

Archives available at journals.mriindia.com

International Journal on Mechanical Engineering and Robotics

ISSN: 2321-5747

Volume 14 Issue 01, 2025

To Study the Effect of Nanoparticles Additives on CI Engine Performance and Emission of Using Non-Edible Biodiesel - Diesel Blends

Nikita D. Khope¹, Monika K. Grawkar², Mohit M. Belsare³, Sandip S. Gote⁴, Shivam H. Bhoyar⁵

Department of Mechanical Engineering, Sarodiya College of Engineering & Technology, Nagpur

Peer Review Information	Abstract
<i>Submission: 11 Feb 2025</i> <i>Revision: 20 Mar 2025</i> <i>Acceptance: 22 April 2025</i> Keywords <i>Carbon Nano-Additive</i> <i>Diesel Engine</i> <i>Biodiesel</i> <i>Performance</i>	This paper investigates the performance and emission traits of single cylinder diesel engine below diverse awareness of Multiwalled Carbon Nanotube (MWCNT) in blends algae biodiesel were investigated to establish the impact of MWCNT as nano-additive at the blend's biodiesel utilized in diesel engine and pursuits to lessen the emissions of hydrocarbon and carbon monoxide into the environment.

Introduction

With our present known shops and the growing price of usage, its miles anticipated that they may be not going to maintain going lengthy. these limited belongings of oil and really moved in unique locales of the world has presented ascend to non-stop interruptions and vulnerabilities in its supply and additionally value. Due deficiency of diesel gas and its expanding cost, a alternative wellspring of fuel for diesel is specifically required. it has been determined that vegetable oil hold super assure in such way when you consider that they may be delivered from the flora broaden in rural areas.

Literature Review

It turned into located, the appropriate thermal performance of the engine was acquired with blends containing as much as 50% quantity of algae oil. From homes and engine test results it's been mounted that forty-50% of algae may be

relieved for diesel without any engine modification and preheating of the blends [1]. The CO emission become reduced through 73-diesel. The smoke opacity was decreased by way of 20-80% by means of the use of B20 to B100 gas in comparison to diesel. The NO_x emission became additionally observed to be decreased with an ordinary reduction of 26% by way of using biodiesel and its blends with diesel compared to diesel [2]. The brake thermal efficiency for biodiesel and its blends was observed to be barely higher than that of diesel gasoline at examined load situations and there has been no difference among the biodiesel and its mixed gasoline efficiencies. For algae biodiesel and its mixed fuels, the exhaust gas temperature increased with an increase in energy and quantity of biodiesel. but Diesel blends confirmed affordable efficiency, lower smoke, CO₂, CO, and HC, and barely increase in NO_x emission [3]. The increased exhaust gas temperature may additionally warmness the combustion chamber also accordingly responsible more load on engine cooling and lubrication system [4].

The emission CO, HC and smoke have been decreased with MWCNT mixed domestic compared to neat home. The addition of MWCNT to algae oil methyl ester effects in an increase in NOX emission as compared to neat domestic however lower than pure diesel. the author has mentioned, ensuring better dispersion of MWCNTs in biodiesel remains a subject to research [5]. A mild vehicular motor (car motor) releases 1 to two kg pollution amid an afternoon and overwhelming autos releases 660 kg of CO amid 12 months. The carbon monoxide is very lethal and the introduction for couple of hours to grouping of 30 ppm can make weaknesses physiological capacities [6]. With the addition of Graphene, MWCNT, and silver nanoparticles to domestic turned into greater the combustion characteristics and catalytic activity of the gasoline, and thereby reduces emissions and ignition put off for the duration of the combustion technique [7]. It became concluded that CNT mixed emulsion gasoline has capacity gain of

enhancing engine overall performance and decreasing emissions [8]. For alumina blended check fuel, percentage reduction of NO emission by means of nine %, Smoke opacity by way of 17 %, unburned hydrocarbon by way of 33 % and carbon monoxide by means of 20 % are discovered together with percent discount of NO emission through 7 %, Smoke opacity through 20 %, unburned hydrocarbon by way of 28 % and carbon monoxide by using 20 % for cerium oxide combined take a look at gasoline [9].

Methodology Fuel Preparation

In nanotechnology, sonication is maximum broadly used approach for uniformly dispersing nanoparticles in base liquid. For getting ready blends of diesel and biodiesel with Multiwalled Carbon Nanotube (MWCNT) Probe type ultrasonicator changed into used.



Figure 1: MWCNT Nanomaterial

Fuel Preparation Procedure

The harmonized blending of algae methyl ester (AME) and diesel done with the assist of digital Magnetic Stirrer to form blend mix biodiesel at 700 RPM for 30 minutes. For dispersing Nano components in organized blends of diesel and

algae biodiesel with MWCNT in extraordinary concentrations of MWCNT of 50 mg, 75 mg and 100 mg had been correctly weighted with car calibrated Electronics digital weighing scale provided facility by using the Physics branch laboratory of our college.



