IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684, p-ISSN: 2320-334X
PP 11-17
www.iosrjournals.org

Performance of internal combustion (CI) engine under the influence of stong permanent magnetic field

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ABSTRACT : *The present study investigates the effect of magnetic field on the performance of single cylinder four stroke compression 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. 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 analyzer. With the application of magnetic field the percentage reduction in fuel consumption is about 12 %, the percentage reduction in hc and co is about 22% and 7 % 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 ci engine is about 7 %.*

Keywords: diesel engine, strong permanent magnets, bomb calorimeter, five gas analyzer, *smoke meter,*

I. NTRODUCTION

A magnet is any material that has a magnetic field. 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. 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. 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 ofcarbon[2]. 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[1,2]. In the present work, it is proposed to study the effect of magnetic field on the internal combustion (ci) engine .

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.[1,2] 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[2]. 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[2,21].

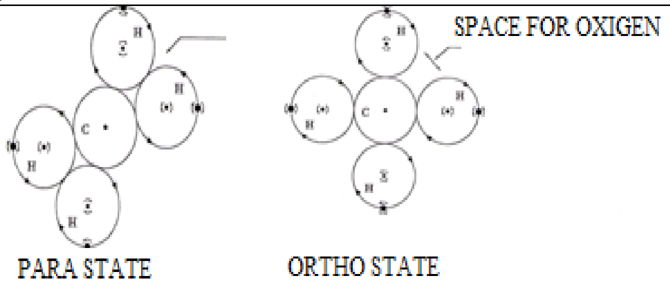

Fig.1.schematic view of para and ortho state of hydrogen[1]

This has the effect of ensuring that the fuel actively interlocks with oxygen and producing a more complete burn in the combustion chamber. Fig.1shows the clusters of hydrocarbons changed with the influence of magnetic field and they are more dispersed.

II. EXPERIMENTAL SETUP

The performance tests are carried on a single cylinder, four strokes, water cooled diesel engine. The setup consists of diesel engine, an eddy current dynamometer, strong permanent magnets, control panel, exhaust gas analyzer, and smoke meter. The schematic diagram of experimental setup is as shown in figure2.

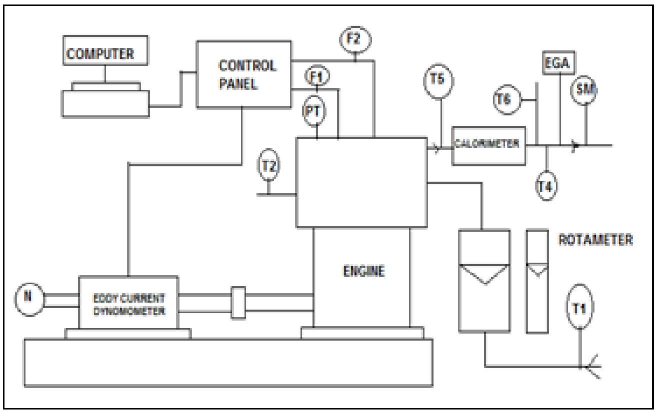

Fig.2 Schematic View Of 1-Cylinder 4-Stroke CI Engine

T1, t3- inlet water temperature, t4- outlet calorimeter water temperature,
T2- outlet engine jacket water temperature,t5- exhaust gas temperature before calorimeter,
T6- exhaust gas temperature after calorimeter,n- rpm decoder, f1- fuel flow difference pressure unit, f2-air intake difference pressure unit, sm- smoke meter, pt-pressure transducer.

Table 1: engine specifications:

Engine	KIRLOSKAR TV1
BORE*STROKE	87.5mm*110mm
Cubic Capacity	661 cm3
Compression Ratio:	17.5:1
Rated output:	5.2kw at 1500 rpm
Fuel injector pressure	20-25Mpa
Injection timing	23 degree before TDC
No of valves	2
Valve timing	4.5 degree
Inlet valve opens BTDC	35.5 degree
Inlet valve opens ABDC	35.5 degree
Exhaust valve opens BBDC	4.5 degree
Governor type	mechanical ,centrifugal type
Class of governing	B1
Fuel injection type	Mechanical individual pump

1.1 Magnetic Field:

The magnetic field is created with the help of strong permanent magnets. Permanent magnets are made of special alloys to create increasingly power of magnets. Some example of the power full magnets are, ferrites, alnico (aluminum-nickel-cobalt),ceramics; samarium-cobalt's; and neodymium's neodymium-iron-boron. Neodymium-iron-boron(ndfeb) magnets are selected for this work. The selection of magnets is done on the basis of strength of magnets. Various shapes and sizes of these type of magnets are shown in the fig.3.

