

Retraction

Retracted: Analysis of Environmental Emission Neat Diesel-Biodiesel–Algae Oil-Nanometal Additives in Compression Ignition Engines

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

- (1) Discrepancies in scope
- (2) Discrepancies in the description of the research reported
- (3) Discrepancies between the availability of data and the research described
- (4) Inappropriate citations
- (5) Incoherent, meaningless and/or irrelevant content included in the article
- (6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their

agreement or disagreement to this retraction. We have kept a record of any response received.

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- [1] R. Surakasi, M. Y. Khan, A. S. Sener et al., "Analysis of Environmental Emission Neat Diesel-Biodiesel–Algae Oil-Nanometal Additives in Compression Ignition Engines," *Journal of Nanomaterials*, vol. 2022, Article ID 3660233, 7 pages, 2022.

Research Article

Analysis of Environmental Emission Neat Diesel-Biodiesel–Algae Oil-Nanometal Additives in Compression Ignition Engines

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The production of biodiesel as an alternative fuel and its use as a mixture and other additives are presented. In the present research work, additive blends with diesel biodiesel from algae oil are physically characterised and an analysis of pollutant emissions is carried out when used in an ignition engine by compression. The measurement of pollutant emissions is carried out through a combined emission analyzer adapted to a system of valves attached to the experimental facility. The properties of each mixture with the polluting emissions are compared with that of the reference diesel. It was found that each of the properties improves compared to that of diesel, reducing most emissions in the use of mixtures with biodiesel.

1. Introduction

Natural resources such as oil, natural gas, and coal have a wide range of applications in science and technology; these resources and their derivatives are widely utilised in power plants, boilers, and some car engines to meet people's demands worldwide. On the other side, the rapid growth of humanity has increased energy demand, which is predicted to increase by 50% by 2040 compared to current levels. This has resulted in a faster depletion of these nonrenewable resources, which are the study of renewable energies which aim to ensure energy security in some form [1]. The energy resources from oil, natural gas, and coal are not sustainable to meet energy demand. The fields identified are dwindling, and there are environmental constraints for

their exploration and development and geopolitical issues. It leads to possible oil and gas reserves and gas becoming scarcer and the exploitation of more restrictive carbon regulations. The increasing industrialization, the motorization of the world, and climate changes have resulted in the hunt for alternative fuels that may be generated using raw materials available in any country. The world's vehicle fleet is powered by gasoline and diesel, which pollute the environment due to their polluting emissions, so bioenergetics such as biomass, biogas, primary alcohols, vegetable oils, animal oils, and biodiesel have been studied. Although the fuels above are part of the solution to the challenge of being environmentally friendly, advantages and disadvantages in their use must be examined in each of them. It is crucial to note that some of the fuels mentioned above can be used directly. Still,

