Webology, Volume 18, Number 5, 2021
ISSN: 1735-188X
DOI: 10.29121/WEB/V18I5/5

Evaluate the Effectiveness of Aqueous Alumina Nano-Fluid on the Engine load and Speed test of CI Engine under Ambient conditions

Durgeshwar Pratap Singh[1], Manish Kumar Lila[2]

[1]Department of Mechanical Engineering, Graphic Era Deemed to be University, Dehradun, Uttarakhand India, 248002
[2]Department of Mechanical Engineering, Graphic Era Deemed to be University, Dehradun, Uttarakhand India, 248002

ABSTRACT

Nanocrystals are nanomaterial concentrations in fluids that significantly improve the flow and heat transfer as well as combustible aspects of a resultant emulsion. The improvements in the efficiency and emissions parameters of the direct injection diesel engine were tested and validated in this work by utilising the burning of a combination of nanofluids with standard petroleum diesel. Therefore, in research, the nano-Al2O3 was employed; different mass proportions of these nanomaterials were combined with water to generate a nanomaterial suspension. Weighed percentages of 2, 4, 6, 8, and 10% were utilised. The resultant solution was then introduced to the gasoline at a predetermined volume fraction and well stirred. Research findings show that adding a nano-alumina-water suspension boosted braking thermal efficiency by 7.1% as well as lowered comparative gas mileage by 4.21% when compared to using diesel fuel. Particulate as well as acoustic pollutants were determined to be fewer than petroleum diesel during an investigation of released exhaust fumes, although emissions of carbon dioxide rose.

Keywords: Alumina Nano-Fluid; Engine load; Engine Speed; Performance Characteristics; Heat transfer rate.

INTRODUCTION

Due to their effective as well as dependable efficiency, internal combustion vehicles are frequently employed in vehicles, railroads, heavy machinery, and the military. The sustainability of this substance, like that of other oil substitutes, is uncertain since oil supplies are depleting more quickly than projected population increase as well as the desire for more energy. Many risks, including global warming, ozone depletion, including environmental issues, have driven some countries to impose stringent controls on effluents discharged by such vehicles, resulting in a rising demand for biofuel production [1]. In recent days, academics have focused on the notion of employing crude oil emulsions. The use of this emulsification in gasoline engines improves engine power while lowering pollutants as well as energy consumption. Numerous benefits of using gasoline emulsification were

Webology, Volume 18, Number 5, 2021
ISSN: 1735-188X
DOI: 10.29121/WEB/V18I5/5

recorded, including lower fuel usage, better combustion characteristics, and much lower engine pollutants. As described in the sources, using a moisture dispersion is also an efficient technique to minimise nitrogen oxides as well as particulate debris pollution [2]. A nano emulsion is created by combining nanomaterials with fluids. When compared to the corresponding liquids like boiled linseed oil, nanoparticles were demonstrated to have improved thermal characteristics like heat flux, thermoelectric dispersion, stiffness, especially friction factor. The heat transfer coefficient of a nanofluid also increases as the volumetric percentage of nanomaterials inside the suspensions increases.

Alloys like aluminium, including compounds like alumina (Al2O3), have long been used as additions in heated gasoline as well as explosions because of their maximum flame efficiency. Rapid innovations in nanotechnology and nanotechnology have enabled the manufacture, tracking, and characterization of nanostructures of various sizes. Nanostructures have demonstrated significant benefits above micron-sized compounds [3]. The massive surface area of metal nanoscales causes brief bursts of igniting, which reduces burning duration and results in a more thorough burning than stutter stepping. Incorporating nanoparticles into gasoline to improve burning is an intriguing idea. The unique properties of alloys, particularly aluminium, improve power generation in vehicles, decreasing the use of hydrocarbons as well as pollutants like hydrogen sulphide dioxide. The addition of nanotubes to gasoline reduces the igniting time delay as well as enhances gasoline combustion via catalysing the hydrolysis. Furthermore, research on the igniting behaviour and burning of hydrocarbons using nanostructures is currently scarce [4].

