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PERFORMANCE INVESTIGATION OF INTAKE MANIFOLD GEOMETRY ON 4-STROKE SINGLE CYLINDER DIESEL ENGINE

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Abstract: The aim of this project is to design different type of inlet manifolds for direct injection (DI) single cylinder diesel engine in order to create the turbulence by swirl. A good swirl promotes the fast combustion and improves the efficiency. The engine should run at low speeds in order to have low mechanical losses and fast combustion, enabling good combustion efficiency. Therefore to produce high turbulence prior to combustion within the cylinder, swirl induced by the inlet manifold will be helpful. This project aims at studying the effect of air swirl generated by directing the air flow in intake manifold on engine performance as well as on its exhaust emissions. The turbulence is achieved in the inlet manifold with different shaped intake manifold. In view this, experimental investigation has been carried out to find the effect of swirl on the performance characteristics of the engine as well as on its exhaust emissions , by inducing swirl in inlet manifolds with helical shaped intake manifold.
Keywords: intake manifold, swirl, helical shaped manifold, efficiency

I. INTRODUCTION

An inlet manifold or intake manifold is the part of an engine that supplies the fuel/air mixture (in case of SI engine) or only fresh air (in case of CI engine) to the engine cylinder. The primary function of the intake manifold is to evenly distribute the combustion mixture (or just air in a direct injection engine) to each intake port in the cylinder head(s). The intake manifold has historically been manufactured from aluminum or cast iron but use of composite plastic materials is gaining popularity. The intermittent or pulsating nature of the airflow through the intake manifold into each cylinder may develop resonances in the airflow at certain speeds. These may increase the engine performance characteristics at certain engine speeds, but may reduce at other speeds, depending on manifold dimension and shape. Engineers discovered that pulsating flow can be used to force additional air into the engine making it more efficient. Air motion in CI engine influences the atomization and distribution of fuel injected in the combustion chamber and also supplies fresh air to the interior portion of the fuel drops and thereby ensures complete combustion.

II. BRIEF OVERVIEW OF SELECTION PARAMETERS

2.1 Shape of intake manifold

From literature review, different researcher used so many methods to produce the swirl in which Benny Paul, V. Ganesan worked on three different shapes viz. helical, spiral and helical-spiral combined. They have used the software Gambit, and CFD and concluded that helical-spiral combine shape gives the best performance with respect to the break specific fuel consumption. In my research work the concluded data will be verified with experimental setup with varying other parameter like engine speed and fuel injection timing.

2.2 Fuel injection timing

From the literature survey it is concluded that the swirl production also depends on the fuel injection timing ,so the selected different intake manifold are checked with changing the fuel injection timing.

2.3 Engine speed:

From the literature survey it is known that the swirl produced varies with varying engine speed. As the engine speed changes variation in the swirl produced as well as its effect on engine performance must be noted. So the selected parameter will be checked with different engine speed.

III. EXPERIMENTAL SETUP

Figure-1 Experimental setup

3.1 Experimental Setup Specification

4-Stroke Single Cylinder Diesel Engine		
SR NO	**SPECIFICATION**	
1	Manufacturer	Newkisan
2	Type	Vertical(TRB)
3	Compression ratio	17.5
4	Kw/hp	4.8/6.5
5	Rev/min	1500
6	S.F.C	250 g/kwh
7	Stroke	110mm
8	Bore	87.5mm
9	Type	water cooled
10	Governing	Class-B1
11	Dynamometer	Eddy current dynamometer
12	Speed measuring device	Tachometer