others must be treated or formulated so that their qualities are comparable to those of the conventional fuel being replaced. Biodiesel and bioethanol are the most widely used biofuels in the world [2]. It is critical to have a clean fuel that does not pollute like traditional diesel and is also nontoxic as it can be used as a mixture with diesel to improve the mechanical efficiency of the engines. High lubricating properties and improved thermal efficiency due to a high compression ratio decreased fuel consumption, reduced sulphur dioxide emissions, and increased engine operating safety due to its high flash point [3]. The massive accumulation of tyre waste, a result of the number of vehicles that exist all over the world, causes us to look at another medium problem environmental, uncontrolled disposal and nonbiodegradability of tyres, which leads to the need for careful action regarding recycling of tyres used to solve this problem. The waste refinery entails thermochemical processes to produce fuels, materials, and chemicals from wastes such as tyres, plastics, sludge, and other wastes due to their chemical composition and carbon and hydrogen richness. They constitute a possible source for the manufacture of fuels. The performance of biofuels and diesel engine emissions is increasingly being studied globally [4]. Because biodiesel is clean, energy-efficient, and highly biodegradable and has strong lubricating properties, it has been explored extensively. Improving diesel fuel's physical and chemical qualities is important to use 100% biodiesel cleanly. Biodiesel as a fuel alternative can only be utilised in compression ignition engines, provided it meets the worldwide standard biodiesel criteria. Chains of unsaturated fatty acids and the double bond in the parent molecule reacting with oxygen during combustion and storage cause the fuel to become acidic, creating a rubber and insoluble silt that can clog filters. Biodiesel's thermophysical properties influence its performance, combustion, and emission characteristics. The viscosity, density, cetane number, calorific value, flashpoints and ignition, cloud point, and pour point of biodiesel are important parameters to consider. According to several types of research, its properties are dependent on fatty acid concentration and chemical composition [5]. So, before utilising biodiesel in a diesel engine with compression ignition, it must meet the ASTM D6751 and EN 14214 criteria. The physicochemical qualities of the fuel used in an engine are vital in determining performance and emissions: injection pressure, compression ratio, ignition delay, air-fuel ratio, and chamber turbulence. Combustion and other factors directly affect compression ignition performance. The most common ternary mixture studied is ethanol-biodiesel-diesel. According to the high latent heat of vaporisation and lower combustion temperature, ternary fuel mixing yields reduced NO_x , smoke, and higher HC and CO emissions. Increasing the quantity of ethanol in blended fuels reduced the peak smoke emission peaks. The ethanol in biodiesel/diesel blends is ideal for lowering NO_x emissions. The binary biodiesel-diesel mixture reduced particle concentration and mass emission. Adding ethanol in biodiesel mixtures results in higher fuel consumption and CO and HC emissions, but decreased NO_x emissions [6]. This research examines the physicochemical properties of binary

and ternary mixes and their environmental pollution emissions. In a compression ignition engine, each fuel is characterised by its harmful emissions of NO_x , CO, CO_2 , HC, and PM.

2. Polluting Emissions

The study of harmful emissions from engines is currently very important because of the high degree of pollution they create as a factor. It has been changed into the main axis while developing a machine due to the strict rules that have been set today for environmental protection and mitigation. Within the pollutants of a diesel engine, this research finds nitrogen oxide, unburned hydrocarbons, carbon monoxide, dioxide carbon, and particulate matter [5]. When oxygen and nitrogen are combined at high temperatures, these gases are formed: nitrogen monoxide, nitrogen dioxide, nitrous oxide, dinitrogen trioxide, and dinitrogen pentoxide are the principal nitrogen oxides that occur in combustion chambers and have a significant influence on the environment and human health due to their toxicity. Fuel that has not been properly burned when it departs the engine's internal combustion chamber through the exhaust is known as unburned hydrocarbons. Because of the low concentration of HC in the exhaust gas, the typical unit of measurement is parts per million (ppm). Carbon dioxide is another name for carbonaceous anhydride and carbonaceous gas (II). Despite its critical relevance for all living things as the primary carbon source, carbon dioxide is significant. The use of fossil fuels has resulted in a rapid increase in carbon dioxide content in the atmosphere, resulting in global warming [6]. They are a collection of small solid entities or liquid droplets scattered in the atmosphere due to anthropogenic or natural activities. Many microscopic soot particles are created mostly caused by the incomplete burning of fossil fuels and coal. It is critical to emphasise that particulate matter does not all have the same physical and chemical properties; it varies in size, shape, and chemical makeup.