Numerous scientists have done experiments in cyan (NM) constructs using aluminium hydroxyl as well as graphite layers. Several investigations revealed a greater likelihood of combustion. The majority of the investigators employed nano-aluminium (n-Al) and emulsifier for nanomaterial additions that increased combustion speeds while decreasing fuel usage. These micro particulates inside the attached gasoline can burn visually, resulting in a diffused explosion within the combustor. The goal of this research is to assess the influence of a hydrophilic aluminium nano-fluid addition on multi-cylinder internal combustion engine performance such as carbon dioxide, carbon monoxide, nitrogen oxide, automobile exhaust, particulates, as well as acoustic pollution. The findings have been measured separately by using normal diesel gasoline devoid of additives. One fundamental goal of this study is to assess burning improvements and gain a good awareness of n-Al2O3 degradation in a diverse multimodal environment [5].

EXPERIMENTAL SETUP

The investigational motor undergoing investigation is a liquid pneumatic valve (DI) multiple, throughout, naturally turbocharged turbo Tipo 501. Table 1 lists the essential characteristics which make up the motor is connected to a hydraulic cylinder, which causes the turbine to work harder by increasing torque. The vapours from the exhaust system enter the analyser via a sensor but are separated from any accompanying humidity by condensation resistors before being sent to the measurement batteries. The sender transmits an IR laser beam using optical devices onto the recorded components. The ocean absorbs distinct light wavelengths depending on its composition.

Webology, Volume 18, Number 5, 2021
ISSN: 1735-188X
DOI: 10.29121/WEB/V18I5/5

TABLE 1. CHARACTERISTICS OF ENGINE

Type of Engine	Diesel Engine 4-stroke in line
Combustion Type	Water Cooled, DI
Engine Valve	Two
Stroke	110 mm
Bore	100 mm

Because of its chemical nature, oxygen, nitrogen gas, as well as oxygen gas need not catch the released photons. As a result, their amounts of such chemicals cannot be determined using radiation. Because of its chemical structure, CO2, especially HC, absorbs visible rays at certain frequencies. The oxygenation levels are measured using a molecular sensor in the testing apparatus. The acoustic measurement was taken with a precise measuring instrument equipped with only an Italian-made microphone model 4615, which calculates the total loudness in disciple units (Dp). A regular mobile telephone was used to synchronise the gadget.

Various specialised instruments can be employed to assess changeable particle quantities based on the use of particle-size-related attributes like the feasibility of electromobility, molecular size, the influence of centrifugal forces and mass, as well as the blocking spectra. The overall substances were measured using a machine technique in this investigation. The validated equipment has a 0.5 percent point error when monitoring fine particulate particles ranging from 5 to 250 g/m^3.

FUEL PREPARATION AND CHARACTERIZATION

The application of nanomaterials in chemical mixes requires essentially dispersing particulates in fluids to avoid binding as well as subsequent accumulation in tanks or pipes. To achieve a normal range as well as the dissemination of such particles, immunotherapy requires a homogenous and persistent suspension for just an extended length of time, which results in a low degree of particles over time. Several investigations have shown that adding lubricants can prevent particulate gathering as well as concentration in nanostructures. The company's submicron aluminium with just an approximate diameter of 50 nm of nanofluids was employed inside the ongoing investigation [6].

The precise characteristics of the utilised materials are listed in Table 3. This submicron gasoline mixture is made by combining plain water without nanoparticles and combining this one with gasoline for at least 30 minutes while using a vibratory mixer to guarantee a homogenous mixture of freshwater liquid fuel oil. This watery graphene combination is stored inside a 250 ml beaker test and thus is examined weekly to assess the emulsion's durability as well as the potential period of usage. Vibration blending was employed as just a substitute to the application of additional surfactants throughout this investigation. Since the acid value of a diesel is fairly low, and thus the introduction of freshwater lowers it even more, high cetane changer kind colleagues found nitrates were already applied to equalise the emulsified octane rating with the baseline gasoline utilised.

