_____

Effect on Diesel Engine Peformance and Emission of Diesel Fuels with Nano Particles Additives : A Review

S.T. Dhande*, K.R. Dudhe, D.S Pachpor
Department of Mechanical Engineering
MGICOET Shegaon,
Maharashtra, India
E-mail id - stdhande@gmail.com

D.T. Dhande
Department of Applied Science and Humanities
MGICOET Shegaon,
Maharashtra, India
E-mail id - dhanshridhande@gmail.com

Abstract- There is huge demand of alternative fuel for good performance of engine as well as important for reduction of emission. Lot of effort has been taken by researches to improve it by use of mixture of diesel and biodiesel, pure biodiesel, mixture of different biodiesel. Efficiency of engine is one parameter for which various combination of fuel used. In few cases the parameters of engine also optimize for improvement. Exhaust emission is consist of various contents like unburned hydrocarbons (HC), carbon monoxide (CO), nitrogen oxides (NOx) or particulate matter (PM). These content have it effect on environment which is very harmful for human. So lot efforts has been taken to reduce the exhaust emission by use of various kind of fuels. Addition to this recently the people are started to use Nano particles in fuel blend. These Nano particles are additives like various metal oxide alumina oxide zink oxide, cerium oxide titanium oxide. In the present study few case studies are reviewed for understanding the its effect at various conduction.

Keywords-Diesel engine,Exhaust Emission, Biodieselblend,Metal Oxide Nano particles

_____*********_____

I. INTRODUCTION

Day by day there is increase in demand of alternative fuel for better performance of engine. The main practices are carryout out by the various authors to reduce emissions and solve the energy crisis, designing diesel engines with low emission and less energy consumption. Now days there are various new technologies have been used in diesel engines for better emission characteristics and the less energy consumption compared with its predecessor. Accordingly, researchers reported that a complete burning fuel instead of conventional fuel is advisable with the use of Nano particles in few conductions [1]. It could not only decrease emission exhaust gas to a great extent, but, also provide better options of blend as energy sources. The use of nano particles in alternative fuels for diesel engines has great attention due to better efficiency of engine. Alternative fuels should be easily available with the various additives like various metal oxide alumina oxide zink oxide, cerium oxide titanium oxide. Use of these biodiesel is environment friendly, and techno-economically competitive. Use of nano particles additive in biodiesel blend offer the opportunity to tap local resources and reduce dependency on fossil energy resources. One of the promising alternative fuels considered for diesel engine is biodiesel and biodiesel blend with nano particles additive.

Biodiesel with nano particles additives also offers the advantage of being able to readily use in existing diesel engines without engine modifications. The alkyl monoester of fatty acids as bio-diesel and metal oxide as additive particles which was obtained from renewable oil and fats materials by transesterification reaction is a good alternative. Biodiesel can be additive to the ultrasonic vibrator for mixing of it. Recently most of the studies recommend the use of alternative fuels with nano particles like vegetable oils and alcohols with aluminum oxide, zink oxide titanium oxide and cerium oxide as additive. When biodiesel with nano particles additive is used as a substitute for diesel, it is highly essential to understand the affect on thermal efficiency and emission. In the present few studies are reviewed in this paper.

II. BASICS OF DIESEL ENGINE

A. Diesel engine

A diesel engine is an internal combustion engine that uses the heat of concentration to begin ignition and ignite the fuel that has been added into the combustion chamber. This distinguishes with spark-ignition engines such as a petrol engine or gas engine, which use a spark plug to ignite an air-fuel mixture. The engine was developed by German inventor Rudolf Diesel in 1893. The diesel engine has the largest thermal efficiency of any standard internal or external combustion engine due to its very high compression ratio. Low-speed diesel engines can have a thermal efficiency that surpasses 50%. Basic of diesel engine enters the compression ratio, injection timing[2-5]. Performance of diesel engine is based on the break specific fuel consumption, efficiency and exhaust emission.

B. Thermal efficience and heat balance

The thermal efficiency of an engine is defined as the ratio of the output. The chemical energy input in the form of

_____

_____

fuel supply to the engine which gives output brake or indicated power. The engine efficiency in which the chemical energy of fuel is converted into mechanical work as an output..

