

# A Review Study of Performance and Emissions of CI Engine Fuelled with Blend of Biodiesel along with Fuel Nano Additives

**P. Jaya Prakash<sup>1</sup>, Dr. S. Sunil Kumar Reddy<sup>2</sup>**

<sup>1,2</sup> Department of Mechanical Engineering  
<sup>1,2</sup> Siddhartha Institute of Engineering & Technology, Puttur, AP, India

**Abstract-** This paper describes the literature review of effect of different nano additives on performance and emission characteristics of diesel engine fuelled with different blends of biodiesel. This study is based on the previous research published articles. It was reviewed that by using nano additives with blend of biodiesel the performance characteristics were improved significantly but the exhaust emissions were found that more reduced compare to the blend of biodiesel. The nano additives act like a catalysts for combustion of Biodiesel in diesel Engine. It was reported that the Mechanical efficiency and Brake thermal efficiency were improved significantly by using nano additives with blend of biodiesel compare with the blend of biodiesel. The Brake specific fuel consumption was reduced by using nano additives with blend of biodiesel compare with blend of biodiesel. It was reviewed that the HC, CO, NO<sub>x</sub> emissions were reduced by using nano additives with blend of biodiesel compare with blend of biodiesel, not only that the smoke levels from exhaust are also reduced.

**Keywords-** Blend of Biodiesel, Exhaust Emissions ,Nano additives, Performance.

## I. INTRODUCTION

The consumption and demand of petroleum products are increasing day to day with increase of vehicles and urbanization. By using the petroleum products the emissions are also enormously increased. So to decrease the consumption and emission of petroleum products we are replacing the petroleum products with the alternative fuels. The alternative fuels are renewable and eco-friendly. One of the drawback of alternative fuels is the heating value of fuel. The alternative fuels has lower heating values compare to diesel. To overcome this problem in alternative fuels we are doing blending process with the petroleum products. Another drawback in the biodiesel is the oxygen content, the biodiesel has less oxygen content with this we cannot get complete combustion. The efficiency of Diesel Engine is also depend up on the rate of combustion take place in the Engine. Not only that if the fuel in the Engine does not burnt completely the exhaust emissions are also more. To overcome this draw back

we are adding nano additives for biodiesel to enhance the combustion characteristics compare with the biodiesel. The nano additives acts as a catalyst in the combustion process because the nano additives has 12-15% of oxygen content with them which helps in increasing the rate of combustion in the engine. Not only that by using nano additives in the biodiesel we are going to reduce the exhaust emissions compare with the biodiesel which is very important aspect for eco system. The performance and emission characteristics of diesel engine depends upon the blending proportions of biodiesel and also the concentration of nano additives added with the biodiesel. The nano additives shows a surprisingly large effect on performance and emission characteristics even when they used in parts per million (PPM) range with the biodiesel.

## II. EFFECT OF FUEL ADDITIVES ON THE PERFORMANCE AND EMISSION CHARACTERISTICS OF THE DIESEL ENGINE FUELLED WITH BLEND OF BIODIESEL

Researchers and scientists have used different nano fuel additives in blend of biodiesel in Diesel Engine. A brief review of the effect of various nano fuel additives with blend of biodiesel in diesel engine is reported here. Many research articles have reported that the performance of blend of biodiesel in diesel engine is higher when an fuel additives are added to the blend of biodiesel and also the emissions of blend of biodiesel in diesel engine is lower when an fuel additives are added to the blend of biodiesel.

Ali Keskinet. [1] Investigated the effect of Mg and Mo based fuel additives on diesel engine performance fuelled with tall oil biodiesel. A single cylinder DI diesel engine is used for their investigation and found that the engine performance values donot change significantly in Mg and Mo based fuel blends compare with tall oil biodiesel. But the engine emissions like HC,CO and NO<sub>x</sub> are reduced significantly in Mg and Mo based fuel blends compare with tall oil biodiesel.

M.Shahabuddinet. [2] investigated the effect of IRGANOR NPA fuel additive on diesel engine performance

fuelled with POME biodiesel with blending proportion of B20+1% (20% biodiesel +80% diesel + 1% additive). A single cylinder Turbocharged (IDI) diesel engine is used for their investigation and found that the engine shows the best performance values at B20+1% compare with POME biodiesel and also the engine CO emissions are reduced by 0.141% at B20+1% blending proportions not only that the HC and NO<sub>x</sub> are reduced significantly compare with POME biodiesel.

