MADHUCA INDICA AND TURMERIC AS FUEL IN CI ENGINE: A REVIEW

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ABSTRACT

Nonconventional energy source is one of the fast growing science in which the biodiesel is one of the method of utilizing nonconventional energy sources. Paper deals with the science of biodiesel technology. Process of biodiesel production is consists of several chemical mechanisms. And the process of transisterification for different experiments and their final conclusion is taken for review. During the review of papers, experimental parameters like Engine performance parameters namely brake power, brake specific fuel consumption, brake thermal efficiency and exhaust emissions of CO, HC, NOx, and smoke density were analyzed from studies carried out for different loading conditions and at constant engine speed of at different speeds. The test result indicates that there is a slight decrease in brake thermal efficiency and increase in specific fuel consumption for all the blended fuels when compared to that of diesel fuel.

Index Terms: Biodiesel, Diesel, Transisterification, Experiments, Engine Performance Parameters, Emissions

I. INTRODUCTION

The increase in population of world demands more utilization of conventional resources. Our present technology is taking the number of steps towards the supply for demand. Biodiesel is one of them, It is a clean burning diesel replacement fuel made of renewable sources such as new and used vegetable oils and animal fats it has been found from many researches biodiesel have massive potential towards the subject of concern. It is also has been found that their use produces less emission which is most important as per the global warming, Ozone layer depletion and other environmental problems are concern. There are lots of biodiesel sources available. Animal fats, plant leaves, seeds, etc. (all bio-products) can produce biodiesel. Biodiesel is a carbon dioxide neutral as the carbon dioxide are exhausted during the growth of plant. In India, seeds like Jatropha, Karanj, Neem, Castor, and Rubber are popular for biodiesel production. Madhuca Indica (mahua) and turmeric are also a potential source of biodiesel. The mechanical and chemical properties are friendly from biodiesel production point of view.

II. METHOD TO CONVERT IN BIODIESEL

There are two methods are being used in to produce biodiesel are direct mixing and micro emulsion. These methods much lowers the viscosity but not works for carbon deposits in case Madhuca Indica. Turmeric oil characteristics

help to reduce the carbon deposits [5]. Also these methods not helps to lube pollution, high temperature pyrolysis cracking is very difficult to control by its reactant at high temperature. The parameter which helps to control these operations are reaction temperature, ratio of alcohol to vegetable oil, amount of catalyst, mixing intensity, catalyst, and the raw oil used.

Ester exchange method is advanced method than others two. Transesterification is the process in which triglyceride can be transformed into monoester [13]. The advantage of this method is viscosity is reduced and the cetane number is increased as moleculer chain is cut into one third.

III. CONVERSION OF VEGETABLE OIL TO BIODIESEL (TRANSESTERIFICATION)

The process of Conversion of Vegetable oil to biodiesel is transesterifcation. It is a process of producing the methyl esters or ethyl esters from triglyceride. For this purpose the catalyst is added to the methanol or ethanol and heated upto certain desired temperature. This solution is then added to the hot vegetable oil slowly as a result the triglyceride is converted into ethyl esters or methyl esters. Formation of ethyl esters or methyl esters is depend upon the use of ethanol or methanol respectively [9]. The Madhuca Indica seeds are considered as one of the potential feedstocks for the biodiesel production in India therefore the annual production of Madhuca Indica flower was expected to increase in the future [1].