Figure 2: Digital Magnetic Stirrer

Formation of fuel blends with MWCNT

Multiwalled Carbon Nanotubes (MWCNT) are combined with combination of diesel and algae biodiesel of two unique proportions of algae

biodiesel 20% through volume (B20) and 30% with the aid of quantity (B30) in 3 exceptional concentrations of 50 mg/lit, 75 mg/lit and a hundred mg/lit

Table 1: Details of MWCNT

SN	Item	Specification
1	Average particle diameter	12-15 nm
2	Average length	0.5-5 μm
3	No. of shells	8-15
4	Surface area	231.85 m ² /g
5	Purity	More than 97%
6	Appearance	Black powder

EXPERIMENTAL SETUP

Experimental Setup for performance testing



Figure 3: The diesel engine experimental setup (front view)

Table 2: The specification of the Engine.

Make and Model	Kirloskar
General details	1- cylinder, 4-S, CI, vertical, DI, water cooled
Bore	80mm
Stroke	110mm
Rating speed	1500 rpm
Swept Volume	553cm ³
Clearance Volume	0.03687 m ³
Compression ratio	12.5-17.5
Rated power	3.7KW

Measurement of Exhaust Gas Emission

The AVL Di-gas 4000 mild make 5 fuel analyzer changed into used to measure diverse constitutes

within the engine exhaust gases including HC, CO, NOX, and CO₂.

table four.1 info of exhaust gasoline analyzer.



Figure 4: AVL Di-gas 4000 gas analyzer

RESULT AND DISCUSSION

Emission Characteristics

The subsequent emission parameters were measured and as compared for diesel, diesel-biodiesel blends and blends with dispersed MWCNT:

- Carbon monoxide (CO)
- Hydrocarbon (HC)

Variation in Carbon Monoxide (CO) Emission

Figure shows the emission of Carbon Monoxide (CO) as opposed to engine BP. The carbon monoxide emission from the engine is oblique indication of incomplete combustion of fuel because of lack of combustion and poor mixing of air-gas. At the overall load situation, the share composition of CO will increase with increase in

engine Brake power for all gas. due to inherently oxygen content material found in biodiesel composition, the CO emission turned into marginally reduced with biodiesel mixture gasoline compare to conventional diesel for all loads. there was extra reduction in carbon monoxide (CO) emission with the nano additives (MWCNT) in blends of biodiesel B20 & B30.

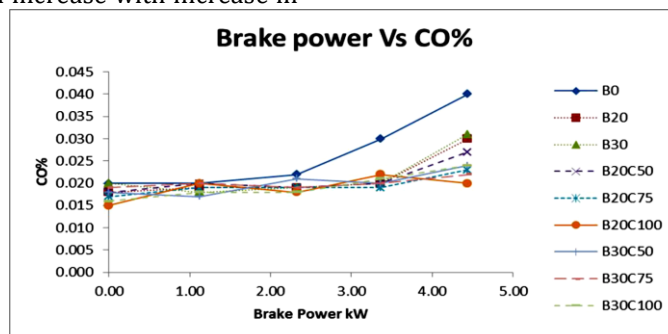


Figure 5: Variation in carbon monoxide emission

With increasing the attention of MWCNT in blends of biodiesel the CO emission decreases for all gas blends. The addition of MWCNT in base fuel improve the surface quantity place with the aid of improving atomization of fuel which complements air gasoline blending and burning price gives greater whole combustion and subsequently lessen CO emission. The better discount in CO emission become located at full load with nanoparticles dispersed combo in comparison to natural diesel and Blends without MWCNT. At complete load the CO emission was 0.040%, 0.030% & 0.031 for diesel, B20 & B30 respectively, wherein because it turned into 0.027%, 0.023%, 0.020%, 0.024%, 0.022% and 0.024% with B20C50, B20C75, B20C100, B30C50, B30C75 and B30C100 respectively. Therefore, at complete load CO emission for

B20C100 & B30C75 considerably lessen examine to B20 & B30. also, it can be determined that MWCNT combined biodiesel suggests decrease CO emission compared to diesel and blends without MWCNTs.

Variation in Hydrocarbon (HC) Emission

The variation of hydrocarbon (HC) emission is represented in Figure 6. The hydrocarbon emission from the engine is direct indication of incomplete combustion of gas. The hydrocarbon emission for biodiesel blends turned into lower for all brake electricity evaluate to pure diesel because of better oxygen content of biodiesel. The addition of MWCNT in blends of diesel and biodiesel (B20 & B30) effects in reduction in HC emission as seen in Figure 6.

