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Review of Experiment on Performance of Diesel Engine With EGR System

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Abstract—Reducing NOx emission in a diesel engine is a major issue for its environmentally harmful influences. To cope with the problem, the current diesel engine is equipped with EGR. Actually, it is known that EGR can help to reduce NOx emission by limiting oxygen supplied into intake manifold, lowering the combustion temperature. However, it also reduces engine performance. In the present investigation is carried out to study the effect of the Exhaust Gas Recirculation (EGR) on the performance and emission characteristics of the C.I. engines. To overcome the problem of NOx formation in the CI engine due to higher temperature the part of exhaust gases are recirculated to the engine cylinder. The EGR rate is varied in the engine I the proportion from 0%, 5%, 10 % and 15%. One set of experiment is conducted for each EGR rate, for studying the performance & emission characteristics of the engine. Then the performances and emissions characteristic for EGR rates were studied and results were compared with the performance and emission characteristics of without EGR.

Keywords—NOx emission,Exhaust Gas Recirculation (EGR), diesel engine performance

I. INTRODUCTION

The EGR framework is intended to decrease the measure of oxides of nitrogen (NOX) made by the motor amid working periods that for the most part results in high burning temperatures, NOx is shaped in high fixations at whatever point ignition temperature surpass around 25000 F. In this distribution framework a bit of an engine‟s fumes gasses are recycled once again into the motor barrels. In diesel motors fumes gas replaces a percentage of the abundance oxygen in the burning chamber. The EGR framework lessens NOx creation by distribution little measure of fumes gasses into the admission complex where it blends with the approaching air. By weakening the air blend under these conditions, crest burning temperature and weight are lessened, bringing about a general decrease of NOx yield. The point of the present exploration study is to research the impact of EGR on emanations and execution parameters of a circuitous infusion diesel motor (IDI) fuelled with diesel.

The present study has been embraced to assess the execution of the diesel motor with the differing EGR rates and its impact on the outflow qualities of the motor with unique consideration on the NOx emanation from the diesel motor.

II. METHODOLOGY AND EXPERIMENTATION

One of the essential inspirations of this task was the contrast between the outcomes from comparative past work and exploratory results from the trials for large amounts of EGR.

2.1 Description of Experimental Test Set Up

The trial test setup comprises of a, pressure ignition motor, with vortex ebb and flow dynamometer as stacking framework, fuel supply framework, water cooling framework, fumes gas distribution framework, oil framework and different sensors and instruments. Figure 3.1 is the photographic picture of the exploratory setup utilized as a part of the research facility to lead the present study and figure 3.2 and 3.3 speaks to the schematic representation of the test setup. Table 3.1 gives the

particulars of motor utilized as a part of the test rig. The setup empowers the assessment of warm execution and discharge constituents of the VCR motor. The warm execution parameters incorporate brake warm effectiveness, brake particular fuel utilization, and fumes gas temperature. The fumes emanations of the motor are broke down utilizing a fumes gas analyzer. The constituents of the fumes gas measured are CO (%), CO2 (%), HC (ppm), NOx (ppm)

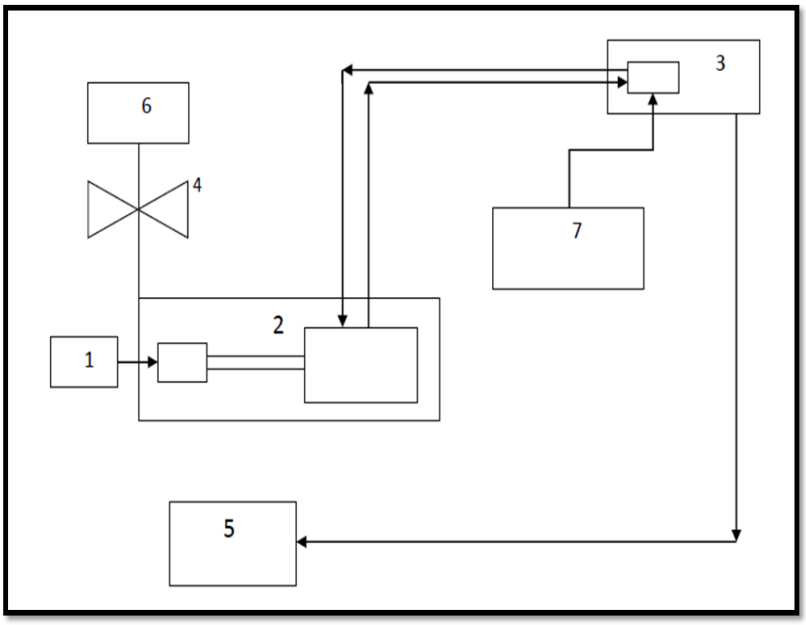

Fig.2.1.Schematic of experimental test set up

1 Eddy Current Dynamometer loading, 2 Single cylinder 4-stroke diesel engine & Alternator,
3 Exhaust gas Recirculation System, 4 Control valve, 5 Gas Analyzer& Smoke meter,
6 Fuel Tank, 7 Air drum

2.2 Measurement Systems

Various measurement systems used to capture the experimental data used in the test rig are load measurement system, emission measurement system and data acquisition system.

2.2.1. Load Measurement System

The test study is directed at different burdens and thus an exact and solid burden measuring framework is an absolute necessity. The heap measuring arrangement of this exploratory test rig comprises of a dynamometer of vortex current sort, a heap cell of strain gage sort and a stacking unit. The heap is connected by supplying current to the dynamometer utilizing a stacking unit. The heap connected to the motor is measured by a heap cell.

