

Effect of magnetic field on performance and emission of single cylinder four stroke diesel engine

Piyush M Patel¹, Prof. Gaurav P Rathod², Prof. Tushar M Patel³

¹(ME Scholar, Department of Mechanical Engineering / KSV University, Gujarat, India)

²(Assistant Professor, Department of Mechanical Engineering / KSV University, Gujarat, India)

³(Associate Professor Department of Mechanical Engineering / KSV University, Gujarat, India)

Abstract: - To analyse experimental investigates on the Performance and Emission of Single Cylinder Four Stroke Diesel engine under the power of producing an effect of magnetic field. The magnetic field applied along the fuel line immediately before fuel injector. It has been reported that magnetic field helps to improved mixture formation by increasing the atomization process of the spray in the combustion chamber due to increasing the rate of disintegration of the droplets as a result of reduction in the surface tension and viscosity of the fuel[1]. The effect of magnetic field on the engine performance parameters such as specific fuel consumption, brake thermal efficiency, exhaust emissions etc. by applying the magnetic field along the fuel line immediately before fuel injector. The strong permanent magnet of strength 2000 gauss is applied to fuel line for magnetic field. At different engine load conditions the experiments are conducted. An exhaust gas analyzer is used to measure the exhaust gas emissions such as CO, CO₂, HC and NO_x. With the application of magnetic field the percentage reduction in fuel consumption is about 8% at higher load, the percentage reduction in HC and NO_x is about 30% and 27.7 % respectively. The CO emission gets reduced with the application of magnetic field at higher load. The percentage reduction in CO₂ emissions is reduced about 9.72% at average of all loads with the effect of magnetic field.

Keywords: - Efficiency, Emission, Exhaust gas analyzer, Magnetic Fuel Energizer.

I. INTRODUCTION

In recent years, 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. The use of diesel engines have been increase day by day, due to their high thermal efficiency and low pollutant formation characteristics but it has a serious drawback of having a comparative larger amount of emission which is larger than that of a gasoline engine.

Magnetic field that ionized the fuel based on the principle of magnetic field mutual action with hydrocarbon molecules of fuel and oxygen molecules. There are various physical attraction forces between hydrocarbons and they form densely packed structures called pseudo compounds which can further organize into clusters [8]. Due to the physical attraction forces between hydrocarbons, oxygen atoms cannot penetrate into their interior during air/fuel mixing process, these structures become stable. The external force by means of magnetic field helps to polarized the hydrocarbon fuel. Due to that hydrocarbon fuel change their orientation and increase space between hydrogen. This hydrogen of fuel actively interlocks with oxygen and producing a more complete burn in the combustion chamber[6] It has been noted that When the fuel passes through a magnetic field, it helps increasing the atomization process by improved mixture formation. Due to increasing the rate of disintegration of the droplets as a result of reduction in the surface tension and viscosity of the fuel[7].

II. MAGNETIC FUEL ENERGIZER

Hydrogen occurs in two distinct isomeric forms one is Para which is normally occurs in fuels, second is ortho which achieved by applying magnetic field. These two forms are characterized by the different opposite nucleus spins. The ortho state can be achieved by applying strong magnetic field along the fuel line [2]. In the para Hydrogen molecule, which occupies the anti-parallel rotation, the spin state of one atom relative to another is in the opposite direction, therefore it is diamagnetic. In the ortho molecule, which occupies the parallel rotational levels, the spin state of one atom relative to another is in the same direction as shown in Figure.1, therefore, it is paramagnetic [3].

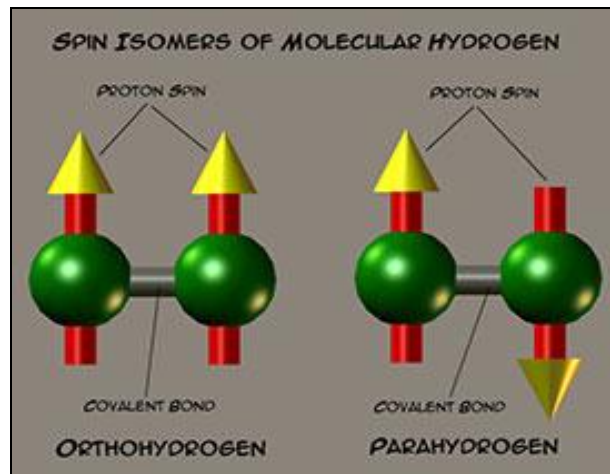


Fig.1 Schematic view of Spin isomers of molecular Para and Ortho state of Hydrogen[9]