S.Sivalakshmiet. [3] investigated the effect of diethyl ether and ethanol as a fuel additive on diesel engine performance fuelled with Neem oil methyl ester biodiesel with proportion of BD-1(5% diethyl ether + 95% biodiesel) and BD-2(10% diethyl ether + 90% biodiesel) not only that with the blending proportions of BD-1(5% ethanol + 95% biodiesel) and BD-2(10% ethanol + 90% biodiesel). A single cylinder DI diesel engine is used for their investigation and found that the engine performance values increases significantly in diethyl ether and ethanol blends compare with Neem oil methyl ester biodiesel and also the brake specific energy consumption is low in both fuel additives at BD-1 and BD-2 blending proportions compare with the Neem oil methyl ester biodiesel, and also the engine emissions like HC,CO and NO<sub>x</sub> are reduced significantly in diethyl ether and ethanol blends compare with Neem oil methyl ester biodiesel.

Gvidonas Labeckaset. [4] investigated the effect of Marisol FT (sweden) and SO-2E (Estonia) as a fuel additives on diesel engine performance fueled with shale oil biodiesel. A single cylinder DI diesel engine is used for there investigation and found that the engine performance values increases significantly in Sweden and Estonia fuel blends compare with shale oil biodiesel and also the brake specific energy consumption declines by 18.3-11.0% in both fuel additives blends compare to shale oil biodiesel and also the engine NO<sub>x</sub> emissions are reduced by 41.6% at Sweden fuel blends and also the HC and CO emissions are reduced significantly comapare with POME biodiesel not only that the engine emissions like HC,CO and NO<sub>x</sub> are reduced significantly with Estonia fuel blends compare with shale oil biodiesel.

Y. V. Hanumantha Rao et. [5] investigated the effect of DM-32 and methyl-ester as a fuel additives on diesel engine performance fuelled with Jatropha oil biodiesel. A single cylinder DI diesel engine is used for their investigation and found that the engine performance values increases significantly with DM-32 and methyl-ester fuel blends compare with jatropha oil biodiesel and also the brake specific energy consumption is lower in both fuel additives blends comapare with Jatropha oil biodiesel and also the engine

emissions like HC,CO and NO<sub>x</sub> are reduced significantly in both the DM-32 and methyl-ester fuel blends compare with jatropha oil biodiesel.

Ali Keskin et. [6] investigated the effect of Metallic based fuel additives on diesel engine performance fuelled with tall oil biodiesel. A single cylinder DI diesel engine is used for their investigation and found that the engine performance values donot change significantly with Metallic based fuel blends compare with tall oil biodiesel, but the brake specific energy consumption declines by 6.0% compare to tail oil biodiesel and also the engine emissions like HC,CO and NO<sub>x</sub> are reduced significantly with Metallic based fuel blends compare with tall oil biodiesel.

G.R.Kannanet. [7] investigated the effect of ferric chloride a metallic based fuel additive on diesel engine performance fueled with waste cooking palm oil biodiesel. A single cylinder DI diesel engine is used for their investigation and found that the engine brake thermal efficiency increased by 6.3% with ferric chloride fuel blends compare with waste cooking palm oil biodiesel and also the brake specific energy consumption declines by 8.6% compare to waste cooking palm oil biodiesel. The ferric chloride a metallic based fuel additives was added at dosage of 20 ppm with waste cooking palm oil biodiesel and also found that the engine CO emissions are reduced by 1.9% with ferric chloride fuel blends not only that the HC and NO<sub>x</sub> emissions are reduced compare with waste cooking palm oil biodiesel and also the smoke emissions are reduced by 6.9% compare to waste cooking palm oil biodiesel.

