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Effect of Fuel Magnetism by Varying Intensity on Performance and Emission of Single Cylinder Four Stroke Diesel Engine

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ABSTRACT— ***The aim of this study is to investigate the effect of the fuel magnetisation on the performance of diesel engine. It has been observed that on magnetisation viscosity of hydrocarbon fuel decreases due to declustering of the Hydrocarbon fuel molecules which results in better atomization of the fuel and efficient combustion of air fuel mixture. This enhances thermal efficiency and improves the fuel economy of I.C engine. The magnetic field applied along the fuel line immediately before fuel injector. The magnetic field of different intensity 1000, 2000, 3000, 4000Gauss is applied with the help of solenoid Electro-magnetic coil and its effect on fuel consumption as well as on exhaust gas emission is studied and compared with performance without application of magnetic field. At different load conditions the experiments are conducted to analyse the fuel consumption, thermal efficiency and exhaust gas analyser is used to measure the exhaust gas emission such a NO_X, HC, CO and CO_2.***

Keywords: **-** Efficiency, Emission, Magnetic intensity, Fuel economy, Fuel magnetization.

1. INTRODUCTION

In recent days due to exhaustive use of fossil fuel in a vehicular and industrial purpose its stock will almost come to end within few decades. Hence there are so many efforts towards the improving power output and emission of internal combustion engines per fuel, so that the products of combustion exhausted from internal combustion (IC) engines environmental friendly, and also beneficial for cost. In terms of emission, for every 1kg of fuel burnt, there is about 1.1kg of water vapour and 3.2kg of carbon dioxide produced. Unfortunately, there is no automobile engines have 100% combustion and so there is also a small amount of products of incomplete combustion and these are carbon monoxide (denoted CO), unburned hydrocarbons, oxides of nitrogen, commonly called NOx and sulphur dioxide. This gaseous lead to hotter exhaust gas emission .Recent studies suggests that magnetic field has positive effect on the performance of the system.

2. Effect of Magnetism on Hydrocarbon Fuel

The fuel of I.C. engine mainly consists of hydrocarbons. Fuel molecule consists of a number of atoms made up of number of nucleus and electrons, which orbits about their nucleus. Magnetic movements already exist in their molecules and therefore they already have positive and negative electrical charges. However these molecules have not been realigned, hence the fuel is not actively inter- locked with oxygen during combustion so that the fuel molecule or hydrocarbon chains must be ionized and realigned.

Hydrogen particle in fuel 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 [6]. Hydrocarbon molecules are in the form of clusters, and it has been technically possible to enhance van der Waals' discovery due to the application of the Magnetic field. These mechanisms are believed to help disperse fuell particles and to become finely divided. As 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. This results in better fuel economy and reduction in hydrocarbons, carbon monoxide and oxides of nitrogen that are emitted though exhaust.

The ionization fuel also helps to dissolve the carbon build-up in carburetor, jets, fuel injector and combustion chamber, thereby keeping the engines clear condition. The ionization and realignment is achieved

through the application of magnetic field, as said by Paul (1993), Park K *et al* (1997) [1]. Figure below the clusters of hydrocarbons changed with the influence of magnetic field and they are more dispersed.

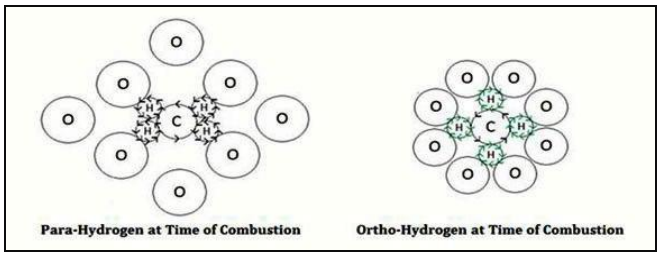

Fig-1

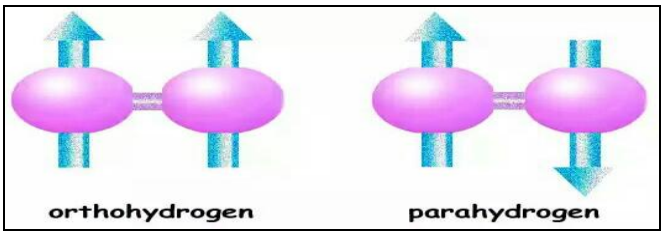

Fig-2

Spin Isomer of Molecular Hydrogen

3. METHODOLOGY

The four stroke single cylinder diesel engine test rig will be prepared to run for all test. The setup consists of an engine, an Rope brake Dynamometer, and an Exhaust gas Analyzer. Magnetic coil just installed before the injector on inlet pipe or housing for maximum alignment & maximum effect [8]. Magnetic coils were used to magnetize the fuel before entering the engine cylinder. This was done with aid of electric magnetic coil which is placed on the pathway of fuel, approximately at one meter before the injector system, to ensure that magnetizing takes place.

