Impact of different additive on performance of Biodiesel

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Abstract *:* In the last few years major research is focused on fuel consumption and emission reduction. There are different work have been done for the production of biodiesel There are many research are going on to find out the best suitable alternative of fossil fuels to reduce the dependency on petroleum product. The previous research shows that biodiesel has the capacity to replace the diesel but it needs to improve The engines are also to be improved for better energy consumption.. There are many additive is being used to improve performance and characteristics of engines like brake thermal efficiency, calorific value, fire point, flash point and reduce the fuel consumption rate, Co_2 emission, Nitrogen Oxide, Carbon monoxide. The study based on the different additive is being used for the betterment of bio diesel.

***IndexTerms* -** Fossil fuels, Petroleum product, Biodiesel, Brake thermal efficiency, Calorific value, Fire point, Flash point, Fuel consumption rate.

I. INTRODUCTION

Diesel engine is heavy duty engine along with durability, reliability and low consumption of fuel due to its leaner fuel–air mixtures and high compression. Apart from above reputation there is a negative reputation is also associated with diesel engine to produce large amount of air pollutants. The developing country like India has big concerns of climate change and the need of clean energy. The present study deals with the use of biodiesel in place of diesel. Biodiesel are not as much efficient as diesel. Many researchers are working on biodiesel to make efficient as the diesel. In this process different additive are being used to make biodiesel efficient and green energy source. Due to the rapid growth of the automobile sector the dependence over the oil producing country increases. To reduce the dependence the biodiesel production should increase. There are many additive are being used for the production of efficient biodiesel among them nano particles has shows a great hope. Nano size material has grate advantage over micron size material. The use of nano particle in biodiesel has great hope but at the same time needs great amount of research to be done.

The previous research shows that the nano particle added biodiesel has significant effect over ignition and combustion behavior Risha et. al. (2007) . Tyagi et al. (2008) has investigated the combustion behavior of liquid water and nano-aluminum, characterized without any gelling agent for a broad range of particle sizes, pressures, and mixture compositions. attempted to improve the ignition properties of bio diesel fuel by investigating the influence of adding nanoparticles to bio diesel.

The addition of nanoparticles to the biodiesel caused significant improvements in its heat/mass transfer properties and radiative property hence, the nano particle added biodiesel droplets ignited at lower temperature in compare to pure bio diesel Gan et. al (2010).

Based on the literature survey, it was noticed that a review on the effects of nanoadditives in biodiesel and its emission characteristics and performance, of a CI engine field with biodiesel, diesel and its blends, are missing. The objective of the present study is to analyze impact of nanoadditives on a CI engine in respect of its emission behavior and performance.

II. EFFECT OF ADDITIVE IN BIODIESEL ON ENGINE PERFORMANCE

Several authors have published different works to improve the low-temperature properties of biodiesels by the usage of different additives for their convenient handling and usage at different climatic conditions.

Zhu et al. (2010) in their work 'Emissions characteristics of a diesel engine operating on biodiesel and biodiesel blended with ethanol and methanol' tested a 4-cylinder naturally aspirated direct-injection diesel engine with Euro V diesel fuel, pure biodiesel and biodiesel blended with 5%, 10% and 15% of ethanol or methanol. They conducted Experiments under five engine loads at a steady speed of 1800 rpm. They observed that compared with Euro V diesel fuel, the blended fuels could lead to reduction of both

NOx and PM of a diesel engine, with the biodiesel–methanol blends being more effective than the biodiesel–ethanol blends. The effectiveness of NOx and particulate reductions was more effective with increase of alcohol in the blends. With high percentage of alcohol in the blends, the HC, CO emissions could increase and the brake thermal efficiency might be slightly reduced but the use of 5% blends could reduce the HC and CO emissions as well. They expect that with the diesel oxidation catalyst t (DOC), the HC, CO and particulate emissions can be further reduced. Nano fuels blended fuel are a new class of fuels, and the application of nano engineering in energetic material in conventional fuel is an interesting concept. Nano additives in biodiesel can play important role to meet the international fuel standards and real time problems which are associated with biodiesel. By the help of nano additives properties the fuel can be enhanced S Madiwale et. al (2015).