RESULTS AND DISCUSSION

4.1 Engine Load analysis

Fig. At steady rotational speeds, 1 reflects the influence of cylinder pressure on blended fuels. Fuel

Webology, Volume 18, Number 5, 2021
ISSN: 1735-188X
DOI: 10.29121/WEB/V18I5/5

economy decreased even as the volume percentage of hydrophilic nano-alumina inside the mix increased. The decreases remained confined to small percentages. In comparison to plain gasoline, the reductions were 1.8%, 3.7%, and 4.1% for 2%, 4%, and 6% N-Al2O3 additions, correspondingly. Average decreases of 7% as well as 10% additions remained at 8.12% and 11.28%, correspondingly. The decreases obtained using increased nitrogen percentage addition are similar to those documented by the other studies. This decrease in blended fuels can be due to a decrease in igniting delayed time due to oxygen enhancement within the combustor that results in more burning. Those findings are consistent with previous research. Such modifications also boosted braking efficiency, as seen in Figure1. The increases in heat release rate were 0.0042%, 2%, 3.2%, 3.98%, and 6.21% for N-Al additions of 2, 4, 6, 8, and 10%. The findings suggest that when heated, nano-alumina may react with water to produce hydrogen, which accelerates combustion by-products [7,8].

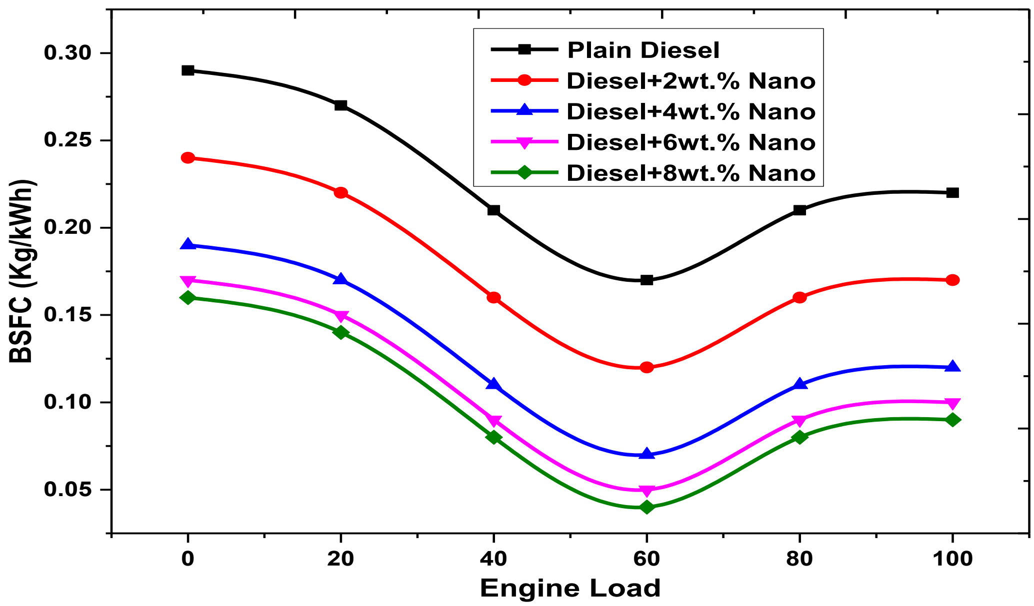

Fig.1. The variations of BSFC based on the Engine loads

The combustor improves because nano-sized aluminium has a higher thermal conductivity as well as an overpotential to stimulate natural process breakdown and O2 and H2 formation.However, introducing modest viscosities of freshwater N-Al2O3 did not elevate either the motor brake specific fuel consumption or even the braking thermal efficiency sufficiently. Increased braking efficiency indicates greater utilisation of heat produced inside the combustor; this could be proven by examining the impact of introducing N-Al2O3 to the biodiesel blend upon pressures and temperatures, as shown in Fig 2. Exhaust stream emissions were lowered by the volume concentration of hydrophilic N-Alumina.

