

# A Review: Performance Evaluation of Single Cylinder Diesel Engine with Oxidized Biodiesel Blends

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**Abstract-** In this paper, the effort through by various researchers on the characteristics and applications of biodiesel were surveyed. The methods for the preparation of biodiesel and also various methods for the oxidized biodiesel were summarized. It was found that biodiesel is a superior clean source of energy in the domestic and industrial application. The blending of biodiesel with diesel decreases the percentage of NOx, CO and HC exhaust emissions. An attempt is made in this paper is to review the literature related to the use of biodiesel in various diesel engine under a variety of operating condition. Also, this paper serves as precious references on the preparation of oxidized biodiesel to use it on the diesel engine and change in the properties of biodiesel after oxidation.

**Index Terms-** diesel engine, oxidized biodiesel, unoxidized biodiesel, performance, blending, load.

## 1. INTRODUCTION

Diesel fuels play an important role in the development of most of the countries. These fuels play a major part in the transport sector and their consumption steadily increases. The high demand for diesel in the industrialized world and pollution problems, it is necessary to develop renewable energy sources this non-conventional sources of energy is BIO-DIESEL.

### 1. BIODIESEL:

Biodiesel is defined technically as “A fuel comprised of mono-alkyl esters of long-chain fatty acids derived from vegetable oils or animal fats, designated B100, and meeting the requirements of the American Society for Testing and Materials D-6751”. In simple terms, biodiesel is an ecofriendly fuel manufactured from methanol/ethanol and vegetable oil, animal fats, and recycled cooking fats (U.S. Department of Energy, 2006). Biodiesel only refers to 100% pure fuel (B100) that meets the definition above and

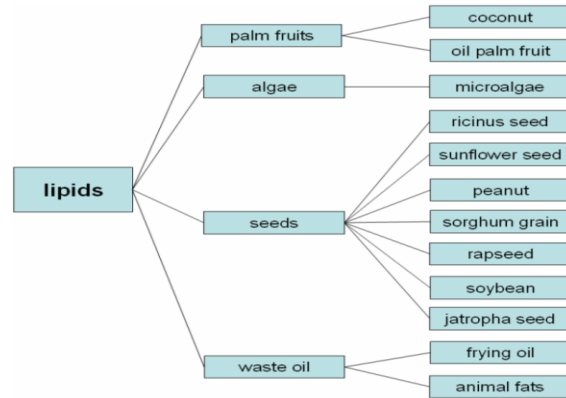


Fig1. Types and Classification of Lipid Feedstock Sources.

Specific standards are given by the American Society of Testing and Materials (ASTM) International (D 6751). There are many options for utilizing different types of pure plant oil and biodiesel production. They are shown in fig.1

## 2 OXIDISED BIODIESEL:

Biodiesel oxidation is a very complex process that is affected by a variety of Factor including the composition of the fuel itself and the conditions of storage. The oxidative degradation during long-term storage of biodiesel occurs mainly in the presence of air, heat, light, and pro-oxidants as a result of the formation of contaminants, such as alcohols, acids, aldehydes, peroxides, etc. The degradation reaction pathways for methyl esters derived from naturally occurring fatty oils are determined by the olefinic unsaturation on the fatty acid chain. The quality of biodiesel is designated by several standards, such as EN 14214 and ASTM D-6751 and the oxidation stability (OS) is among the monitored parameters.

### CHEMICAL OXIDATION:

The chemistry of oxidation is complex because fatty acids typically occur in

Complex Mixtures. Chemical oxidation is subcategorized into primary oxidation and secondary oxidation.