Subbaiah et al. [26] found higher BTE for all the diesel– biodiesel–ethanol blends compared to fossil diesel fuel at all load conditions. This might be due to the extended ignition delay and the leaner combustion of biodiesel. They found the BTE increased as the ethanol in the blend is increased. They compared their obtained data for the diesel–biodiesel–ethanol blends with the B10 blend. They found the BTE of the diesel–biodiesel–ethanol blends increased by 1.5%, 2.2% and 2.91% for the B10E5, B10E10 and B10E15 respectively compared to B10 blend. The maximum BTE was 28.2% for the blend of B10E15, which is 3.67% higher than diesel fuel at all engine loads.

Selvan et al. (2014) studied the performance, combustion and emission characteristics on a single cylinder, constant speed (variable compression ratio) engine using the stable diesterol–CERIA–CNT blends under various loading conditions at an optimum compression ratio of 19:1. They have used CERIA and CNT of each 25, 50 and 100 ppm of concentrations are added with dieseterol blends. They observed that the addition of CERIA and CNT in dieseterol blend increases the cylinder gas pressure when compared with neat dieseterol blend. Moreover, the authors concluded that the CNT act as a catalyst to accelerate the burning rate which results in decrease in the ignition delay and cause for lower heat release rate and advancement of the peak heat release rate.

Basha and Anand (2013) have recently studied the influence of nanoadditive blended biodiesel fuel on the working characteristics of a diesel engine. The whole investigation was carried out on a constant speed diesel engine in four phases, using neat biodiesel fuel, alumina blended biodiesel, CNT blended biodiesel and alumina–CNT blended biodiesel. The experimental results indicate a considerable enhancement in the brake thermal efficiency of the nanoparticles blended biodiesel fuels compared to neat biodiesel fuel. Further, the authors confirmed through the hot plate evaporation test, a shorter ignition delay effect, and improved heat transfer rate, associated with the nanoparticles blended biodiesel fuels, owing to their enhanced surface area/volume ratio, and heat conduction properties.

The study of Kannan et al. (2011) on nano material FBC addition at different concentration to the biodiesel to check the different parameter given bellow table-

TABEL1

Fuel	Kinematic viscosity cSt	Density kg/m3	Flash point 1C	Fire point 1C	Cetane index/ number	Calorific value MJ/kg
Biodiesel	4.56	866	170	190	66	38.034
Biodiesel+5 µmol FBC	4.55	865.8	170	190	67.4	38.10
Biodiesel+10 µmol FBC	4.52	865.4	168	187	67.9	38.14
Biodiesel+15 µmol FBC	4.52	865.2	167	186	68.1	38.21
Biodiesel+20 µmol FBC	4.51	864.6	167	185	68.68	38.30

Biodiesel+25 µmol FBC	4.54	864.6	167	185	68.9	38.32
Biodiesel+30 µmol FBC	4.55	864.8	167	185	68.93	38.30
Biodiesel+35 µmol FBC	4.56	865.2	166	184	69.2	38.28
Biodiesel+40 µmol FBC	4.56	865.4	165	184	69.4	38.36
Biodiesel+45 µmol FBC	4.57	865.4	165	183	69.3	38.40
Biodiesel+50 µmol FBC	4.57	865.8	165	183	69.6	38.43

III. EFFECT OF ADDITIVE IN BIODIESEL ON ENGINE EMISSION CHARACTERISTICS

Diesel engines are well known for their extremely low hydrocarbon and carbon monoxide emissions. However, they have also been rejected by many for their odorous and sooty exhaust, that is characterized by high nitric oxide (NOx) and particulate matter emissions (PM). Although the improvements in the modern diesel engine design and combustion conditions have led to significant reductions in both NOx and PM emissions, these reductions have not been sufficient to meet the new standards without additional control measures. Further reductions in emissions can be achieved more efficiently, if engine development is coupled with diesel fuel reformulation and/or the use of fuel additives. In this work, the literature survey on the effects of various nanoadditives such as metal, metal oxide, carbon nanotube, magnetic, nano-organic additives and mixed nanoadditives on engine emissions, are reported.

Metal based additives have been reported to be effective in reducing diesel emissions in two ways: (1) the metals react with water vapor in the exhaust emissions to produce highly reactive hydroxyl radicals, and (2) the metals serve as an oxidation catalyst and thereby lower the oxidation temperature for diesel soot and lead to increased particle burn out. The influence of a cerium additive on ultrafine diesel particle emissions and kinetics of oxidation were presented in Jung H et. al. (2005).

