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"A REVIEW OF EFFECT OF NANOPARTICLES AN ADDITIVE WITH BIODIESEL DIESEL- JATROPHA BLEND"

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ABSTRACT

The increasing efficiency and reducing the emission from the diesel engine is the main objectives of many research. Many researchers have many disadvantages like higher viscosity and lower calorific value. In order to overcome these many additives are used in biodiesel-diesel blends. One such way of improving performance and reducing the emission is adding the Nano particles as an fuel additives. Using of Nano particles in the fuel shows dramatically increase in the combustion quality and hence in the overall performance of the engine. A review on the effect of Nano particles as on additive with fuels has been in this paper.

Key Words: *Nano-particles, Bio-diesel, CI engine, emission, performance..*

I. INTRODUCTION

The petroleum resources are decaling day by day, the increasing demand of fuels and stringiest regulations, create a challenge to science and technology. The commercialization of biofuels is a successful way to fight against the petroleum scare and the influence on the environment. Several researchers have tried to explore the performance, emission and combustion characteristics of the diesel-Engine fueled with biodiesel blend.

They found that the overall that the overall performance of the engine decreased slightly and emission was improved the $NO_x$and Particular matter (PM) emissions user slightly higher, because of higher oxygen –content in the biodiesel.

The combustion characteristics may be improved by adding Nano particles in the biodiesel-diesel blends. Fuel additives are included at a level from a few PPM to thousand PPM. It's important that, additives which improve some properties do not impair other properties. Some of the Nano particles are antioxidants, corrosion resistance; others may help in easy and smooth flow of fuel. Some of the metal based Nano particles are cerium (Ce), Cerium-iron(Ce-Fe), Platinum(Pt), CuO, $CuCl_2$, $Cocl_2$, $Fecl_3$, Al_2O_3 and multiwall carbon nanotube (MWCNT), MgO, SiO_2 etc are used in biodiesel to improve viscosity, density and flow properties. Many researchers have used the above Nano particles and proved the effective results.

II. OBJECTIVE

The objective of this paper is to provide the most comprehensive summary of the most result literature available on the Nano particles as on additive in biodiesel and its effect on the combustion, and overall performance of the diesel engines.

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III. Literature Review

[1] Mostafa Mabrouk , Diganta B. Das , Zeinab A. Salem and Hanan H. Beherei , Designing of nanomaterials has now become a top-priority research goal with a view to developing specific applications in the biomedical fields. In fact, there is a lack of in-depth reviews that specifically highlight the current knowledge based on the design and production of nanomaterials. Considerations of size, shape, surface charge and microstructures are important factors in this regard as they affect the performance of nanoparticles. These parameters are also found to be dependent on their synthesis methods. The characterization techniques that have been used for the investigation of these nanomaterials are relatively different in their concepts, sample preparation methods and obtained results

[2] Michael G. Bidir , N.K. Millerjothi, Muyiwa S. Adaramola, Ftwi Y. Hagos , Diesel engines are compulsory due to depletion of fossil fuel. Various types of bio-based fuels are investigated by the researchers. Biodiesel is anticipated as potential contenders of diesel fuel. Though it is possible to utilize pure biodiesel in diesel engines, some burdens like higher density, lower cetane number and lesser calorific value hinder it from replacing conventional diesel completely. Therefore, using blends with biofuels in diesel engines has a preference. Thus, this paper reviews two different approaches on the role of nanoparticles on biofuel production and effects of nanoparticles in biodiesel–diesel fuel blends on performance, combustion analysis and emission characteristics of diesel engines. Wide range of results from previous research studies with potential and application of nanoparticles in bioethanol production, the effect of the addition of nanoparticles into diesel fuel with different biofuels ratios are collected in this review study. There are different engine performances enhancing methods surveyed. Nanoparticles can be utilized in the production of biofuels from feedstock pre-treatment to chemical reaction as catalysts. It was observed from the overall results that by adding nanoparticles, there was a significant reduction in the brake specific fuel consumption about 20% to 23% as compared with biodiesel–diesel blends with and without alcohol as additives. Besides as nanoparticles possess high thermal conductivity, the addition of nanoparticles enhanced the process of combustion and increases the brake power about 2.5% to 4%. Emission results showed that in most reviews, NOx emission is increased by up to 55%, while HC, CO and PM are decreased significantly. It was concluded from the study that a diesel engine could be effectively run and give better performance and effective regulated emissions on the application of added nanoparticles with biodiesel and their blends as fuel in a CI engine.