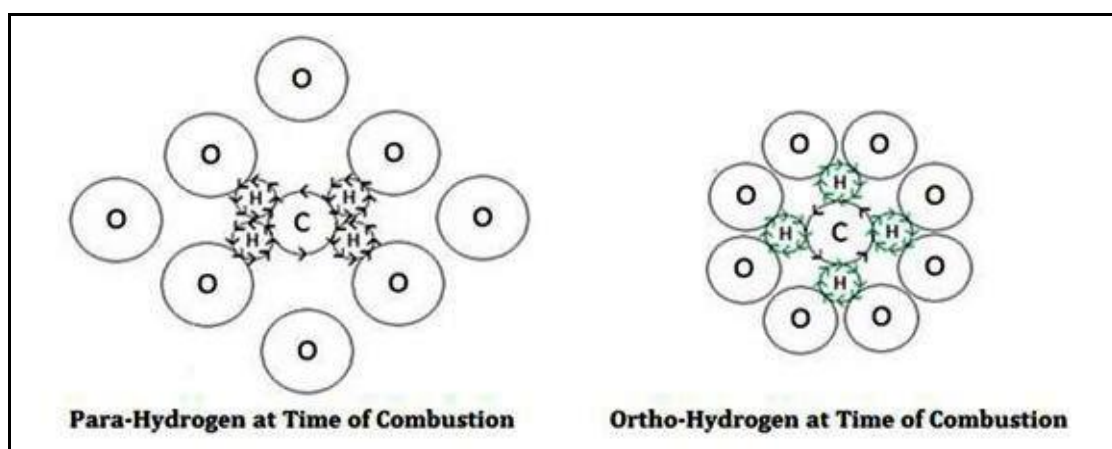


Fig.2 Schematic view of (a) Para state of Hydrogen and (b) Ortho state of Hydrogen[9]

When the fuel passes through a magnetic field, created by the strong permanent magnets, due to that magnetic field hydrocarbon change their orientation and convert from para state to ortho state[5]. In ortho state inter molecular force is considerably reduced and increase space between hydrogen. This hydrogen of fuel actively interlocks with oxygen and producing a more complete burn in the combustion chamber[4]. The magnetic field helps to disperse oil particles and to become finely divided. Figure.2 shows the schematic view of para state and ortho state of Hydrogen of clusters of hydrocarbons changed with the influence of magnetic field and they are more dispersed.

III. EXPERIMENTAL SET UP AND PROCEDURE

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

Technical Specifications

Model	TV1
Make	Kirlosker Oil Engines
Type	Four stroke, Water cooled, Diesel
No. of cylinder	One
Bore	87.5 mm
Stroke	110 mm
Combustion principle	Compression ignition
Cubic capacity	0.661 liters
Compression ratio 3 port	17.5:1
Lubrication system	Forced feed system



Fig.3 Photographic view of single cylinder four stroke diesel engine

The engine was prepared to run on 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 directly by using the burette method. The fuel consumption was measured at different engine loading conditions and exhaust gas measured by Exhaust gas analyzer. The exhaust gas analyzer is used to measure exhaust emissions from the engine during experimental tests. It measures gases such as HC, CO, NO_x and CO₂ concentrations at each and every load. This procedure was done twice one for without magnet situation and other for with magnet situation, and results were compared.



Fig.4. Photographic view of exhaust gas analyzer

Properties of Magnet

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 as shown in Figure.5 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



Fig.5 Photographic view of Ferrite Magnets

Installation Position: It is just before the injector on inlet pipe or housing for maximum alignment & maximum effect.

