A Review: Production, Performance Parameter and Emission Characteristics of A. Mexicana Methyl Ester

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Abstract— Day by day the use of fossil fuel is increasing and the limited resources of it will be exhausted in near future. Hence, it is necessary for us to find the alternatives that will reduce load on fossil fuels. Biodiesel is one of the alternative for it. In this paper, we studied researches on A. Mexicana oil production and physiochemical properties. Also investigated the blends of Mexicana methyl ester which gives optimum results at various loads and Compression Ratios.

Key words: A. Mexicana Methyl Ester

I. INTRODUCTION

The major part of all energy consumed worldwide comes from fossil sources (petroleum, coal and natural gas). However, these sources are limited, and will be exhausted by the near future. Biodiesel, an alternative diesel fuel, is made from renewable biological sources such as vegetable oils and animal fats. This fuel is biodegradable and non-toxic and has low emission profiles as compared to petroleum diesel. Usage of biodiesel will allow a balance to be sought between agriculture, economic development and the environment. Recently, the demand of biodiesel has increased due to petroleum price rises in the last few months and the development of government measures like the EU Directive 2003/30/EC on the promotion of the use of biofuels or other renewable fuels for transport (Vicente et al., 2007). Biodiesel, is produced through a reaction known as transesterification. In a transesterification or alcoholysis reaction, one mole of triglyceride reacts with three moles of alcohol (molar ratio of methanol to vegetable oil of 3:1) to form one mole of glycerol and three moles of the respective fatty acid alkyl esters. The process is a sequence of three reversible reactions, in which the triglyceride molecule is converted step by step into diglyceride, monoglyceride and glycerol. The main purpose of this work is based on the study of the influence of vegetable oils properties and composition on the quality of biodiesel synthesized. It has been reported the transesterification of common oils (rapeseed, soybean, sunflower and palm oil) and others less investigated as olive, almond, corn, grape seed and high oleic sunflower oil. The fatty acid profile of vegetable oils used was measured following the International and European Standards.

II. LITERATURE REVIEW

A. Material and Method

Singh Dipti et al. [1] produced esters from A. Mexicana seed which contains 30% of oil. In this paper they discussed the procedure of extraction of oil from seeds through solvent extraction process and purification of oil by expeller. Ester is extracted by the transesterification of oil producing mixture of fatty acid alkyls ester and glycerol. They determined calorific value of A. Mexicana seed waste and oil by bomb calorimeter. In addition, Flash point, Fire point, Viscosity, Density of A. Mexicana oil was determined. The results were compared to normal diesel oil. Calorific value, Flash point and Fire point of methyl ester was found out to be lower than diesel oil whereas Viscosity and Density of methyl ester oil was higher than diesel oil. They concluded that A. Mexicana is a viable source of production of ester.

1) Experimental setup and physiochemical results:

Manoj sarma et al. [2] had written a thesis on Transesterification of A. Mexicana oil. First, they removed pulp, and seed were sun dried. Dried seeds were crushed into powder and further dried to 100^0C for 2 hours. The oil was extracted with Soxhlet extraction apparatus using light petrol as solvent. The dried rice straw was burnt and ash formed. Ash was calcined in oven at temperature 250-300^0C for 2-3 hours and then it was used as catalyst. For transesterification process A. Mexicana oil was carried out in 250ml flask with addition of catalyst, rice husk and methanol. The reaction was carried out at 40^0C for 4 hours using 5% ethyl acetate in petroleum ether as solvent. Buchner funnel was used to filter oil and residue washed with petroleum ether. The Fatty Acid Methyl Ester(FAME) was made and physicochemical properties were tested and results were as follows.

Sr. No.	Properties	Unit	Observed	Desired (EN 12414 standard)
1	Relative Density	g/cc	0.859	0.86-0.9
2	Kinematic Viscosity	mm^2s^{-1}	4.38	3.5-5
3	Cetane Number	-	44.8	-
4	Flash Point	^{0}C	<120	120 max

Hence, they concluded that, heterogeneous catalytic transesterification method was successful. The FAME (36% saturated, 64% unsaturated fatty acid) not only has ideal flow properties but also has high percentage of methyl oleate which is highly desirable for good quality diesel.

2) Performance Parameter of various blends compared to Diesel fuel:

Paramjit Singh et al. [3] investigated the performance parameters of single cylinder, four stroke engine connected to eddy current dynamometer fuelled with argemone biodiesel and blend with diesel fuel under different load condition (0%, 20%, 40%, 60%, 80%, 100%) and constant engine running speed. The performance parameters consist of Brake Power (BP), Brake Thermal Efficiency (BTHE), and Brake Specific Fuel Consumption (BSFC).In this research investigation five blends were prepared 10% (v/v) argemone biodiesel with 90% (v/v) diesel fuel denoted by AB10

(argemone biodiesel blend). The experiment was conducted using diesel and argemone blend with diesel AB10, AB20, AB30.Following results were obtained-

The brake power was increased with increase in load. The brake power was maximum value (4.27 KW) for AB20 at full load condition.

The brake thermal efficiency was increases with increase in load on engine. The brake thermal efficiency was maximum for AB20 (31.95%) at full load conditions.

The specific fuel consumption was decreased for different load conditions. The specific fuel consumption value was slightly higher than that of diesel fuel for AB10, AB30 but AB20 value was lower than that of diesel fuel at full load condition.