Fig 3.strong permanent magnets.

1.2 Experimental Procedure

The engine is prepared to run on a diesel as a fuel during all tests. The fuel system is designed to facilitate for accurate measurement of the fuel flow rate. The fuel consumption is measured by burette method. A 20 ml division were made on the burette and the fuel consumption flow rate is measured directly by using the burette method. 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 fuel from the burette. Loads are applied to measure the fuel consumption at different engine loading conditions.

Fig.4.photographic view of ci engine with magnetic field.

Exhaust gas analyzer:the exhaust gas analyzer is used to measure exhaust emissions from the engine during experimental tests.

Fig 5 photographic view of five gas analyzer

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 are compared.

III. RESULTS AND DICUSSIONS

The performance tests were 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.

4.1 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 following results are obtained

Diesel	without magnet	with magnet	result(%)
Density(kg/m^3)	826.44	824.67	0.19↓
Cal.value(kj/kg)	42223.52	42408.55	0.40 ↑

4.2 magnetic field effect on break specific fuel consumption

The experimental results show that the break specific 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 bsfc graph is as shown in fig.5

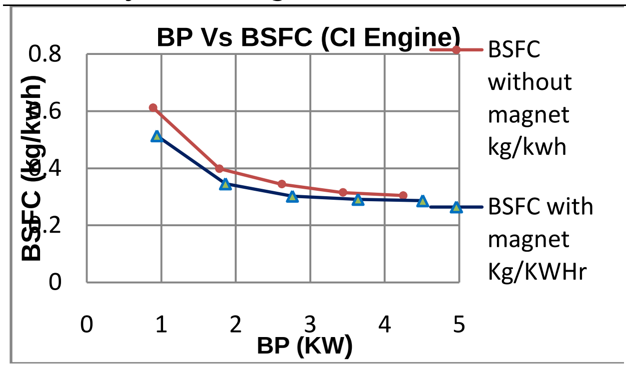

Fig 5.variation of bsfc with brake power

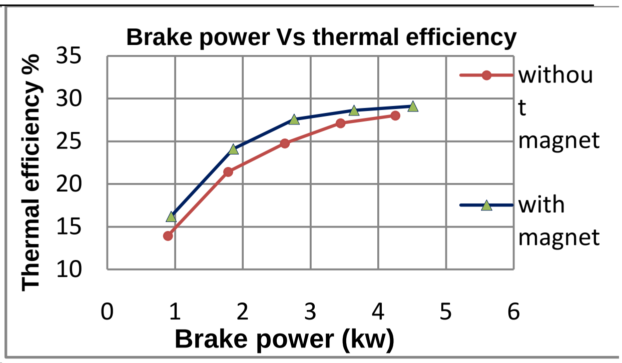

Fig.6.variation of thermal efficiency with brake power

As the fuel consumption rate goes on increases with bp the variation of bsfc goes on reducing and by applying magnetic field it further reduces. The maximum percentage reduction of bsfc is about 15 percent 0.91 kw.

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.

Fig shows the variation of brake thermal efficiency with respect to brake power. The increase in efficiency is about 14 %. It is clear from fig the percentage increase of thermal efficiency is more at the start and it goes on decreasing with increase in brake power.

Magnetic 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.

