

# “Experimental studies on Performance Characteristics in Diesel Engine Using Different Blends of WCO Biodiesel”: a review

**Aniruddha Joshi 1**

*Assistant Professor, Mechanical Engineering,  
Department of Technology, Shivaji University, Kolhapur,*

**Dr. Anantkumar Gujar 2**

*Professor, Department of Mechanical Engineering,  
Dr. D.Y. Patil College of Engineering,  
Shivaji University, Kolhapur*

## **Abstract**

Indian populace dependably energetically holds up to eat hot items because of which the era of Waste Cooking Oil is more. Waste cooking oil (WCO) is enormously accessible in eateries, lodgings and other cooking sources in India. In the present days concerns in regards to vitality assets and the earth have expanded enthusiasm for the investigation of option sources like generation of biodiesel by utilizing WCO to give an appropriate diesel oil substitute for inner burning motors. The use of fluid energizes, for example, biodiesel delivered from waste cooking oil by transesterification utilizing methanol with antacid impetus NaOH/KOH prepare speaks to a standout amongst the most appropriate choice. In this proposed examine work, essentially Biodiesel is delivered through Transesterification handle by utilizing WCO and mixed with petroleum diesel in different extents B10, B25, B30. Optionally this paper surveys the Experimental reviews on Performance Characteristics in Diesel Engine utilizing diverse mixes of delivered Biodiesel at variable stacking conditions.

**Keywords:** Waste Cooking Oil, Transesterification, Biodiesel and Diesel Blends, Diesel Engine

## **Introduction**

The overall investigates on diesel Engine have accomplished verifiable outcomes like improvement of diesel motors with high warm effectiveness and particular power yield, keeping inside the casing of forced emanations directions that consistently turns out to be more stringent. Some another accomplishments for the improvement of cleaner diesel motors have been made, by different motor related procedures, such as the utilization of basic rail frameworks, fuel infusion control methodologies, fumes gas distribution, fumes gas after-treatment, and so forth [1,2]. Besides, particularly for the lessening of contamination emanations, analysts have centered their enthusiasm around the area of fuel-related procedures, such as the utilization of option powers having renewable nature that are agreeable to the earth [5,6], or oxygenated powers that demonstrate the capacity to diminish particulate outflows [7], for the most part with an expansion of the transmitted nitrogen oxides. Substitution (halfway) of fossil powers with renewable biofuels has been set as an objective worldwide to decrease nursery impact and vitality reliance.

Historically, fossil diesel fuel has successfully contributed in all sectors such as agricultural, transportation and industrial sectors because of their adaptability, high combustion efficiency, availability, reliability as well as the handling facilities. However, their reserves are wiping out every day. Several factors such as world-wide environmental concerns, price hiking of the petroleum products as well as the expected depletion of fossil diesel fuel have promoted to look over the clean combustion of diesel engine using alternative fuel sources. Since last decades researchers around the world have been trying to find new alternative fuels that are available, technically feasible, economically viable and environmentally acceptable [3].

Various vegetable oil esters implies biodiesel have been attempted as other option to diesel fuel. A considerable measure of analysts have detailed that with the utilization of vegetable oil ester as a fuel in diesel motors, least hurtful fumes outflows and also equal motor execution with diesel fuel were accomplished. Biodiesel is non-hazardous, biodegradable, non-combustible, renewable, non-lethal and also condition neighborly. It has comparable properties with diesel fuel. The significant focal points of biodiesel are; it can be mixed with diesel fuel at any extents, can be utilized as a part of a diesel motor with no adjustment, does not contain any unsafe substances and deliver less hurtful outflows to the earth [8].

There are four essential approaches to create biodiesel: loss of motion, miniaturized scale emulsification, weakening and Transesterification. Transesterification is a procedure of changing over vegetable oil into biodiesel fuel. This procedure supplies a fuel that can be worked in unmodified diesel motors [7]. In the present review, we concentrating on taking after audit goals; Careful study of Biodiesel production Process and Properties of Biodiesel

1. To identify current Problems of diesel engines running on biodiesel.
2. To design a layout for Experimentation
3. To test engine performance and emission characteristics of biodiesel blends and diesel fuel in an unmodified diesel engine with suitable software and equipments.
4. To compare results of different blends.

