International Journal of Engineering Research and General Science Volume 3, Issue 1, January-February, 2015
ISSN 2091-2730

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

KUSHAL CHAWARE
Student M-Tech [Heat Power Engineering]
Ballarpur Institute of Technology
Chandrapur 442401, M.S India
Email Id:kushal.chaware@rediffmail.com

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 (E.g. 2000, 3000, *4000 Gauss)* is applied with the help of permanent magnet or Electro-magnetic coil and its effect on fuel consumption as well as on exhaust gas emission will be 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, Exhaust gas analyser, Magnetic coil, 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.

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 Otrho. 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 is 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. 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.

Magnetic movements already exist in their molecules. In normal condition molecules have not been realigned, the fuel is not actively interlocked with oxygen during combustion, thus for efficient combustion the fuel molecule or hydrocarbon chains must be ionized and realigned. At the same time inter molecular force is considerably reduced or depressed. These mechanisms are believed to help disperse oil particles and to become finely divided. This has the effect of ensuring that fuel actively interlocks with oxygen producing a more complete burn in the combustion chamber. The result is 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 carburettor, 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 **P**aul (1993), Park K *et al* (1997) [1].

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

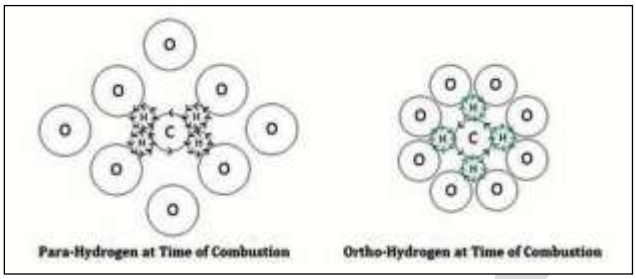


Figure [a]

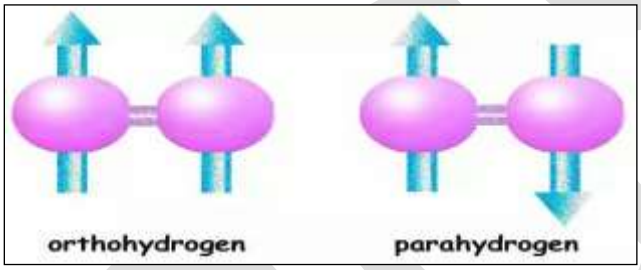


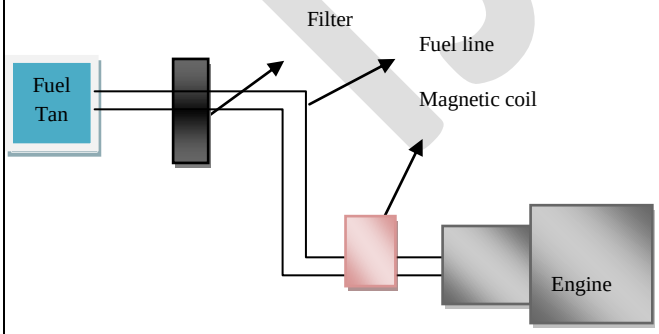
Figure [b]

Spin Isomer of Molecular Hydrogen

2 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 eddy current dynamometer, and an exhaust gas analyser. Magnetic coil just installed before the injector on inlet pipe or housing for maximum alignment & maximum effect [8].Two types of 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 carburetor 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 leaded gasoline with magnetic effect and without magnetic effects. This procedure was done twice one for without magnet installation and other for with magnetic coil installation and results will be compared.