4.4.1 *magnetic field effect on HC emissions*

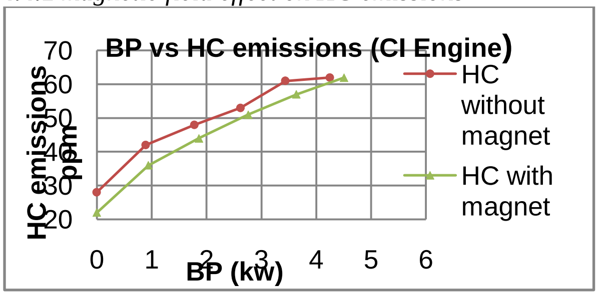

Fig.7. Variation of hc emissions with bp

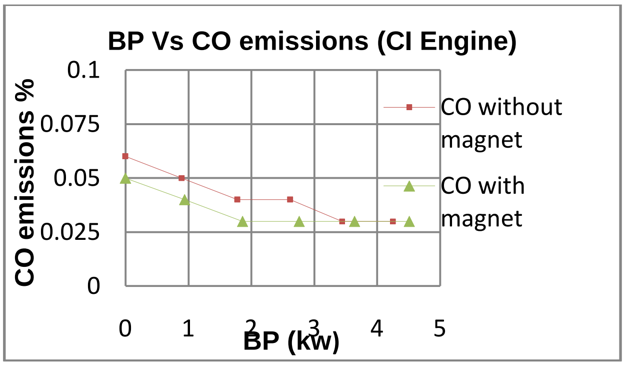

Fig. 8 variation of co emissions with bp

Fig. 7 clearly shows the effect of magnetic field in the reduction of hc emissions. And the percentage of reduction of hc as compared with the percentage of co reduction is more. The hc reduction in the application of magnetic field is about 21% at no load condition and reduces to 15 %. At 0.94 kw.

4.4.2 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 .

Fig.8 shows the variation of co emissions with the brake power. The co emissions have already very less so with help of magnetic field the co variations are not much affected.

4.4.3 magnetic field effect on co_2 emissions.

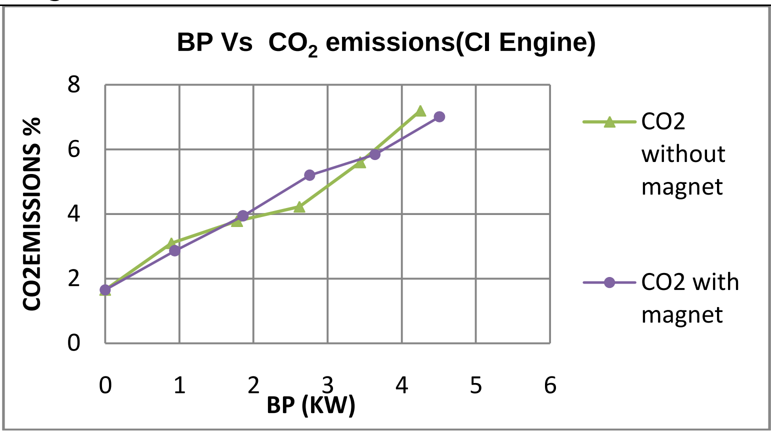

Fig.9.variation of co_2 emissions with bp

Fig.9 shows co_2 variation with respect to brake power, it is clear from fig that the the co_2 emissions are maximum between bp 1.5-3.5 kw. And as bp increases the co_2 emissions get lowered in the application of magnetic field.

4.4.4 magnetic field effect on no_x emissions

The variation of nox emissions with brake power is as shown in fig.4.10 the nox percentage gets increased with the application of magnetic field and the percentage increase is about 18 % at 0.94 kw.

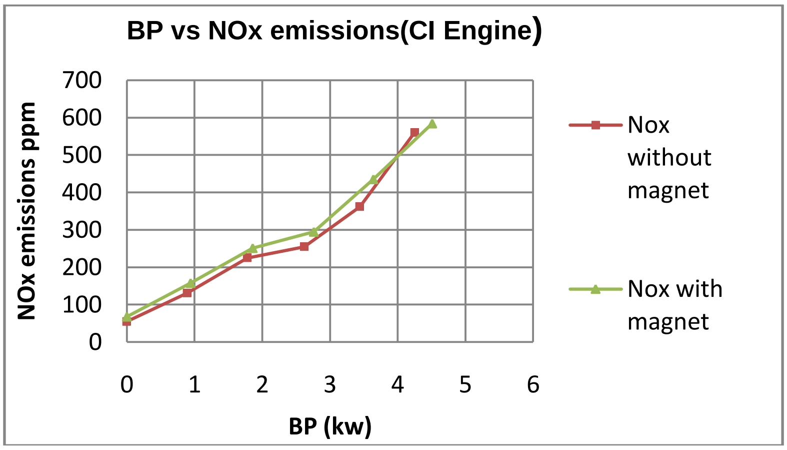

Fig..10.variation of no_x emissions with bp

IV. CONCLUSIONS 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 shows 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.

V. ACKNOWLEDGEMENTS

The authors express their sincere thanks to department of mechanical engineering and the department of chemistry in visvesvaraya national institute of technology, nagpur for their kind cooperation in doing this research work.

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