IV. RESULTS AND DISCUSSION

Magnetic field effect on Specific fuel consumption

The experimental results show that the fuel consumption of engine was less when the engine with magnet than that without fuel magnet at higher load. Always less amount of fuel was consumed with the fuel with magnetic field. The SFC vs LOAD graph is as shown in fig.6

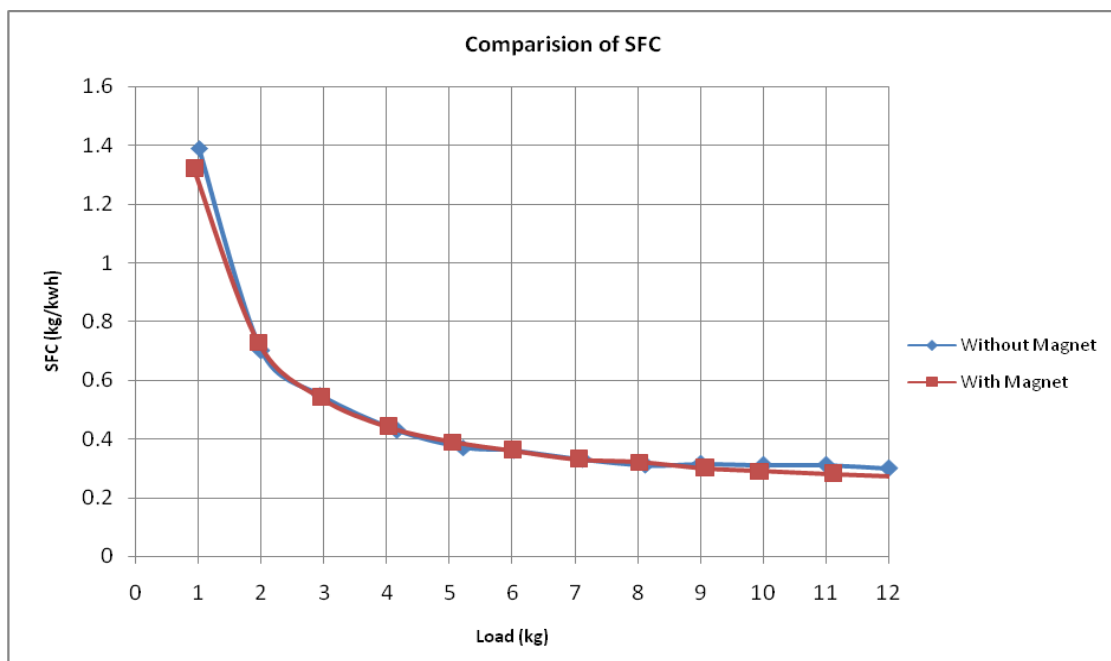


Fig.6 Variation of Specific fuel consumption with load

Magnetic field effect on Brake Thermal Efficiency

The experimental results show that the Brake Thermal Efficiency of engine was less when the engine with magnet than that without fuel magnet at higher load.