**PRIMARY OXIDATION:** Oxidation occurs by a set of reactions categorized as initiation, propagation, and termination.

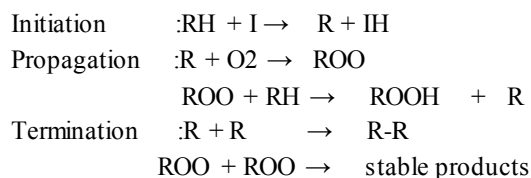


Fig: 2 primary processes during oxidation, where I indicate initiator

In oxidation, the first step (initiation) involves the removal of hydrogen from a carbon atom to produce a carbon-free radical. If diatomic oxygen is present, the subsequent reaction to form a peroxy radical becomes extremely fast, preventing the significant production of the alternative carbon-based free radical. The peroxy free radical is quickly abstract hydrogen from a carbon to form another carbon radical and a hydroperoxide (ROOH) in the second step (propagation). This chain reaction terminates when two free radicals react with each other to yield stable products like aldehydes, alcohols, and carbonic acids.

**SECONDARY OXIDATION:** The fatty oil hydro-per-oxides ultimately decompose to form hexenals, heptenals, propanal, pentane, and 2,4-heptadienal.(22-24).As hydro-per-oxides decompose, oxidation linking of fatty acid chains can occur to form species with higher molecular weights, known as oxidation polymerization. One of the results of polymer formation is an increase in the oil viscosity. This demonstrates that the oxidation decreases with increasing content of polyunsaturated methyl esters.

## 2. LITERATURE SURVEY

Following literature survey is done on the attribute and the properties of biodiesel to use in a diesel engine are:

Jun Cong Ge , it presents Using Canola Oil Biodiesel (COB) as an Alternative Fuel in Diesel Engines. This paper Summarizes and reviews studies related to the use of COB in different diesel engines under a variety

of operating conditions. It provides a detailed summary and review of the application of canola oil biodiesel to diesel engines based on the fuel performance (such as density, viscosity, oxygen content, cetane number, etc.), engine performance, and combustion and emission characteristics.

A. Monyem, the objective of this paper is” The Effect Of Timing And Oxidation On Emissions From Biodiesel–Fueled Engines”. *Biodiesel has different chemical and physical properties than diesel fuel, including a larger bulk modulus and a higher cetane number. Some of these properties can be affected by oxidation of the fuel during storage. The objective of this study was to evaluate the effect of injection and combustion timing on biodiesel combustion and exhaust emissions. A John Deere diesel engine was fueled with two different biodiesel fuels, one of which had been deliberately oxidized, and with their 20% blends with No. 2 diesel fuel. The engine was operated at three different timings and two loads at a single engine speed of 1400 rpm.*

N. Stalin and H. J. Prabhu worked on “Performance Test of IC Engine Using Karanja Biodiesel Blending with Diesel”. This paper present the performance of IC engine using karanja biodiesel blending with diesel and with various blending ratios has been evaluated. The engine performance studies were conducted with a prony brake-diesel engine set up. Parameters like the speed of the engine, fuel consumption, and torque were measured at different loads for pure diesel and various combinations of dual fuel. Brake power, brake specific fuel consumption, and brake thermal efficiency were calculated.

Mr. Venkata Sundar Rao they're worked on “Performance of the IC Engine Using Alternative Fuels” From these paper it is clearly observed that the effect of using alternative fuel on the design and life and the efficiency on IC engine parts like combustion chamber, liner, piston, piston rings are addressed. Here an attempt is made to design and develop IC engine parts that are most suitable for alternate fuels that last longer without affecting the performance of the Engine.

Mukesh Kumar research on “study of biodiesel as a fuel for ci engines and its environmental effects”, Here *a series of engine tests, with and without preheating have been conducted using each of the above fuel blends for comparative performance*

*evaluation. The results of the experiment in each case were compared with baseline data of diesel fuel.* The engine used in this study was a light-duty, direct-injection, four-cylinder, and four-stroke, turbocharged, intercooled diesel engine with a high-pressure common-rail fuel system. The common-rail fuel injection system was from Bosch, and has a high-pressure (over 1000 bar) fuel rail. The engine has a 3.3-L displacement, with a rated power output of 79 kW at 3200 rpm and a peak torque output of 275 Nm at 2000 rpm.