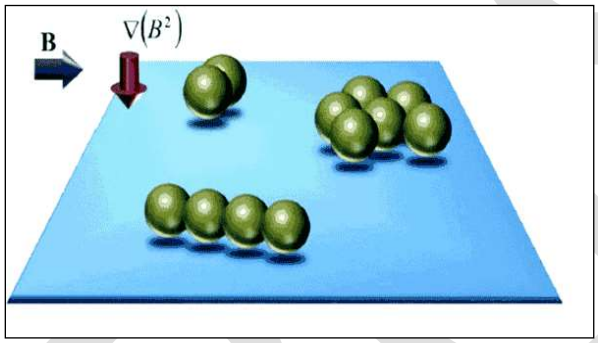


Figure[3] Schematic diagram for magnetic coil installation [3]

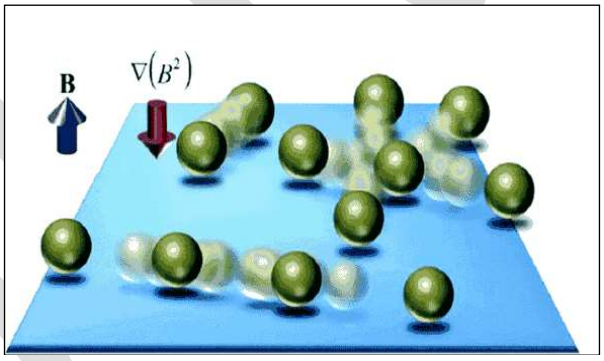
The magnet for producing the magnetic field is oriented so that its South Pole is located adjacent the fuel line and its North Pole is located spaced apart from the fuel line. [13]

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 [12]. 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].



Fuel structure before passing through magnetic field



Fuel structure after passing through magnetic field

Figure [2]

3 MAGNET SPECIFICATION

There are two types of magnets

1) Permanent magnet
2) Electromagnet

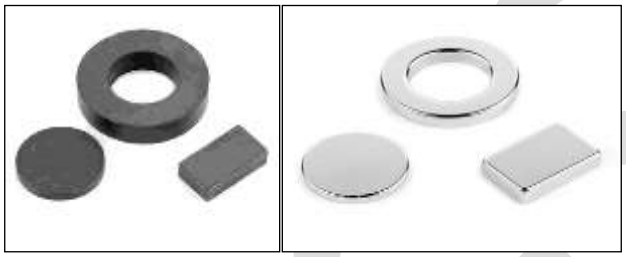
Permanent magnets are basically classified as

Neodymium Magnets

This magnet also known as Neo magnet which is most widely used type of rare earth magnet and in bright silver colour. This is a permanent magnet which made from alloy of neodymium, iron and boron and this magnet considered to be the strongest magnet type among other permanent magnet.

Ferrite Magnets

Ferrite magnet is the compound of ceramic and Iron oxide. This is an example of permanent magnet and used as ferrite cores in the transformer. Generally, ferrite magnets are carbon black in colour and brittle because the present of ceramic particle in the chemical compound. Ferrite magnets also considered as strong magnets but not as strong as neodymium magnets.



Ferrite Magnets **Neodymium Magnets**

Figure [4]

Toroidal core magnetic coil

Toroidal core are widely used since the magnetic fields are largely confined within the volume of the form.

Figure [5] Magnetic coil in Toroid Shape

4 EXPERIMENTAL SETUP

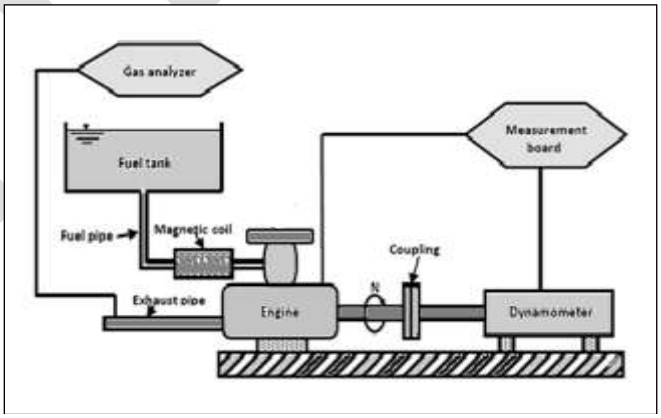


Figure [6] Experimental set-up diagram

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 3500 Gauss, and the most preferred range is from 1400 to 1800 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. [11].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.