The fuel system is designed to facilitate for accurate measurement of the fuel flow rate. The fuel consumption is measured directly by using the burette method. The fuel consumption will be measured at different engine loading conditions and exhaust gas measured by Exhaust gas analyzer. Engine performance including brake power, brake specific fuel consumption and thermal efficiency are studied using diesel fuel with magnetic effect and without magnetic effects. This procedure was done four times one for without magnet installation and other for different intensity magnetic coil installation and results will be compared.

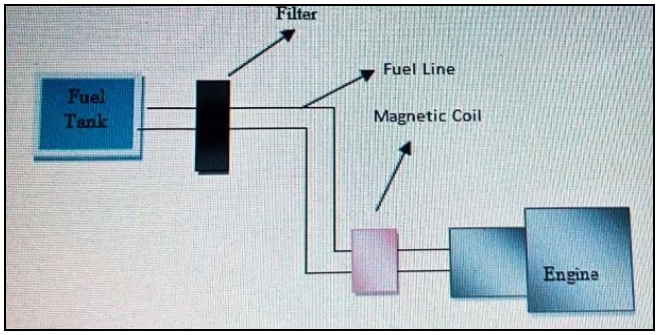

Fig-3: Schematic diagram of magnetic coil installation

The magnet for producing the magnetic field is oriented so that its South Pole is located adjacent the fuel line and its North Pole is located spaced apart from the fuel line. Magnetic fuel conditioner is used to maximize the mileage by using less diesel fuel. In other words, magnetic fuel saver able to reduce the diesel consumption in the diesel engine. Diesel fuels is in the form of liquid when it's in the oil tank and the important point is fuel will only combust when they are vaporized and mixed with the air. Thus, something has to be done to break the particles into finer tiny particles to improve the combustion. Magnets help to ionize the fuel. Fuel is basically from the groupings of hydrocarbons. When the molecules of hydrocarbon flowing through a magnetic field, it changes their orientation in the direction opposite to the magnetic field. Thus this results in changes of molecule configuration and weakens the intermolecular force between the molecules [9].

In other words, magnetic field actually disperses the molecules into more tiny particles and making the fuel less viscous [7]. Figure below shows how magnets help to disperse the molecules. Emission is another hot topic of diesel engine. Emission of dangerous gaseous such as oxides of nitrogen and oxides of sulphur is the result of incomplete combustion in the combustion chamber Magnetic field can improve the combustion level. Thus, automatically the amount of dangerous gaseous can be reduced. The amount of unburned hydrocarbon also can be reduced as the combustion rate improved [5].

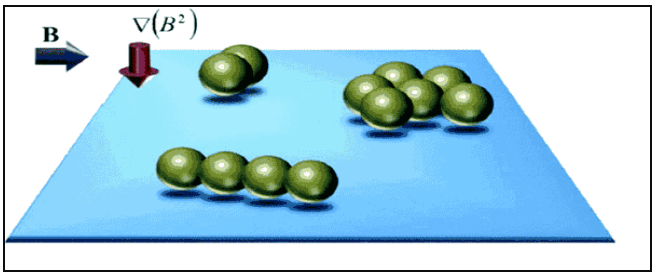

Fig-4: Fuel structure before passing through magnetic field

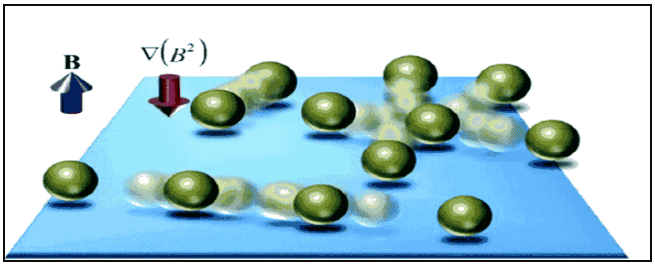

Fig-5: Fuel structure after passing through magnetic field

3.1Magnet Specification

Solenoid magnetic coil

Solenoid coil are widely used since the magnetic fields are largely confined within the volume of the form.