We are locked in with generation of biodiesel from waste cooking oil by utilizing any impetus with high return rate. Fundamental point of this review is to research the motor

execution; discharge and ignition qualities of a diesel motor fuelled mixes of diesel and created biodiesel; B10, B25 and B30. It is additionally expected that the new information exhibited here will help in growing new techniques or systems to take care of current diesel motor issues.

## EXPERIMENTAL

### -Production of Biodiesel from Waste cooking oil

The crude materials like waste vegetable oils or ordinarily known as waste cooking oils is one of the option sources among different sources [3]. Squander cooking oil is anything but difficult to gather, for example, local utilization and eatery and furthermore less expensive than different oils (refine oils). Henceforth, by utilizing these oils as the crude material, we can lessen the cost in biodiesel creation. The benefits of utilizing waste cooking oils to deliver biodiesel are the minimal effort and avoidance of condition contamination. These oils should treat before arrange to the earth to counteract contamination. Because of the high cost of transfer, numerous people arrange squander cooking oils specifically to nature particularly in provincial zone. The kinematic consistency of waste cooking oil (UCO) is around 10 times more noteworthy, and its thickness is around 10% higher than that of mineral diesel. These properties assume essential part in the ignition procedure of Diesel motor; in this manner these must be changed before to the utilization of WCO in the motor. Numerous procedures have been produced to diminish the kinematic consistency and particular gravity, which incorporate pyrolysis, emulsification, inclining and transesterification. Among these procedures, transesterification is the most loved strategy. This is a direct result of the way that this strategy is generally simple, did at typical conditions, and gives the best change productivity and nature of the changed over fuel [3].

Transesterification technique, which alludes to a catalyzed concoction response including waste cooking oil and liquor to yield unsaturated fat alkyl esters (i.e., biodiesel) and glycerol. The response requires an impetus, ordinarily a solid base, for example, sodium and potassium hydroxide. An impetus is normally used to enhance the response rate and the yield. Particularly methanol is utilized as liquor on account of its ease and its physical and synthetic preferences. Methanol can rapidly respond with waste cooking oil and NaOH can without much of a stretch break up in it. To finish a transesterification response stoichiometrically, a 3:1 molar proportion of liquor to triglycerides is fundamental. The triglycerides are responded with a reasonable liquor (Methyl, Ethyl, or others) within the sight of an impetus under a controlled temperature for a given time span. The last items are Alkyl esters and Glycerin. The Alkyl esters, having great properties as fills for use in CI motors, are the fundamental item and the Glycerin, is a result.

For the laboratory scale production of Biodiesel from WCO following Equipments and apparatus required;

1. Magnetic stirrer
2. Heater
3. Separating funnel
4. Two conical flasks

5. Thermometer and Weighing balance

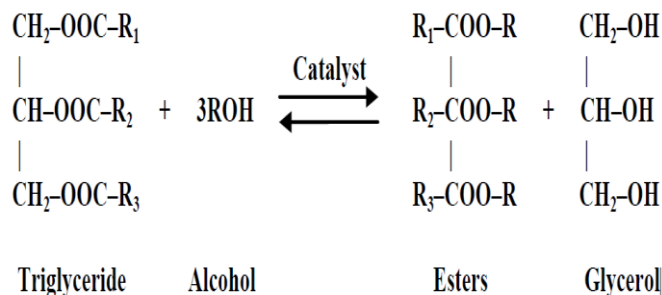


Figure 1: WCO reaction [10]

### Reagents:

1. Methanol (CH<sub>3</sub>OH)
  2. Sodium Hydroxide (NaOH)/ Potassium Hydroxide (Koh)
- For this research; following production process flow chart we are going to use which is based on the transesterification of triglycerides by alcohols to fatty acid methyl esters, with glycerol as a byproduct.