Brake Thermal Efficiency = B.P./(m_f x C.V.) [3-10]

Where, CV = Calorific value of fuel, kJ/kg, and

m_f = Mass of fuel supplied, kg/sec.

Input energy to the engine come out in various forms like brake output, exhaust, and the rest is taken by cooling water and the lubricating oil. Heat Balance has already defined that break-up of the total energy input into these different parts. The important components in a heat balance are brake output, coolant losses, heat going to exhaust, radiation and other losses. Formation of heat balance sheet gives us an idea about the amount of energy wasted in various parts and allows us to think of methods to reduce the losses so incurred.

C. Exahust smoke and emissions

Diesel engine converts the chemical energy of fuel into mechanical power. Diesel exhaust gases are primarily composed of CO_2, H_2O and the unused particles.

The concentrations depend on their content is depends on the engine load, with the content of CO_2 and H_2O increasing and that of O_2. These contents are also affected by engine load. All types of diesel engine emissions (with the exception of CO_2 for its greenhouse gas properties) have adverse health or environmental effects [3].

Diesel emissions include pollutants that have a bad effect on health and/or environmental. All these pollutants get from various non-ideal methods during flaming, such as unfinished combustion of fuel, reactions between hybrid components under high temperature and pressure, combustion of engine lubricating oil and oil additives as well as flaming of non-hydrocarbon elements of diesel fuel, such as sulfur compounds and fuel additives. General pollutants include unburned hydrocarbons (HC), carbon monoxide (CO), nitrogen oxides (NOx) or particulate matter (PM)[4].

The complete concentration of pollutants in diesel exhaust gases typically amounts to some tenths of one per cent much lower, "near-zero" levels of pollutants are emitted from diesel engines equipped with emission after-treatment devices such as NOx reduction catalysts and particulate filters. Other exhaust emissions and smoke like oxides of nitrogen (NOx), unburned hydrocarbons (UBHC), etc. are harmful to the public environment. With increasing stress on air pollution control, all efforts are being made to keep them as minimum as it in the environment. Smoke is the result of incomplete combustion. It limits the output of an engine if air pollution control is the consideration [1-9].

II. CURRENTS STATUS ON UNSE OF NANO PARTICLES IN DIESEL FUEL

V. Sajith [1] has investigated the effect of the use of cerium oxide nanoparticles fuel additive in biodiesel. They found a result that reduction in the NOx and hydrocarbon. Heejung Jung also carried out the experimentation on and found a similar result.

Ajin C. Sanjeevan and V.Sanjit [2] carried out the experimentation on a diesel engine in which catalytic cerium oxide Nanoparticles are used. As a result of this authors found that there is an improvement in brake power thermal efficiency as well as a reduction in the exhaust emission.

C. Syed Aalam and C. G. Saravana [3] carried out experiments in which nano metal oxide was used in mahua biodiesel. The author wanted to investigate it to reduce harmful pollutants. Result reveals that there is a reduction in the smoke, NOx, CO and HC. Authors also found that improvement in the break power thermal efficiency.

T. shaft and R. Velraj [4] have carried out an investigation on the performance of a single-cylinder diesel engine with two types of blends. The first blend consists of 80% diesel and 20% soybean oil. The second blend consists of 80% diesel 15% soybean oil.4%ethanol and 1% isopropanol. Alumina ($Al2O3$) Nanoparticles of 100gm are used in the blend. They found in a review that behaviour of traditional fuel with the Nanoparticles results in improved performance hence cylinder pressure during combustion and maximum heat release in aluminum blended fuel. It improves the break thermal efficiency by 15%. Also they were reported that reduction in CO was due to presence of oxygen in soybean biodiesel.

M. Srinivasa and R. B. Ananad [5] have completed their experimentation on the emission and performance of DICI Engine. In this work author wanted to improve the performance of engine by using aluminum oxide hydrocarbon nano particles. The result revels that performance and emission characteristics were improved by the inclusion of water and Nanoparticles.