3. Experimental Installation

The diagram of each of the engine components is shown in Figure 1. The experimental installation consists of a diesel engine, a mass flow sensor, an IR rpm sensor, a data acquisition and control system, and an analyzer of gases. The diesel engine in the installation is a 4-cylinder engine, 5.9 L, 180 HP @2500 rpm 6BTA model, which is shown in Figure 1. For engine, rpm control has a metal gear servo motor model RB-330 MG and an infrared sensor model E18-D80NK for rpm. It has a control system in the LabVIEW software through which it is activated and speeds up and slows down the engine as required. The gas analyzer that the experimental installation has is a gas analyzer combined with gases. The analyzer consists of basic equipment, gas analyzer and opacimeter in a high-quality plastic housing with an integrated display unit and keyboard, a grating measuring probe of 600 mm steel, 2000 mm probe hose, one LAN interface with LAN cable (RJ 45), a power supply 110 V-230 V, 50/60 Hz, a transparent hose for condensate separation with



FIGURE 1: Experimental setup with engine and analyzer.

the receiver, one main filter, point filter zero and condensate filter, an electrochemical O_2 sensor, trigger clamps for MET 6.4 for the inductive recording of the number of revolutions in ignition cables, and measurement value software for continuous measurement.

4. Experimental Protocol

Experimental protocol for measuring polluting emissions: once the physicochemical characterisation of the established mixtures has been carried out; the polluting emissions are measured. The medicines are injected into the Cummins 4 cylinder engine, model 6BTA 5.9 L, 180 HP using the combined gas analyzer MET. The equipment's method is to pass an infrared light through a gas cell and measure each gas's energy absorbed with chemical gas sensors. The MAHA Emission and Viewer software communicates via an Ethernet connection to the analyzer. Through this software, tests are carried out of tightness and the zero adjustment required when starting the measurements and controlling the beginning and end of the test. Similarly, the MAHA Emission Viewer software monitors the test since its interface allows you to view sizes in real time. It is important to highlight that all the tests are carried out under the same conditions for the same period where the engine runs empty without any load. Five trials are performed on the test bench for each experimental trial to verify repeatability in the sampling. Then, averages are obtained, minimum value and maximum value to be graphed later. In each test, the exhaust gases CO_2 , CO, NO_x , HC, and PM are measured and monitored oxygen, rpm, and oil temperature. Verification of equipment connection and operation of the LabVIEW user interface: once the experimentation starts in the laboratory of the SCR begins by verifying that all the equipment of the installation necessary for the measurement is connected and

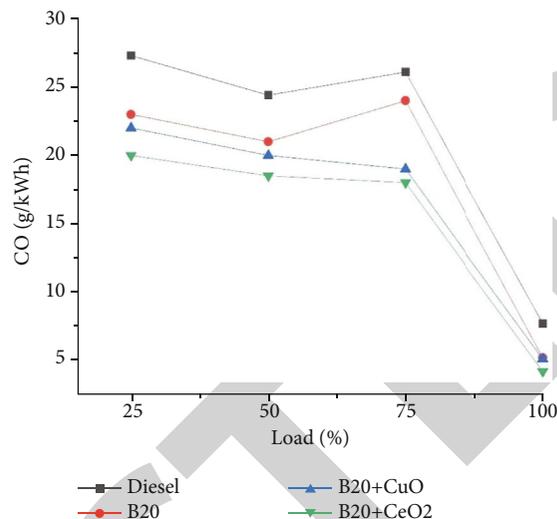


FIGURE 2: Variation of CO with load.

working correctly. The computer is turned on, and in the LabVIEW program, the file test 14 is opened, where the engine control interface will appear. It is important to emphasise that you must check that the signal module box is turned on before running the program. The gas analyzer is then connected to its wiring network to prepare for the start of trials.

5. Result and Discussion

This section shows the results of the polluting emissions of each of the mixtures of the importance of CO, CO_2 , HC, NO_x , and PM. The results obtained from the present investigation are shown below. A comparison is made with the properties of the reference diesel. The polluting emissions measured in the present investigation for defined mixtures are CO, CO_2 , NO_x , HC, and PM. Five measurements were made during a time of 1 minute for each of the mixtures from which a weighted average and said value are the published ones. The analyzer used performs simultaneously measuring each one of the reported emissions. The engine was operated in all tests at 1000 rpm without load; the power and the specific fuel consumption are not measured in the experiment. It is important to mention that the oil temperature was monitored in each of the measurements to take them at the same temperature, in the range of 86 to 88°C.

