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**AN OVERVIEW OF EXHAUST GAS RECIRCULATION (EGR) EFFECT ON  
EMISSION CHARACTERISTICS OF DIESEL ENGINE FUELED WITH BIODIESEL.**

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**ABSTRACT**

Vegetable oils present very promising alternate to Diesel oil since they are renewable and have similar properties. Recent concerns over the environment, increasing fuel prices and scarcity of its supply have promoted the interest in development of alternative sources for petroleum fuels. Bio-diesel is an attractive alternative fuel which is renewable, non-toxic, reduces carbon monoxide and hydrocarbon emission due to higher content of oxygen. Though many advantages biodiesel is not so popular because of high NOx emission. So to take advantage of this alternative fuel one EGR technique has been developed to reduce NOx emission as it enables lower flame temperature and oxygen concentration in combustion chamber. The purpose of this Paper is to determine the possibility of using biodiesel as an alternative fuel for petro diesel and effect of EGR on emission Characteristic of Engine.

**KEYWORDS:** Transesterification, Biodiesel, EGR, NOx.

**INTRODUCTION**

National interest in generating fuels for internal combustion engines continues to be strong to fulfill the energy demand of the world. The search for energy independence and concern for a cleaner environment have generated significant interest in biodiesel, despite its shortcomings. India happens to be world's fourth largest consumer of crude and petroleum products after United States, China and Japan. The net oil import dependency of India rose from 43% in 1990 to 71% in 2012 that resulted in a huge strain on the current account. Evidently India's energy security would remain vulnerable until alternative fuels are developed to substitute or supplement petro-based fuels. Biodiesel is an alternative diesel fuel which can be obtained from the transesterification of vegetable oils or animal fats and methyl or ethyl alcohols in the presence of a catalyst (alkali or acidic). Rudolph Diesel, the father of diesel engine, demonstrated the first use of vegetable oil in compression ignition engine in 1910. He used peanut oil as fuel for his experimental engine.

There are, at least, five reasons that justify the development of biodiesel.

1. It provides a market for excess production of vegetable oils and animal fats.
2. It decreases, although will not eliminate, the country's dependence on imported petroleum.
3. Biodiesel is renewable and does not contribute to global warming due to its closed carbon cycle.
4. The exhaust emissions of carbon monoxide, unburned hydrocarbons, and particulate emissions from biodiesel are lower than with regular diesel fuel. Unfortunately, most emissions tests have shown a slight increase in oxides of nitrogen (NOx).
5. When added to regular diesel fuel in certain amount, it can convert fuel with poor lubricating properties into an acceptable fuel.

NOx emissions can be reduced by lowering the cylinder temperatures. This can be done by three ways 1) Enriching the air fuel mixture 2) Lowering the compression ratio and retarding ignition timing 3) Reducing the amount of Oxygen in the cylinder that inhibits the combustion process. The first two methods reduce the efficiency of combustion and so

the best way is to reduce the amount of Oxygen. This is done by recirculating some exhaust gas and mixing it into the engine inlet air. This process is known as Exhaust Gas Recirculation (EGR).

### RELEVANCE/MOTIVATION

Fossil fuels (i.e., petroleum, natural gas and coal), which meet most of the world's energy demand today, are being depleted rapidly. Also, their combustion products are causing global problems, such as the greenhouse effect, ozone layer depletion, acid rains and pollution, which are posing great danger for our environment, and eventually, for the total life on our planet. The depletion of fossil fuel and the impact of increasing environmental pollution from exhaust gas emissions have led the search for alternative fuels. To solve both energy concern and environmental concern, the renewable energies with lower environmental pollution impact should be necessary.

Several research and project in the field of Internal combustion Engine are being focused on reduced Emission, which not only makes commercial sense but also helps benefit the environment reducing harmful emission from diesel vehicles that improve local air quality which is now becoming increasingly important towards corporate social responsibility.

Over past few years, stringent emission regulations have been imposed on NO<sub>x</sub>, smoke and particulate emissions emitted from automotive diesel engines worldwide. Diesel engines are typically characterized by low fuel consumption and very low CO emissions. However, the NO<sub>x</sub> emissions from diesel engines still remain high. Hence, in order to meet the environmental regulations, it is highly desirable to reduce the amount of NO<sub>x</sub> in the exhaust gas. EGR is good technique to reduce all regulated emissions from diesel engine but it gives even good result when engine is operated with EGR using bio-diesel.

### LITERATURE REVIEW

1. **A. Paykani et al. [1]** Carried out an experimental investigation on diesel engine using biodiesel fuel, B20, B50 and B100 with exhaust gas recirculation. The effect of blending biodiesel (canola oil ethyl ester) on emissions and efficiency were analyzed. They observed that the NO<sub>x</sub> emissions increase directly with increasing biodiesel percentage. The NO<sub>x</sub> emissions were then decreased with increase in EGR flow percentage. The emissions of CO and UHC were found to be lower with increasing biodiesel percentage.

2. **R. Selvan et al. [2]** experimentally investigated the performance and emission characteristics of Jatropa oil and its fuel blends with diesel in a single cylinder diesel engine with the effect of EGR. Results showed that Petro diesel and blends of jatropa oil exhibited similar performance and similar emission characteristics under various normal and EGR operating condition. Also the NO<sub>x</sub> emission decreased with EGR, CO emissions increased and HC emissions decreased in all blends of jatropa oil.
3. **N. Ravi Kumar et al. [3]** conducted a test on single cylinder variable compression diesel engine with different compression ratios, percentages of EGR and loads to estimate performance, combustion and emission characteristics of the engine. It was found that with increase in compression ratio the brake thermal efficiency increases and specific fuel consumption decreases. Also with raise in % EGR the NO<sub>x</sub> emissions was gradually decreased by 11% to 85% at different compression ratios due to less flame temperatures and low oxygen content in the combustion chamber.
4. **Achuthanunni V et al. [4]** concluded that Biodiesel improved combustion in the engine due to the presence of molecular oxygen but leads to higher NO<sub>x</sub> emissions. Moreover the experimental analysis on a single cylinder diesel engine with diesel and biodiesel blend at 10% EGR has proved minimized pollution and improved performance. There is an average reduction of 40% NO<sub>x</sub> emission obtained by 10% EGR.
5. **A.S. Ramadhas et al. [5]** experimentally investigated the performance and emission characteristic of diesel engine fueled with methyl esters of Rubber seed oil. He concluded that use of the biodiesel as partial diesel substitute can boost the farm economy, reduce uncertainty of fuel availability and make farmers more self-reliant. Also, this help in controlling air pollution to a great extent.
6. **Pooja Ghodasara et al. [6]** investigated the usage of biodiesel blends and EGR simultaneous in order to reduce NO<sub>x</sub> emission along with other regulated pollutants from diesel engine without any engine modification and observed from the experiment that EGR is good technique

to reduce all regulated emission from diesel engine but it gives good result when engine is operated with EGR using bio-diesel blend.

### CONCLUDING REMARK

Biodiesel seems to have a potential to use as alternative fuel in diesel engines. The following results are made from the study-

1. Biodiesel properties are very close to diesel fuel specifications. Moreover it undergoes improved combustion in the engine due to presence of molecular oxygen. It reduces emissions like CO and HC but leads to higher NO<sub>x</sub> emissions.
2. Biodiesel and EGR both can be employed together in CI engines to obtain reduction of NO<sub>x</sub> emissions.
3. EGR is an effective technique to reduce the NO<sub>x</sub> emissions. The NO<sub>x</sub> emissions decreases with increase in EGR flow rate. However, increasing EGR flow rates to high level results in considerable rise in CO and HC emissions.

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