S.Manibharathiet. [8] investigated the effect of Rhodium oxide as a fuel additive on diesel engine performance fueled with Pongamia oil and Pongamia pinnata biodiesels. A single cylinder DI diesel engine is used for their investigation and found that the engine brake thermal efficiency was marginally increased with Rhodium oxide fuel blends compare with Pongamia oil and Pongamia pinnata biodiesel and also the brake specific energy consumption declines by 3% compare to Pongamia oil and Pongamia pinnata biodiesel and also found that the engine HC emissions are reduced up to 45% with Rhodium oxide fuel blends compare with Pongamia oil biodiesel and also the NO<sub>x</sub> emissions are reduced up to 37% and the CO emissions are reduced up to 45% compare to Pongamia oil biodiesel not only that the engine CO emissions are reduced by 20% in Rhodium oxide fuel blends compare with Pongamia pinnata biodiesel and also the NO<sub>x</sub> emissions are reduced by 17% and the HC emissions are reduced by 25% compare to Pongamia pinnata biodiesel.

M. Mohan Rao et. [9] investigated the effect of Zinc oxide as a fuel additive on diesel engine performance fuelled with Palmolion Stearin Wax biodiesel with proportion of B20(20% biodiesel + 80% diesel) , B20 + 150 ppm (20% biodiesel + 80% diesel + 150 ppm of additive) and B20 + 200 ppm (20% biodiesel + 80% diesel + 200 ppm of additive) . A single cylinder DI diesel engine is used for their investigation and found that the engine mechanical efficiency was increased by 5.57% at blending proportion of B20 + 150 ppm compare to other blending proportion of biodiesel not only that the brake thermal efficiency was increased by 8.64% at blending proportion of B20 + 200 ppm compare to other blending proportion of biodiesel and also the brake specific energy consumption was declines by 12.77% for B20 + 200 ppm and 5.15% declined for B20 + 150 ppm compare with the other blending proportion of biodiesel and also found that the engine CO emissions are reduced at blending proportion of B20 + 150 ppm compare to other blending proportion of biodiesel not only that the HC emissions are reduced up to 16.5% at blending proportion of B20 + 200 ppm compare to other blending proportion of biodiesel and also the HC emissions are reduced by 21.07% for B20 + 150 ppm blending proportion compare with the other blending proportion of biodiesel.

B.Sachuthananthan et. [10] investigated the effect of diethyl ether as a fuel additive on diesel engine performance fuelled with Water- biodiesel emulsion with proportion of BD-1(5% diethyl ether + 95% biodiesel) and BD-2(10% diethyl ether + 90% biodiesel). A single cylinder DI diesel engine is used for their investigation and found that the engine brake thermal efficiency was increased by 0.7% at BD-1 compare to other blending proportion of biodiesel and also the brake specific energy consumption is low at BD-1 and BD-2 blending proportions compare with the other blending proportion of biodiesel and also found that the engine emissions like HC,CO and NO<sub>x</sub> are reduced at BD-1 compare to other blending proportion of biodiesel and also the smoke emissions are low at BD-1 and BD-2 blending proportions compare with the other blending proportion of biodiesel.

S.Karthikeyanet. [11] investigated the effect of Zinc oxider as a fuel additive on diesel engine performance fueled with Palmolion Stearin Wax biodiesel with proportion of B20(20% biodiesel + 80% diesel) , B20 + 50 ppm (20% biodiesel + 80% diesel + 50 ppm of additive) and B20 + 100 ppm (20% biodiesel + 80% diesel + 100 ppm of additive) . A single cylinder DI diesel engine is used for their investigation and found that the engine brake thermal efficiency was increased with Zinc oxide fuel blends compare to Palmolion Stearin Wax biodiesel and also the brake specific energy

consumption was decline compare with thePalmolion Stearin Wax biodiesel not only that they found that the engine emissions like HC,CO and NO<sub>x</sub> are reduced with Zinc oxide fuel blends compare to Palmolion Stearin Wax biodiesel.

Keskin et. [12] investigated the effect of Nickel based and Manganese based fuel additives on diesel engine performance fueled with Crude tall oil biodiesel with proportion of B20(20% biodiesel + 80% diesel) , B20 + 8 ppm (20% biodiesel + 80% diesel + 8 ppm of additive) and B20 + 12 ppm (20% biodiesel + 80% diesel + 12 ppm of additive) . A single cylinder DI diesel engine is used for their investigation and found that the engine brake thermal efficiency was increased with Nickel and Manganese based fuel blends compare to Crude tall oil biodiesel and also the brake specific energy consumption was decline in both fuel additives blends compare with the crude tall oil biodiesel not only that they found that the engine emissions like HC,CO and NO<sub>x</sub> are reduced with Nickel and Manganese based fuel blends compare to Crude tall oil biodiesel and also the smoke emissions was reduced in both fuel additives blends compare with the crude tall oil biodiesel.