5.1. CO Emissions. The formation of carbon monoxide depends on the oxygen content and the combustion temperature so that combustion with a supply of inadequate oxygen results in the production of carbon monoxide. Figure 2 represents the raw values of CO emission from pure diesel and other blending fuels [7]. The CO values are for mixtures B20+CeO₂100ppm, B20+CuO100ppm, B20, and D100 at 1000 rpm. Figure 2 shows how the combination of biodiesel and nanoparticle affects slightly polluting emissions. In the case of biodiesel, the trend line shows that adding biodiesel to diesel causes CO to decrease which coincides with the literature where they report that carbon

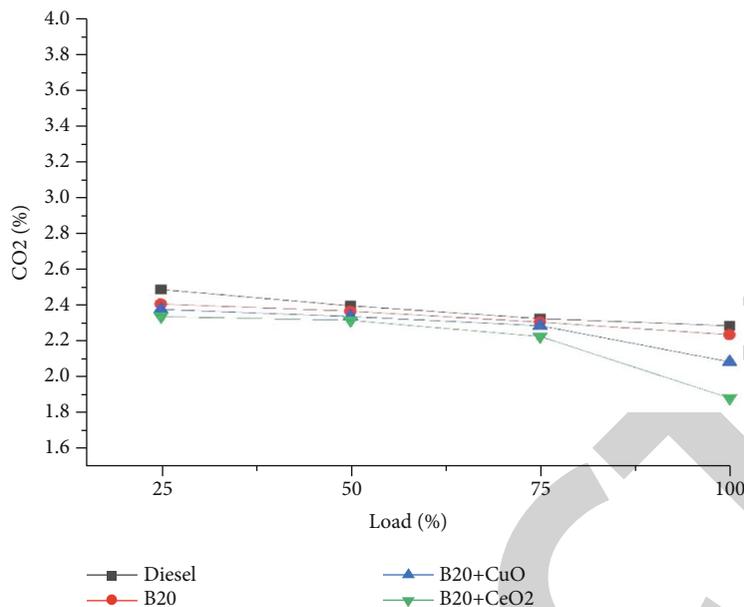


FIGURE 3: Variation of CO₂ with load.

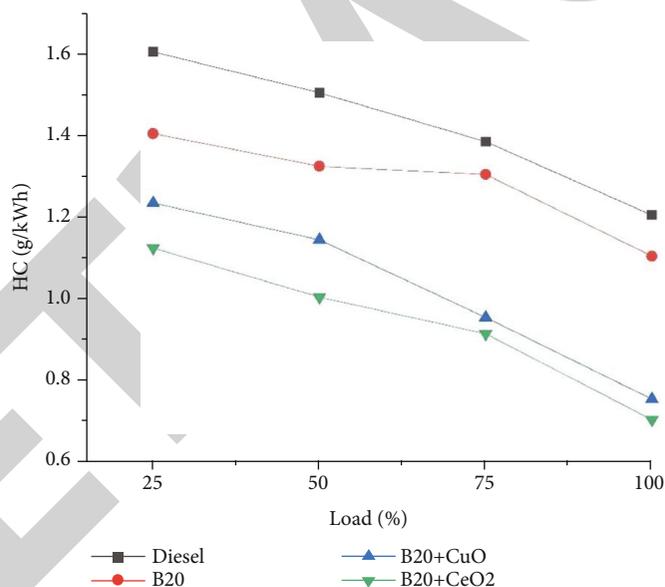


FIGURE 4: Variation of HC with load.

monoxide emissions of carbon blend with biodiesel are lower due to the presence of extra oxygen in biodiesel molecules. It is observed that as the percentage of algae oil is increased, the value of monoxide is closer to the diesel value. Light oil is a naphthenic fluid composed of carbons and hydrogens like diesel and is not an oxygenated compound like biodiesel [8].