Webology, Volume 18, Number 5, 2021
ISSN: 1735-188X
DOI: 10.29121/WEB/V18I5/5

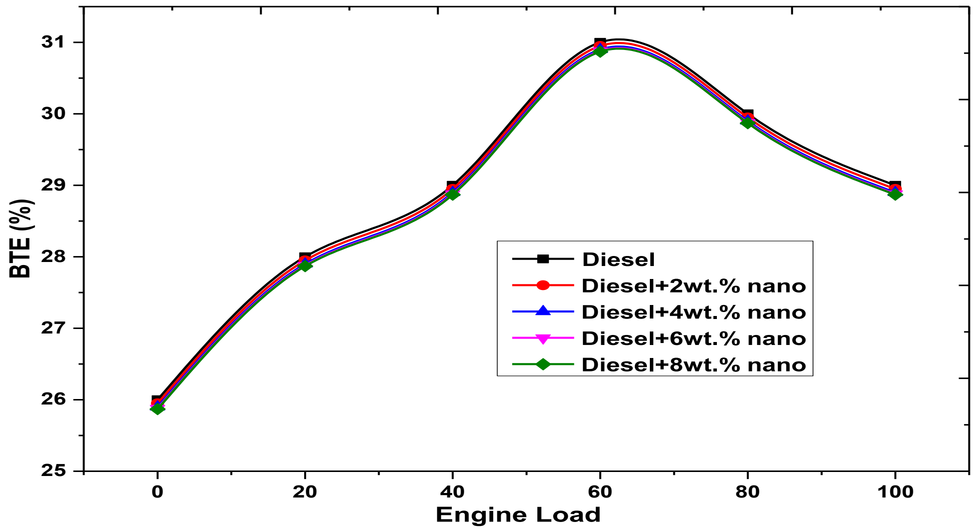

Fig.2. The variations of BTE based on the Engine loads

When compared to diesel, the decreases were 3.21%, 15.32%, 21.36%, as well as 28.69% for 2, 4, 6, 8, and 10% N-Al2O3 emulsified mixes, correspondingly. Figure 2 depicts the fluctuation concentration induced by the addition of aqueous N-Alumina. CO2 levels increase by 0%, 10.25%, 15.36%, 29.62%, and 31% for 2, 4, 6, 8, and 10% increases, correspondingly. As a result of the addition of N-Alumina, carbon dioxide content was lowered. The current findings show the CO2 level increases when N-Al2O3 is added, particularly in large mass fractions. Such increases might be attributed to decreases in both CO and HC content generated by burning efficiencies [9,10].

4.2 Engine Speed Analysis

As the volumetric percent of hydrophilic N-Alumina inside the mix increases, so does the overall power of the braking system, as shown in Figure 3 derives. In comparison to pure gasoline, overall pp increases were 1.08%, 2.63%, 4.25%, 4.98%, and 5.89% for 2, 4, 6, 8, and 10% freshwater N-Al2O3 additions. This graph reveals that somehow a low proportion of N-Alumina supplementation had little effect just on pp, but 8% as well as 10% additions improved the arterial pressure. This bps gain is due to a reduction in blended fuels, as seen in Fig. 2b stands for when compared to diesel, it must have been lowered by 1.03%, 3.21%, 4.89%, 6.32%, and 16.25% for 2, 4, 6, 8, and 10% hydrophilic N-Alumina additions. As rotational velocity climbed, exhaust stream emissions climbed as well, yet decreased as the hydrophilic N-Al volume percentage inside the mixtures improved, as seen in Fig. 2c elucidates. Engine exhaust emissions were significantly reduced by 0.06%, 0.421%, 5.02%, 10.36%, and 15.23% in comparison to pure gasoline for examined mixtures of 2, 4, 6, 8, and 10% freshwater N-Al2O3 but instead of gasoline.