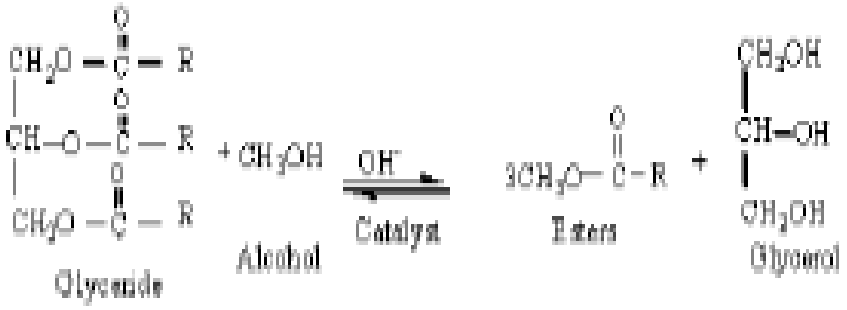

Fig.1 Transesterification Mechanism

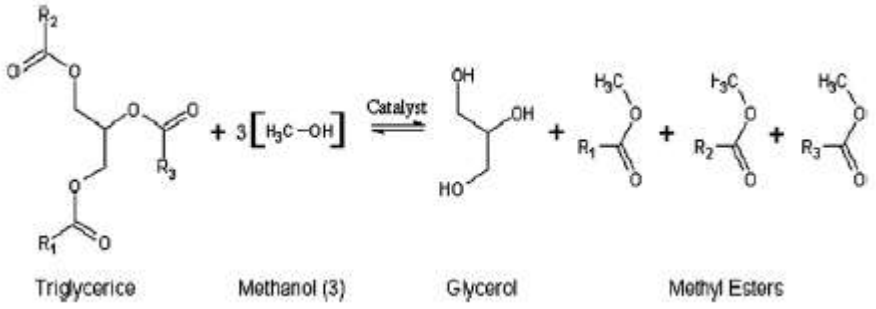

Fig.2 Transesterification Mechanism

Selection of vegetable oils is different according to the climate and soil conditions of country. Soybean oil is used in USA, rapeseed and sunflower oil is used in Europe, palm oil in south East Asia and in Philippines coconut oil are

most favorable. In India, madhuca indica is found abundantly in Maharashtra, Orissa in south Indian forests, Sri Lanka, and in Australia [1].

IV. PROPERTIES OF MADHUCA INDICA

From literature available it is found that Madhuca Indica has responsive characteristics as fuel in diesel engine. Further identified properties claim their usefulness in diesel engine.

Fatty acid	Structure	Formula	Weight
Palmitic	16.0	$C_{16}H_{32}O_2$	23.1
Stearic	18.0	$C_{18}H_{36}O_2$	21.6
Arachidic	20.0	$C_{20}H_{40}O_2$	1.8
Oleic	18.1	$C_{18}H_{34}O_2$	38.2
Linoleic	18.2	$C_{18}H_{32}O_2$	11.3

Fig 3. Composition of free fatty acid present in Mahua (Madhuca Indica) oil

The chemical formula of Madhuca Indica bioethanol is $C_{1.723}H_{4.348}O$. The molecular weight is 54. Madhuca Indica contains 14.489%. 0.23% nitrogen, 0.717% sulphur, and 38.564% oxygen on volume basis. The molar ratio found is 3.72 [1].

V. PROPERTIES OF TURMERIC LEAF OIL

Turmeric oil is used in various solvents such as ethanol, chloroform, benzene, toluene and hexane [2]. Terpenes is present in the turmeric oil. It is found from studies that carbon deposition is reduced in SI Engine.

Parameter	Result
Colour	Pale yellow
Odour	Characteristic
Solubility	Soluble in ethanol, chloroform, benzene, toluene and hexane
Specific gravity	0.8505
Viscosity (At Room Temperature)	0.00876 poise
Refractive Index	1.51

Fig 4. physiochemical evaluation of Turmeric leaf oil

Pollution is reduced in SI engine when used as substitute fuel. Also it resists the corrosion and erosion problem in SI engine. So one could say the turmeric oil can also used as additives in fuel blends. Specific gravity found in those studies gives the figure of 0.8505. viscosity at room temperature is 0.00876 poise. Refractive index is 1.51.

VI. MATERIALS AND METHODS

In all these studies and there literature experimentation was the path of analysis of biodiesel characteristics in engine whether in SI Engine or CI Engine. The parameters of measurement were mostly combustion characteristics, engine performance and exhaust emission. The blends or emulsion were prepared and titled as B10, B20, B30 on respective 10%, 20%, 30% volume basis mixture. The CI Engine or SI Engine were fuelled by those blends order wise one after another as experiment is to be revised. The compression ratio is to be change according to blend characteristics i.e. 14, 16, or 16. Engine is to be started and running on the speed ranging from 1000 to 2000 rpm.

