Performance of Single Cylinder 4-Stroke Diesel Engine Using Blower at Exhaust in assorted Compression Ratio - An Experimental Study

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Abstract

The present analysis is an experimental work prepared for the performance Characteristics of the 4-stroke diesel engine using suction blower at the exhaust in two different compression ratios. The experiment integrates the device consisting of a suction blower based on requirements. The experiment is carried out for the two different compression ratios with the variation of load on engine. The result shows the improvement in the break power, specific fuel consumption, volumetric efficiency, break thermal efficiency and mechanical efficiency of the engine with the blower at exhaust of an I.C.Engine when compared with the normal 4- stroke diesel engine in two different compression ratios.

Keywords: I.C. Engines, CR - Compression Ratio, SFC – Specific fuel consumption, blower, break power, thermal efficiency, mechanical efficiency.

1. Introduction

In the World, Industrial development and population growth have led to a surge in the global demand of fossil fuel in recent years. Fuel is any substance used to produce heat and energy through a chemical reaction. Fossil fuel forms when buried flammable geologic deposits of carbon-containing materials including decayed plants and animals are exposed to high temperature, heat, and pressure conditions excessive piling of layers of sedimentary rocks over them. However this process is not as easy as it appears to be and it takes millions of years to accomplish. Hence a serious effort is made to enhance the combustion process of an I.C. engine and finally focused on consumption of fuel during the experiment.

2. Specifications of Engine

Table 1. Specifications of engine

Item	Specifications
Engine Make	Kirloskar
Engine power	3.50 kW
Engine speed	1500 rpm
No. of cylinders	1
No. of strokes	4
Type of cooling system	Water Cooled
Type of fuel used	Diesel
Cylinder Bore	87.50 mm

Stroke Length	110.00 mm
Connecting Rod length	234.00 mm
Compression Ratio	18.00
Swept volume	661.45 (cc)
Dynamometer Type	eddy current, water cooled, with loading unit

3. Experimental Set Up

The experiments are conducted on single cylinder four stroke water cooled direct injection diesel engine as shown in figure 1. The engine was coupled to eddy current, water cooled dynamometer. Fuel flow rates were regulated with calibrated measuring device.

The engine was run at the idling condition for certain period of time. The engine was properly fitted with the mechanical loading arrangement for better results. After running the engine with this condition for certain time, readings were taken for different load conditions. The suction blower was attached with the exhaust of an engine as shown in figure 2.

The experiment is performed on Diesel Engine at compression ratio as 18 with the variation of load in normal condition (When suction blower is not attached at exhaust of an engine) and the performance parameters are recorded. Again the experiment is performed on Diesel Engine with the variation of load at same compression ratio as 18 when the suction blower is attached at exhaust of an engine and the performance parameters are recorded. Now to examine the variation of performance parameters with compression ratio, the same experiment is performed by changing the compression ratio as 16 and the performance parameters are recorded. The comprise study was done to know the effect of compression ratio and the other independent variables on performance parameters of I.C. Engine.

Figure 1. Experiment Set-up

Figure 2. Suction Blower at exhaust

4. Result

From the experimental informations, the graphs are drawn. These graphs demonstrate the variation in brake power, brake thermal efficiency, mechanical efficiency, volumetric efficiency and specific fuel consumption at various loads on the diesel engine in two different compression ratios, 16 CR and 18 CR.

Based on the above experimental results, a graph was drawn between Load and Brake power which is shown in Figure 3. The graph indicates that for 18 compression ratio, the brake power increases 4 % with increase in full load condition when the suction blower is attached with exhaust. Also, the graph indicates that for 16 compression ratio, the brake power increases 2 % with increase in full load condition when the suction blower is attached with exhaust. Hence more brake power is obtained during 18 compression ratio as compared to 16 compression ratio using blower at exhaust of an engine.