The magnetizing apparatus is located on the pipe between pumping means and the burner, carburetor or fuel injectors, because it is unnecessary for any other parts to be magnetized [10]. A portion of the fuel feeding system extending from a point downstream of the magnetizing apparatus to the burner must be made of non-magnetic material. In this case, magnetized fuel is directly fed to burners or atomizing nozzles with a minimum reduction of magnetism. The magnets are embedded in a body of non-magnetic material, such as plastic, copper or aluminium, to secure them to the fuel line. No cutting of the fuel line and no hose and clamps are necessary to install this device, outside a fuel line without disconnection or modification of the fuel or ignition system for producing magnetic flux in the flow path of combustible fuel within the pipe. These units have been installed without other fuel line or ignition adjustments to treat vehicles failing required emission tests as an inexpensive retrofit accessory to give substantially immediate improvements of up to the order of 80 % reduction in hydrocarbon and carbon monoxide emissions.

5 CONCLUSION

The study of fuel magnetism got importance in recent year due to its effect on decreased fuel consumption and reduced exhaust emission. It also shows improvement in brake Thermal efficiency and Indicated power. Hence by varying strength of magnetic field better result can be obtained.

REFERENCES:

[1] Park K.S. et al 1997. “Modulated Fuel Feedback control of a fuel injection engine using a switch type oxygen sensor”, Procedure Instrumentation Mechanical Engineers vol 211.

[2] 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’

[3] Farrag A.El Fatih, Gad M.saber, Australian Journal of Basic and Applied Sciences, 4(12): 6354-6358, 2010 ISSN 1991- 8178

[4] 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.

[5] Gary T Jones “The effect of molecular fuel energizer on emissions and fuel economy”. The study done in the year 1981 for “environmental protection agency”

[6] Vivek Ugare, Nikhil Bhave, Sandeep Lutade,2013 Performance of spark ignition engine under the influence of magnetic field, International journal of research in aeronautical and mechanical engineering *,vol.1 Issue.3* July 2013 Pgs:36-43

[7] Ajaj R. Attar, Pralhad Tipole, Dr. Virendra Bhojwani , Dr.Suhas Deshmukh, “Effect of Magnetic Field Strength on Hydrocarbon Fuel Viscosity and Engine Performance”, International Journal of Mechanical Engineering and Computer Applications, Vol 1 Issue 7,December 2013, ISSN 2320-634

[8] Ali S. Faris, Saadi K. Al- Naseri , Nather Jamal, RaedIsse, Mezher Abed, Zainab Fouad, Akeel Kazim, Nihad Reheem, Ali Chaloob, Hazim Mohammad, Hayder Jasim, Jaafar Sadeq, Ali Salim, AwsAbas, “Effects of Magnetic Field on Fuel Consumption and Exhaust, Emissions in Two-Stroke Engine”, *Energy Procedia 18*(2012) 327 – 338 www.sciencedirect.com

[9] A. Janezak, E. Krensel Permanent Magnetic Power for treating fuel lines for more efficient combustion and less pollution .U.S. Pat. 5,124,045, 1992.

[10] Kolandavel MANI and Velappan Selladurai, “Energy savings with the effect of magnetic field using r290/600a mixture as substitute for cfc12 and hfc134a”, thermal science: Vol. 12 (2008), No. 3, pp. 111-120.

[11] Barathal/ ponnusamy, “magnet device to reduce diesel consumption in diesel engine”, Faculty of Mechanical Engineering, university Malaysia Pahang.

[12] Shweta Jain, Prof. Dr. Suhas Deshmukh,2012 Experimental Investigation of Magnetic Fuel Conditioner (M.F.C) in I.C. engine, ISSN: 2250-3021 Volume 2, Issue 7 (July 2012), PP 27-31.

[13] Hejun Guo, Zbizhong Liu, Yunchao Chen, Rujie Yao, “A study of magnetic effects on tee physicochemical properties of individual hydrocarbons”, Logistical Engineering College, Chongqing 400042, P.RChina