Table :1 Engine specification

3.2 Prototype of helical intake manifold

IV. RESULTS AND DISCUSSIONS

4.1 Break thermal efficiency

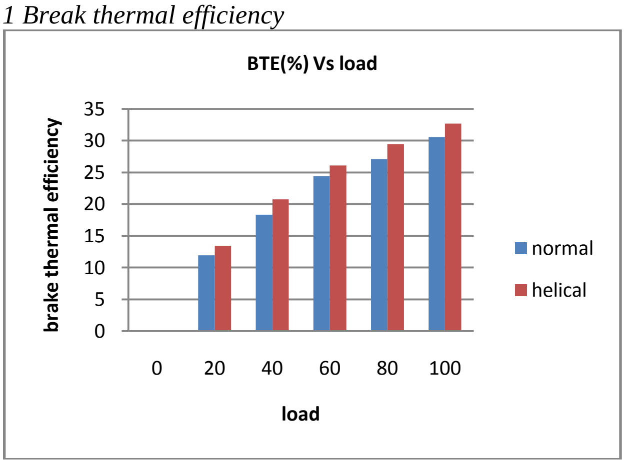

Figure 2 : BTE Vs Load

The brake thermal efficiency of the engine is one of the most important parameter for evaluating the performance of the engine. It indicates the combustion behavior of the engine to a greater extent. It is noticed that the BTE of the engine increased with increasing loads. It can be observed from the figure that the thermal efficiency is highest for engine with helical manifold compared to normal manifold.

4.2 Brake Specific Fuel Consumption

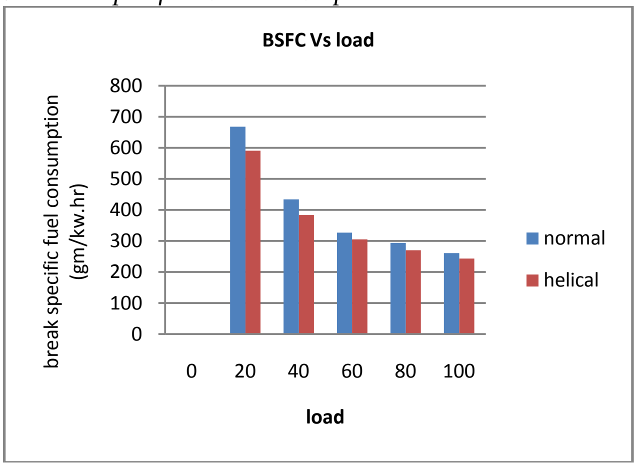

Figure 3: BSFC Vs Load

The variation in BSFC (brake specific fuel consumption) with respect to brake power. It can be seen from the Figure that fuel consumption decreases with increase in load. One possible reason for this reduction is that the brake power increases in higher percentage compare to fuel consumption. The fuel consumption decreases when engine is modified with helical manifold.

4.3 Mechanical Efficiency (η_{mech})

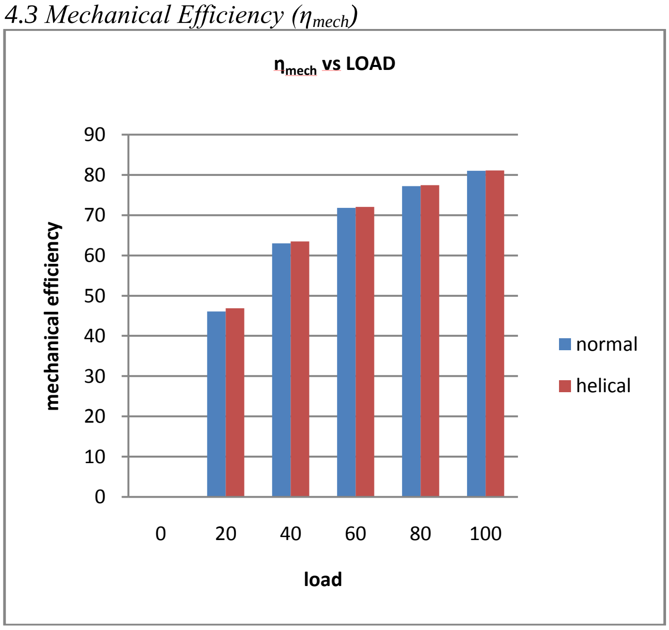

Figure 4: η_{mech} vs LOAD

Figure shows the variation in mechanical efficiency with brake power with different condition at various load conditions normally from 0 % to 100 % load.