[3] Rakhamaji S. Gavhane et al , The soybean biodiesel (SBME) was prepared using the transesterification reaction. Numerous characterization tests were carried out to ascertain the shape and size of zinc oxide nanoparticles. The synthesized asymmetric ZnO nanoparticles were dispersed in SBME25 at three dosage levels (25, 50, and 75 ppm) with sodium dodecyl benzene sulphonate (SDBS) surfactant using the ultrasonication process. The quantified physicochemical properties of all the fuels blends were in symmetry with the American society for testing and materials (ASTM) standards. Nanofuel blends demonstrated enhanced fuel properties compared with SBME25. The engine was operated at two di_erent compression ratios and a comparison was made, and best fuel blend and compression ratio (CR) were selected. Fuel blend SBME25ZnO50 and compression ratio (CR) of 21.5 illustrated an overall enhancement in engine characteristics. For SBME25ZnO50 and CR 21.5 fuel blend, brake thermal efficiency increased by 23.2%, brake specific fuel consumption (BSFC) were reduced by 26.66%,

[4] Manzoore Elahi M. et al., The physicochemical properties of diesel, diesel + 30 ppm ZnO nanoparticles (D10030), 20% Mahua biodiesel (MOME20), and Mahua biodiesel (20%) + 30 ppm ZnO nanoparticles were measured in accordance to the American Society for Testing and Materials standards. The effects of modification of fuel injectors (FI) holes (7-hole FI) and toroidal reentrant combustion chamber (TRCC) piston bowl design on the performance of CRDI using different fuel blends were assessed. For injection timings (IT) and injection opening pressure (IOP) average increase in brake thermal efficiency for fuel blend D10030 and MOME2030 was 9.65% and 16.4%, and 8.83% and 5.06%, respectively. Also, for IT and IOP, the average reductions in brake specific fuel consumption, smoke, carbon monoxide, hydrocarbon and nitrogen oxide emissions for D10030 and MOME2030 were 10.9% and 7.7%, 18.2% and 8.6%, 12.6% and 11.5%, 8.74% and 13.1%, and 5.75% and 7.79%, respectively and 15.5% and 5.06%, 20.33% and 6.20%, 11.12% and 24.8%, 18.32% and 6.29%, and 1.79% and 6.89%, respectively for 7-hole fuel injector and TRCC. The cylinder pressure and heat release rate for D10030 and MOME2030 were enhanced by 6.8% and 17.1%, and 7.35% and 12.28%. The 7-hole fuel injector with the nano fuel

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blends at an injection timing and pressure of 10° btdc and 900 bar demonstrated the overall improvement of the engine characteristics.

[5] R. Rajasekar and P. Naveenchandran., It is an unprecedented alternative fuel source for biodiesel designed to increase the value of fossil fuels and increase the longevity and purity of the diesel engine. The origin of fossil fuels will decrease in the coming years, besides, the price and demand for fuel will be rare. The negative environmental barrier prompted researchers to find alternative fuels for fossil fuels. Biodiesel from watermelon seed oil had a lot of appeal and could be a different alternative to diesel without any mechanical modifications. This will help protect the environmental status of crude oil in oil imports, which is expected to increase by 82% by 2020. The present study focuses on the comparative behavior of B20 [1], which is zirconium dioxide (ZrO2) with various nanoparticles. In some cases, Zirconia is the white crystalline oxide of Zirconia, so it's most natural form with a monoclinic crystal structure is batiste ore. Zirconium dioxide (ZrO2) with 20% watermelon seed oil biodiesel + 80% diesel (B20). The compounds were mixed with 20 particles per million (ppm), 40 ppm, B20 with 60 ppm and B20 with a magnetic motion for 30 min, followed by sonication of the nanoparticles for 30 min, respectively. Biodiesel compounds at a B20 ratio in diesel fuel increase efficiency and reduce emissions of hydrocarbons, carbon monoxide and smoke due to the emission of nitrogen oxides due to better combustion properties. Criticisms conclude that additional applications of biodiesel are best for improving combustion efficiency and reducing emissions.