Therefore, it can be concluded that the argemone biodiesel blend AB20 (biodiesel 20%+80% diesel by volume) has improved fuel properties for diesel engine and improved performance.

Rakesh Kumar et al. [4] studied on the blend of biodiesel of A. Mexicana oil. They made blend having 20%,40%, 60%, 80%, 100%oil of A. Mexicana oil. They named it as B20 B40 B60 B80 B100 respectively. They carried out test on the C.I engine. The results for these blends were compared with normal diesel. For brake power the B20 result was 3 BHP which was higher than the normal diesel which come out to be 2.87. For Brake thermal efficiency the optimum result was found for B20 blend which was much closer to the normal diesel fuel. The emission like CO HC and SOx was minimum for the B100 blend but the Brake power and the Brake thermal efficiency was to low compared to the normal diesel so it could not be used instead of diesel. So, the optimum result was found out on the B20 blend which had more efficiency then the normal diesel and less emission.

Dong Han et al. [5] investigated the spray development process of three fatty acid including methyl laurate, methyl oleate, ethyl oleate were investigated in this study and compared to diesel fuel. The purity of test fatty esters is above 98%. It was found that spray parameters are influenced by fuel properties. Compared to diesel and methyl laurate, higher viscosity and surface tension of methyl oleate and ethyl oleate lead to slightly higher tip penetration distance but produce less projected spray area, spray cone angle and the maximum spray width. The variation in the macroscopic spray parameters caused by fuel properties could be reduced with increased injection pressure. The microscopic test characteristics of test fuel revealed that fuel properties have influences on the droplet size distribution.

Ameya Vilas Malvade et al. [6] studied the biodiesel made from Palm Fatty Acid Distillate (PFAD) which is waste extraction of palm oil. The PFAD was produced by transesterification process and the blends are PFAD10, PFAD15, PFAD20, PFAD25, PFAD30, PFAD50. Experiment conducted on diesel engine and Brake power, BSFC, Torque, Brake thermal efficiency, indicated power, mechanical efficiency was calculated at various loads. They concluded that, Brake power and torque obtained through all blends and diesel engine was same. As blending percentage increases with increase in the load BSFC decreases which is same as diesel fuel. Indicated power increases with increase in the load but lower than the diesel fuel. Mechanical Efficiency of various blends was close to that of Diesel fuel.

3) Emission Characteristics of various blends compared to diesel fuel:

S V Channapattana et al. [7] studied the emission and performance evaluation of DI CI-VCR Engine using blends of Honne Oil Methyl Ester(HOME) and compared with standard diesel at compression ratios(CRs) of 15, 16, 17 and 18. The oil was extracted from Calophyllum Inophyllum Linn. The oil was transestrified by chemically reacting triglycerides with methanol and sodium hydroxide as catalyst. The blends were B20, B40, B60, B80 and 100% Biodiesel was used. The test not only includes Thermal performance of Engine but also Emission characteristics of biodiesel at various CRs. They concluded, at higher CRs, combustion of fuel was efficient and exhaust emissions was found out to be lower than that of Diesel Engine. However, the NO_x emissions were found to be increase at higher CRs with HOME as compared to diesel. Therefore, HOME biodiesel at CR of 18 results in minimum emissions but more NO_x emissions.

Thulasiram.S et al. [8] investigated the emission characteristics of Mahua Fatty Acid Methyl Ester at varying load and compression ratios. The Mahua Fatty Acid Methyl Ester was made by transesterification process. The blend used was BD10%(90% Mahua biodiesel + 10% diesel) B20 %(80% Mahua biodiesel + 20% diesel) BD60%%(40% Mahua biodiesel + 60% diesel). The experiment was carried out on direct load conditions. They had kept the rpm constant and changed the compression ratio from 13 to 19. HC emission increases with decrease in compression ratio. As the compression ratio made complete combustion of fuel optimum results were found at BD60 blend at 100% and 125 % load. Higher compression ratio creates higher temperature in combustion chamber and it leads to lower CO emission. At BD60 and 19 compression ratio they got less emission of CO. The combination at 100% and 125% load same as the CO_2 emission also decreases. The NOx emission was found to be higher at higher compression ratio as at higher compression ratio the temperature in the cylinder were higher. For lower compression ratio the temperature was less hence NOx emitted was less but the HC CO CO_2 was increasing. this was controlled by adding DEE to fuel which provided a cooling effect and less temperature is maintain inside the cylinder. Optimum result was found at 18 compression ratio, where HC CO CO_2 emission was less but the NOx was higher than the normal diesel fuel.

III. CONCLUSION

The conclusion of this report summarised as

1) Mexicana oil can be transestrified into Mexicana Methyl Ester
2) Physiochemical properties of Mexicana methyl ester is suitable for diesel engine.
3) Flash point of Biodiesel is higher than diesel fuel hence it can be stored for long time.
4) Performance of blend B20 was found out to be closer to that diesel fuel.
5) Emissions of CO_2, HC, CO is minimum at high load and high CRs as compared to that of diesel fuel.
6) However, N_{Ox} emissions are slightly higher than that of diesel fuel.

Concluding the reviews of researches, we select Mexicana Methyl Ester for further research work. A. Mexicana seeds will be used for production of biodiesel. We will try to obtain better results and to reduce NO_x emission.

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