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Prediction on Increasing the Efficiency of Single Cylinder DI Diesel Engine Using EGR System

P.Muni Raja Chandra[1], Ayaz Ahmed[2], Mohd.F.Shabir[3], S.Mohamed Abbas[4], A. Khadeer Ahmed[5]

[1,2,3,4,5]*(Department of Mechanical Engineering, Aalim Muhammed Salegh College of Engineering, INDIA)*

ABSTRACT : *Exhaust Gas Recirculation (EGR) System means to use the Exhaust Gas coming from Exhaust Manifold to Inlet Manifold in order to reduce the Emission of NOX which is particularly very harmful. Engine without EGR are more pollutant & uses more atmospherically air for combustion. By Implementation of EGR system in Engine, the Partial Exhaust Gas is re-circulated again in Engine. The aim of this work is to review the potential of exhaust gas recirculation (EGR) to reduce the exhaust emissions, particularly NOX emissions, and to delimit the application range of this technique. The system is very much Eco Friendly. Using Exhaust Gas Recirculation (EGR) Technique in engines, the emissions are very much controlled. This method is very reliable in terms of fuel consumption.*

Keywords: *BMEP, Direct Injection, EGR, IMEP*

I. Introduction

The use of natural gas in Diesel engines has both economic and environmental advantages .Over past few years, stringent emission regulations have been imposed on NOx 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 NOx emissions from diesel engines still remain high. Hence, in order to meet the environmental regulations, it is highly desirable to reduce the amount of NOx in the exhaust gas. Diesel engines are predominantly used to steer tractors, heavy Lorries and trucks. Owing to their low fuel consumption, they have become increasingly attractive for smaller lorries and passenger cars also. But higher NOx emissions from diesel engine remain a major problem in the pollution aspect. In order to reduce emission levels, some external engine features can be applied, such as EGR or after-treatment systems. Cooled EGR systems have been used to reduce emissions of nitrogen oxides (NOx) from diesel engines. Depending on the engine operating conditions ,High EGR flow is necessary during mid-range acceleration, when combustion temperatures typically very high, Low EGR flow is required during low speed and light load conditions, No EGR flow should occur when idle and cold start operating conditions.

II. EGR Technique

It is a well known technique to reduce NOx emission in which a part of exhaust gas is recirculated it acts as diluents to the combustion mixture. Introduction of EGR is to reduce oxygen concentration Increase specific heat of incoming charge which ultimately reduce peak combustion temperature Resupply of unburned hydrocarbon (opportunity to reburn).

EGR ratio is calculated as

EGR %= Megr/ Mi * 100

Megr = Mass of recirculated gas/ Mass of total intake air of cylinder.

III. Experimental Setup

The experiments are conducted on a single cylinder, direct injection, variable compression, high speed diesel engine. Specifications of the engine are given in Table At the rated speed (1500 RPM), the engine develops approximately 3 kW power output. The engine is coupled to an eddy current dynamometer. A mass flow sensor is used to find the mass flow rate of air enter into the cylinder. A non-contact PNP sensor is used to measure the engine RPM. A PNP sensor gives a pulse output for each revolution of the crankshaft. The frequency of the pulses is converted into voltage output and connected to the computer. Torque is measured using a load cell transducer. The transducer is a strain gauge base. The output of the load cell is connected to the load cell transmitter. The output of the load cell transmitter is connected to the USB port through interface

card. Overall sensor setup is connected to DAS setup. DAS is directly plugged to computer by means of usb port. Exhaust from the engine is partly send back to the inlet manifold by appropriate piping, regulator, and pressure gauge setup.