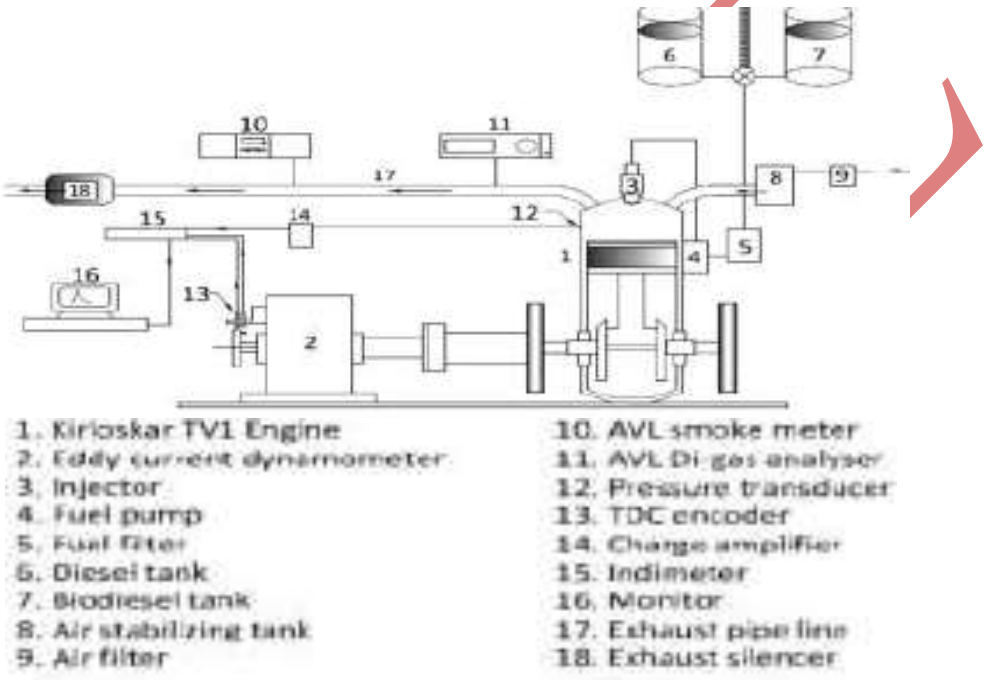

Fig 5. Experimental setup

After the experimentation, the result is analyzed by plotting the readings on graph. It gives the visual behavior of blends helps to understand their effectiveness. Finally authors concluded their observation.

VII. EXPERIMENTAL INVESTIGATION PARAMETER AND THEIR RESULT

1. ENGINE PERFORMANCE

1.1 ENGINE TORQUE

The torque increase as the compression ratio increase this is due to higher pressure inside the combustion chamber and so higher indicated power will results and the torque will be increased [3]. The lower heat of combustion of the biodiesel blend and lower fuel delivery at full load due to the higher mass flow rate required from the fixed nozzle area.

1.2 EFFECT OF COMPRESSION RATIO

In all The engine torque for all blends increases as the compression ratio increases. but as percentage of biodiesel increases the torque decrease [3].

2. BRAKE SPECIFIC FUEL CONSUMPTION

It is defined as the ratio between mass fuel consumption and brake effective power, the loss of heating value of biodiesel must be compensated with higher fuel consumption. The Brake specific fuel of pure diesel and its blends with biodiesel fuel higher percentage of specific fuel consumption when running on biodiesel than diesel fuel at same speed [12]. The results of beef tallow study indicated that specific fuel consumption for neat biodiesel methyl esters of beef tallow were higher than that of diesel fuel[8].

2.1 EFFECT OF BLEND

As fuel energy content rated lower hence one could conclude that specific consumption values in case of vegetable oil is higher [3].

2.2 EFFECT OF COMPRESSION RATIO

As the compression ratio increases the Brake specific fuel consumption is higher [3].