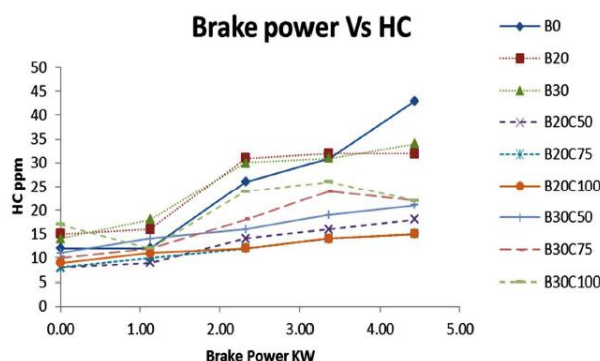


Figure 6: Variation in hydrocarbon emission

The MWCNT nanoparticles introduced to the gasoline enhance the combustion which reduces HC emission. At lower load, there has been no huge distinction in HC emission the various check fuels because of lower gasoline intake charge at decrease load. Also, it is visible from the Fig. 5.1

that the HC emission decreases with increasing dosing level of MWCNT within the gasoline.

At complete load the HC emission have been 43, 32 & 34 ppm for diesel, B20 & B30 respectively, wherein as it became 18, 15, 15, 21, 22 and 22 with B20C50, B20C75, B20C100, B30C50, B30C75 and B30C100 respectively. in addition,

blends with MWCNT shows decrease HC emission evaluate to neat diesel.

Conclusion

The overall performance and emission traits of unmarried cylinder diesel engine underneath diverse attention of MWCNT in blends B20 and B30 biodiesel had been investigated to set up the impact of MWCNT as nano-additive at the blend's biodiesel. Primarily based on experimental effects following conclusions is derived:

The addition of nanoparticles in the gas decorates the atomization of gasoline which improve air fuel mixing and burning fee which offers greater complete combustion. Therefore, there was noteworthy reduction in HC and CO emission through using MWCNT delivered biodiesel blends.

At complete load CO emission decreased by 10%, 25.81%, and 25.nine% with B20C50, B20C75 and B20C100 in comparison to B20, and 22.6%, 29%, and 22.6% with B30C50, B30C75 and B30C100 respectively as compared to B30, while extensive reduction found in HC emission by means of 45.75%, 53.13%, and 53.12% with B20C50, B20C75 and B20C100 compared to B20, and 38%, 35.3%, and 35.3% with B30C50, B30C75 and B30C100 respectively compared to B30.

References

K. Pramanik, "Properties and use of jatropa curcas oil and diesel fuel blends in compression ignition engine," *Renew. Energy*, vol. 28, no. 2, pp. 239–248, 2003

H. Raheman and A. G. Phadatare, "Diesel engine emissions and performance from blends of karanja methyl ester and diesel," *Biomass and Bioenergy*, vol. 27, no. 4, pp. 393–397, 2004.

R. Yarrapathruni, S. Voleti, R. Pereddy, and R. Alluru, "Jatropha oil methyl ester and its blends used as an alternative fuel in diesel

engine," *Therm. Sci.*, vol. 13, no. 3, pp. 207–217, 2009.

S. Kumar, A. Chaube, and S. K. Jain, "Experimental evaluation of C.I. engine performance using diesel blended with Jatropha biodiesel," *Int. J. Energy Environ.*, vol. 3, no. 3, pp. 471–484, 2012.

P. Tewari, E. Doijode, N. R. Banapurmath, and V. S. Yaliwal, "Experimental Investigations on a Diesel Engine Fuelled With Multiwalled Carbon Nanotubes Blended Biodiesel Fuels," *Int. J. Emerg. Technol. Adv. Eng.*, vol. 3, no. 3, pp. 72–76, 2013.

V.M. Domkundwar in *Internal Combustion Engines*; 3rd Edn. Dhanpat Rai & Co., Delhi, 2010, pp. 7.17-7.18, 22.65-22.67.

N. R. Banapurmath, R. Sankaran, A. A. V. Tumbal, N. T. N, A. M. Hunashyal, and N. H. Ayachit, "Experimental investigation on direct injection diesel engine fuelled with graphene, silver and multiwalled carbon nanotubes-biodiesel blended fuels," *Int. J. Automot. Eng. Technol.*, vol. 3, no. 4, pp. 129 – 138, 2014.

J. Sadhik Basha and R. B. Anand, "Performance, emission and combustion characteristics of a diesel engine using Carbon Nanotubes blended Jatropha Methyl Ester Emulsions," *Alexandria Eng. J.*, vol. 53, no. 2, pp. 259–273, 2014.

P. Arockiasamy and R. B. Anand, "Performance, combustion and emission characteristics of a D.I. diesel engine fuelled with nanoparticle blended jatropa biodiesel," *Period. Polytech. Mech. Eng.*, vol. 59, no. 2, pp. 88–93, 2015.

M Vaishnav,P mekhuri , "A Study of emission and performance characteristics of CI engine implementing biodiesel adding nano particles components as an additive" *ICRTESM-2016,10th April2016,, ISBN 978-81- 932074-4-4.pg. 229-237*