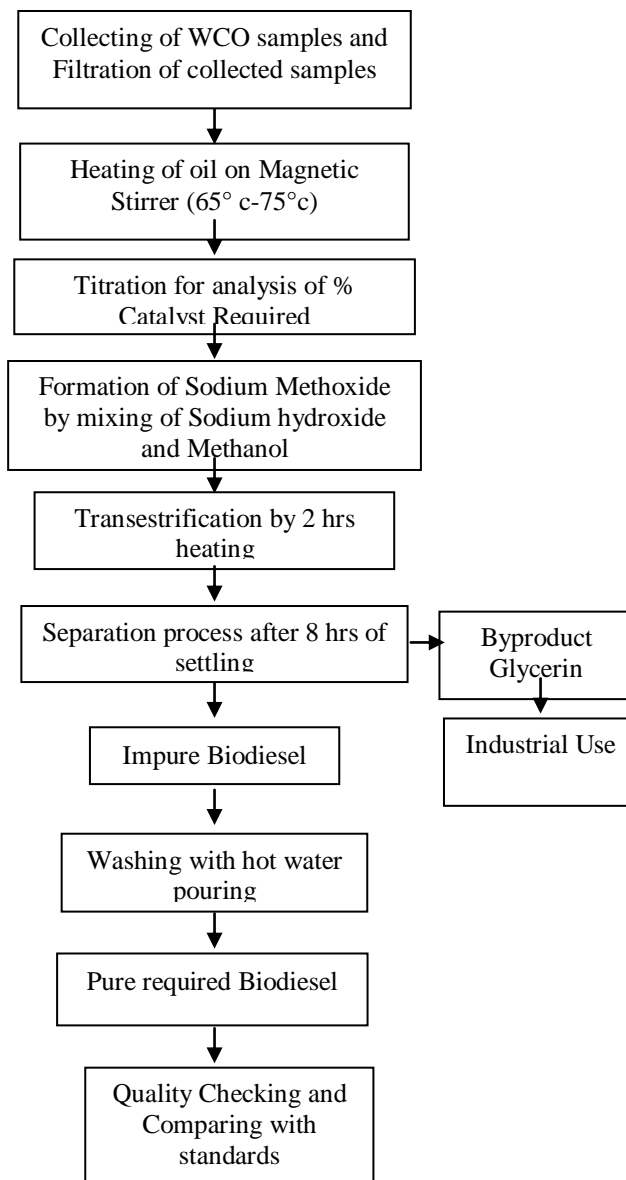


Figure 2. Flow Chart of WCO Biodiesel Production Process

### -WCO Biodiesel Blending With Diesel

To defeat the restrictions of diesel fuel, it is worthwhile to mix WCO biodiesel with diesel fuel without much motor alterations. Consequently, the relative "advantage" of each fuel may be used. The mixed fuel holds the alluring physical properties of diesel fuel yet incorporates the cleaner blazing ability.

At universal level fewer endeavors by analysts are seen in the utilization of Biodiesel-diesel mix fuel in CI motor. The mix B10 (90% diesel and 10% WCO biodiesel), B25 (WCO 25% biodiesel and 75% diesel) and B30 (WCO 30% biodiesel and 70 % Diesel) and so forth is required to do for finding of best reasonable option for the execution examination of diesel motor. The expansion of WCO biodiesel to diesel fuel changes the physicochemical properties of energizes. With an expansion of WCO Biodiesel mass part in mix, Cetane number, C/H proportion and oxygen substance of the mixes are improved.

### -Performance Characteristics in Diesel Engine Using Different Blends of produced Biodiesel

The points of interest of the trial set up required for this exploration is exhibited beneath. The data about the motor, segments, instrumentation and controls utilized as a part of test motor are portrayed.

In this paper work it has been proposed to do Experimental reviews on Performance Characteristics in Diesel Engine Using Different Blends of Biodiesel like B10, B25, B30 and so on. Prior columnist directs the examination on execution attributes of diesel motor works under biodiesel fuel and advances in these for better yield; notwithstanding, Performance Characteristics in Diesel Engine Using Different Blends of Biodiesel is required to complete. Henceforth, it displays a chance to investigate use of the Engine, Dynamometer, Smoke meter, Exhaust gas analyzer, there legitimate usage for better yield to keep up simplicity of operations with superior and least ecological contamination. Additionally in this paper work, Analysis of Temperature variety and the execution parameters, for example, Brake Power (BP), Brake warm proficiency ( $\eta_{B.th}$ ), particular Fuel utilization (bsfc), Exhaust Gas temperature (EGT) is required to complete. The discharge parameters, for example, Carbon Monoxide (CO), Carbon dioxide (CO<sub>2</sub>), Un-copied hydrocarbons (UHC), Nitrogen oxides (NO<sub>x</sub>) and Smoke Opacity (Smoke) will be assessed and examined from charts.

