The Performance and Emission Test for Modified Piston of 2 Stroke Petrol Engine

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Abstract
The aim of this project is to investigate the effect of high refractive index material coating on piston head of a two stroke petrol engine. The experiment was based on comparison of Performance & Emission characteristics of a two stroke petrol engine (0.81 Kwh at 5500 Rpm) with a conventional piston and modified piston (coated piston head). Performance parameters such as brake power, specific fuel consumption, volumetric efficiency & emission parameters such as HC, CO are calculated and compared for conventional and modified piston engine .The resultant values are plotted for
1. Volumetric efficiency vs valve opening
2. Specific fuel consumption vs valve opening
It was observed from the experiment that specific fuel consumption is minimum and volumetric efficiency is maximum for modified piston compared to conventional piston.

Keywords:- Brake power, specific fuel consumption, volumetric efficiency.

I. Introduction

1.1 HEAT ENGINES

A heat engine is a device, which transforms the chemical energy of a fuel into thermal energy and uses this energy to produce the mechanical work.

Heat engines are classified into two types.
1. External Combustion Engines.
2. Internal Combustion Engines.

External combustion engine is one in which the products of combustion of air and fuel transfer heat to a second fluid, which then becomes the working fluid for producing power. Steam engine is an example of external combustion Engine.
Internal Combustion Engine is one in which the products of combustion of air and fuel becomes directly motive the motive fluid. Petrol engines, gas engine, diesel engine, wankel engine, the open cycle gas turbine, jet engine are the examples of internal combustion Engines.
The main advantage of IC engines over EC engines are greater mechanical simplicity, lower ratio of weight and bulk output due to absence of auxiliary apparatus like condenser and boiler and hence lower initial cost, higher overall efficiency and lesser requirement of water for dissipation of energy through cooling systems. IC engines are mainly used for transport vehicle, automobiles, locomotive, aircraft etc.

1.2 **TURBULENCE**

Turbulence plays a very vital role in combustion phenomenon. The flame speed is very low in non-turbulent mixtures. A turbulent motion of the mixture intensifies the processes of heat transfer and mixing of the burned and unburned portions in the flame front (diffusion). These two factors cause the velocity of turbulent flame to increase practically in proportion to the turbulence velocity. The turbulence of the mixture is due to admission of fuel-air mixture through comparatively narrow sections of the intake pipe, valves, etc. in the suction stroke. The turbulence can be increased at the end of the compression by suitable design of combustion chamber, which involves the geometry of cylinder head and piston crown. The degree of turbulence increases directly with the piston speed.
If there is no turbulence the time occupied by each explosion would be so great as to make the high speed internal combustion engines impracticable. Insufficient turbulence lowers the efficiency due to incomplete combustion of the fuel. However, excessive turbulence is also undesirable. The effects of turbulence can be summarized as follows,
(i) Turbulence accelerates chemical action by intimate mixing of fuel and oxygen. Hence turbulence allows the ignitiol4, advance to be reduced and therefore weak mixtures can be burnt.
The increase of flame speed due to turbulence reduces the combustion time and hence minimizes the tendency to detonate.
(ii) Turbulence increases the heat flow to the cylinder wall and in the limit excessive turbulence may extinguish the flame.
(iii) Excessive turbulence results in the more rapid pressure rise (though maximum pressure may be lowered) and the high rate of pressure rise causes the crankshaft to spring and rest of the engine to vibrate With high periodicity, resulting in rough and noisy running of the engine

II. EXPERIMENTAL

2.1 EXPERIMENTAL SETUP:.

A two-stroke, or two-cycle, engine is a type of internal combustion engine which completes a power cycle in only one crankshaft revolution and with two strokes, or up and down movements, of the piston in comparison to a "four-stroke engine", which uses four strokes. This is accomplished by the end of the combustion stroke and the beginning of the compression stroke happening simultaneously and performing the intake and exhaust (or scavenging) functions at the same time.

