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Experimental Analysis of Emission Performance Characteristics on Diesel-Biodiesel Blends with an Additive of Ethyl Tetra Nitrate & Exhaust Gas Recirculation a Review

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Abstract - The increase in world population leads to the growth in energy demand. Today it is undoubted that human have to reduce their impact on the environment. Internal combustion engines, being the major power source in the transportation sector as well as in individual transport, play an important role in the man-made emissions. To reduce the emissions that result from transportation. The diesel engine provides a high efficiency and hence it can be help to reduce CO2 emissions, which are believed to be the main reason cause for global warming. Diesel exhaust also contains toxic gases, mainly nitrogen oxides (NOx) and soot particles. One efficient method to control NOx in order to achieve the future emission limit are the rather exhaust gas recirculation (EGR). EGR is one of the most effective means of reducing NOx emissions from diesel engine also named as compression ignition (CI) engines and is widely used in order to meet the emission standards. In the present work experimental investigators are carried out on a single cylinder direct injection diesel engine using diesel-biodiesel blends with cetane improver Ethyl Tetra Nitrate as an additive under different exhaust gas recirculation conditions. The combined effect of EGR and Ethyl Tetra Nitrate on the reduction of NOx emissions. The combined effect of EGR and Ethyl Tetra Nitrate on exhaust emissions is studied. With increase in EGR percentage CO2, CO emissions while HC, NOx emissions decreases.

***Key Words*: CO2 Emissions, CO Emissions, Exhaust Gas recirculation, Ethyl Tetra Nitrate, HC emissions, NOx Emissions, Jatropha Oil.**

1. INTRODUCTION

Using of renewable and alternative fuels from sustainably available feedstock sources have been the vital subject of research in recent years for replacing current petroleum fuels these alternate fuels are suggested for opposing the effects contributed by the present use of petroleum fuels in transportation and power generation. The main combustion products that are contained in engine exhaust gases are carbon dioxide (CO2), nitrogen oxides (NOx), particulate matter (PM), hydrocarbons (HC), and carbon monoxide (CO). All of these are considered environmentally harmful. This is also reflected in the fact that governments all over the world enact limits for the emission of these gases. Therefore, engine developers work on diminishing these emissions.

A way to reduce the formation of NOx in diesel engine is the use of EGR, recirculation exhaust gas. Part of the exhaust gas is rerouted into the combustion chamber, where it helps to attenuate the formation of NOx by reducing the local reaction temperature.

NOx formation in diesel engines is predominant when the temperature in the combustion chamber is high since at higher temperature the tendency of nitrogen to react with oxygen causes NOx to increase. Many authors reported that biodiesel has oxygen content which allows for better combustion and reduces emissions of engine exhaust, except NOx emissions. This problem can be overcome by using NOx reduction techniques like Exhaust Gas Recirculation (EGR). EGR is recirculation of a part of the exhaust gas which helps in reducing the NOx which however is accompanied by increased particulate and unburned hydrocarbon (UHC) emissions.

The amount of EGR that can be used is limited by different factors. One of them is the need for delivering enough fresh air for the combustion to take place; another is the decrease of engine efficiency that can be caused by high amounts of EGR. EGR is applied in diesel engines both with diesel and biodiesel as fuel separately. Especially jatropha biodiesel (JBD) produced higher NOx in diesel engine when compared to other biodiesel fuels. JBD combined with EGR operation in diesel engines reduced NOx emissions considerably. Ethanol-diesel blends with ETN as additive increased BTE and reduced significantly the emissions like CO, HC, smoke and particulates in CRDI diesel engine and also decrease cylinder pressure, ignition delay, the maximum rate of pressure rise, and the combustion noise. While Ethanol-diesel blends with

cetane improver with advanced fuel injection angle shows a large decrease in exhaust smoke concentration and a small decrease in exhaust NOx concentration. The main objective of the paper is to ascertain which of the locally available biodiesel is most suitable to replace diesel engine in C.I engines. The paper sought to establish the best blends that give highest thermal efficiency, minimum brake specific fuel consumption of the engine, minimum smoke density, and lower emissions. The test for both fuels is conducted at a constant engine speed of 2500 rpm in full load conditions.

2. Emission Formation in Diesel Combustion

2.1 Nitrogen Oxides (NOx)

Nitrogen Oxides, NO and NO2 are referred to as NOx. They are harmful for the lungs when local concentrations get too high. They also contribute to acid rain and form smog in combination with hydrocarbon. NOx formation take place in combustion zones with high oxygen concentration and high combustion temperatures. The most important mechanism for NOx formation in internal combustion engines are thermal NOx and prompt NOx. A theoretical approach to the thermal NO formation is the extended Zeldovich mechanism.

2.2 Hydrocarbons (HC)

HC formation is usually not problematic in diesel engines. It occurs when combustion is not completed which can happen when there is a lack of oxygen or close to cool walls. Another phenomenon that leads to HC formation is caused by the injector sac volume. In this volume a small fuel portion is left at the end of injection. It is evaporated by the combustion heat and enters the combustion chamber with a low pressure. This leads to slow mixing with air and thus some fuel can escape the combustion. As diesel combustion usually is run with excess air, the fuel is burned almost completely. Modern combustion systems with high EGR-rates tend to have HC-emissions problems. HC is suspected to be highly carcinogenic and is one of the causes of smog.