In this work we proposed to do probes a solitary barrel four stroke diesel motor. Trial set up proposed for this work is as per the following;

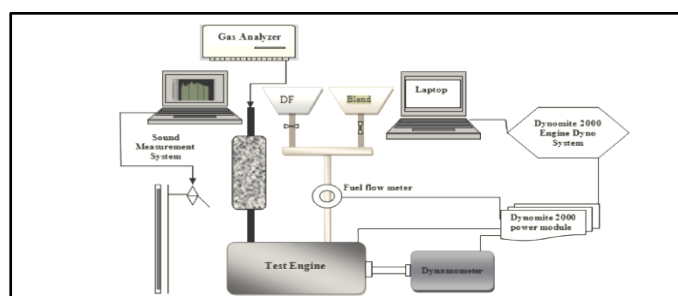


Figure 3. Proposed Layout of Experimental Work [9]

Figure 1 gives proposed layout details of experimental work, The experimental investigation will carried out using different blends with diesel fuel, B10 (90% diesel and 10% biodiesel), B25 (25% biodiesel and 75% diesel) and B30 ( 30% biodiesel and 70 % Diesel). In order to carry out engine performance tests, the engine will run on different load conditions like Starting from no load observation was recorded at 20%, 40%, 60%, 80% and 100% of rated load, keeping the throttle open. The engine should be equipped with a DC electrical dynamometer to measure its output. The dynamometer will be calibrated statistically before use. Load will be controlled by changing the field current. Engine test conditions should be monitored with the help of computer/ Laptop connected to the engine test bed. A exhaust gas analyzer will be used to measure the exhaust emission gases NO<sub>x</sub>/NO, HC and CO. The emissions analyses have been conducted only at maximum engine speed. To get the average values, all tests will be repeated. Analysis will be carried out with the help of suitable software.

Considering the dependency on the Diesel there is need for alternate fuels, this experimental investigation will provide better solution, which should be feasible to daily use without any major modification of diesel engine [17]. This dissertation work will provide outcomes like change in Brake thermal efficiency and volumetric efficiency, Brake specific fuel consumption and Exhaust gas temperature for different blends, this is because of high viscosity coupled with lower heating value of the fuels. Also we expect reduction in the emission of Hydrocarbon HC, CO, NO<sub>x</sub> & smoke with different blends. We will predict the best suitable blending percentage which suits to meet basic needs and to do it in a way that promotes sustainable development.

### Conclusion

In this review of research work, the brief explanation about the experimental methodology and the expected results are discussed. Performance, emission and combustion characteristics of a direct injection compression ignition engine fueled with waste cooking oil biodiesel and their blends with diesel will be experimented and compared with diesel fuel. Results of the review work are summarized as; the diesel engine can perform satisfactorily on biodiesel and its blends with the diesel fuel without any major engine modifications. It is also studied that there will be significant reduction in CO, UBHC and smoke emissions for biodiesel and its blends compared to diesel fuel. However, NO<sub>x</sub> emission of WCO biodiesel will slightly higher than petroleum diesel. It can be concluded that WCO biodiesel could replace the diesel in order to help in controlling air pollution, encouraging the collection and recycling of waste cooking oil to produce biodiesel and reduce the dependency on fossil fuel resources to some extent without changing engine performance.

### References

- [1] Shailen Saha, J. U. AhamedM. A. Razzaq, S.M.Fahadullah, Himal Barman and Sajal Kumar Bala, "Production of Biodiesel from Waste Vegetable Oil",