5.2. CO₂ Emission. The CO₂ emission is the result of the complete combustion of the fuel. Figure 2 represents the raw values of CO₂ emission of pure diesel and other blending fuels. The carbon dioxide values are for mixtures B20 +CeO₂100ppm, B20+CuO100ppm, B20, and D100 at

1000 rpm. It is seen in Figure 3 that the importance of carbon dioxide that emits the combination with biodiesel participation is within the same rank [9]. In the case of algae oil, as its percentage of participation increases, the amount of CO₂ decreases, possibly due to less complete combustion with increasing percentage. However, if you compare the reference diesel and all the mixtures, when 100 ppm of algae oil is added, values are below the value of the diesel; these are the mixtures that emit the less amount of carbon dioxide. Figure 3 shows the dimensionless values concerning diesel from reference, where it is observed that for B20 +CeO₂100ppm and B20+CuO100ppm of biodiesel, the addition of nanoparticles does have a great impact [10].

5.3. HC Emissions. HC emissions occur when a rich mixture is delivered to the cylinder. The cross does not burn completely, which can be reduced by delaying the ignition associated with fuels with a higher cetane number [11]. Figure 4 shows the effects of test fuels on HC emissions. The highest HC emission is obtained for pure diesel, B20, B20+CeO₂100ppm, and B20+CuO100ppm. The lowest HC emission for mixtures is obtained for B20+CeO₂100ppm; this value is less than that for diesel, due to which its naphthenic characteristics need more energy to break its bonds and have complete combustion. For mixtures with biodiesel, the opposite occurs. Due to the oxygen content, the explosion of this is more complete. For all varieties, the same effect occurs as in the mixtures of a decrease in HC for nanoparticle mixtures. The addition of nanoparticles has the same impact when comparing the diesel mixture. There is no noticeable variation when adding one or the other; however, all combinations decrease the amount of HC [12–14].

5.4. Nitrogen Oxides. The emissions of nitrogen oxides in combustion result from the combustion temperature in the cylinder, which if it is approximately higher than 1600°C, the nitrogen molecules begin to participate in the reaction and, therefore, produce NO_x [15]. The variation of the emissions of nitrogen oxides concerning 1000 rpm for all test fuels is presented in Figure 5. In the nanoparticle mixture, slight increases in NO_x emissions are compared with B20+CeO₂100ppm, B20+CuO100ppm, B20, and diesel. This is a consequence of the high content of oxygen in biodiesel which causes higher NO_x emission rates; as the amount of participation of these nanoadditives increases, the oxides of nitrogen increase [16, 17]. Figure 5 shows that the number of nitrogen oxides was lower for all ternary mixtures evaluated for the same engine speed. It is observed in the graph of dimensionless values for the ternary mixtures that the emission of NO_x has a very particular trend by increasing the percentage of nanoadditives for each quantity of biodiesel in the mix, which can be attributed to the fact that the additive would be accelerating the ignition time of the diesel and reducing the amount of mixture in the combustion premixed resulting in NO_x reduction. It is important to mention that the formation of NO_x is not only a function of the temperature of combustion, factors such as the geometry of the piston and the fuel play a vital role in their formation [18].

5.5. Particulate Matter (PM). The amount of particulate matter emitted into the atmosphere is a consequence of a combination of parameters such as engine speed, load, strategy of injection, combustion process, and ultimately the after-treatment system. Particles are considered any material in the exhaust gases in a liquid or solid state under approximately ambient conditions [19]. Figure 6 shows the particulate matter for the mixtures, managing to observe that, compared to the reference diesel, the PM emissions for all the mixtures decrease in speed conditions of 1000 rpm on the engine—the PM concentration of the mixtures B20+CeO₂100ppm, B20+CuO100ppm, B20, and diesel [20]. As the percentage of nanoparticle concentration of particulate