Experimental setup

1. Two stroke petrol engine
2. Blower
3. Venturimeter
4. Two way valve
5. Manometer
6. Fuel tank
7. Specific fuel indicator

2.2 ENGINE SPECIFICATION:-

Side view of engine used in Test Rig

SL. NO	ENGINE PARAMETERS	SPECIFICATIONS
1	Engine maker	Enfield India ltd, Madras
2	Engine type	M-30(Enfield, 2 stroke)
3	Number of cylinder	Single cylinder
4	Number of strokes	4 Strokes
5	Rated power	0.81 kw @ 5500 rpm
6	Bore Diameter	30.2mm
7	Stroke length	43mm
8	Piston diameter	30mm
9	Compression ratio	(28:1)
10	Rated speed	5500rpm
11	Type of cooling	Air cooling
12	Fuel	Petrol
13	Load measurement	Based on valve opening
14	Speed measurement	Tachometer

2.3 PISTON COATING:-

A **coating** is a covering that is applied to the surface of an object, usually referred to as the **substrate**. The purpose of applying the coating may be decorative, functional, or both. The coating itself may be an all-over coating, completely covering the substrate, or it may only cover parts of the substrate. An example of all of these types of coating is a product label on many drinks bottles- one side has an all-over functional coating (the adhesive) and the other side has one or more decorative coatings in an appropriate pattern (the printing) to form the words and images.

Paints and lacquers are coatings that mostly have dual uses of protecting the substrate and being decorative, although some artists paints are only for decoration, and the paint on large industrial pipes is presumably only for the function of preventing corrosion.

Functional coatings may be applied to change the surface properties of the substrate, such as adhesion, wetability, corrosion resistance, or wear resistance. In other cases, e.g. semiconductor device fabrication (where the substrate is a wafer), the coating adds a completely new property such as a magnetic response or electrical conductivity and forms an essential part of the finished product.

A major consideration for most coating processes is that the coating is to be applied at a controlled thickness, and a number of different processes are in use to achieve this control, ranging from a simple brush for painting a wall, to some very expensive machinery applying coatings in the electronics industry. A further consideration for 'non-all-over' coatings is that control is needed as to **where** the coating is to be applied. A number of these non-all-over coating processes are printing processes.

III. PERFORMANCE CHARACTERSTICS:

3.1 SPECIFIC FUEL CONSUMPTION (SFC):

Comparing the specific fuel consumption of conventional piston and modified piston for different valve opening at 2000rpm

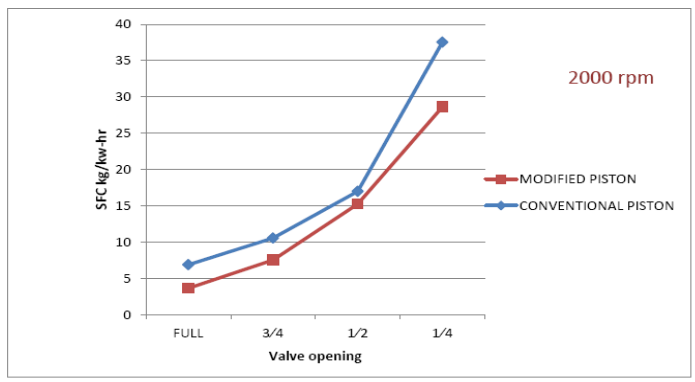

Fig 3.1(a) Comparing the specific fuel consumption of conventional piston and modified piston for different valve opening at 2000rpm

- From the above graph it is observed that specific fuel consumption for modified piston is minimum when compared with conventional piston for different valve opening at 2000rpm.
- For full valve opening SFC for modified piston is 3.24Kg/Kw hr and for the conventional piston is 6.88Kg/Kw hr at 2000 rpm.