Webology, Volume 18, Number 5, 2021
ISSN: 1735-188X
DOI: 10.29121/WEB/V18I5/5

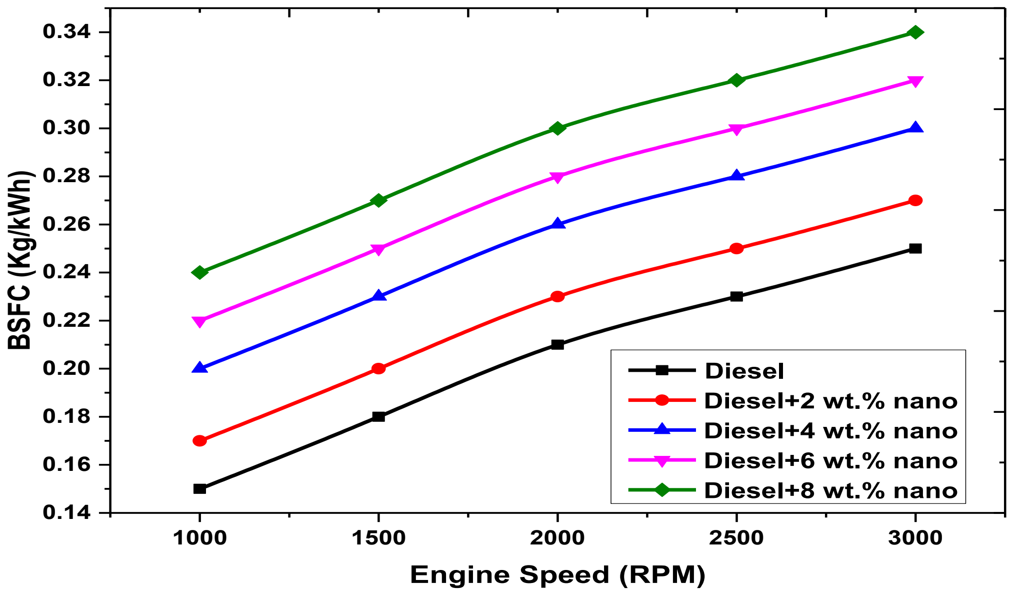

Fig.3. The variations of BSFC based on the Engine speed

As shown in Fig. 1, Co2 levels rose at turbocharger power as well, with a growing hydrophilic N-Alumina weight percentage in mixtures. Figure 3 stands for in comparison to pure gasoline, the increases are 2.1%, 5.23%, 7.01%, 10.25%, and 11.63% for 2, 4, 6, and 8, as well as 10% freshwater N-Al2O3 additions. Such increases are indeed the result of improved burning with water N-Alumina application, which lowered CO and HC concentrations. CO emissions were lowered as a result of improved ignition, as seen in Fig. 2e is an example. For 2, 4, 6, 8, and 10% freshwater N-Al2O3 weight percentage with petroleum, the corresponding decrease reached 6.01%, 12.36%, 14.01%, 14.28%, and 15.32%. Methane gas emissions are mostly determined by the atmosphere proportion, and because CI motors run at thin mixes, CO quantities are minimal. Freshwater N-Alumina dispersion provides increased oxygen in flame transmission, resulting in more complete and swift burning. HC content was also lowered, as seen in Fig. 2f demonstrates. When compared with standard petroleum diesel, the decreases were 4.01%, 6.32%, 12.39%, 18.36%, and 21.85% for 2, 4, 6, 8, and 10% hydrophilic N-Alumina mixtures [11,12].

CONCLUSIONS

The pollution potential of a gasoline engine using emulsified fuel was investigated in this research by introducing nano alumina dispersion to gasoline. The results are summarised below under this study: introducing freshwater N-Al2O3 to gasoline lowered specific fuel use compared to diesel fuel for any and all workloads tested while the motor was driven at an angular velocity. Furthermore, for all workloads tested, the cylinder brake power was again investigated and was higher than that of standard diesel. When compared with untreated octane, its application of hydrophilic N-Alumina-diesel dispersion lowered exhaust fumes as well as HC concentrations inside the flue gases. Furthermore, NO as well as particulate emissions were significantly reduced when using the same settings. At varied workloads as well as constant acceleration, the increasing addition of hydrophilic N-Al2O3 to clean gasoline enhanced vehicle exhaust. Carbon dioxide levels rose when hydrated N-Alumina was added to gasoline, attributable to decreases in HC and CO content. Introducing

Webology, Volume 18, Number 5, 2021
ISSN: 1735-188X
DOI: 10.29121/WEB/V18I5/5

freshwater N-Al2O3 to petroleum diesel while operating the engines at speed control as well as functions that support improved engine efficiency by increasing thrust force while lowering brake fuel economy. CO, HC, as well as nitrogen concentrations were also significantly reduced. There was more carbon dioxide gas and fewer particulate emissions, as well as motor vibration. The outcomes showed that raising the content of freshwater N-Alumina increases their impact.