- Proceedings of the International Conference on Mechanical Engineering and Renewable Energy 2015 (ICMERE2015) 26 – 29 November, 2015
- [2] Alemayehu Gashaw, Abile Teshita, “Production of biodiesel from waste cooking oil and factors affecting its formation: A review”, *International Journal of Renewable and Sustainable Energy* 2014; 3(5): 92-98
- [3] Anton Alexandru Kiss, “Process Intensification Technologies for Biodiesel Production”, *Springer Briefs in Applied Sciences and Technology*, 2014, ISBN: 978-3-319-03553-6 (Print) 978-3-319-03554-3 (Online).
- [4] M. Mofijur\*, H.H. Masjuki, M.A. Kalam, A.E. Atabani, Evaluation of biodiesel blending, engine performance and emissions characteristics of *Jatropha curcas* methyl ester: Malaysian perspective, ElsewherePublication, *Energy* 55 (2013) 879e887.
- [5] Ebtisam K. Heikal, Salah A. Khalil, and Ismaeil K. Abdou, “*Jatropha* Bio-Diesel Production Technologies”, *International Journal of Bioscience, Biochemistry and Bioinformatics*, Vol. 3, No. 3, May 2013.
- [6] Nithyananda B. S, Anand A, Dr. G. V. Naveen Prakash, “ Performance Study on Diesel Engine Using Different Blends of Neem Biodiesel”, *International Journal of Engineering Research and Applications (IJERA)* ISSN: 2248-9622, Vol. 3, Issue 4, Jul-Aug 2013, pp.1778-1781.
- [7] Bobade S.N and Khyade V.B, Detail, “Study on the Properties of *Pongamia Pinnata* (Karanja) for the Production of Biofuel”, *Research Journal of Chemical Sciences*, 2(7), 2012, 16-20.
- [8] Pooja Ghodasara, Mayur Ghodasara, “Experimental Studies on Emission and Performance Characteristics in Diesel Engine Using Bio-Diesel Blends and EGR (Exhaust Gas Recirculation),” *International Journal of Emerging Technology and Advanced Engineering Website: (ISSN 2250-2459, Volume 2, Issue 2, February 2012).*
- [9] Nishant Tyagi, Ambuj Sharma, “Experimental Investigation of Neem Methyl Esters as Biodiesel on C.I Engine”, *International Journal of Engineering Research and Applications*, 2, 2012, 1673-1679.
- [10] M. Prabhakar, R. Murali Manohar, S.S endilvelan, “Performance and Emission Studies of a Diesel Engine with *Pongamia* Methyl Ester at Different Load Conditions”, *International Journal of Engineering Research and Applications*, 2, 2012, 2707-2713
- [11] Prafulla D. Patil, Veera Gnaneswar Gude, Harvind K. Reddy, Tapaswy Muppaneni, Shuguang Deng, “ Biodiesel Production from Waste Cooking Oil Using Sulfuric Acid and Microwave Irradiation Processes”, *Journal of Environmental Protection*, 2012, 3, 107-113 /jep.2012, .31013 Published Online January 2012
- [12] A.B.M.S. HOSSAIN and A.N. BOYCE, “Biodiesel production from waste sunflower cooking oil as an environmental recycling process and renewable energy”, *Bulgarian Journal of Agricultural Science*, 15 (No 4) 2009, 312-317, Agricultural Academy
- [13] A. Singh, B. He, J. Thompson, J. Van Gerpen, “Process optimization of biodiesel Production using alkaline catalysts”, *Applied Engineering in Agriculture*, Vol. 22(4): 597-600 \_ 2006 American Society of Agricultural and Biological Engineers ISSN 0883–8542.
- [14] Machacon HTC, Seiichi Shiga, Takao Karasawa, Hisao Nakamura, “Performance and Emission Characteristics of a Diesel Engine Fueled with Coconut Oil – Diesel Fuel Blend”, *Journal Biomass Bioenergy*, 2001, (20). PP: 63-69
- [15] Cigizoglu, K. Baris, Ozaklam Turgon, Karaosmanoglu. “Use of Sunflower Oil as an Alternative Fuel for Diesel Engines”, *Energy Sources*, Vol. 19, 6, July, 1997, P.559-566.
- [16] Sapvan S.M., Nasjuki H.H., Azlan, A., “Use of Palm Oil as Diesel Fuel Substitute”, *Proceedings of the Institution of Mechanical Engineers, Part-A, Journal of Power and Energy*, Vol.210, N1, 1996, PP: 47-53.
- [17] Srinivasa Rao, R and Gopala Krishna, K.V., “Esterified Vegetable Oils as Fuels in Diesel Engines”, *XI National Conference on I.C. Engines & Combustion*, PP: 171-179, 1989.