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EXHAUST BACK PRESSURE EFFECT ON THE PERFORMANCE FEATURES OF A DIESEL ENGINE

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ABSTRACT

Automobiles play a key role in our day today life. Today, studying the parameters which affect the performance of diesel engines is important. In spite of the previous studies, still some aspects needs investigations. In previous researches, valve timing and fuel injection effects on engine performance was studied. In this work, the effect of changing the back pressure of the exhaust gases on the performance of the single cylinder four stroke diesel engine was studied experimentally. The study was experimentally made by varying the length of exhaust pipes with lengths of 0.250m, 0.500m, 0.750m, 1m and 2m. It was found that with increase in exhaust pipe length, the exhaust back pressure increases as this decreases the combustion efficiency. The fuel economy and the volumetric efficiency were found to be the best for a minimum exhaust pipe length.

Keywords: exhaust back pressure, valve timing, exhaust pipes, combustion efficiency.

INTRODUCTION

In the diesel engines, during suction and exhaust stroke there is some power loss. This will reduce the brake thermal efficiency, which change from maximum at full throttle to zero at idling. The pressure in the engine cylinder during exhaust stroke is almost equal to atmospheric pressure. During exhaust stroke, the back pressure of the exhaust gases will reduce the volumetric efficiency of the engine. Due to this back pressure some residual gases may be left in the combustion chamber. These residual gases will decrease the combustion rate which in turn will affect the volumetric efficiency and the performance of the engine. These residual gases will increase the fuel consumption and emissions from the engine. S. M. Rabia *et al* [1] have studied the effects of timing of valve and back pressure of exhaust gases on a Gasoline engine's performance by simulation. In their work, it was seen when timing of valves and back pressure of exhaust gases were varied, the fuel consumption decreased and performance of the engine improved for a particular condition. They validated their findings with experimental findings and they were found to be in good agreement. Twinkle Panchal *et al* [2] studied the effects of exhaust back pressure on emission by altering the manifold position in a bike engine. Their objective was to reduce the specific fuel consumption and pollution. It was seen during their study that the emissions were reduced for a particular manifold position. Nikhil Kanawade *et al* [3] reviewed several works on exhaust manifold design. He was in a view that the research that is taking place in the recent past on the design of exhaust manifold, the performance appraisal using investigational methods and Numerical methods (CFD), different geometrical forms of exhaust manifold and their brunt on the performance had also been brought together and discussed. M. S. Shehata *et al* [4] experimentally studied the methods for reducing emissions for a SI engine. They investigated parameters lie brake power, air-fuel ratio and exhaust gas temperature. Recirculation of exhaust gases was used at a rate of 5%, 7%, 8%, 10% and air is injected at a rate of 3%, 4%, 5%, 6%. It was found during their study that the emission of unburnt HC and CO was reduced by injecting air in the exhaust manifold. They also found that unburnt HC & CO concentration increases with increase in exhaust gas recirculation. I. Ibrahim *et al* [5] have experimentally studied the exhaust configuration's effects on the performance of a diesel engine. The experiment was conducted on a in-line OHC four stroke, four cylinder engine and indirect injection diesel engine with different exhaust middle pipe configuration attached. The work was performed under two conditions, 50% and 100% of throttle. The performance parameters of the engine were studied. In this work, an investigation was carried out experimentally to investigate the effect of back pressure of exhaust gases on performance characteristics of a diesel engine by varying the length of exhaust pipes.

EXPERIMENTAL METHODOLOGY

Single cylinder diesel engine with computerized test rig as shown in Figure-1 was chosen for the experimental study.

The engine is connected with an exhaust pipe of 0.250 m. After checking the fuel supply, water circulation and lubricating oil in the oil sump the engine is started. The engine is run on idle speed for a few minutes without any load. Gradually the engine is loaded by electrically and the speed is maintained constant. The value of load in terms of current is noted from the test rig. The values of fuel consumption, volumetric efficiency and brake thermal efficiency are noted from the computerized test for various loads. The same procedure is repeated by changing the length of exhaust pipes as 0.500 m, 0.750 m, 1.0 m & 2.0 m respectively.

Figure-1. Experimental setup.

The specifications of the engine is given below,

Table-1. Specifications of the engine.