The addition of cerium was observed to cause significant changes in number-weighted size distributions, light off temperature and the kinetics of oxidation. The oxidation rate increased significantly (20) with the addition of cerium to the fuel. The authors concluded that, the oxidation rate was relatively insensitive to doping beyond a certain threshold level. The effects of a platinum–cerium bimetallic fuel additive on the chemical composition of diesel engine exhaust particles, was explored by Okuda et al.(2009).

Studies shows that the reaction between water molecule and aluminum powder produce hydrogen during combustion hence, increase the aqueous aluminum bio fuel's combustion heat was studied in Kao MJ (2008).

The emission study carried out by Kannan et al. (2011) reported that the fuel borne catalyst (FBC) added biodiesel showed lower nitric oxide (NO) emission, and slightly higher carbon dioxide (CO2) emission, as compared to diesel. Carbon monoxide (CO), total hydrocarbon (THC) and smoke emission of FBC added biodiesel, decreased by 52.6%, 26.6% and 6.9%, respectively, compared to biodiesel without FBC, at an optimum operating condition of 280 bar injection pressure and 25.51 bTDC (before top dead centre) injection timing.

The exhaust gas from the CI engine was tested by Mehta et al. (2014) for emissions of regulated parameters of varying load conditions. The emission study showed a decline of 25–40% in CO (vol%), along with a drop of 8% and 4% in hydrocarbon emissions for aluminum and iron nanofuels respectively. Due to elevated temperatures, a hike of 5% and 3% was observed in NOx emission with aluminum and iron.

The metal oxide nanoadditive acts as an oxygen donating catalyst, and provides oxygen for the oxidation of CO, or absorbs oxygen for the reduction of NOx. The emission study in a CI engine with cerium oxide nanoparticles was performed Selvan VAM et. al (2009). The authors observed that, the carbon monoxide emission decreases with the use of cerium oxide nanoparticles in the diesel–biodiesel–ethanol blends and neat diesel. The addition of cerium oxide decreases the HC emission, when compared with neat diesel and diesel–biodiesel–ethanol blends. The NOx emission is lower for neat diesel than for the oxygenated blends. The smoke decreases with the fuel blends with the oxygenated additives. The addition of cerium oxide nanoparticles in neat diesel and diesel–biodiesel–ethanol blends decreased the smoke further.

The effect of 0.1% TiO2 additive blended in biodiesel fuel on CO, CO2 and NOx was investigated Fangsuwannarak K et. al. (2013). The results revealed that the emission of carbon monoxide from the CI engine was less when TiO2 nanoparticles were added with palm oil biodiesel fuels. The effects of cerium oxide nanoparticles added to biodiesel on emissions was studied Sajith V (2010). The NOx emissions were found to be generally reduced on the addition of cerium oxide nanoparticles to biodiesel, where an average reduction of around 30% was found to occur with a dosing level of 80 ppm nanoparticles. In general, there is a reduction in the NOx emissions due to the addition of cerium oxide. Hydrocarbon emission is found to be significantly reduced on the addition of nano additives.

Basha and Anand (2011) have presented an experimental investigation on the role of nanoadditive blended biodiesel emulsion fuel on the working characteristics of a diesel engine. Their result indicates that the NOx and smoke emissions are appreciably reduced for the biodiesel emulsion fuels compared to that of Jatropha biodiesel. The magnitude of NOx and smoke emission observed is 870 ppm and 49% for JBDS15W100A (83% jatropha biodiesel+2% surfactant+15% water+100 ppm of alumina) fuel, whereas it is 1282 ppm and 67% for JBD (Jatropha biodiesel) fuel at full load, respectively. Research on the impact of CeO2-based solid solution metal oxide on diesel engine emissions was carried out by Xin et al. (2013). They pointed that the reductions of NOx and CO are highly comparable with those of pure heavy oil.

IV. CONCLUSION

The above literature survey concludes that additives can play a vital role to improve biodiesel performance as well as emission. The blend of ethanol/bioethnaol-diesel–biodiesel, and the blending amount should be lower. Till now the best results (performance) obtained by the blending of 5% ethanol or less than that to the biodiesel. In the case of nano additive different study suggest that increase of the nanoadditive concentration in diesel and biodiesel does not increase the performance proportionately. The mix of Nanoadditives with pure diesel or biodiesel resulted increase in NOx due to increased peak temperature. To reduce the peak temperature use emulsifier can be the best idea however the use of water in the emulsion reduce the performance.

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