3. BRAKE THERMAL EFFICIENCY

Thermal efficiency is the ratio between the power output and the energy introduced through fuel injection, the latter being the product of the injected fuel mass flow rate and the lower heating value[8]. The brake thermal efficiency obtained for these blends is lower than diesel could be due to a reduction in the calorific value and an in- crease in fuel consumption as compared to biodiesel. The Brake Thermal Efficiency of blended fuel is very close to diesel fuel. Thus the difference in Brake Thermal Efficiency between diesel fuel and blend is very significant at maximum load [8]. Fuel consumption increases due to higher density and lower heating value consequently, brake thermal efficiency decreases. However the Brake Thermal Efficiency of blended fuels is higher than that of neat biodiesel.

3.1 EFFECT OF BLEND

concentration of biodiesel reduces the thermal efficiency [3]. Brake thermal efficiency of beef tallow decreases with increasing proportion of biodiesel in the test fuels [8].

3.1 EFFECT OF COMPRESSION RATIO

Ratio when the compression ratio rated for biodiesel from14 to 18, it causes the improvement in performance of engine [3]. This is due to reduction in ignition delay [3].

4. EMISSION

4.1. CO, CO_2,HC

The emissions of CO decreases as substitute's diesel fuel with biodiesel can be considered as the general trend [1-4]. At high revolutions and high radial turbulence intensity in the combustion chamber, the mixing of the fuel rich portions with ambient air should be improved, but on the other hand, the duration of the combustion process expressed in units of time becomes too limited, which results in increasing CO emission. CO formation decreases with increase in speed. Also, as load increases the CO emission increases.

4.1.1 EFFECT OF BLEND

It requires the additional air feed into the combustion chamber for better air fuel mixture this helps to reduce co emission. HC emission is reduced for biodiesel as compared to diesel. As the speed of engine increases CO2 also get reduced.

4.1.2 EFFECT OF COMPRESSION RATIO

As the temperature of air inside the cylinder is higher this causes reduction in delay period and thus the reduction in co emission comes into result [3].

4.2 NOX EMISSION

4.2.1 EFFECT OF BLEND

The Adiabatic flame temperature is higher for biodiesel than petroleum diesel. Therefore the NOx amount is less for biodiesel [3].

4.2.2 EFFECT OF COMPRESSION RATIO

The increment in compression ratio results into rising of NOx formation.

5. COMBUSTION CHARACTERISTICS

5.1 CYLINDER PRESSURE

In a CI engine, cylinder pressure depends on the burned fuel fraction during the initial stage of combustion. Cylinder pressure characterizes the eligibility of the fuel to mix well with air and burn. High peak pressure and maximum rate of pressure rise correspond to large amount of fuel burned in stage before the combustion. Also Peak pressure is recorded at different RPM [12].

5.1.1 EFFECT OF BLEND

Higher peak pressure and maximum rate of pressure rise forced maximum amount fuel to burn at premixed combustion stage. This raising in pressure is because of the ignition delay is shorter as compared to the petroleum diesel.

5.1.2 EFFECT OF COMPRESSION RATIO

As compression ratio is increased the cylinder pressure also increases. Increasing the compression ratio had more benefits with biodiesel than with pure diesel.

6. DELAY PERIOD

6.1 EFFECT OF BLEND

As the fuel viscosity increases, atomization of fuel is less so the mixing is quiet slower in case of diesel but in case of biodiesel the scenario is different. In biodiesel as the atomization is proper due to its lesser viscosity than diesel it takes less time to ignite and the ignition delay is reduced.

6.2 EFFECT OF COMPRESSION RATIO

As the compression ratio increase, the delay period will decrease for all blends at all speeds.

7. EXAHAUST GAS TEMPERATURE

The biodiesel blend used in engine showed the nearest exhaust temperature to the petroleum diesel operation and the petroleum diesel fuel operation recorded lower exhaust temperatures than biodiesel blends at low speeds [12]. At higher speeds the exhaust temperature of all blends decrease than diesel fuel. The Exhaust gas temperature increases with increase in load for all tested fuels. Higher viscosity results in poorer atomization, poorer evaporation and extended combustion. The Exhaust gas temperature of biodiesel beef tallow is higher than diesel fuel [8].

VIII CONCLUSION

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