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Analysis of Brake Thermal efficiency and Oxygen in exhaust using oxygen enriched air in Compression Ignition engine.

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ABSTRACT: *Pollution is one a major factor which affects the environment nowadays, resulting in green house effect and global warming. One way of increasing efficiency is by inducting oxygen into the combustion chamber since oxygen is a combustion enhancer the amount of oxygen entering into the combustion chamber if increased it would result in better engine performance and lower emissions. Oxygen can be inducted in the intake manifold by the help of an external source. This additional increase of air will affects all parameters of the engine like Brake power, emissions, and heat release but we are going to consider only Brake thermal efficiency and Oxygen in the exhaust. Load test was conducted on a compression Ignition engine for various concentration of oxygen from (21% to 27%) with an interval of 2%. This analysis shows better Brake thermal efficiency and better brake specific fuel consumption but led to a very high percentage of Oxygen in the exhaust and lower carbon monoxide (CO), hydro carbon(HC) emission..*

Keywords - *O_2 exhaust, Brake thermal efficiency, Enriched oxygen intake, Diesel engine.*

1. INTRODUCTION

A Diesel engine is an internal combustion engine which uses the heat of compression to initiate ignition in the combustion chamber. Diesel engine has the highest thermal efficiency of all standard internal combustion engine because of the nature of the fuel used pollutants such as soot particles, carbon monoxide, oxides of nitrogen has become a major environmental issue[6].

Diesel engine always operated in excess air conditions hence air entering has about 78% Nitrogen improving engine performance and reducing pollution has always been a problem because higher operating temperature would result in better engine performance but will lead to NO_x emission. To improve the performance and fuel economy of the engine of the engine nitrogen getting into the engine has to be eliminated.

To overcome the said problem 100% oxygen in the intake can be given which would result in zero NO_x emission. But this method has a lot of limitation. Secondly the nitrogen entering into the engine can be replaced by different kind of gas (eg: Inert gas) in the intake system so that it doesn't interact with the combustion process and should not be a pollutant to the performing system or to the environment.

These both methods have serious limitations. Another way of doing this is by increasing the percentage of oxygen in the intake air which will effectively replace the nitrogen from getting into the engine. This will serve as a suitable alternative.

In this study the effect of various percentage of oxygen in the intake air is studied with respect to Brake thermal efficiency and O_2 in the exhaust.

2. H EXPERIMENTAL SETUP

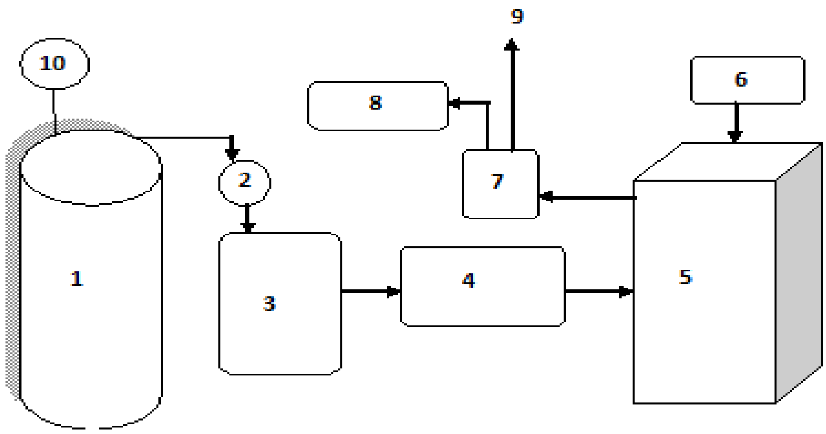
Test was conducted on a single cylinder, naturally aspirated, air cooled, and constant speed Greaves engine. An eddy current Dynamometer was used as the Loading device and a Krypton gas analyzer was used for the study of the exhaust gases.

Table -1: Engine specifications

Engine type	Naturally aspirated, air cooled, constant speed Greaves engine
No of cylinders	1
Compression ratio	18:1
Bore	68mm
Stroke	78mm
B.H.P	5
Fuel	Diesel
Specific gravity	0.8275
Loading device	Eddy current dynamometer

The source of oxygen is a commercial used oxygen cylinder which is attached to a flow meter which is fitted to a flame trap and then goes to a mixing chamber which helps in mixing of air and the supplement oxygen. Then it is feed into the engine.

Fig -1: Experimental setup



(1) Oxygen cylinder; (2) Flow meter; (3) Flame trap; (4) Engine; (5) Engine; (6) Loading Device; (7) Exhaust gas; (8) Krypton gas analyzer; (9) To Atmosphere

Test was taken for all the different percentage of Oxygen in the intake air. The amount of oxygen entering is monitored in such a way that it doesn't exceed 28% because higher percentage of oxygen would result in very high heat release and may result in explosion.