Amy Richards, a study on “evaluation of oxidative stability of canola oils by headspace analysis” Canola oils freshly extracted in the laboratory from different seed samples were subjected to accelerated oxidation and analyzed for peroxide value (PV) by standard methods and headspace volatiles by solid phase microextraction. The PV calculated using this formula correlated ( $R^2 = 0.73$ ) with those measured by conventional methods.

James Pullen, KhizerSaeed has discussed on “biodiesel oxidation stability” in this researches into biodiesel oxidation stability is presented in an attempt to convey the significance of this important property of biodiesel fuel. Aspects covered include significance of biodiesel oxidation stability, oxidation chemistry, methods used for characterization of stability, factors known to influence stability, and consequences of biodiesel oxidation for diesel engines. By 1. Compositional analysis: Gas or liquid chromatography methods, Various structural indices based on composition, such as Iodine Value (IV), APE, BAPE, OX, FFA, free and total glycerol content, Electromagnetic spectroscopy, 2. Primary oxidation product levels: Peroxide Value (PV), 3. Secondary oxidation product levels: Anisidine Value (ARV), (aldehyde content), Total acid number (TAN), Polymer levels, Quantities of filterable insoluble materials present, 4. Physical properties: Viscosity and density, Accelerated oxidation tests, such as Oil Stability Index (OSI) or Rancimat induction period (RIP), Pressurized-differential scanning calorimetry (P-DSC).

Shunji Kato has worked on “determination of triacylglycerol oxidation mechanisms in canola oil using liquid chromatography–tandem mass spectrometry”. They are trying to understanding oxidation mechanisms that cause the formation of Triacylglycerol hydroperoxide (TGOOH). With the

use of the method, photo- or thermal- oxidized edible oils were analyzed.

Venkata Ramesh Mamilla worked on “Performance analysis of IC engines with bio-diesel jatropha methyl ester (JME) blends” this investigates the percentage substitution of jatropha methyl ester blends to diesel as fuel for automobiles and other industrial purposes. The study details the analysis of the performance and emission characteristics of the jatropha methyl esters and its comparison with petroleum diesel. The tests were carried out on a 3.7 kW single cylinder, direct injection and a water-cooled diesel engine with different proportion of blending. The engine performance indicating parameters like brake power, indicated power, indicated thermal efficiency, brake thermal efficiency, mechanical efficiency, etc., have been observed for various blends at different loads.

B.L. Maharana study on “evaluation of the performance of diesel engine with biodiesel” In this paper biodiesel and its blending with pure diesel has been taken for the experimental work to evaluate the performance of four-stroke diesel engine. Their test was carried out on single cylinder 3.7 KW KIRLOSKAR diesel engine at 1500 R.P.M.

### 3. CONCLUSION

In this review paper, the discussion had been done about the various configurations for the Biodiesel enhancement. The conclusions drawn from literature review are listed below:

- Biodiesel can be used as alternative fuel in the Diesel engine without any engine modifications.
- Biodiesel and its blends as a fuel for diesel engine have better emission characteristics compared with diesel. CO emissions are less compared with diesel, NO<sub>x</sub> emissions for biodiesel and blended fuel are slightly higher than that of diesel, From this analysis, it can be concluded that 20% biodiesel gives better performance with reduced pollution.
- The oxygen atoms in COB play a major role in reducing CO, HC, and PM emissions. However, their presence promotes combustion, increase combustion temperature, and increase NO<sub>x</sub> emissions. EGR technology can significantly reduce NO<sub>x</sub> emissions.

- The oxidized and unoxidized biodiesels experienced shorter ignition delays than diesel fuel and had less premixed burning. The neat oxidized biodiesel had a 0.9° shorter ignition delay than the neat unoxidized biodiesel at the standard timing. Retarded injection timing reduced the ignition delay for all fuels.
- It is observed that by using the alternative fuel gum or wax is formed in the fuel tank after a long period. This wax will mix with the fuel and affect the IC engine performance. This problem does not exist in the regular fuel (diesel).

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