REFERENCES

1. Ryu, K.; Zacharakis-jutz, G.E.; Kong, S. Performance Characteristics of Compression-Ignition Engine Using High Concentration of Ammonia Mixed with Dimethyl Ether. Appl. Energy 2014, 113, 488–499, doi:10.1016/j.apenergy.2013.07.065.
2. Kumar, A.; Kumar, D.; Dhar, A.; Kumar, R.; Chandra, P.; Pratap, A. Effect of Fuel Injection Timing and Pressure on Combustion , Emissions and Performance Characteristics of a Single Cylinder Diesel Engine. FUEL 2013, doi:10.1016/j.fuel.2013.03.016.
3. Ahmed, W.; Usman, M.; Shah, M.H.; Abbas, M.M.; Saleem, M.W.; Kalam, M.A.; Mahmoud, O. A Comparison of Performance , Emissions , and Lube Oil Deterioration for Gasoline – Ethanol Fuel. 2022.
4. Gross, C.W.; Kong, S. Performance Characteristics of a Compression-Ignition Engine Using Direct-Injection Ammonia – DME Mixtures. Fuel 2013, 103, 1069–1079, doi:10.1016/j.fuel.2012.08.026.
5. Devarajan, Y.; Nagappan, B. RESEARCH ARTICLE A Comprehensive Study on Emission and Performance Characteristics of a Diesel Engine Fueled with Nanoparticle-Blended Biodiesel. 2019.
6. Fayaz, H.; Mujtaba, M.A.; Elahi, M.; Soudagar, M.; Razzaq, L.; Nawaz, S.; Ahsan, M.; Farooq, M.; Afzal, A.; Ahmed, W.; et al. Collective Effect of Ternary Nano Fuel Blends on the Diesel Engine Performance and Emissions Characteristics. Fuel 2021, 293, 120420, doi:10.1016/j.fuel.2021.120420.
7. Press, A.I.N. Performance Characteristics of a Low Heat Rejection Diesel Engine Operating with Biodiesel. 2008, 33, 1709–1715, doi:10.1016/j.renene.2007.08.002.
8. Lin, B.; Huang, J.; Huang, D. Experimental Study of the Effects of Vegetable Oil Methyl Ester on DI Diesel Engine Performance Characteristics and Pollutant Emissions. Fuel 2009, 88, 1779–1785, doi:10.1016/j.fuel.2009.04.006.
9. Al-hinti, I.; Samhouri, M.; Al-ghandoor, A.; Sakhrieh, A. The Effect of Boost Pressure on the Performance Characteristics of a Diesel Engine : A Neuro-Fuzzy Approach. 2009, 86, 113–121, doi:10.1016/j.apenergy.2008.04.015.
10. Kanog, M. Performance Characteristics of a Diesel Engine Power Plant. 2005, 46, 1692–1702, doi:10.1016/j.enconman.2004.10.005.
11. Pradhan, D.; Volli, V.; Singh, R.K.; Murgun, S. Co-Pyrolysis Behavior , Engine Performance Characteristics , and Thermodynamics of Liquid Fuels from Mahua Seeds and Waste Thermocol : A Comprehensive Study. Chem. Eng. J. 2020, 393, 124749, doi:10.1016/j.cej.2020.124749.
12. Dressier, G.A.; Bauer, J.M. TRW Pintle Engine Heritage and Performance Characteristics 36th AiAA / ASME / SAE / ASEE Joint Propulsion. 2000.