Engine make	**Kirloskar**
Number of cylinders	1
Power (BP)	5HP(3.7kW)
Speed (N)	1500 rpm
Bore (B)	80 mm
Stroke (SL)	110 mm
Type of Lubrication	Splash lubrication
Fuel used	Diesel
Circumference of brake drum(C_b)	0.785m
Length of Exhaust pipes	0.250 m, 0.500 m, 0.750 m, 1.0 m, 2.0 m.
Type of loading	Electrical
Efficiency of the alternator	0.8

From Figure-2, it is clear that the fuel consumption was minimum for an exhaust pipe length of 0.250 m and maximum for a length of 2 m. It was seen that with increase in exhaust pipe length, the fuel consumption increased. This is due to the increase in back pressure of the exhaust gas.

From Figure-3, it was seen that the brake thermal efficiencies remained nearly the same for all exhaust pipe lengths. But brake thermal efficiency was maximum for an exhaust pipe length of 0.250 m and it increased gradually with the increase in exhaust pipe length.

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RESULTS AND DISCUSSIONS

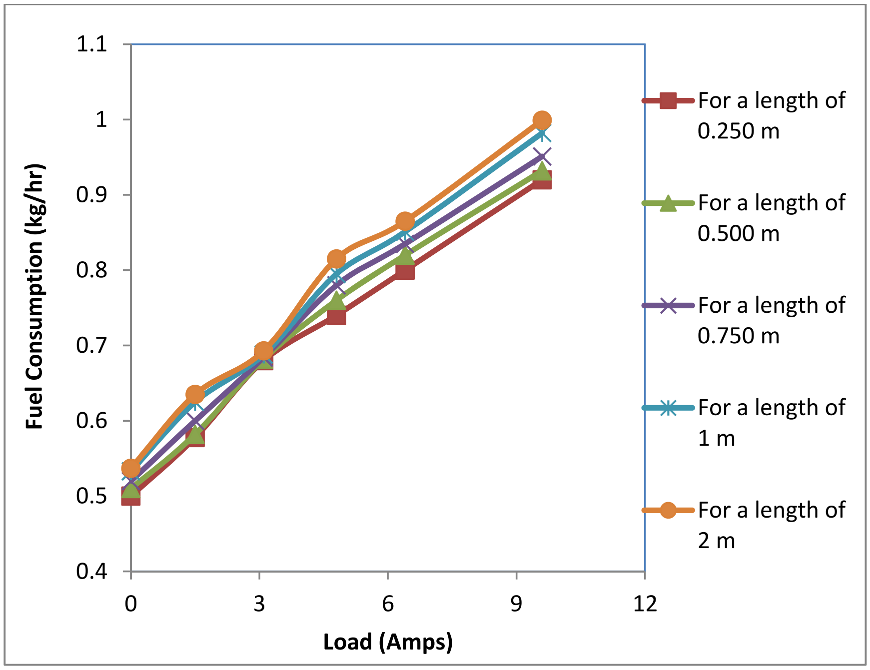

Figure-2. Variation of fuel consumption with respect to load.