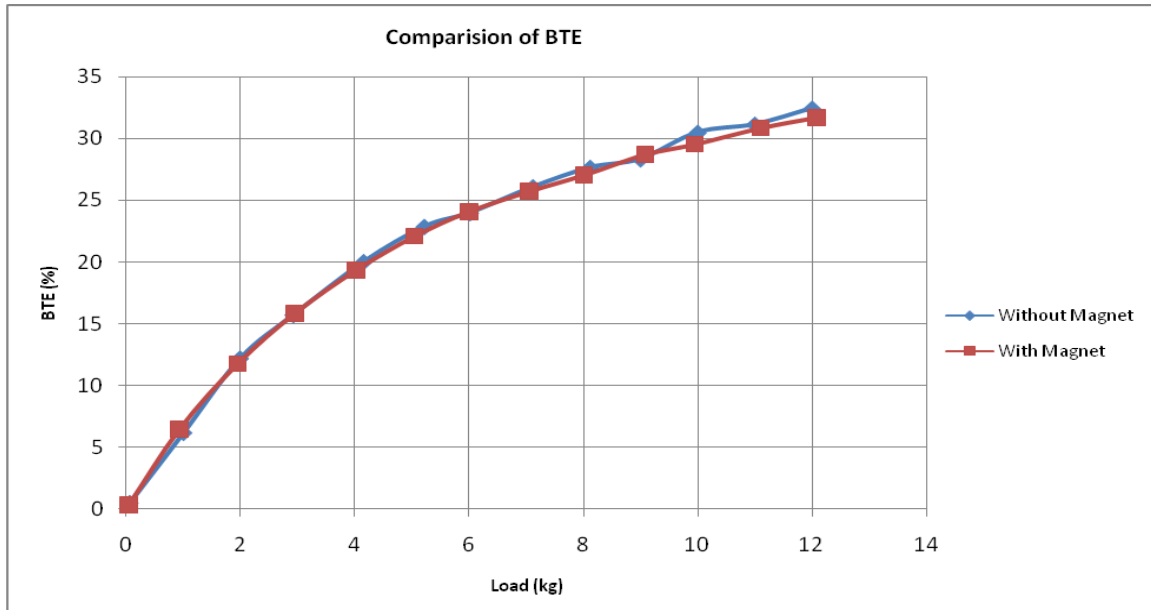


Fig.7 Variation of Brake Thermal Efficiency with load

The variation of Brake power Vs brake thermal efficiency is as shown in fig.7. It is clear that with the application of magnetic field the brake thermal efficiency goes on increasing. The percentage increase of brake thermal efficiency is about up to 2 %.

Magnetic field effect on Nox emissions

The NO_x emission gets decrease with the application of magnetic field as compared to the NO_x without magnetic field. Here the magnetic field shows adverse effect. The NO_x emissions are decrease around 27.7% at average of all loads. The variation of NO_x emissions with load is as shown in fig.8

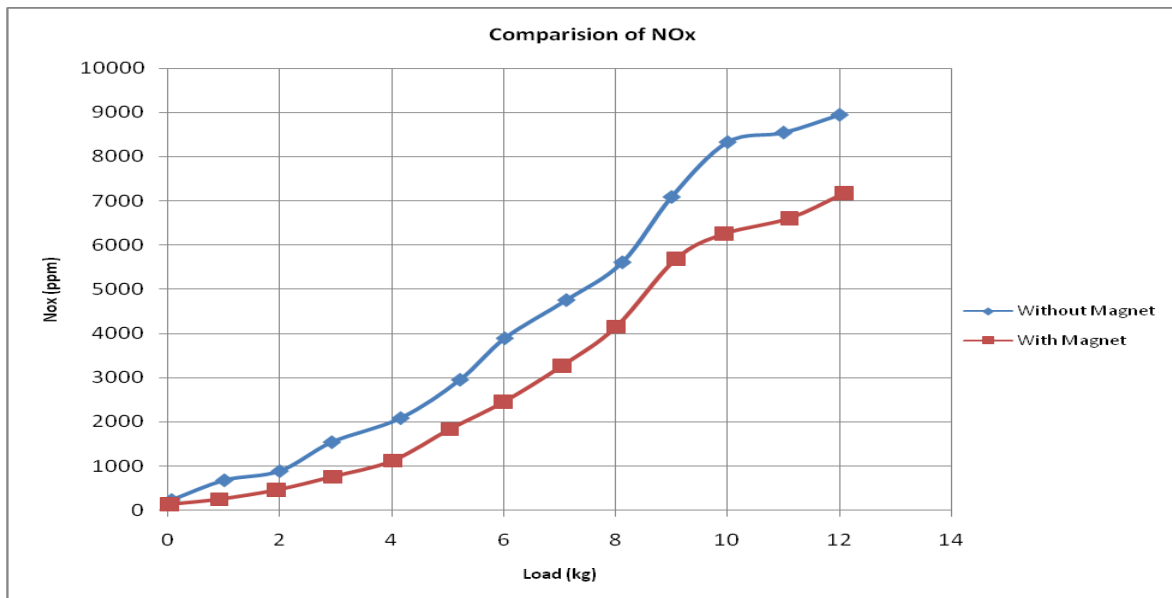


Fig.8 Variation of NO_x(ppm) with load

Magnetic field effect on HC emissions

Fig.9. Clearly shows the effect of magnetic field on HC emissions, and the percentage reduction of HC. The HC emissions are decrease around 30% at average of all loads. The variation of HC emissions with load is as shown in fig.9