C. Syed Aalam et. [13] investigated the effect of Aluminium oxide as a fuel additive on diesel engine performance fueled with zizipus jujube methyl ester biodiesel with proportion of B25(25% biodiesel + 80% diesel) , B25 + 25 ppm (25% biodiesel + 80% diesel + 25 ppm of additive) and B25 + 50 ppm (25% biodiesel + 80% diesel + 50 ppm of additive) . A single cylinder DI diesel engine is used for their investigation and found that the engine brake thermal efficiency was increased by 2.5% at B25+50 ppm blending proportion compare to other blending proportions of biodiesel and also the brake specific energy consumption was decline by 6% at B25+50 ppm blending proportion compare to other blending proportions of biodiesel not only that they found that the engine CO emissions are reduced by 48.9% at B25+25 ppm blending proportion compare to other blending proportions of biodiesel and also the smoke emissions was reduced by 15-20% at B25+25 ppm blending proportion compare to other blending proportions of biodiesel.

### III. CONCLUSION

From the study of the above articles published by the Researches/Scientists, We are concluded that the Brake thermal efficiency of the Diesel engine was increased significantly by adding nanoadditives with the biodiesel compare with only biodiesel, and also the Brake specific energy consumption is decreased by adding nanoadditives with the biodiesel compare with only biodiesel. The exhaust emissions like HC,CO ,NOxand Smoke levels of the Diesel

engine was majorly reduced by adding nanoadditives with the biodiesel compare with only biodiesel

## REFERENCES

- [1] Suthar Dinesh Kumar.L, RathodPravin.P, Prof .Patel Nikul. K. "Performance And Emission by effect Of Fuel Additives for CI Engine fuelled with blend Of biodiesel and Diesel", JERS PaperVol.III ,2012/01-04.
- [2] C.SyedAalam,C.G.Saravanan,M.Kannan "Experimental Investigations on a CRDI System Assisted Diesel engine fuelled With Aluminium Oxide Nano Particles blended Biodiesel", AEJ Paper, April 2015.
- [3] C.SyedAalam,C.G.Saravanan,B.Premanand "Influence Of Iron ( $\Pi,\text{III}$ ) Oxide Nano Particles Fuel Additive on Exhaust emissions and Combustion Characteristics of CRDI System Assisted Diesel engine",IJAERS,Vol-2,March 2015.
- [4] S. Manibharathi, B.Annadurai, R. Chandraprakash, "Experimental Investigation of CI Engine Performance by Nano Additive in Biofuel", IJSETR, Vol-3,Dec-2014.
- [5] MohanRao,D.Krishnaiah,"Experimental Investigation on the effect of Zno Nano Particles with Palmolion Stearin Wax Bio Diesel blend on DI Diesel engine", IJSART, Vol-1,10-October 2015.
- [6] B.Sachuthananthan,K.Jeyachandran,"Combustion, Performance and Emission Characteristics of Water-Biodiesel Emulsion as fuel with DEE as Ignition improver in a DI Diesel Engine",JERD,Vol-2, Dec-2007.
- [7] S.Manibharathi,R.Chandraprakash, B.Annadurai, R.Titus "Experimental Investigation of CI Engine Performance and Emission Characteristics by effect of Nano Additives in PongamaPinaata Biodiesel", IJSRD, Vol-3. 2015.
- [8] S.Karthikeyan.,A.Elango,A.Prathima,"Performance and Emission study on Zinc Oxide Nano Particles Addition with Pamolion Stearin Wax Biodiesel of CI Engine",JSIR,Vol-73,March 2014.
- [9] M.SrinivasRao, R.B. Anand, "Techniques to Improve the Performance while reducing the Pollutants Level in the Exhaust Gases of Compression Ignition Engines – A Review", APRN Journal Of Engineering and Applied Sciences, Vol-9,No.5,May 2014.