Comparing the specific fuel consumption of conventional piston and modified piston for different valve opening at 2500 rpm

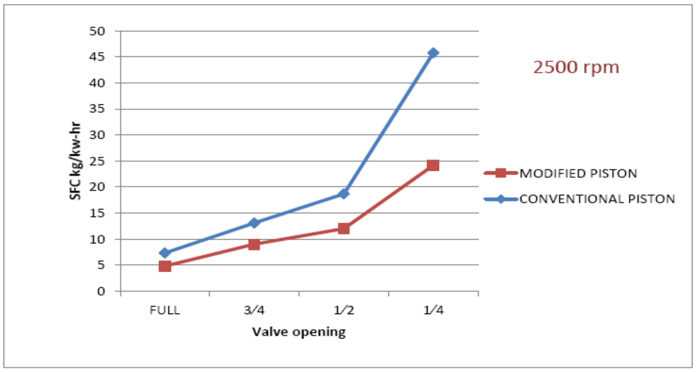

Fig 3.1(b) comparing the specific fuel consumption of conventional piston and modified piston for different valve opening at 2500 rpm.

- From the above graph it is observed that specific fuel consumption for modified piston is minimum when compared with conventional piston for different valve opening at 2500 rpm.
- For full valve opening SFC for modified piston is 4.80 Kg/Kw hr and for the conventional piston is 7.34 Kg/Kw hr at 2500 rpm.

Comparing the specific fuel consumption of conventional piston and modified piston for different valve opening at 3000 rpm

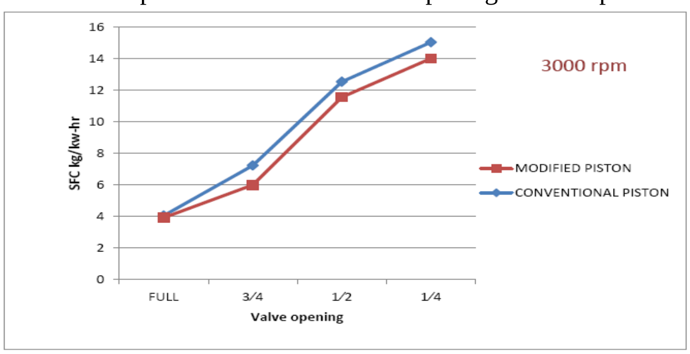

Fig 3.1(c) Comparing the specific fuel consumption of conventional piston and modified piston for different valve opening at 3000 rpm

- From the above graph it is observed that specific fuel consumption for modified piston is minimum when compared with conventional piston for different valve opening at 3000 rpm.
- For full valve opening SFC for modified piston is 3.93 Kg/Kw hr and for the conventional piston is 4.60 Kg/Kw hr at 3000 rpm.

3.2 VOLUMETRIC EFFICIENCY:

Comparing the volumetric efficiency of conventional piston and modified piston for different valve opening at 2000 rpm

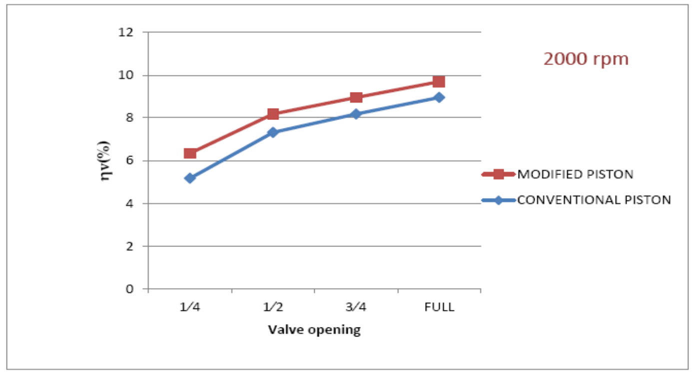

Fig 3.2(a) Comparing the volumetric efficiency of conventional piston and modified piston for different valve opening at 2000 rpm

- From the above graph it is observed that volumetric efficiency for modified piston is maximum when compared with conventional piston for different valve opening at 2000 rpm.
- For full valve opening volumetric efficiency for modified piston is 9.7% and for conventional piston is 8.96% at 2000 rpm.