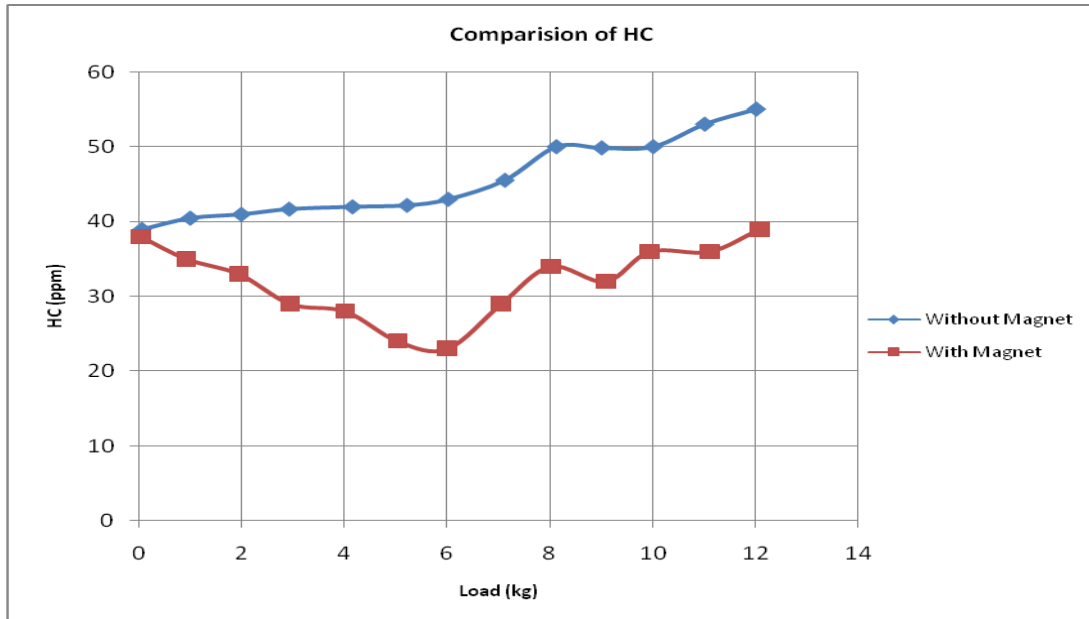


Fig.9 Variation of HC(ppm) with load

Magnetic field effect on CO emissions

With the application of magnetic field CO emissions gets reduced as compared to the CO emissions without magnetic field. Fig.10. Clearly shows the effect of magnetic field on CO emissions and the CO emission reduces at higher load.