2.3 Carbon Monoxide (CO)

The formation of CO is an intermediate step in the combustion of hydrocarbons. The next step, the complete oxidation to CO2, is mainly done with the help of OH-radicals. For this process temperature above 1200 k and sufficient available oxygen are needed. The oxidation of CO can locally stop due to unmixedness and thus lack of oxygen or due to low temperature close to cylinder walls.

3. Methodology

Exhaust gas recirculation is an efficient method to reduce NOx emissions from the engine. It works by recirculating a quantity of exhaust gas back to the engine cylinders. Intermixing the recirculated gas with incoming air reduces the amount of available O2 to the combustion and lowers the peak temperature of combustion. Recirculation is usually achieved by piping a route from the exhaust manifold to the intake manifold. A control valve within the circuit regulates and the gas flow. Diesel engines to run more efficiently than gasoline engines also cause them to run at a high temperature. This leads to a pollution problem, you see fuel is in any engine is burned with extra air which helps eliminate unburned fuel from the exhaust. The air approximately 79% nitrogen and 21% oxygen. When air is compressed inside the cylinder of the diesel engine, the temperature of air is increased enough to ignite diesel fuel after it is ignited in the cylinder. When the diesel fuel ignites the temperatures of the air increases to more than 1500 $^{\circ}$F and the air expands pushing the piston down and rotating the crankshaft. Since higher cylinder temperature causes NOx, so it can be reduced by lowering cylinder temperature. Charge air coolers are commonly used for this reason. Reduced cylinder temperature can be achieved in three ways – Enriching the air fuel (A/F) mixture, lowering the compression ratio and retarding ignition timing, reducing the amount of oxygen in the cylinder. Enriching the air fuel mixture to reduce combustion temperature. However this increases HC and CO emissions. Also lowering the compression ratio and retarded ignition timing make the combustion process start at a less than optimum point and reduces the efficiency of combustion. These techniques lower the cylinder temperature, reducing NOx. But it also reduces fuel economy and creates excess soot, so the best way is to limit the amount of oxygen in the cylinder. Reduced oxygen results in lower cylinder temperatures. This is done by circulating some exhaust gas and mixing it into the engine inlet air. This process is known as Exhaust Gas Recirculation

4. Conclusion

In these review paper, the study of emission analysis of HC, NOx, CO and CO2 are carried out for jatropha oil biodiesel with an additive of ethyl tetra nitrate. It was observed that HC emissions decrease with biodiesel percentage at all loads. It can also be seen that HC emissions increase with increase in EGR rates. NOx emission increases with increases in biodiesel percentage. However with increase in EGR rate NOx decreases significantly. It can be seen that CO emissions decrease with biodiesel percentage at all loads. It also decreases with increase in EGR rate. CO2 emission decrease with increase in EGR rate.

1. Increase in fuel economy are obtained with the use of jatropha biodiesel with and additive of ethyl tetra nitrate and EGR employment at the specific engine speed.
2. The decrease in the exhaust gas temperature are obtained when the EGR is employed for both test fuels.
3. NOx emission is reduced significantly when the EGR is applied with increase in UHC emissions are obtained for both fuels.

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REFERENCES

[1] Reza rahimi1, s. jafarmadar2, sh. Khalilarya3, a. mohebbi4 numerical and experimental investigation of exhaust gas recirculation distribution in a di turbocharged diesel engine received January 2013, accepted march 2013 13-csme-02, e.i.c accession 3460

[2] Kraenvoddernielsenb. Mogenblankeb,c,larseriksond, mortenvejlgaardlaursena adaptive feed forward control of exhaust recirculation in large diesel engines control engineering practice 65 (2017) 26-3

[3] Maroa semakula 1 and prof. freddienambao 2 the effects of exhaust gas recirculation on the performance and emission characteristics of a diesel engine- a critical review international journal of applied engineering research issn 0973-4562 volume12, number 23 (2017) pp.13677-13689.

[4] Kapil dev choudharya, Ashish nayyarb, M.S. dasgupta effect of compression ratio on combustion and emission characteristics of CI engine operated with acetylene in conjuction with diesel fuel journal home page: contents list available at science direct pp.489-496.

[5] B.L Salvi, K.A. Subramaniam, Experimental investigation on effects of exhaust gas recirculation on flame kernel growth rate in a hydrogen fulled spark ignition engine.

[6] Aikun tanga, tao caia, jiang denga, yiming xub, jianfeng pana, experimental investigation on combustion characteristics of premixed propanel air in a micro planer heat recirculation combustor contents list available at science direct energy conversion and management pp. 65-71.

[7] M.koegla,b, b.hofbecka, s.willa,b,l.zian investigation of soot formulation and oxidation of ethanol and butonol fuel blends in a disi engine at different exhaust gas recirculation rates contents lists available at science direct applied energy

[8] J. Devraj, Y. Robinson, P. Ganapathi experimental investigation of performance emission and combustion characteristics of waste plastic pyrolysis oil blended with diethyl ether used as fuel for diesel engine contents list available in science direct energy conversion (2015) pp.1-6

[9] Shivakumar & P. Dinesha experimental study use of alternative fuels in compression ignition engines: a review content list available on biofuel, DOI:10.1080/17597269.2017.1329494, ISSN 1759-7269.

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