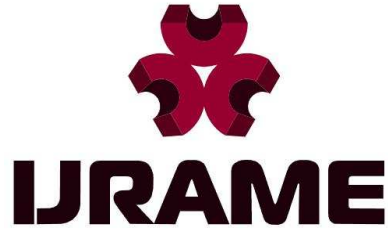

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PERFORMANCE OF SPARK IGNITION ENGINE UNDER THE INFLUENCE OF MAGNETIC FIELD

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Abstract

The present study investigates the effect of magnetic field on the performance of Single Cylinder Four Stroke Spark Ignition engine. The study concentrates on the effect of magnetic field the engine performance parameters such as fuel consumption, break thermal efficiency and exhaust emissions and on fuel properties like density and calorific value. The magnetic field is applied along the fuel line immediately before carburetor. The magnetic field is applied with the help of strong permanent magnets of strength 5000 gauss. The experiments are conducted at different engine loading conditions. The exhaust gas emissions such as CO, CO_2, HC and NO_X are measured by using an exhaust gas analyser. With the application of magnetic field the percentage reduction in fuel consumption is about 12 %, the percentage reduction in HC and CO is about 27% and 11 % respectively. The NOx level in engine increases with the application of magnetic field. The percentage increase in NOx is about 19%. The effect of magnetic field on percentage increase of CO_2 emissions from SI engine is about 7 %.

Keywords: Strong permanent magnets, Bomb calorimeter, five gas analyser.

1. INTRODUCTION

The effect magnetic field on the biological and mechanical systems is the subject of study of interest from last fifty years. Many studies suggest that magnetic field has positive effect on the performance of the system. The study related to the effect of magnetic field on the fuel of I.C. engine is gaining importance in order to reduce the fuel consumption and the engine emissions [8]. Since fuel of I.C. engine is a complex molecular arrangement of hydrocarbon as Fuel mainly consists of hydrocarbons. The simplest of hydrocarbon is methane. The chemical composition of methane is CH_4. It has the major (90%) constituent of natural gas (fuel) and an important source of hydrogen [5]. The greatest amount of releasable energy lies in the hydrogen atom. As an example, in octane (C_8H_{18}) the carbon content of the molecule is 84.2%. When combusted, the carbon portion of the molecule will generate

28,515 KJ/Kg of carbon. On the other hand, the hydrogen, which comprises only 15.8% of the molecular weight, will generate an amazing energy- 22,825 KJ /Kg of H_2. In the present work, it is proposed to study the effect of magnetic field on the internal combustion (SI) engine.

1.1 Effect of magnetic field on fuel molecule

Hydrogen occurs in two distinct isomeric forms Para and ortho. It is characterized by the different opposite nucleus spins. The ortho state of hydrogen has more effective than para state for maximum complete combustion. The ortho state can be achieved by introducing strong magnetic field along the fuel line [5]. Hydrocarbon molecules form clusters, It has been technically possible to enhance van der Waals' discovery due to the application of the Magnetic field, a high power, permanent magnetic device strong enough to break down, i.e. de-cluster these HC associations, so maximum space acquisition for oxygen to combine with hydrocarbon [8].

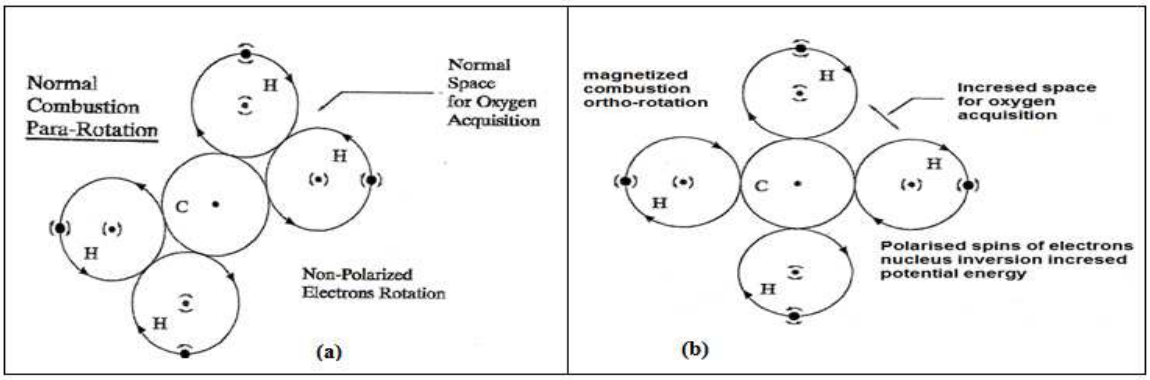

Figure 1.Schematic view of (a) Para state and (b) Ortho state of Hydrogen [5]