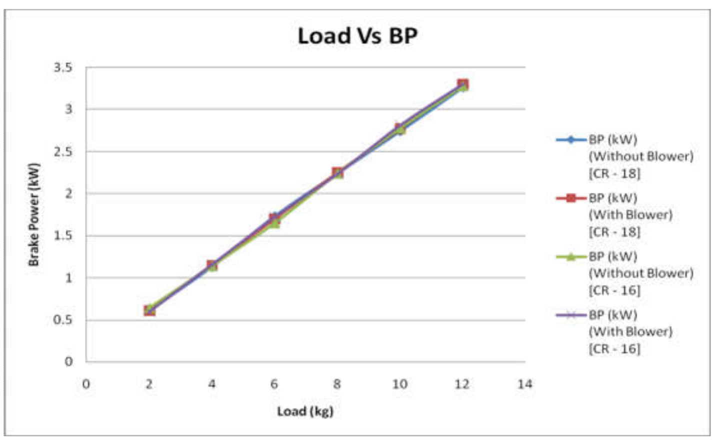

Figure 3. Load Vs Brake Power

Based on the above experimental results, a graph was drawn between Load and Mechanical efficiency which is shown in Figure 4. The graph indicates that for 18 compression ratio, the mechanical efficiency increases 2.54 % with increase in load when the suction blower is attached with exhaust of an engine. Also the graph indicates that for 16 compression ratio, the mechanical efficiency increases 5.15 % with increase in load when the suction blower is attached with exhaust. Hence more mechanical efficiency is obtained during 16 compression ratio as compared to 18 compression ratio using blower at exhaust of an engine.

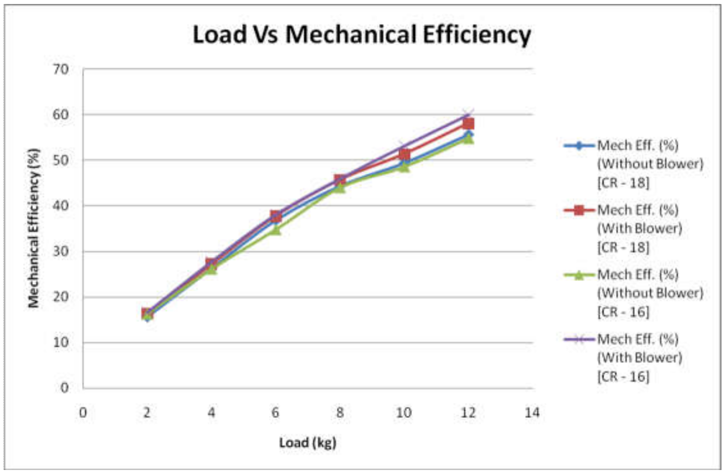

Figure 4. Load Vs Mechanical Efficiency

Based on the above experimental results, a graph was drawn between Load and Brake thermal efficiency which is shown in Figure 5. The graph indicates that for 18 and 16 compression ratio, brake thermal efficiency increases diminutive with increase in load when the suction blower is attached with exhaust. As per experimental results, during 18 compression ratio, the brake thermal efficiency increases as compared to 16 compression ratio when blower is attached to exhaust of an engine.

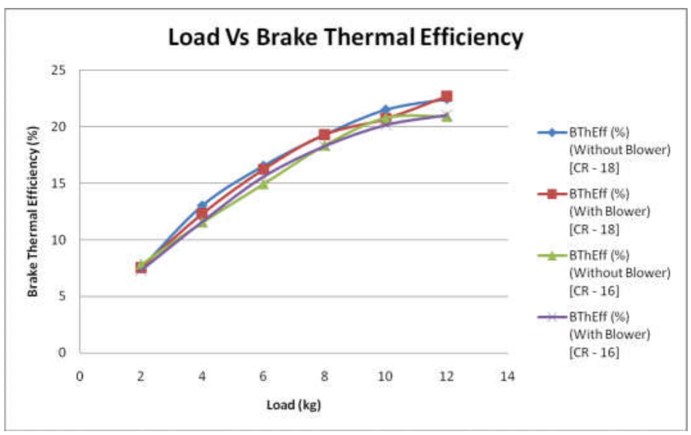

Figure 5. Load Vs Brake Thermal Efficiency

Based on the above experimental results, a graph was drawn between Load and volumetric efficiency which is shown in Figure 6. The graph indicates that the volumetric efficiency remains almost same and does not defer much compared to normal engine condition (without suction blower at exhaust of an engine) with increase in load at compression ratio as 18 when the suction blower is attached with exhaust. And nearly same result is obtained for 16 compression ratio. But the experimental results show that as compared to 18 compression ratio, during 16 compression ratio, the volumetric efficiency increases.