[6] Rakhamaji S. Gavhane, Ajit M. Kate, Abhay Pawar ., The influence of metallic copper-coated zinc oxide (Cu-ZnO) nanoparticles (NPs) and soybean biodiesel on the improvement in efficiency and emission characteristics of a VCR engine are examined. The soybean methyl ester (SBME) was produced utilizing the transesterification reaction. Several characterization experiments were performed to determine the shape, scale, and contents of the synthesized Cu-ZnO NPs. The Cu-ZnO NPs and SDBS surfactant were steadily distributed utilizing the ultrasonic vibration in SBME25-diesel at three stages (25, 50, and 75 ppm). The prepared physicochemical properties of fuels are comparable with ASTM requirements. In comparison to SBME25, nanofuel mixtures displayed better fuel properties. A compression ratio of 21.5 was used and a comparison was made with the SBME25. The SBME25Cu-ZnO50 combination and the CR 21.5 have illustrated an increase in overall engine characteristics. For the SBME25Cu-ZnO50 mixture, BTE and HRR raised by 16.1% and 19.2%, BSFC and ID dropped by 18.9% and 14.6%, and hydrocarbon, carbon monoxide, and smoke emissions lowered by 24.1%, 34.5%, and 16.8%. In all nanofuel blends, the oxide of nitrogen raised owing to a higher oxygen supply to the CC.

[7].Amit Kumar Sharma et al ,Fuel blends with a single-cylinder four-stroke diesel engine at di_erent loads. It was shown in the results that, at rated load, thermal e_ciency of the engine decreased from 34.6% with diesel to 34.1%, 33.7%, 34.1%, 34.0%, 33.9%, and 33.5% with MB10, MB20, JB10, JB20, PB10, and PB20 fuels, respectively. Unburned hydrocarbon, carbon monoxide and smoke emissions improved with third-generation fuels (MB10, MB20) in comparison to base diesel fuel and second-generation fuels (JB10, JB20, PB10 and PB20). Oxides of nitrogen emissions were slightly increased with both the thirdand second-generation fuels as compared to the base diesel. The combustion behavior of microalgae biodiesel was also very close to diesel fuels. In the context of comparable engine performance, emissions, and combustion characteristics, along with biofuel production yield , microalgae biodiesel could have a great potential as a next-generation sustainable fuel in compression engine (CI) engines compared to jatropha and polanga biodiesel fuels.

[8] Abul Kalam Hossain and Abdul Hussain ., Jatropha biodiesel with 100 ppm Al2O3 nanoparticle (J100A100) was selected for engine testing due to its higher heating value and successful amalgamation of the Al2O3 nanoparticles used. The brake thermal efficiency of J100A100 fuel was about 3% higher than for neat fossil diesel, and was quite similar to that of neat jatropha biodiesel. At full load, the brake specific energy consumption of J100A100 fuel was found to be 4% higher and 6% lower than the corresponding values obtained for neat jatropha biodiesel and neat fossil diesel fuels respectively. The NOx emission was found to be 4% lower with J100A100 fuel when compared to jatropha biodiesel. The unburnt hydrocarbon and smoke emissions were decreased significantly when J100A100 fuel was used instead of neat jatropha biodiesel or neat fossil diesel fuels. Combustion characteristics showed that in almost all loads, J100A100 fuel had a higher total heat release than the reference fuels. At full load, the J100A100 fuel produced similar peak in-cylinder pressures when compared to neat fossil diesel and neat jatropha biodiesel

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fuels. The study concluded that J100A100 fuel produced better combustion and emission characteristics than neat jatropha biodiesel.

[9] Nitin Shrivastava , Biodiesels have come up as a very strong alternative for diesel fuel. Biodiesels such as Jatropha Oil Methyl Ester (JOME) are comparable in performance with that of the diesel engine. The thermal efficiency of engines fuelled with biodiesels was found lower than conventional diesel fuel but due to the bio-origin, the emission characteristics are much better. However, biodiesel increases the NOx emissions as these are rich in oxygen, hence nanoparticles are used in this experiment to curb thehigh temperatures and reduce the NOx formation. The experiment on naturally aspired diesel engine was conducted with four prepared test fuels other than neat diesel and neat biodiesel. The 50 and 150 of alumina nanoparticles were added separately to the pure diesel and pure Jatropha biodiesel to formthe nano emulsions using ultrasonicator. The properties of nanoemulsion were evaluated using dynamic light scattering technique using zetasizer. The performance and emission characteristics of multicylinder diesel engine with these nanoemulsions were compared with that of neat fuels.

[10] A. Prabu ., This experimental work investigates the performance, combustion and emission characteristics of a single cylinder direct injection (DI) diesel engine with three fuel series: biodiesel–diesel (B20), biodiesel–die sel–nanoparticles (B20A30C30) and biodiesel–nanoparticles (B100A30C30). The nanoparticles such as Alumina (Al_2O_3) and Cerium oxide (CeO_2) of each 30 ppm are mixed with the fuel blends by means of an ultrasonicator, to attain uniform suspension. Owing to the higher surface area/volume ratio characteristics of nanoparticles, the degree of mixing and chemical reactivity are enhanced during the combustion, attaining better performance, combustion and emission attributes of the diesel engine. The brake thermal efficiency of the engine for the nanoparticles dispersed test fuel (B20A30C30) significantly improved by 12%, succeeded by 30% reduction in NO emission, 60% reduction in carbon monoxide emission, 44% reduction in hydrocarbon emission and 38% reduction in smoke emission, compared to that of B100.