Thus when the fuel flows through a magnetic field, created by the strong permanent magnets, the hydrocarbon change their orientation (para to ortho) and molecules of hydrocarbon change their configuration, at the same time inter molecular force is considerably reduced. This mechanism helps to disperse oil particles and to become finely divided. This has the effect of ensuring that the fuel actively interlocks with oxygen and producing a more complete burn in the combustion chamber. Figure.1 shows the clusters of hydrocarbons changed with the influence of magnetic field and they are more dispersed.

2. Experimental set up and procedure

The performance tests were carried out on a single cylinder, four stroke water cooled spark ignition petrol engine. The setup consists of an engine, an eddy current dynamometer, and an exhaust gas analyzer.

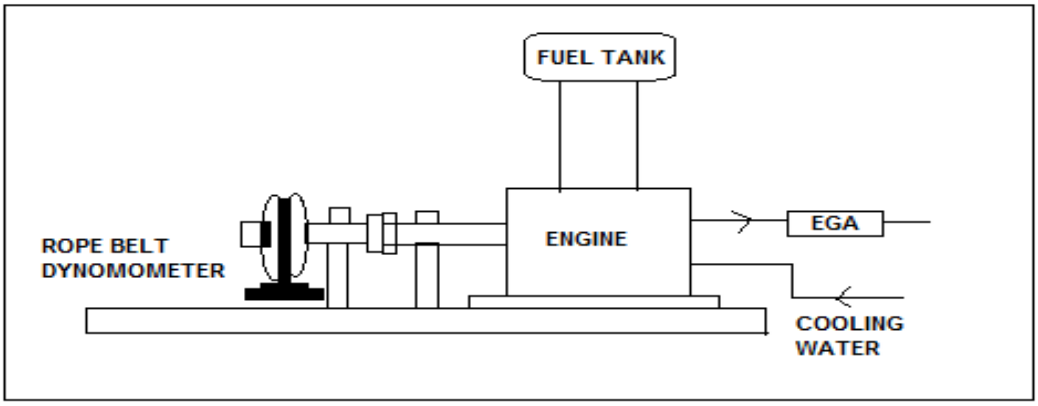

Figure.2. Schematic view of 1-cylinder 4-stroke SI engine

Figure.2. shows the schematic view of single cylinder four stroke spark ignition engine. Rope belt dynamometer is used for varying the load on the engine.

The engine was prepared to run on petrol as a fuel during all tests. The fuel system is designed to facilitate for accurate measurement of the fuel flow rate. The gasoline fuel consumption is measured by Burette method. The gasoline fuel system utilizes the gravity effect to feed the carburettor with gasoline. The gasoline fuel consumption flow rate is measured directly by using the burette method.20 ml division were made on the burette. A digital stopwatch of 0.1 second accuracy is used to measure the time required by the engine to consume a specific volume (20 ml) of gasoline from the burette. Loads are applied to measure the fuel consumption at different engine loading conditions.

Make	Greaves ltd.
Type	Single cylinder
Cooling mediam	Water cooled
Rated Power	2.2 kw
Rated rpm	3000
Stroke(mm)	66.7
Bore(mm)	70
Compression Ratio	4.7
Capacity	256 cc

Table 1. Engine Specification

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Figure.3. Photographic view of exhaust gas analyzer.

The photographic view of exhaust gas analyzer is as shown in figure 3.The exhaust gas analyzer is used to measure exhaust emissions from the engine during experimental tests. The exhaust gas analyzer measures gases such as HC, CO, NO_x and CO_2 concentrations at every instant. this procedure follows twice one for without magnet situation and other for with magnet situation, and results were compared.

3. Results and Discussions

The performance tests are carried out on engine with and without application of magnetic field. The properties of fuel like calorific value and density are calibrated in chemistry laboratory.

3.1 Magnetic field effect on fuel properties

The standard technique used for measuring calorific value of fuel was used for conducting the experiment. The water equivalent of bomb calorimeter was determined by burning a known quantity of benzoic acid. And the heat liberated is absorbed by a known mass of water. Then the fuel sample was burned in bomb calorimeter. And the calorific values of fuel samples were calculated. The density reduces up to 1.25 % and the calorific value of Petrol increases by 1.19 %.