4.4 Exhaust Gas Temperature

The brake power and exhaust gas temperature. The exhaust gas temperature of the engine is the indication of conversion of heat into work

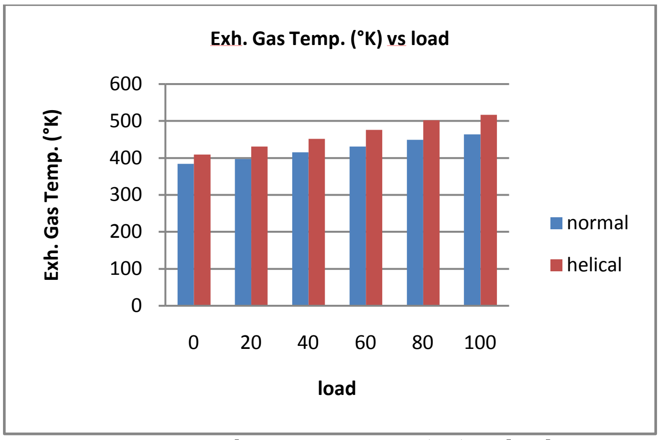

Figure:5 Exhaust Gas Temp. (°K) vs load

With increase swirl production by helical manifold, there is increase in fuel combustion so the temperature in the combustion chamber increases.

4.5 Carbon Dioxide (CO_2)

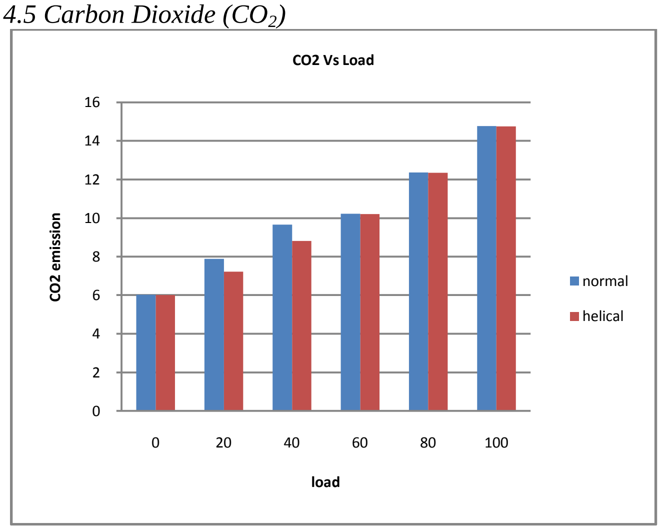

Figure :6 Carbon Dioxide (CO_2) Vs Load

4.6 Hydrocarbons (HC)

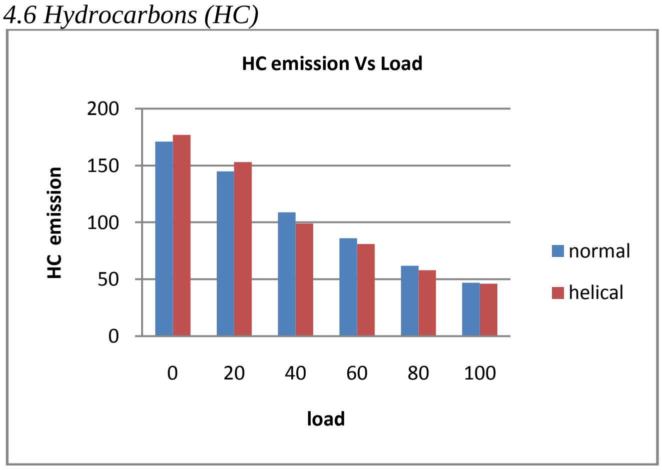

Figure : 7 HC emission Vs Load

V. CONCLUSION

Here from the all result we can say that engine with helical shaped manifold is more efficient. there was reduction in pollutant gases as well as increase in mechanical effeiciency.

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