Magnetic flux density= $\mu_0\mu_r NI / L$

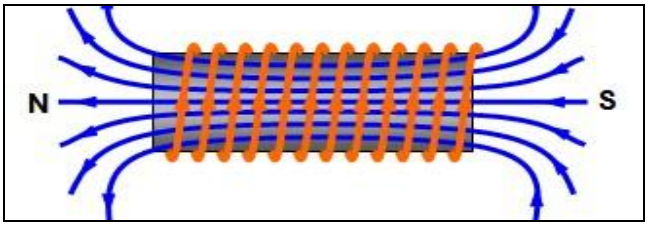

Fig-6: Magnetic domain of solenoid coil

Fig-7: Installation position of solenoid magnetic coil

3.2 Experimental Setup

Engine Specification:

The schematic shows is single cylinder water cooled diesel engine with experimental set up. The engine set has rated output 3.75kw at speed 1500rpm with compression ratio 17.5, injection pressure 180 kg/cm3 and coupled with rope break dynamometer.

Technical specification:

Engine Speed	1500rpm
BHP	5
Bore	87.5mm
Stroke	110mm
No of cylinder	1
Dynamometer	Mechanical Loading
Drum Diameter	330mm
Coefficient of Discharge (Cd)	0.65

Experimental Test-rig`

Fig-8: Experimental test setup diagram

The four stroke single cylinder diesel engine test rig will be prepared to run for all test. The magnetic flux density to be imparted to fuel widely varies depending upon fuel, air or steam, and combustion equipment and conditions. In general, the preferred range of magnetic flux density is from 1000 to 4000 Gauss when fuel oil is used in combination will be determined through experimental runs. The field strength is a function of the engine size based on fuel consumption. The Ferrite magnets are the most cost effective for treating fuel. When high energy Neodymium Iron Boron Magnets are applied, we can obtain a decrease in the fuel mileage and unburned hydrocarbons and carbon monoxide.

4. RESULTS

Effect of magnetic field on fuel consumption

Figure 9 show fuel consumption with different Magnetic Intensity. It can be seen from the figures that the fuel consumption increases with increase in brake power. It is found that the fuel consumption is lower with all magnetic Intensity relative than DF. It can be seen that the fuel consumption is decreased nearly by 12 % by average of all load.

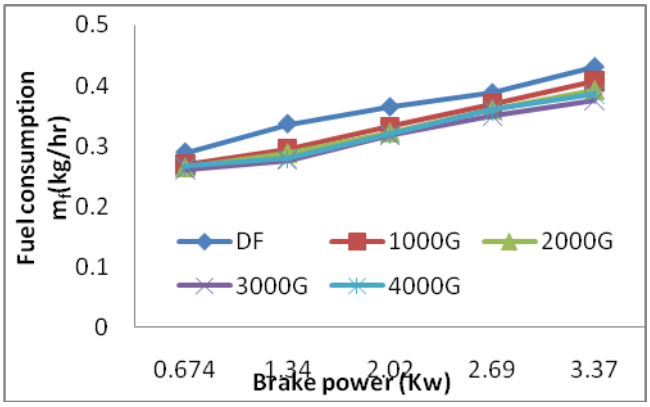

Fig-9: Variation of Fuel consumption with Brake power

Effect of magnetic field on Brake specific fuel consumption (BSFC)

Figure 10 show BSFC with different Magnetic Intensity. It can be seen from the figures that the BSFC decreases with increase in brake power. It is found that the BSFC is lower with all magnetic Intensity relative than DF. It can be seen that the BSFC is decreased nearly by 13 % by average of all load.

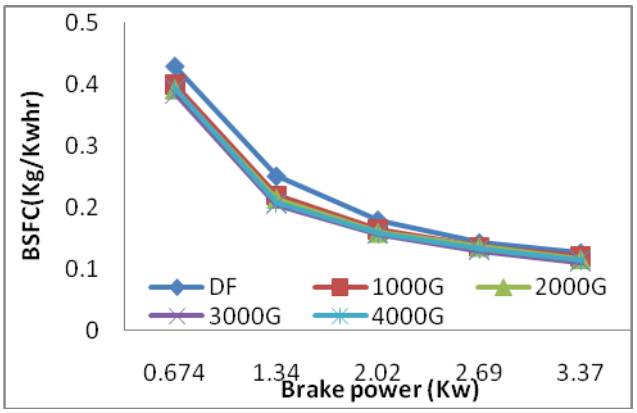

Fig-10: Variation of BSFC with Brake power

Effect of magnetic field on Brake Thermal Efficiency

The variation of brake thermal efficiency with brake power with different Intensity is as shown in fig 11. From the figure it is observed that brake thermal efficiency increases with increase in brake power for all magnetic intensity. It is interesting to note that efficiency is increased by 14 % by average of all loads.