2.2.2Emission Measurement System

The outflow estimation framework is utilized to quantify the constituents of fumes gas and for this AIRREX Automotive Emission Analyzer is utilized. The fumes gas analyzer measures the fumes gas constituents of carbon dioxide (CO2), carbon monoxide (CO), oxides of nitrogen (NOx), unburnt hydrocarbons (HC), and oxygen (O2).

III. EGR TECHNIQUE FOR NOX REDUCTION

EGR is a valuable system for lessening NOx development in the burning chamber. Debilitate comprises of CO2, N2 and water vapors chiefly. At the point when a part of this fumes gas is re-

coursed to the barrel, it goes about as diluents to the combusting blend. This additionally lessens the O2 focus in the ignition chamber. The particular warmth of the EGR is much higher than natural air; consequently EGR builds the warmth limit (particular warmth) of the admission charge, hence diminishing the temperature ascend for the same warmth discharge in the burning chamber,

$$\%\text{EGR} = \frac{\text{volume of EGR}}{\text{total intake charge into the cyclinder}} \times 100.$$

Another way to define the EGR ratio is by the use of CO2 concentration

$$\text{EGR ratio} = \frac{[CO_2]_{\text{intake}} - [CO_2]_{\text{ambient}}}{[CO_2]_{\text{exhaust}} - [CO_2]_{\text{ambient}}}.$$

Three prominent clarifications for the impact of EGR on NOx diminishment are expanded ignition delay, expanded warmth limit and weakening of the admission accuse of latent gasses. The ignition delay theory declares that in light of the fact that EGR causes an expansion in ignition delay, it has the same impact as impeding the infusion timing. The warmth limit theory expresses that the expansion of the idle fumes gas into the admission builds the warmth limit (particular warmth) of the non responding matter present amid the ignition. The expanded warmth limit has the impact of bringing down the crest ignition temperature. As per the weakening hypothesis, the impact of EGR on NOx is brought about by expanding measures of idle gasses in the blend, which diminishes the adiabatic fire temperature.

Usage of EGR in diesel motors has issues like (an) expanded residue discharge, (b) presentation of particulate matter into the motor chambers. At the point when the motor segments come into contact with high speed ash particulates, particulate scraped spot might happen. Sulphuric corrosive and dense water in EGR likewise cause erosion. A few studies have distinguished harm on the chamber dividers because of the decrease in the's oil limit, which is hampered because of the blending of sediment conveyed with the particulate loaded recycled fumes gas. This requires the utilization of a productive specific trap.

Considers have demonstrated that EGR combined with a high gathering productivity particulate trap, controls smoke, unburnt hydrocarbon and NOx discharges all the while. The particulate trap, be that as it may, should be recovered since its pores get obstructed by the caught residue particles. Stopped up residue traps expand backpressure to the motor fumes, in this way influencing motor execution too. These traps should be recovered now and again utilizing warm or streamlined or electrostatic recovery strategies. Different strategies for diminishing the particulate outflow from diesel motors incorporate numerous infusions, supercharging and higher fuel infusion weight and so forth. The most noteworthy consideration is as of now being paid to two self-recovering frameworks: fuel added substance upheld recovery by utilizing cerium-or iron-based added substances, and a persistent recovery trap (CRT) utilizing without sulfur diesel fuel.

IV. EXPERIMENTAL PROCEDURE

The present study was completed to explore the execution and outflow attributes of diesel motor at different EGR rates and without EGR, in a stationary single chamber, four stroke, motor. The vortex current dynamometer is utilized as a stacking gadget whose force ingestion unit comprise of an all around adjusted star wheel rotor mounted on exactness course, turns in the stator. The response torque is detected by utilizing different measuring component, for example, spring adjust or stack cell with advanced pointer and so forth. The principle shaft of the dynamometer is having game plan for fitting rib coupling at both closures. The control of augmentation unit is mounted on a different board.

The real poisons in the fumes of a diesel motor are CO, CO2, HC and NOx. Fumes gas analyzer was utilized for the estimation emanations. The motor was worked on diesel without EGR first and afterward on various EGR rates. The execution information were then broke down from the diagrams with respect to warm proficiency, brake-particular fuel utilization and fumes gas temperature.
The diesel fuel was initially tried at zero EGR and at variable burdens. Keeping the no EGR condition and differing the heap in the scope of 3 kg, 6 kg, 9 kg and 12 kg all the execution parameters are noted. The EGR rate was then changed to 5%, 10% and 15% and the execution parameters were recorded for every heap considered. The methodology for the different tests is as given beneath; For getting the standard data of the engine first the experimentation is performed with diesel with no EGR.

1. Fill the diesel in fuel tank.
2. At first alter the EGR rate to zero EGR by keeping EGR valve shut.
3. Begin the water supply. Set cooling water stream for motor at 150 LPH and calorimeter stream at 80 LPH.
4. Check for every single electrical association.
5. 5 Likewise guarantee sufficient water stream rate for dynamometer cooling and piezo sensor cooling.
6. Supply the diesel to the motor by opening the valve gave at the burette.
7. Rehash the investigation for various burden.
8. Note down the readings for specific pressure proportion.
9. Change the EGR valve position according to necessity.
10. Rehash the entire trial for various EGR rates.
11. Note down the readings for each EGR rate.
12. Toward the end of the trial convey the motor to no heap condition and kill the motor

V. CONCLUSIONS

The main objective of the present investigation was to study of Exhaust Gas Recirculation system for use in a C.I. engine and to evaluate the performance and emission characteristics of the engine.By this experimentation we can find the performance and emission characteristics of diesel fuel with exhaust gas recirculation were investigated.

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