A Review on Emission Analysis of Waste Vegetable Oil Methyl Ester on IC Engine

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Abstract—Biodiesel is to be a solution for future. Biodiesel is produced by transesterification of vegetable oil methyl ester with an alcohol (methanol/ethanol) in the presence of a base catalyst. Waste vegetable oil methyl ester is also a major feedstock in the production of biodiesel. Mainly animal fats and vegetable oils are used for the production of biodiesel. The transesterification reaction yields methyl or ethyl esters (biodiesel) and a byproduct of glycerin. Parametric optimization of process parameters viz. reaction time, reaction temperature, methanol/oil molar ratio yields in ecologically friendly properties, having the potential opportunity to be used in biodiesel production process as heterogeneous base catalyst. Optimization adopted by using various optimization techniques such as Taguchi, SRM, genetic algorithms etc. Today with the help of advance technology and the knowledge there is a way to control pollution; use of biofuel can be an alternative to current fuels. Biodiesel may be used in any diesel automotive engine in its pure form or blended with petroleum-based diesel. No further modifications are required, and the results are low cost, renewable source, less exhaust emissions. This work shows how use of biodiesel will affect the emission of pollutants and performance parameters of diesel engine. Diesel Engine is compression ignition engine and use diesel as fuel. Biodiesel can be used in pure form or may be blended with petroleum diesel at any concentration.

I. INTRODUCTION

The concept of alternative, renewable energy has been in existence for over a century. Rudolf Diesel is credited as the inventor of the first diesel engine which was originally designed to run on fuel derived from peanut oil. Rudolf Diesel was quoted as saying; the diesel engine would help considerably in the development of agriculture of the countries which use it. Unfortunately, due to the low cost of mineral oils at the time, the diesel engine was modified to run on petroleum oil. Biodiesel technology was overlooked while the demand for crude oil increased significantly as the automotive and industrial age ensued. Rudolf Diesel was well aware that renewable fuel would not be of major relevance during his lifetime when he said, The use of vegetable oils for engine fuel may seem insignificant today. Biodiesel which is defined as the mono-alkyl esters of vegetable oils or animal fats, obtained by transesterifying oil or fat with an alcohol. Mainly animal fats and vegetable oils are used for the production of biodiesel. Several types of fuels can be derived from triacylglycerol-containing feedstock. This also describes the use of glycerol which is the by-product in etherification process along with biodiesel.

II. LITERATURE REVIEW

E.M. Shahid [1] et al. transesterified cooking oil using 1% sodium hydroxide and 20 % methanol at the temperature range of 65-69 °C. In their experimentation, the reaction time was two hours and conversion efficiency was 92.5% accordance with ASTM 6751, physical and chemical properties of the biodiesel were determined. They carried out emission analysis and concluded that, specific fuel consumption was increased by increasing the ratio of biodiesel in the blends.

S.Sreenatha Reddy [2] adopted Transesterification process to eliminate the clogging of fuel lines and filters due to fine particles, gums, waxes, carbon deposits and higher smoke formation which occur due to the higher viscosity of vegetable oils. The objective of their study was to optimization of transesterification process for methyl ester production and testing its performance in diesel engine. They used diesel Engine for performance analysis.

J. Hancsok [3] et al. tried to find a solution to utilize the greatly available spent frying oils as engine fuels. They were able to find process parameters and solvents promoting the etherification, resulting in 97-98% methyl ester content within relatively short time, considering 2-4 h acidic transesterification (depending on the free fatty acid content of the feeds) followed by 2 h alkali catalyzed transesterification.

Jeskha. M [4] studied about biodiesel made from non-toxic, biodegradable, renewable resources, such as new and used cooking oil and non-edible oil. Bio-fuel characteristics such as free fatty acid content, iodine value, saponification value, cetane number, energy value and density were studied. They were recovered the productions of Fatty Acid Methyl Ester by transesterification of oil samples. The results validate that all these samples were used as sources for biodiesel production.

S¸ehmus ALTUN [5] investigated the performance and exhaust emissions of a direct injection diesel engine using 2 biodiesel fuels with promising economic perspective, one obtained from inedible animal tallow and the other from waste cooking oils. The experiments were conducted at different engine speeds under the full load condition of the engine to investigate the performance and exhaust emissions. The results compared with the diesel fuel were shows that the biodiesel fuels resulted in a reduction in brake torque and in an increase in brake specific fuel consumption.