Fig 1.1 Photo view of the EGR Setup

Engine Type	Air cooled
Bore	80 mm
Stroke Length	110 mm
Cubic Capacity	0.553 lit
Compression Ratio	16.5
Brake Power	3.7 kw, 5HP
Rated Speed	1500 rpm
Specific Fuel Consumption	245 g/kw-h

Experimental Procedure:

Without EGR System:

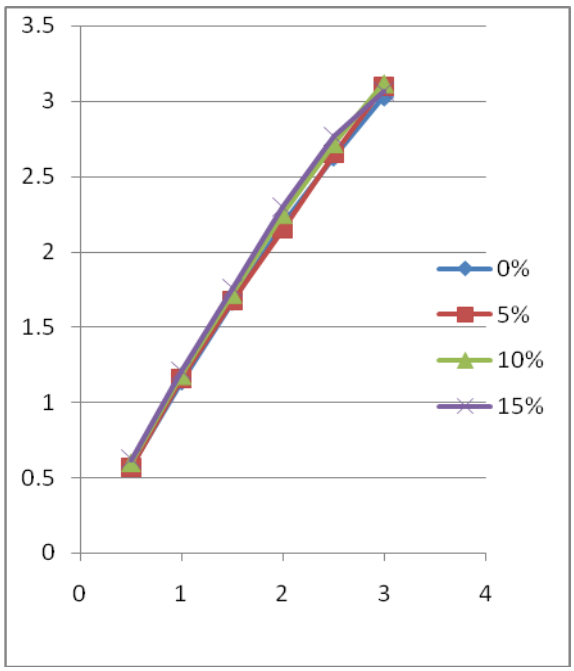
The experiment was carried out on a single cylinder, air cooled, four stroke diesel engine. Engine was first started and kept in running condition up to 10 minutes. After that add the part load by electrical loading. Once load was set wait for some time to reach its stability. Calculations for different parameters (BP, FC, SFC, BSFC, BTE, etc.) were calculated by DAS. The experiments were further carried out by setting different loads of engine. The relevant difference of measurement of BP, FC, SFC, BSFC, BTE, etc.) were calculated by DAS.

With EGR System:

The experiment was carried out on a single cylinder, air cooled, four stroke diesel engines. It was necessary to make some of modifications in the engine since the original engine had no EGR. It was necessary to connect the exhaust manifold with the air intake manifold. The experimental set-up is shown in Fig 1.5. and comprises a diesel particulate air filter, a heat exchanger, a liquid fuel metering systems, and an exhaust gases analysis system. It was necessary to connect the exhaust manifold with the air intake manifold. A tachometer is connected with engine; it is use for measuring RPM of the engine. The EGR pipe connected with exhaust manifold to the inlet of the engine. Procedure for measurement and calculation of various parameters, temperature, BP, SFC, BSFC, BTE, etc was same as that carried out for without EGR system.

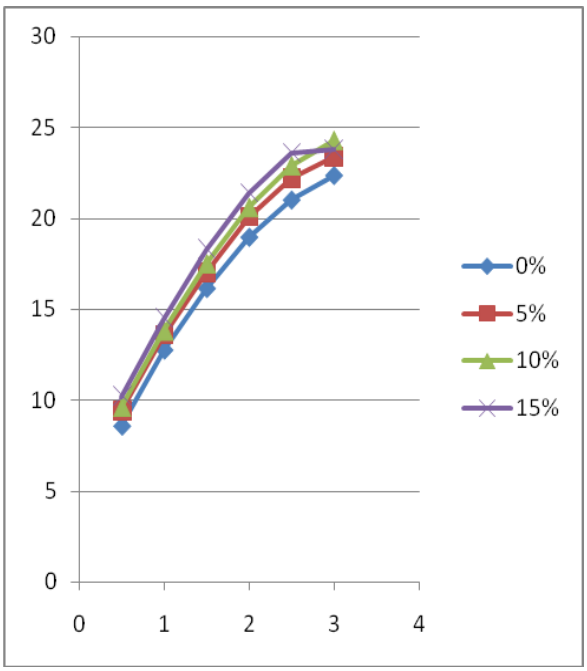
DISCUSSION:

LOAD VS BP (KW)