3.1 Magnetic field effect on fuel consumption

The experimental results show that the fuel consumption of engine was less when the engine with fuel magnet than that without fuel magnet. Always less amount of fuel was consumed with the fuel with magnetic field. The brake power vs fuel consumption graph is as shown in fig.4

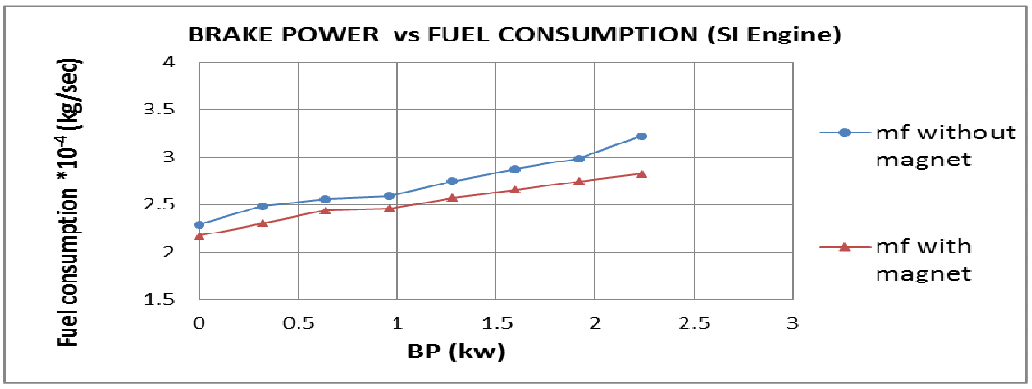

Figure 4. Variation of fuel consumption with Brake power

It is clear that the fuel consumption is reduced maximum about 12% at maximum break power that is at 2.2 kw. The result is better fuel economy.

3.2 Magnetic field effect on brake thermal efficiency

As the fuel consumption rate reduces with the application of magnetic field the brake thermal efficiency goes on increasing.

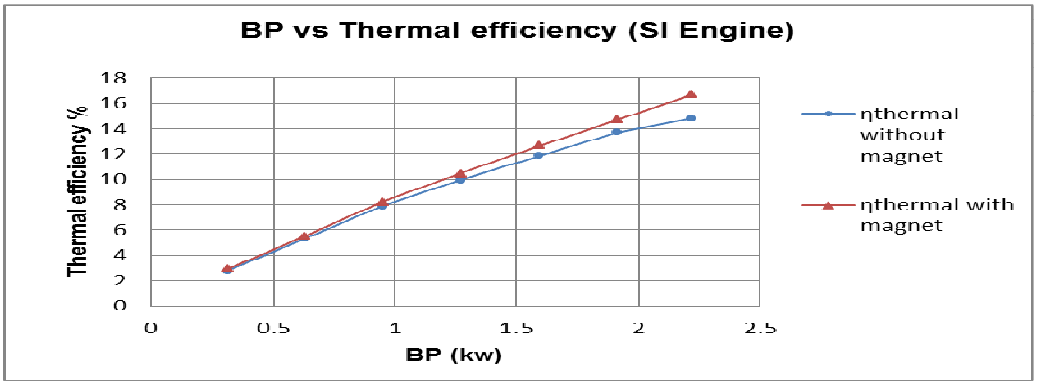

Figure.5.Variation of thermal efficiency with brake power

As shown in figure.5. it is clear that the brake thermal efficiency goes on increasing with the application of magnetic field. The percentage increase of brake thermal efficiency is about up to 11 %. The variation of Brake power Vs brake thermal efficiency is as shown in fig.5.

3.3Magnetic field effect on exhaust emissions

The emission readings were carried out with the help of five gas analyzer. The exhaust emissions like CO, CO_2, HC, NO_X were measured at different load conditions. The emission graphs shows the variation of curve with respect to Brake power.