Comparing the volumetric efficiency of conventional piston and modified piston for different valve opening at 2500 rpm.

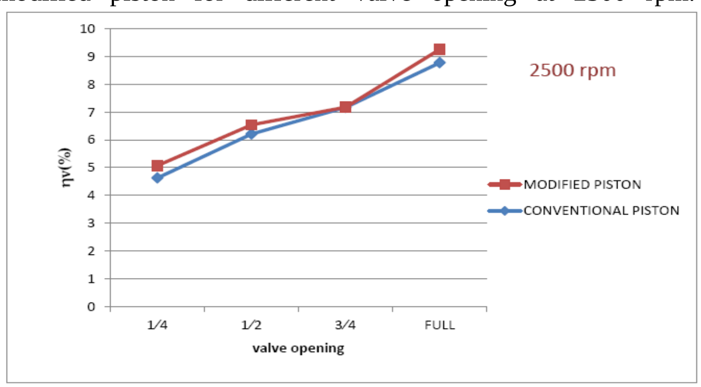

Fig 3.2(b) Comparing the volumetric efficiency of conventional piston and modified piston for different valve opening at 2500 rpm

- From the above graph it is observed that volumetric efficiency for modified piston is maximum when compared with conventional piston for different valve opening at 2500 rpm.
- For full valve opening volumetric efficiency for modified piston is 9.26% and for conventional piston is 8.78% at 2500 rpm.

Comparing the volumetric efficiency of conventional piston and modified piston for different valve opening at 3000 rpm

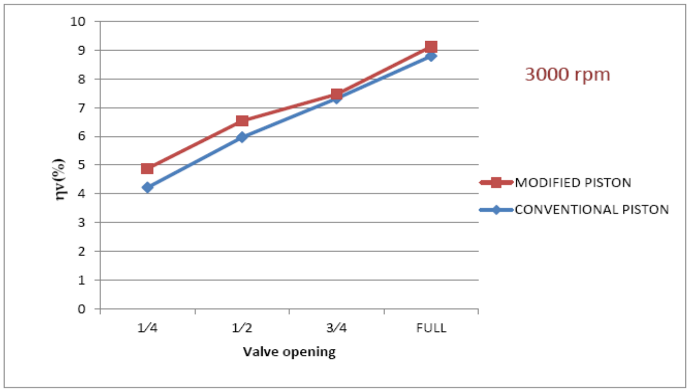

Fig 3.2(c) Comparing the volumetric efficiency of conventional piston and modified piston for different valve opening at 3000 rpm

- From the above graph it is observed that volumetric efficiency for modified piston is maximum when compared with conventional piston for different valve opening at 3000 rpm.
- For full valve opening volumetric efficiency for modified piston is 9.13% and for conventional piston is 8.80% at 3000 rpm.

CONCLUSION

- Brake thermal efficiency for modified piston at 10 microns metal coating for two stroke petrol engine is increased by 0.0035 Kw, 0.0036 Kw, 0.0002, 0.0013 Kw compared to conventional piston at the valve opening FULL,3/4**,** 1/2**,** and ¼ respectively**.**
- Specific fuel consumption of modified piston for 10 microns metal coating for two stroke petrol engine is reduced by 3.64 kg/Kw-hr , 3.02 kg/Kw-hr ,1.74 kg/Kw-hr, and 8.95 kg/Kw-hr compared to conventional piston at the valve opening FULL, 3/4**,** 1/2**,** and ¼ respectively.
- Volumetric efficiency of modified piston for two stroke petrol engine is increased by 0.74%, 0.78%, 0.86%, and 1.17% compared to conventional piston at the valve opening FULL, 3/4**,** 1/2**,** and 1/4 respectively.

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