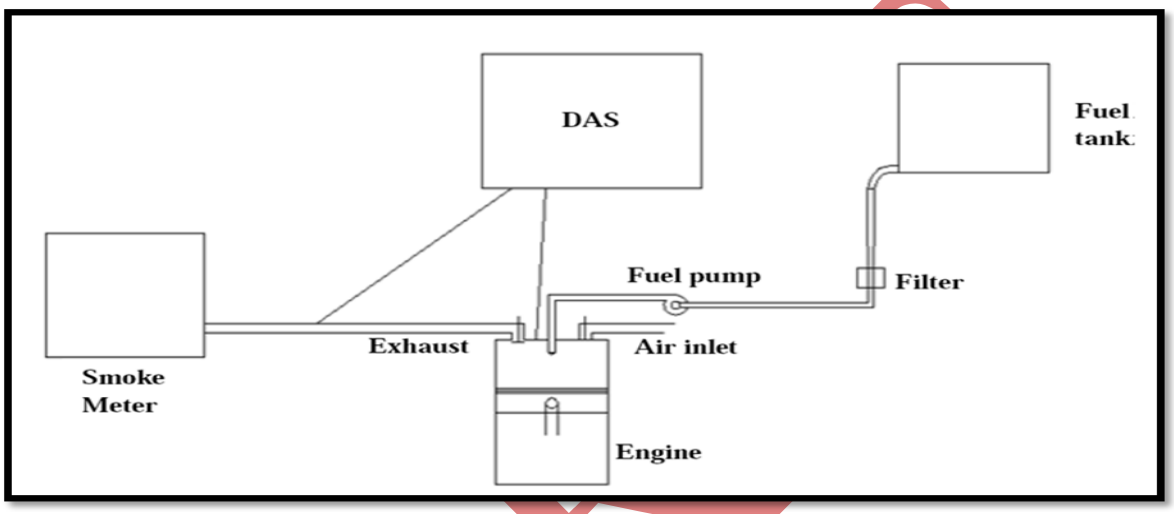


Fig. 5 The experimental set-up

As shown in the Fig. 5 experimental set-up, blended fuel is supplied to the engine through filter and fuel pump. Data acquisition system (DAS) is used to take readings of speed, inlet pressure, temperature, etc. and show output on the computer monitor. Smoke meter gives smoke reading per minute. Emissions such as NOx, CO, HC, and SO2 can be measured with the help of exhaust gas analyzer (not shown here).

In this experiment, the objective is the production of biodiesel from Animal fat oil & Mahua oil. After that mixing the two different biodiesels (i.e. from Animal fat & Mahua oil) in the ratio of 50% & 50% by volume, prepare its blends with ethanol-diesel fuels, study their properties and to compare above blends with diesel (such **B5E10D85, B10E10D80, B15E10D75, B20E10D70, B25E10D65** & **pure diesel**). Comparing considered performance parameter like brake specific fuel consumption (BSFC), brake thermal efficiency (BTE), Exhaust gas temperature (EGT) and smoke emission. Engine tests at different engine speeds to 1800 rpm.

Table 1: Proporartions of Biodiesel Blends (Volume Basis)

S N	DIESEL (%)	Multi BIODIESEL (%)	ETHANOL (%)
1.	85	5	10
2.	80	10	10
3.	75	15	10
4.	70	20	10
5.	65	25	10

Table 2: Properties of Diesel, Ethanol and Biodiesel (Animal Fat) & Biodiesel (Mahua Oil)

Property	Diesel	Ethanol	Biodiesel (animal fat)	Biodiesel (Mahua oil)
Density (kg/m^3)	850	789	883	872
Kinematic viscosity at 40^0C at mm^2/sec	3.05	0.795	4.0-6.0	4
Calorific value (KJ/Kg)	42,800	29700	36000 to 38000	41000
Flash point(^0C)	85	14	170	204
Pour point(^0C)	-4	-	-5 to10	1
Cetane number	47	5-7	56	50
Cloud point (^0C)	-15 to 5	-	-3 to15	6
Acid value mg KOH/gm	0.03	-	0.15	0.5

V. CONCLUSION

The experimental study of the addition of biodiesels in ethanol-diesel blended fuel engine gave better engine performance and emissions characteristics. Diesel-biodiesel–ethanol blends (BDE) show better stability and can be used in diesel engine without major modification.

From all the result and discussion main conclusion came arise is that BDE in blend form is better to use in diesel engines. It shows performance closer to that of diesel on the expense of cost little higher. So these fuel blends proved as sustainable, suitable, prominent alternative fuel for all types of diesel engines.

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