3.3.1 Magnetic field effect on *HC emissions*

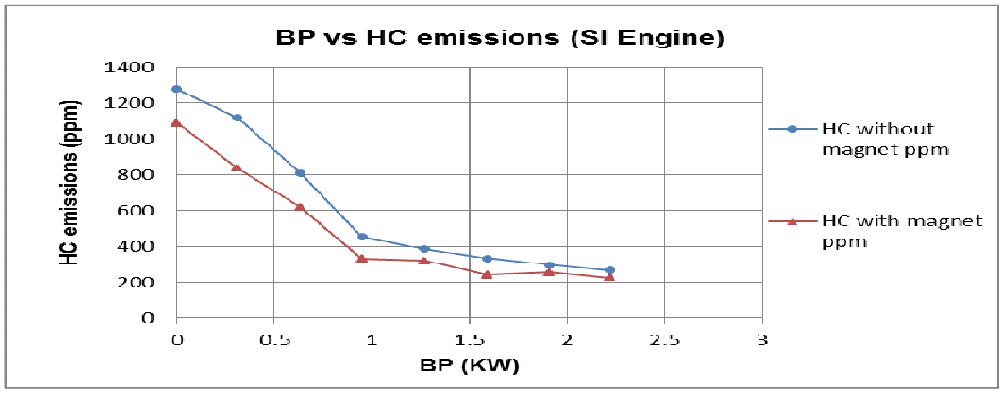

Figure.6. Variation of HC emissions with BP

Fig.7. Clearly shows the effect of magnetic field on HC emissions, and the percentage reduction of HC. The HC emission reduction in the application of magnetic field maximum about 26 % at 0.96 kw.

3.3.2 ***Magnetic field effect* on *CO emissions.***

CO emissions with the application of magnetic field gets reduced as compared to the CO emissions without magnetic field . In both the cases the CO emissions gets increased up to 3 kg load and after that it gets reduced. The CO reduction in the application of magnetic field is maximum of 11.5 % at 0.64 kW, and at load of 2 kg as shown in fig.7.

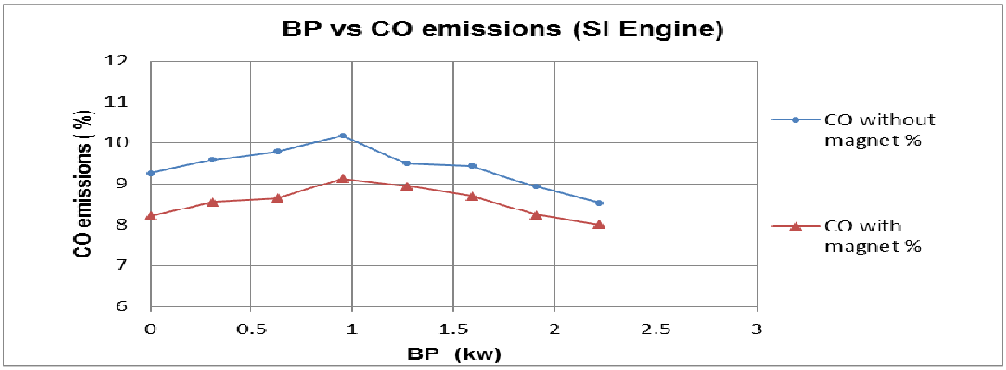

Figure.7 Variation of CO emissions with BP

3.3.3 Magnetic field effect on *CO_2 emissions.*

As shown in fig.10. the effect of magnetic field in the reduction of CO_2 emissions is shown in fig 8. The percentage increase of CO_2 as compared with the percentage of CO_2 without magnet is about 11.2 %.