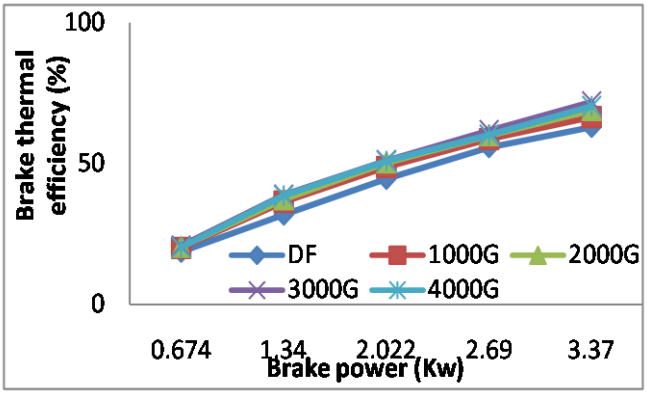

Fig-11: Variation of BTE (%) with brake power

Effect of magnetic field on Exhaust Gas Temperature

The variation of exhaust gas temperature at various brake power as shown in figure 12. It is observed that exhaust gas temperature increases with BP because more fuel is burnt to meet the power requirement. Higher exhaust gas temperature is due to better intermixing of oxygen content of magnetized fuel which improves combustion.

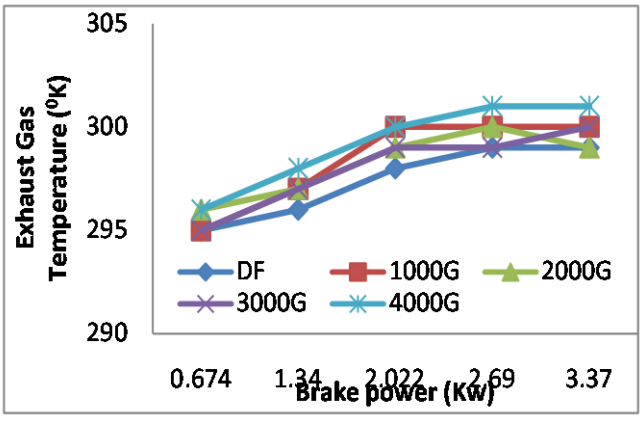

Fig-12: Variation of Exhaust gas temperature with Brake power

Effect of magnetic field on NOx emission

Figure 13 shows that the concentration of NOx emission in the exhaust gases was found to be decrease using magnetized fuel. The magnetic field makes the fuel more repetitive to oxygen thus producing a more efficient combustion which causes less heat liberated inside cylinder. The concentration of NOx in exhaust gases is reduced to about 17%.

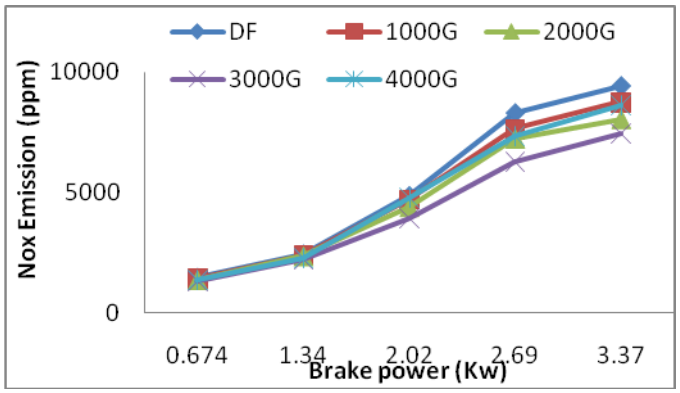

Fig-13: Variation of NOx emission with Brake power

Effect of magnetic field on HC emission

Figure 14 shows that the concentration of HC emission in the exhaust gases was found to be decreased using magnetized fuel. HC concentration decreases due to the more complete combustion and increase of heat release rate. The HC concentration is reduced by about 34 %