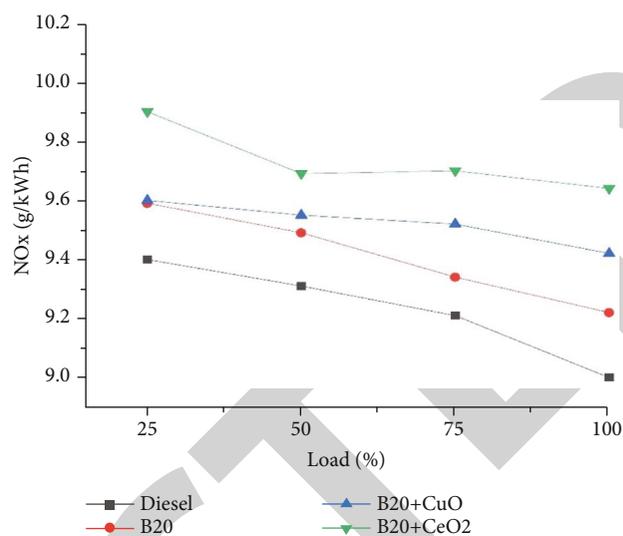


FIGURE 5: Variation of NO_x with load.

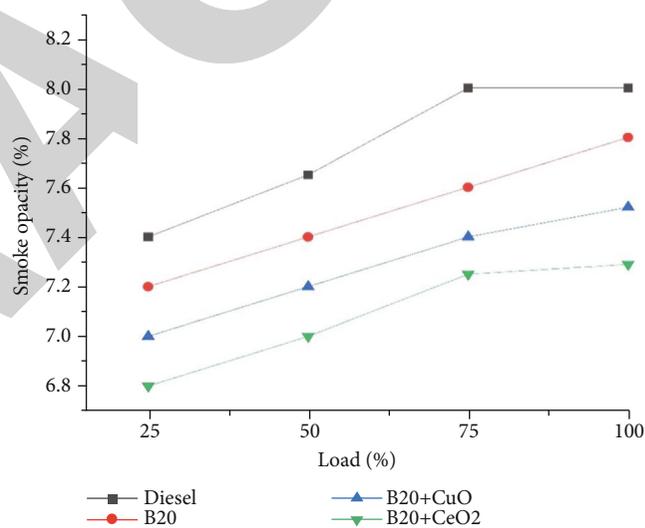


FIGURE 6: Variation of NO_x with load.

material rises, the mixture with higher PM is diesel [21]. As seen in Figure 6, as the mixtures increase, the PM concentration does not significantly impact. However, the particulate material for mixtures with biodiesel decreases with more oxygen molecules. However, more studies should be done to carry out a deeper discussion of the behaviour found. In the same way, it was observed that the nitrogen oxides decreased as an effect of the addition of nanoparticles, which would cause a decrease in the particulate matter possibly caused by a shorter duration of the combustion and the increase of the oxygen concentration in the mixture of air and fuel or also due to complete combustion [22, 23].

6. Conclusions

This study is aimed at analyzing polluting emissions from mixtures between B20+CeO₂100ppm, B20+CuO100ppm,

B20, and diesel to evaluate its use in compression ignition engines. Pollutant emissions from mixtures: the CO emitted by pure diesel is higher than that by all mixtures with biodiesel and nanoadditive blends. CO₂ emissions from blends with biodiesel are lower compared to those from pure diesel fuel. In the medicines, the diesel had a greater effect on the emission of CO, although adding biodiesel mixture with nanoadditives, due to its content of oxygen, decreases the percentage of CO. All the mixtures studied in this investigation showed that their HC emissions are lower compared to the pure fuel diesel. NO_x emissions for blends with biodiesel with nanoadditives are higher than those of diesel due to their oxygen content. The particulate matter for all the mixtures evaluated in this study is below the reference diesel. The mixtures with the highest particulate matter emitted mixtures with higher concentrations of biodiesel, which was of a maximum of 20% for this study. In the varieties, as biodiesel content was increased, NO_x emissions increased while PM emissions decreased, as mentioned in the literature.

Data Availability

The data used to support the findings of this study are included in the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest regarding the publication of this paper.

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