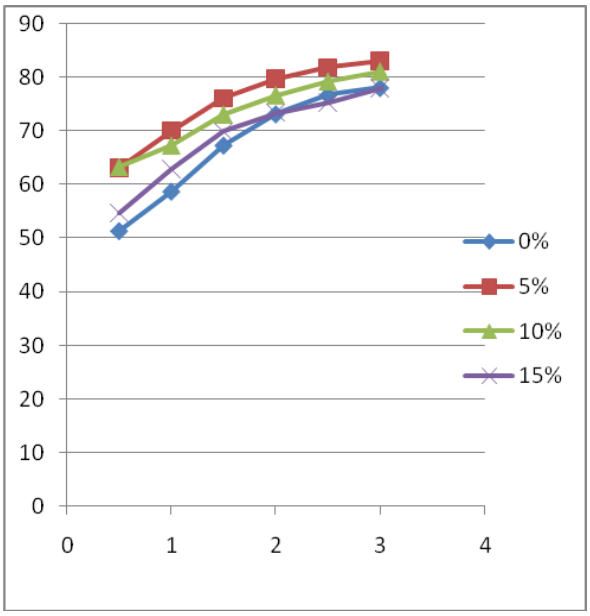
LOAD VS BP (KW)

LOAD VS BRAKE THERMAL



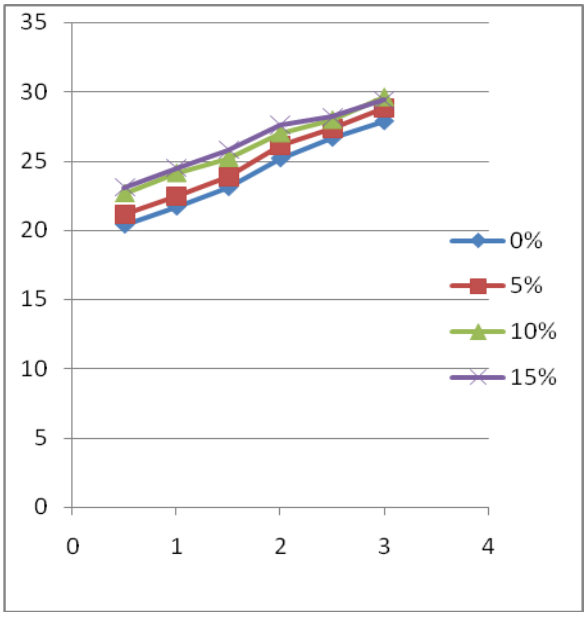
LOAD vs. THERMAL EFFICIENCY

LOAD VS MECH. EFFICIENCY



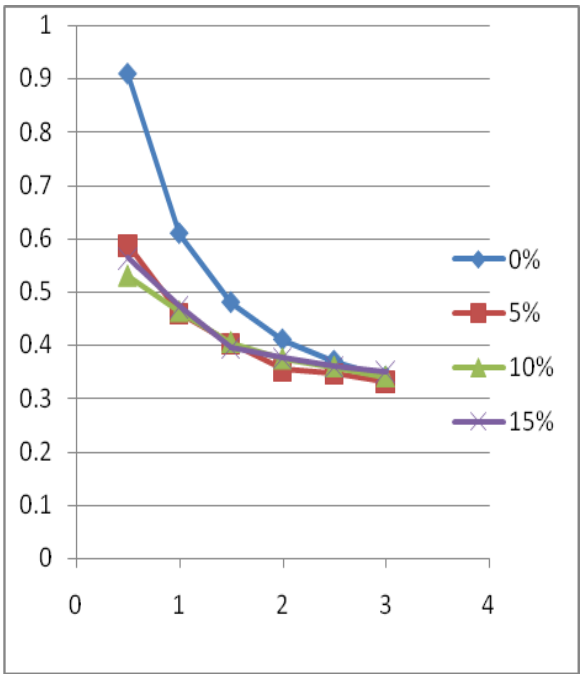
LOAD VS MECH.EFF