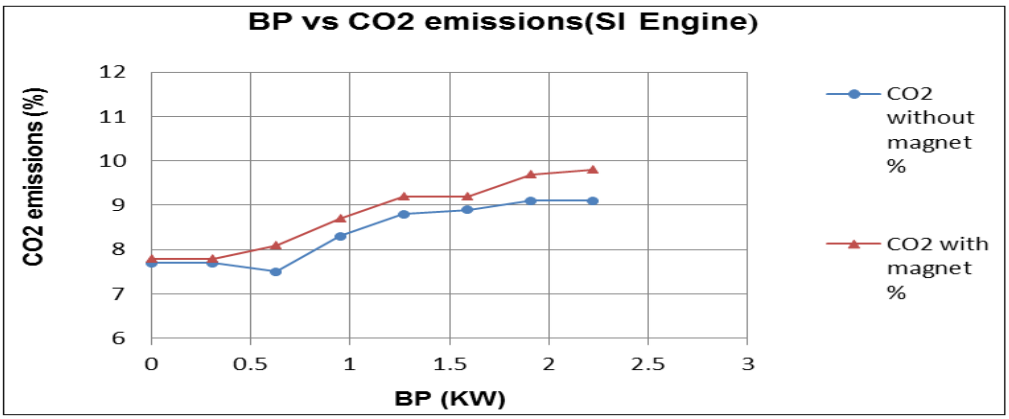

Figure.8. Variation of CO_2 emissions with BP

3.3.*4 Magnetic field effect* on *NO_x emissions*

The NO_x emission gets increased with the application of magnetic field as compared to the NOx without magnetic field. Here the magnetic field shows adverse effect. The maximum increase of NOx emissions are 19% at 1.60 kw. The variation of NO_x emissions with BP is as shown in fig.9

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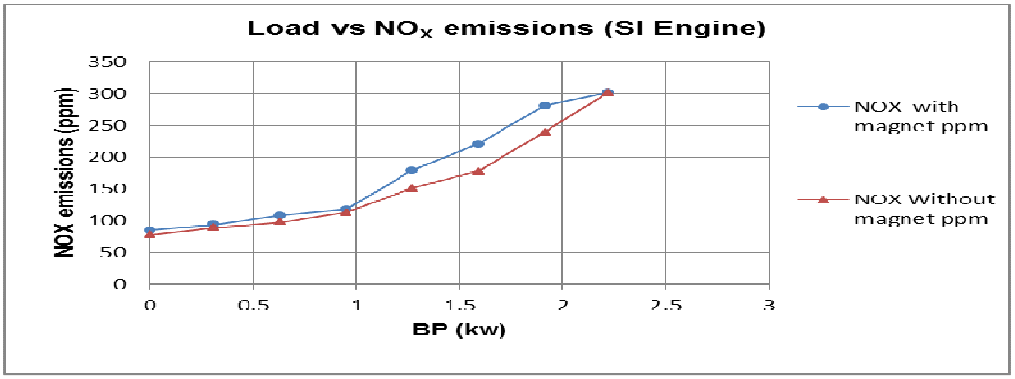

4. Conclusion and Recommendations

There is significant increase in brake thermal efficiency due to the reduction of fuel consumption and also the reduction in the exhaust emissions. The experiments show the magnetic effect on fuel consumption reduction was up to 12%. CO reduction was range up to 11%. The effect on NO emissions increases range up to 19%. The reduction of HC emissions was range up to 27%.

It is recommended to conduct this method similarly to internal combustion engines fuelled by diesel fuel and CNG as well. By varying the strength of magnet one can perform this experiment for better results.

4.1 Acknowledgment

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5. References

- M. Faraday, " On the Diamagnetic Conditions of Flame and Gases", The London, Edinburgh and Dublin Philosophical Magazine and Journal of Science, Series 3, Vol. 31, No. 210, December 1847, pp.401-421
- N. I. Wakayama and Masaaki. Sugie, "Magnetic Promotion of Combustion in Diffusion Flames", Physica B, Vol. 216, 1996, pp. 403-405
- Park K.S. *et al* 1997. "Modulated Fuel Feedback control of a fuel injection engine using a switch type oxygen sensor", Proc Instn Mech Engrs vol 211 partD, IMechE
- Samuel M. Sami and Shawn Aucoin,"Effect of magnetic field on the performance of new refrigerant mixtures" International journal of energy research int. j. energy res. 2003; 27: 203–214 (doi: 10.1002/er.868).
- P. Govindasamy and S. Dhandapani,"Experimental Investigation of Cyclic Variation of Combustion Parameters in Catalytically Activated and Magnetically Energized Two-stroke SI Engine". journal of scientific and industrial research vol.66, 2007;pp-457-463
- International Journal of Automotive Technology, Vol. 8, No. 5, pp. 533 542 (2007)
- Al Dossary, Rashid. M.A., 2009. "The Effect of Magnetic Field on Combustion and Emissions", Master's thesis, King Fahd University of Petroleum and Minerals
- . Farrag A.El Fatih, 2Gad M.saber, Australian Journal of Basic and Applied Sciences, 4(12): 6354-6358, 2010 ISSN 1991-8178
- http://saepcelec.saejournals.org/content/4/1/80.abstrat
- http://www.thch.unibonn.de/pctc/bargon/PHIP/parahydrogen.html
- http://www.ionizationx.com/index.php?topic=1881.0