The quantity of oxygen sent additionally into the engine is given in the table

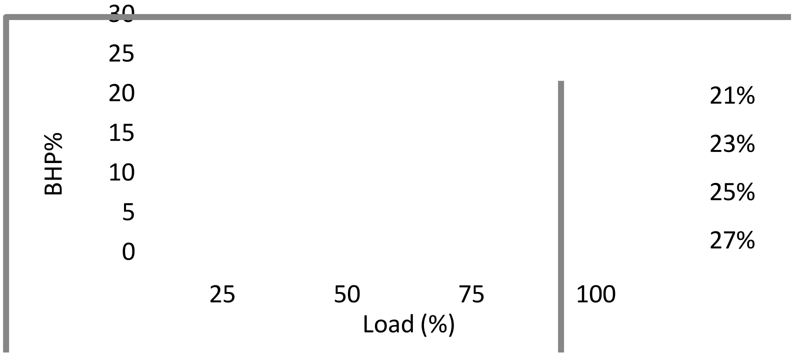
Table -2: Quantity of oxygen supplemented

Percentage	Liters per minute	O_2 % in CC	Total O_2 in CC
21%	Atmosphere oxygen	918	918
23%	2.5	918+42	959
25%	5	918+83	1001
27%	7.5	918+125	1043

3. RESULT AND DISCUSSION

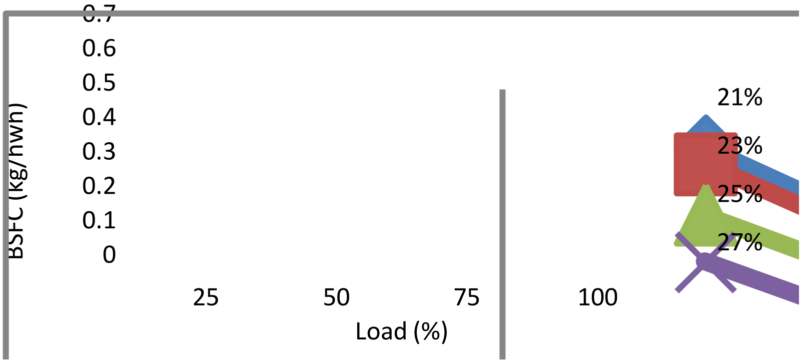
The The enrichment of oxygen in the intake air would help in better combustion and result in higher heat release for the same quantity of fuel. By increasing the percentage of oxygen in the intake air from (21% to 27%) the variation can be easily found in the figure. It is observed that for normal 21% oxygen level the engine had a maximum BHP value of 24.9% at 100% load when taken for 23% of oxygen enrichment there was very significant change when compared with 25% and 27% of oxygen there was a distinct change of 9% and 14% Increase was found only for minimum load and for maximum load there was almost no change. This shows that the engine has higher BHP at low load for oxygen enriched air intake.

Graph:1 BHP vs Load



The brake specific fuel consumption also showed a distinct variation at higher percentage of oxygen levels in the intake air for 21% and 23% of oxygen levels the specific brake power was high as 0.645 kg/wh at minimum load and at high load conditions the amount of fuel consumed for unit brake power reduced by about 35% for oxygen enrichment of 25% and 27% the variation was distinct there was a reduction of 11% and 18% less fuel consumption at all loads which shows that higher oxygen percentage in the intake air results in better economy.

Graph:2 BSFC vs Load



The percentage of oxygen in the exhaust also increased considerably when more oxygen is sent into the engine but when compared the burning ratio of oxygen inside the cylinder it is gradually getting increased. The Percentage of oxygen burnt inside the cylinder for peak load was found to be 17% for 21% oxygen induction and 19% for 23% oxygen induction and for 25% and 27% oxygen induction it has a burning ratio of 24% and 29% which was found to be high which results better burning of fuel.

Graph:4 O_2% vs Load

CO level reduced by 33%, 39%, 53% for the respective oxygen percentage of 23%, 25%, 27% in the intake air.

4. CONCLUSION

The use of oxygen enrichment on diesel engine under different load condition was studied and the main observations are as follows:

1. Brake thermal efficiency at low loads for enriched oxygen intake increases the brake power compared to the normal air intake but when load increases the Brake power remains normal.
2. Fuel consumption rate decreases for higher oxygen percentage in the intake air.
3. The amount of fuel consumed for unit brake power is high at minimum load, and reduces when the load increases and this happens for all oxygen percentages in the intake air.
4. Oxygen which is coming out of the exhaust also increases with respect to the percentage of oxygen in the intake air but the percentage of oxygen burnt inside the cylinder increases with respect to the supplement of oxygen inducted into the cylinder.
5. CO drops a very high percentage with respect to oxygen induction in the intake as oxygen helps in better combustion.

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