LOAD VS INDI.TH EFFICIENCY



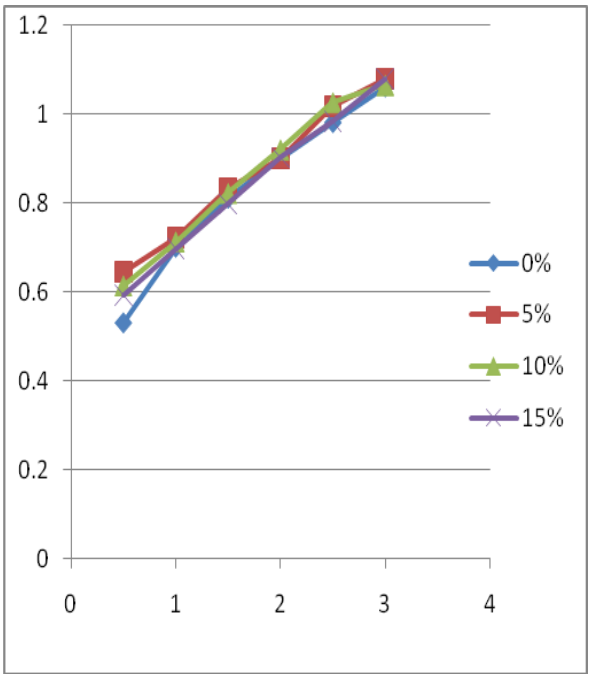
LOAD VS INDI.TH EFFICIENCY

LOAD VS SFC



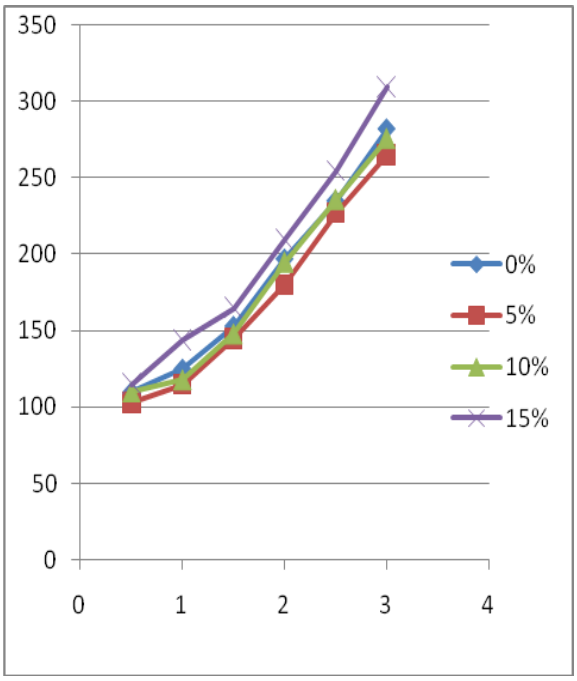
LOAD vs. SFC (kg/kw/hr)

LOAD VS TFC



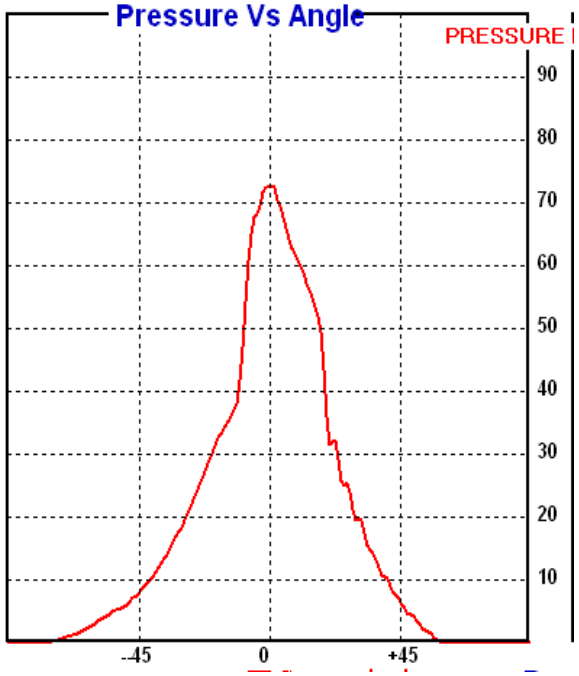
LOAD vs. TFC (kg/hr)