A. Prabu [6] has studied the effect of Nano particles additive on working characteristics of direct injection engine. In this work authors used two types of nano partials that alumina and cerium oxide. According observation author, it was reported that may of researchers focused on the fuel formulation technique to improve the performance of biodiesel hence he decide to work on it. As a result of this he found that there is reduction in NO by 13%, improvement in break thermal power efficiency by 12%, 60% reduction in carbon monoxide, 44% reduction in hydro carbon, and 38% reduction in dark smoke.

Chiranjeeva Rao Seela [7] has studied the effect of CeO_2 Nano particles on diesel engine performance and emission. To the best of the authors knowledge, only few attempts has been carried out by researches hence this study is address. In this study they wanted to find out effect of metal

140

_____

Nano particles on performance and emission characteristics of four stroke diesel engine. The result shows that decrease in fuel composition, nitrogen oxide (NOx), and HC emission when nano particle applied. They also found that there was slightly increase in carbon monioxide as comp aired with pure diesel. Further, more they point out that there was no significant change in break power.

Ahmed I. El Seesy [8, 9] have been carried out the experimentation on the effect of biodiesel diesel mixture with multi walled carbon Nano tubes additives on performance , emission and combustion characteristics. This investigation was carried out by the auther because they found that Nano additives blended biodiesel have it positive impact on the combustion of single cylinder direct injection diesel engine.

CONCLUSIONS

The work presented here is an overview of few studies on laser and its industrial application
From above discussion in most of cases the common observation found are listed below:

1. Addition of Nano particles results in the combustion capacity in chamber.
2. It has its effect on the efficiency of engine in the range of 3 to 10 %.
3. There is change in the engine performance in the range on 5 to 15 %
4. Nano particles have their contribution to improve the emission control.
5. Because of this improvement emission control will help to reduce bad effect on environment.
6. From observation out of number of metal oxide cerium oxide will give better improvement in performance and the reduction in the emission

REFERENCES

[1] V. Sajith "Experimental investigations on the effects of cerium oxide Nanoparticle fuel additives on biodiesel" Advances in mechanical engineering 2010
[2] Ajin C. Sajeevan and V. Sajith "Diesel engine emission reduction using catalytic Nano particles: an experimental investigation" Hindawi Publishing Corporation Journal of Engineering Volume 2013, pp 9
[3] C.Syed Aalam and C. G. Saravana "Effects of nano metal oxide blended Mahua biodiesel on CRDI diesel engine" Ain Shams Engineering Journal 2015 PP8
[4] T.Shaafi and C.G. Velraj "Effect of dispersion of various Nano additives on performance and emission charateristices of ci enginer fulled with diesel, biodiesel and blend – Areview" Renewable and sustainable enefgy 2016 pp49
[5] M. Srinivasa Rao and R.B. Anand, Performance and emission characteristics improvement studies on a biodiesel fuelled DICI engine using water and AlO(OH) nanoparticles, Applied Thermal Engineering 98 (2016) 636–645
[6] Prabhu Appavu & M. Venkata Ramanan " Study of emission characteristics of a diesel engine using cerium oxide nanoparticle blended pongamia methyl ester" international journal of ambient energy 2018
[7] Chiranjeeva Rao Seela ,B. Ravi Sankar,D. Kishore &M. V. S. Babu "Experimental analysis on a DI diesel engine with cerium-oxide-added Mahua methyl ester blends" 2019,Vol 40
[8] Ahmed I. El Seesy, Ali Kamel Abdel-Rahman , Mahmoud Bady Shinichi Ookawara "The Influence of Multi-walled Carbon Nanotubes Additives into Non-edible Biodiesel-diesel Fuel Blend on Diesel Engine Performance and Emissions" Energy Procedia Energy Procedia Elsevier 2017 pp 166-172 ·
[9] Ahmed I. El Seesy, Ali K.Abdel Rahman ,Mohmoud Bady , S.Ookawara "performance ,combustion and emission charateristics of diesel engine fuled by bio diesel diesel mixture with multiwalled carbon nanotubes additives" Energy conbersion and management 2017 pp137-393
[10] Book internal combustion by V. Ganeshan