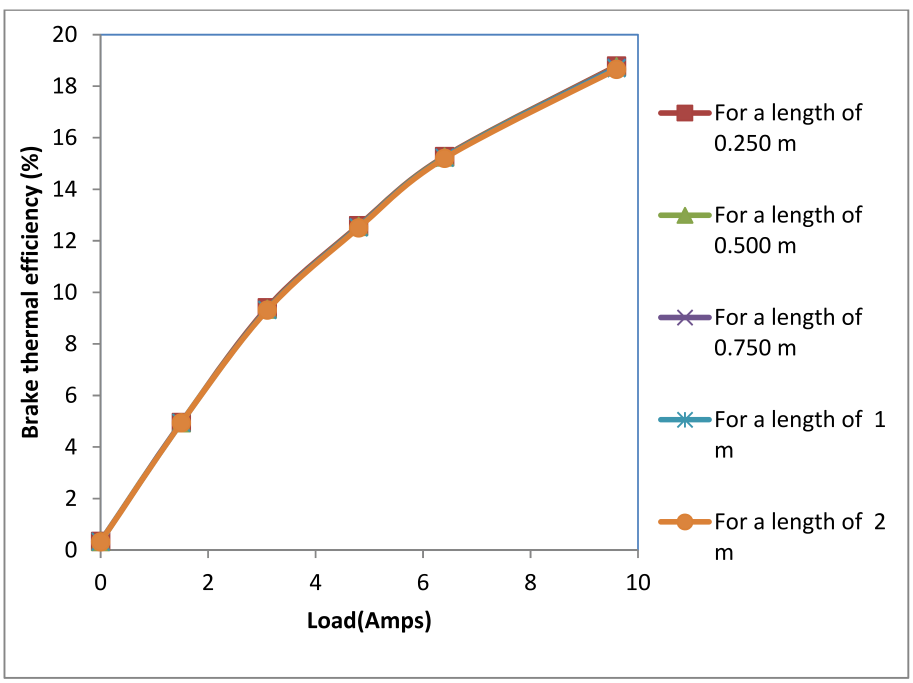

Figure-3. Variation of brake thermal efficiency with respect to load.

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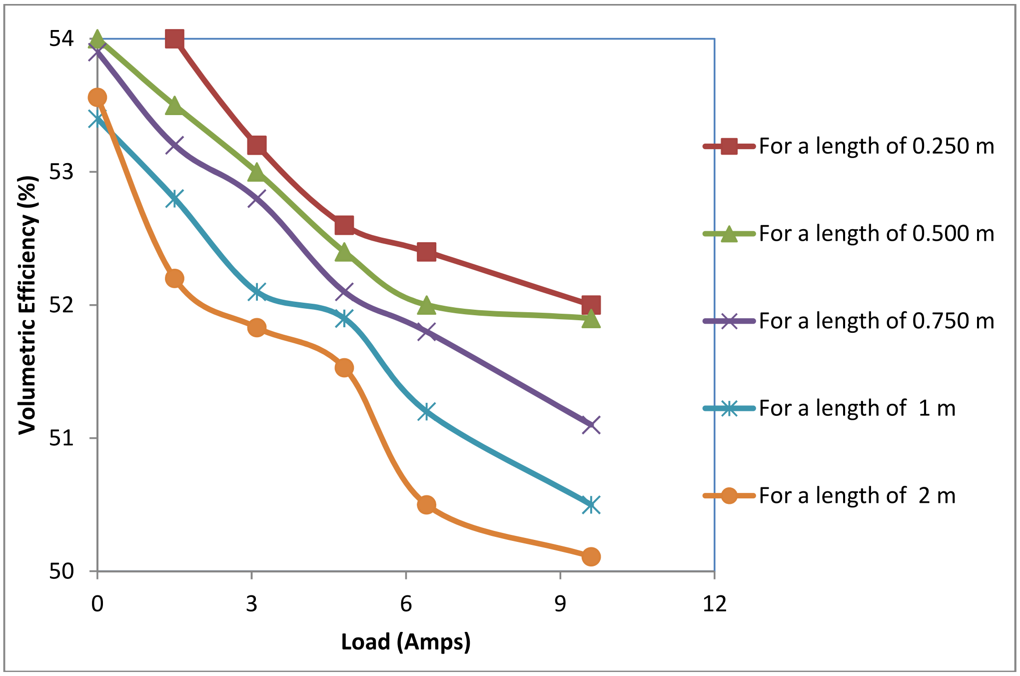

Figure-4. Variation of brake volumetric efficiency with respect to load.

From Figure-4, it was seen that the volumetric efficiency increased with the increase in exhaust pipe length. Volumetric efficiency was found to higher for a exhaust pipe length of 0.250 m and lower for an exhaust pipe length of 2.0 m. It was also seen that with the increase in load, volumetric efficiency also increased.

CONCLUSIONS

The exhaust back pressure effects on the performance characteristics of a single cylinder four stroke diesel Engine have been experimentally investigated with computerized test rig. The values of fuel consumption, brake thermal efficiency and volumetric efficiency were maximum for a pipe length of 0.250 m and minimum for a pipe length of 2.0 m. It was found that fuel consumption, brake thermal efficiency and volumetric efficiency decreased with the increase in exhaust pipe length. When the length of exhaust pipes increased, the back pressure of the exhaust gases increased. When the back pressure of the exhaust gases increases, the combustion efficiency decreases. So with the increase in exhaust back pressure, volumetric efficiency and fuel consumption decreases. Volumetric efficiency, fuel economy and combustion efficiency can be improved by decreasing the exhaust back pressure.

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