LOAD VS EXHAUST GAS TEMP

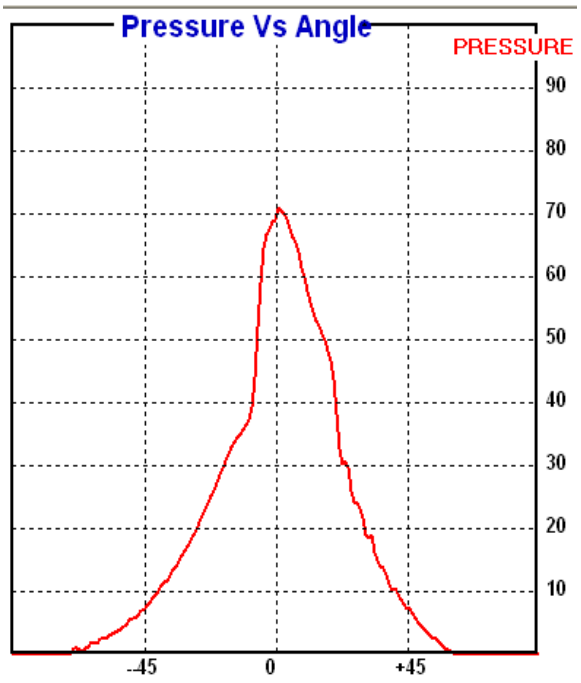


LOAD VS EXHAUST GAS TEM

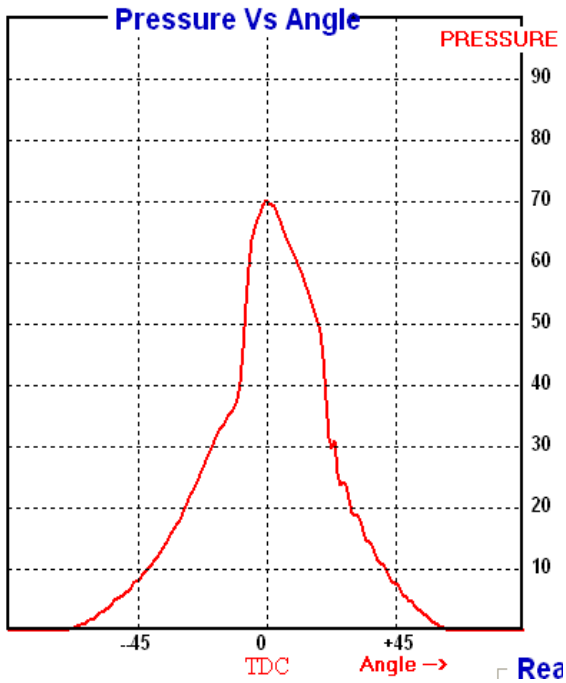
COMPARISON OF EGR AT PEAK LOAD



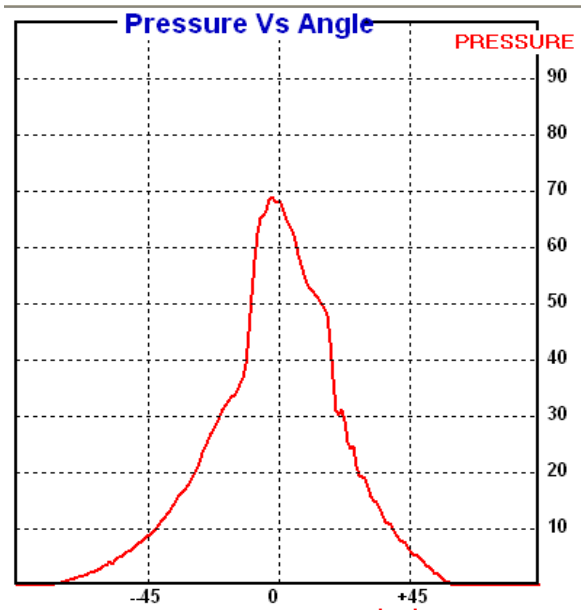
EGR AT 0%



EGR AT 5%



EGR AT 10%



EGR at 15%

IV. Conclusion

The present investigation was evaluated suitability of Exhaust Gas Recirculation system for use in a C.I. engine and to evaluated the performance and efficiency of the engine. The experimental study shows the above results. The engine performance on EGR system, Exhaust Gas Temperature reduces as compared to that of without EGR system and also various performance of engine were improved at 5% to 10%.

Future Scope

Exhaust Gas Recirculation system advantageous for environment further work in same project can be done for measurement of inlet air flow and exhaust air flow and percentage flow of EGR can be calculated and optimum value of EGR rate can be used for practical use. Biodiesel contain more sulphur and lead, while using biodiesel in engine it produces more emission in surrounding due to sulphur and lead. As EGR system reduces the emission rate, Biodiesel can be used as fuel in engines.

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