Ridvan Arslan [6] studied the use of waste cooking oil (WCO) methyl ester as an alternative fuel in a four-stroke turbo diesel engine with four cylinders, direct injection. They applied test in which an engine was fuelled with diesel and three different blends of diesel/biodiesel (B25, B50 and B75) made from WCO. The test engine runned at 18 different speeds with a full load. They observed...
that the exhaust emissions of diesel/ biodiesel blends were lower than those of the diesel fuels, which indicates that biodiesel has more favourable effects on air quality.

D. Subramanian [7] examined performance, emission, and combustion characteristics of methyl esters of Punna, Neem, Waste Cooking Oil and their diesel blends in a C.I. engine. On the other hand, above B30 (30% Biodiesel with 70% diesel) a reduction in performance, combustion, and emission characteristics.

A.M. Liaquat [8] et al. used unproductive land to produce vegetable oil which is a potential biodiesel source has opened up a way to reduce oil bill. They were evaluated the performance and exhaust emissions of a diesel engine operated on “Envo Diesel” which consists of 5% palm diesel and 95% ordinary diesel fuel (also termed as P5) and C5 (5% coconut biodiesel and 95% ordinary diesel fuel. They were seen that P5 and C5 reduced brake power compared to diesel fuel by 1.2% and 0.7% respectively. Emissions such as HC, smoke, CO and NOx concentration were lesser for P5 and C5.

Gaurav Dwivedi [9] et al. derived biodiesel from the transesterification of vegetable oils was composed of saturated and unsaturated long-chain fatty acid alkyl esters. Accompanying with the imperceptible power loss, the increase in fuel consumption and the increase in NOx emission on conventional diesel engine with no or fewer modification there was the reduction in PM, HC and CO emissions. They were recommended the many further researches about modification on engine, low temperature performance of engine, new instrumentation and methodology for measurements, etc. while using biodiesel as a substitute of diesel.

V.Gopinath [10] et al. was used corn oil extracted from the germ of corn (maize). They were investigated the emission characteristics of single cylinder diesel engine using biodiesel blends and compares that with diesel fuel. Various emission parameters like NOx, Carbon dioxide and Unburned Hydrocarbon were tested with above blends and different load conditions. Compared to diesel fuel at all the load conditions, the emission parameters for IC engine fuelled with biodiesel blends were less.

Tom Varghese [11] et al. used algae based biodiesel with blends of Diesel additives and experimental investigation was done to find the engine performance and emission characteristic of a compression ignition engine by using organic materials also some other alchoholic substances as additives to diesel-biodiesel blends. They were noted engine emission to have reduced emission of hydrocarbon (HC) emission, Nitrogen oxide (NOx) emission, Carbon monoxide (CO) emission. It was done first by using pure diesel as base fuel, and then by adding nano particles to the diesel-biodiesel blends, which is the modified fuel.

G Lakshmi Narayana Rao [12] et al. disposed used vegetable oils from restaurants in large quantities. They were analysed the combustion, performance and emission characteristics of Used Cooking oil Methyl Ester (UCME) and its blends with diesel oil in a direct injection C.I. engine. A significant improvement in reduction of particulates, carbon monoxide and unburnt hydrocarbons was observed compared to diesel with minor decrease in thermal efficiency. They were used transesterified used cooking oil and its blends as fuel for diesel engines will reduce dependence on fossil fuels and also decrease considerably the environmental pollution.

Amrinder Mehta [13] et al. investigated the performance of methyl esters of Canola waste cooking oil and their blends in a direct injection diesel engine. Under various loading conditions the effects of pure biodiesel and their blends on engine performance, and exhaust emission were studied. They were concluded that up to 20% of methyl esters did not affect the performance parameter like fuel consumption rate and brake thermal efficiency. They were clearly observed that above CB20 (20% Canola biodiesel with 80% diesel) a decrease in performance and combustion parameter.

S.K. Sinha [14] et al. compared the 5%, 10%, 15% and 20% (v/v %) blends of Jatropha oil methyl ester (JOME) and ethanol with neat diesel and 100 %JOME in terms of performance and emission characteristics. They were found that brake thermal efficiency of the engine was higher for all the blends compare to baseline diesel fuel. The brake Specific energy Consumption (BSEC) was highest for 100% JOME and lowest for 20% % blend. At full load condition hydrocarbon emission (HC) was highest for diesel and lowest for 100% JOME due to presence of enriched oxygen.

III. CONCLUDING REMARKS

- Transesterification is widely used method for production of biodiesel.
- Wide research had done on Undi, Karanja, Jatropha biodiesel.
- Researchers adopted emission parameters viz. CO, Carbon dioxide and Unburned Hydrocarbon.
- Researchers observed that the exhaust emissions of biodiesel blends were lower than those of the diesel fuels, which indicates that biodiesel has more favourable effects on air quality.

REFERENCES