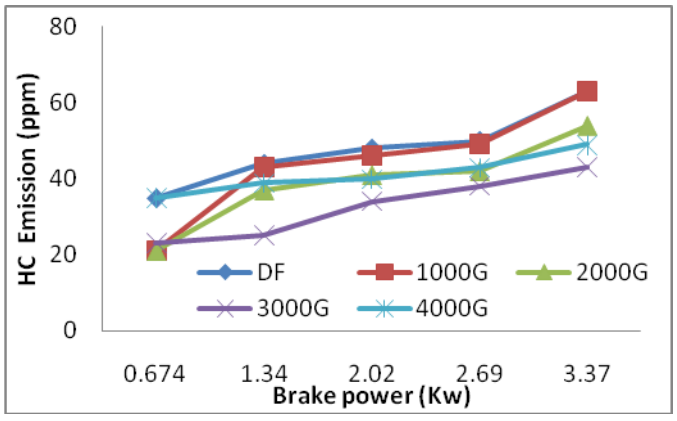

Fig-14: Variation of HC emission with Brake power

Effect of magnetic field on CO_2 emission

The variation of CO_2 emission at various brake power as shown in figure 15. The concentration of CO_2 in exhaust gases is reduced to about 9% due to complete and efficient combustion.

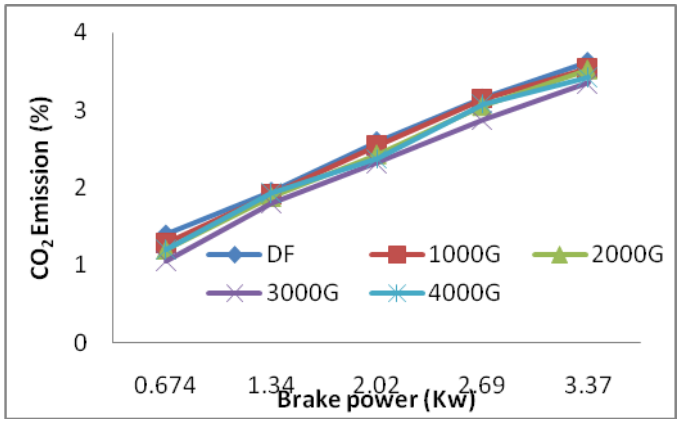

Fig-15: Variation of CO_2 emission with Brake power

Effect of magnetic field on CO emission

Figure 16 shows that the concentration of CO in the exhaust gases was found to be decreased using magnetized fuel. CO concentration decreases due to actively interlocking of fuel particle with oxygen producing a complete burn in combustion chamber. It can be seen that CO concentration is reduced about 8.5% by average of all loads.

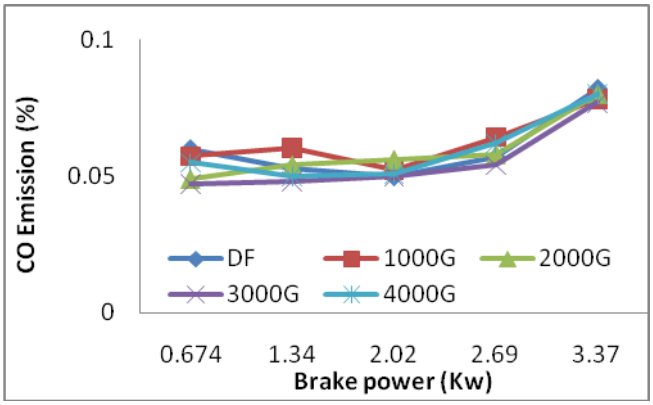

Fig-16: Variation of CO emission with Brake power

5. CONCLUSIONS

From the experimental work, it is clear that Magnetism shows positive effect on engine performance and emission. Results shows that

[1] Fuel consumption and BSFC both decreases about 12% and 13% by the application of Magnetic Field

[2] Brake thermal efficiency shows about 14% increase by average of all loads.

[3] The exhaust gas temperature increases with brake power and shows slight variation with using magnetized fuel.

[4] The concentration of CO, CO_2, NOx, HC in exhaust gases shows 8.5%, 9%, 17%, 34% reduction by average of all loads.

[5] By applying magnetic field of different intensity i.e. 1000G to 4000G the best result is found at 3000 Gauss.

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