[11] Ashok et al. evaluated the experimental parameters of Calophyllum inophyllum methyl ester and its blends in a diesel engine. They observed that the brake thermal efficiency of Calophyllum inophyllum methyl ester is slightly decreased. They also observed that the reduction in CO and HC emissions with a significant penalty in oxides of nitrogen emissions. They reported that the combustion parameters such as in-cylinder pressure, ignition delay and heat release rate for Calophyllum inophyllum methyl ester were closer to diesel fuel.

[12] Aydin investigated the use of neat vegetable oil blends with diesel fuel in a zirconium oxide coated diesel engine. He has thermally insulated the surfaces of piston, exhaust and intake valves to reduce the heat transfer through walls during combustion. He observed that there are no major problems due to thermal barrier coating after the long run. He also observed that the most important engine performance parameters such as power, torque, mean effective pressure and brake specific fuel consumption were improved for vegetable oil blends on the coated engine due to the reduction in heat transfer through walls. He also reported that the CO and HC emissions were reduced due to the presence of surplus oxygen content in vegetable oil blend helps to improve combustion. He also reported that the NOx emission was increased probably due to the increased combustion temperature in the coated engine.

[13] Muthukumaran et al. performed the fuel production process in a fixed bed catalytic reactor. They have made an attempt for improving the fuel properties of C. inophyllum oil using fly ash catalyst against the conventional zeolite catalyst. From GC-MS.

[14] Silitonga et al. have used two-step of acid-alkaline catalyst transesterification to produce biodiesel from crude jatropha curcas, Calophyllum inophyllum and Ceiba pentandra oil. They obtained 98.23%, 98.53% and 97.72% ester yield for crude jatropha curcas, Calophyllum inophyllum and Ceiba pentandra oil by using 9:1 methanol to oil ratio with 1% (v/v) of H_2SO_4 for acid catalyst esterification and 1 wt.% KOH catalyst for catalyst transesterification.

[15] Silitonga *et al.* converted Calophyllum inophyllum oil into biodiesel using acid-catalysed esterification, followed by alkaline-catalysed transesterification and crude palm oil is converted into methyl ester using an alkaline-catalysed transesterification process. They have achieved good biodiesel yield for both palm and C. inophyllum methyl esters for laboratory scale production (99.76% and 92.82%) and pilot-scale production (99.21% and 80.83%).

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[16] Puhan *et al* have discussed the characteristics of monoalkyl esters of vegetable oil and its effect on diesel engine operation. They said that the biodiesel consists of different fatty acid compositions with chain length and bonding. Therefore, they focused on the impact of molecular weight, structure of biodiesel and the number of double bonds during diesel engine operation. They tested three types of biodiesel with different molecular weight and number of double bonds in a diesel engine. They observed that higher HC, CO, Smoke and NOx emissions for unsaturated biodiesel compared to highly saturated biodiesel fuel. They concluded that the biodiesel having high unsaturated fatty acid produces more NOx and low thermal efficiency due to higher ignition delay and advancement in fuel injection timing.

[17] Roy *et al.* investigated engine performance using three series of fuels blended with conventional diesel at high idling operations. They have mentioned the similarity between the fuel properties, engine performance and emissions characteristics of pure and used canola biodiesel blends. They found the CO and HC emissions from biodiesel blends as significantly lower than standard diesel fuel. They also stated that the pure canola oil up to 5% in diesel showed significantly less CO emissions compared with diesel fuel. They concluded that the NOx emissions were either reduced or maintained at the same level for diesel up to 5% biodiesel and canola oil in diesel fuel.

[18] Can investigated the performance and emission characteristics of a CI engine under various engine loads at a constant engine speed of 2200 rpm using different biodiesel fuels prepared from waste cooking oil blends. They found that the slight decrease in the maximum heat release rate and in-cylinder pressure and an increase in the combustion duration due to the addition of biodiesel which has a high cetane number. They also found that the increase in the proportion of biodiesel resulted in higher BSFC and lower fuel conversion efficiency. They reported that the addition of biodiesel increases the oxides of nitrogen and CO_2 emissions and reduces the smoke and hydrocarbon emissions at the full load.