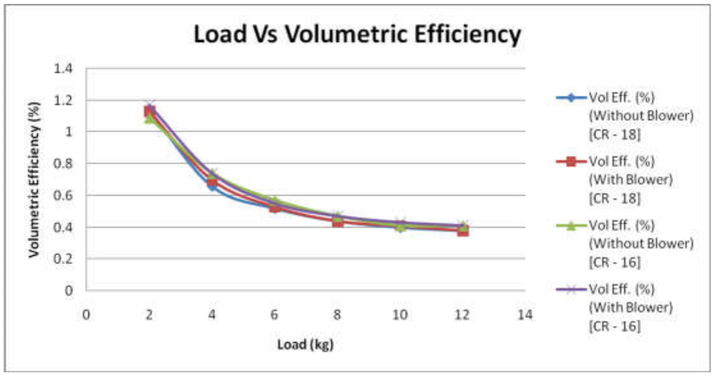

Figure 6. Load Vs Volumetric Efficiency

Based on the above experimental results, a graph was drawn between Load and Specific fuel consumption which is shown in Figure 7. The graph indicates that the Specific fuel consumption remains almost same and does not defer much compared to normal engine condition (without suction blower at exhaust of an engine) with increase in load at compression ratio as 18 when the suction blower is attached with exhaust. And almost same result is obtained for 16 compression ratio. But the experimental results show that as compared to 18 compression ratio, during 16 compression ratio, the Specific fuel consumption increases.

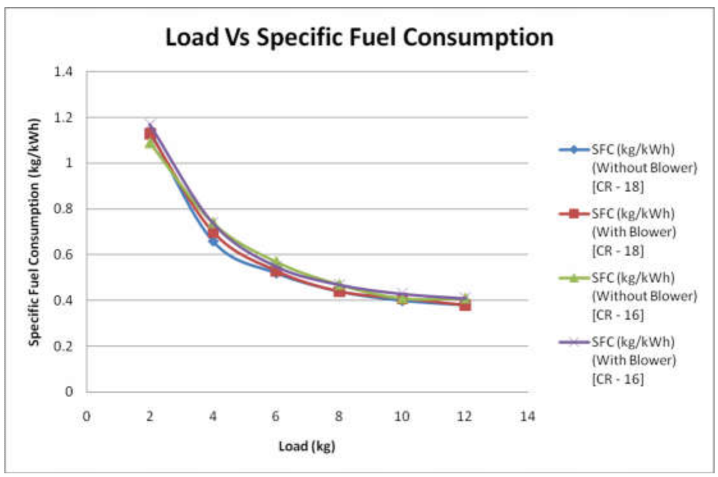

Figure 7. Graph – Load Vs Specific Fuel Consumption

5. Conclusion

The following conclusions are drawn from the experimental work.

1. More brake power is obtained during 18 compression ratio as compared to 16 compression ratio using blower at exhaust of an engine.
2. More mechanical efficiency is obtained during 16 compression ratio as compared to 18 compression ratio using blower at exhaust of an engine.
3. Brake thermal efficiency increases during 18 compression ratio as compared to 16 compression ratio when blower is attached to exhaust of an engine.

4. Volumetric efficiency increases during 16 compression ratio as compared to 18 compression ratio when blower is attached to exhaust of an engine.
5. Specific fuel consumption increases during 16 compression ratio as compared to 18 compression ratio in both the situation of an engine i.e. when blower is attached to the exhaust of an engine and without blower.

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