[19] Rajasekar *et al.* critically reviewed the combustion characteristics like cylinder pressure, peak pressure, rate of pressure rise, the start of combustion, ignition delay period, combustion duration, mass fraction burned, instantaneous heat release rate and cumulative heat release rate of biodiesel and its blends in CI engine. They have pointed out the difference in peak pressure between diesel and biodiesel blends is within 1%. They have reported that the start of combustion was earlier than that of diesel.

[20] Muthukumaran *et al* prepared a hydrocarbon fuel from Calophyllum inophyllum oil using fly ash catalyst. They revealed that the brake thermal efficiency of the engine fueled with B25 performed closer to diesel and decreased for higher blends. They reported that the NOx emission reduced and other emissions such as hydrocarbon, carbon monoxide and smoke were found to be comparable for B25 with diesel.

[21] Ashok *et al.* evaluated the experimental parameters of Calophyllum inophyllum methyl ester and its blends in a diesel engine. They observed that the brake thermal efficiency of Calophyllum inophyllum methyl ester is slightly decreased. They also observed that the reduction in CO and HC emissions with a significant penalty in oxides of nitrogen emissions. They reported that the combustion parameters such as in-cylinder pressure, ignition delay and heat release rate for Calophyllum inophyllum methyl ester were closer to diesel fuel.

[22] Yadav et al. studied the performance and exhaust emissions characteristics of methyl esters of oleander, Kusum, bitter groundnut oil in a transportation diesel engine at full load condition with different engine speeds. They found that all methyl esters showed poor performance compared to diesel fuel. They reported that the CO, HC emissions and smoke opacity of all methyl esters were lower and NOx emissions were higher than that of diesel fuel

[23] Hazar et al. investigated the effects of performance and exhaust emission characteristics of low heat rejection diesel engine using corn oil methyl ester. They used the plasma spray method to coat the ceramic material Al_2O_3-TiO_2 over the piston, cylinder head, exhaust and inlet valves of a diesel engine. They observed that the smoke density and CO emission were decreased with increase in NOx emission which may be attributed to the increase in combustion temperature. They also observed that the maximum engine power and specific fuel consumptions were decreased due to the decrease in volumetric efficiency as a result of higher temperature generated in the coated engine. They noticed that the coated components are protected from irregular thermal tension and thermal shock.

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[24] Hazar coated surfaces of the cylinder head, piston, exhaust and inlet valve of a diesel engine with molybdenum (Mo) using the plasma spray method and studied the performance and emission characteristics of cottonseed oil biodiesel in the molybdenum coated engines. He reported that the specific fuel consumption improved up to 6%, smoke density reduced up to 8% and CO emission decreased up to 18.0% for all tested fuels comparedwith the uncoated engine. He also reported that the NOx emission was increased up 4.5% with the increased temperature in the coated engine.

[25] Hazar et al. (2016) investigated the effects of performance and exhaust emission characteristics on thermal barrier coated gasoline engine loaded on Artificial Neural Network (ANN). They used the plasma spray method to coat the chrome carbide over the piston, cylinder head, exhaust and inlet valves of a diesel engine. They observed that the smoke density, hydrocarbon and CO emission were decreased with increase in NOx emission and exhaust gas temperature. They have used Artificial Neural Network for reducing the experiment repetitions and experimental costs by forming mathematical modeling of the engines.

[26] Krishnamani et al. studied the effects of rapeseed methyl ester-Diethyl ether blends in the lanthanum zirconate coated low heat rejection engine. They found that the thermal efficiency of diethyl etherbiodiesel blends is lower due to due to the lower energy content of the diethyl ether blends resulted in higher fuel consumption. They also found that the HC and CO emissions were considerably reduced due to the presence of oxygen content in the diethyl ether and higher combustion temperature. The NOx emissions were higher due to the higher rate of heat release during premixed combustion and higher cetane rating of diethyl ether enhances early heat release rate.

IV. CONCLUSION

The objectives of this review paper was to determine the effect of Nano particle as an additives in biodiesel-diesel blend which can be used as an alternative fuel in diesel engine from the resent available literature.
The major findings of various researchers are summarized as follows.
The use of Nano particle increases the performance and also reduces the emission level.
Brake thermal efficiency and net heat release rate increase with the addition of Nano-particles
1. The efficiencies and heat release rates are increase with increase in the percentage of Nano-Particles in the biodiesel-diesel blend.
2. The combustion increases with the addition of Nano particles with the biodiesel-diesel blend.

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