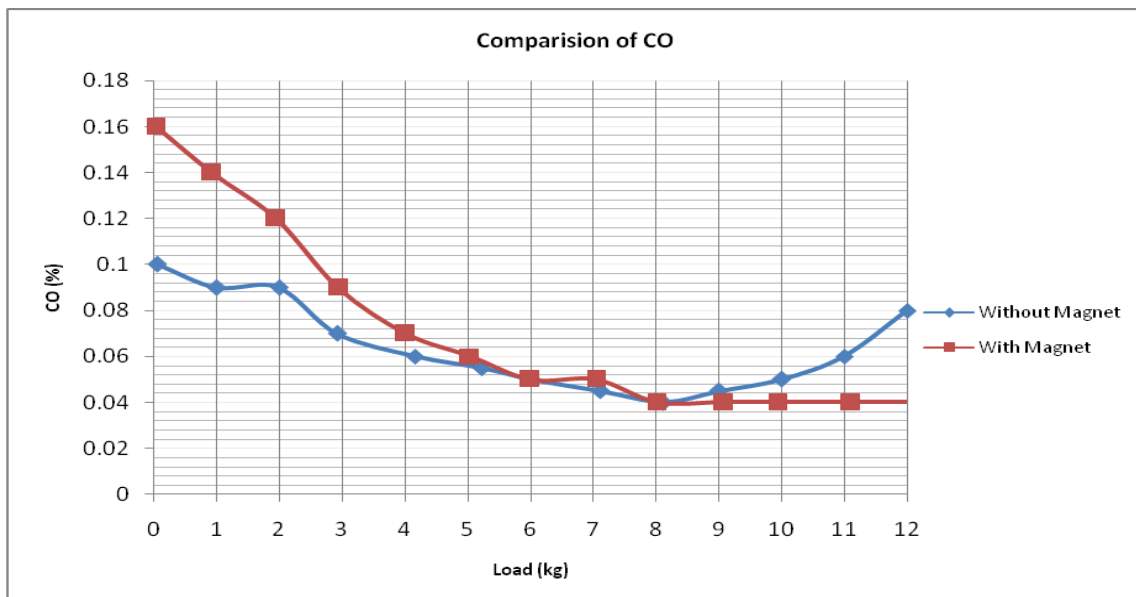


Fig.10 Variation of CO with load

Magnetic field effect on CO₂ emissions

The CO₂ emission gets decrease with the application of magnetic field as compared to the CO₂ without magnetic field. Here the magnetic field shows adverse effect. The CO₂ emissions are decrease around 9.72% at average of all loads. The variation of CO₂ emissions with load is as shown in fig.11

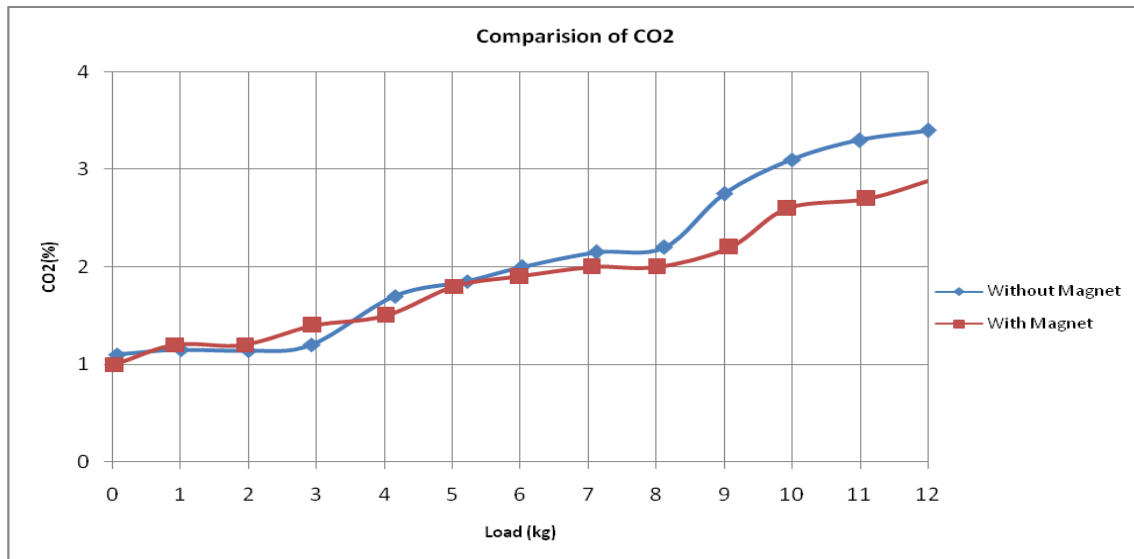


Fig.11 Variation of CO₂ with load

V. CONCLUSION

From the above experimental results the following conclusions were made:

It is clear from the experiment result that the brake thermal efficiency, indicated power are similar in both with and without Magnet Fuel Energizer but indicated power gets improve at lower load condition. Specific fuel consumption decreases due to the reduction of fuel consumption at higher load.

There is significant reduction in the exhaust emissions at all load condition in both neodium and ferrite but among them two neodium gave better effect than the ferrite .The experiments results show the magnetic effect on fuel consumption reduction was up to 8% at higher load condition. The CO emission gets reduce at higher load. The effect on NO_x emissions reduces range up to 27.7%. The reduction of HC emissions was range up to 30%. The CO₂ emission reduction was up to 9.72% at average of all loads.

REFERENCES

- [1] Daniel C. Uguru-Okorie and Ademola A. Dare “Combustion Enhancers in Diesel Engines: Magnetic Field Option”*IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684 Volume 5, Issue 5 (Mar. - Apr. 2013), PP 21-24*
- [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, 2Gad M.saber, Effect of Fuel Magnetism on Engine Performance and Emissions, *Australian Journal of Basic and Applied Sciences, 4(12): 6354-6358, 2010 ISSN 1991-8178*
- [4] 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*
- [5] Ali S. Faris, Saadi K. Al-Naseri, Nather Jamal, Raed Isse, Mezher Abed, Zainab Fouad, Akeel Kazim, Nihad Reheem, Ali Chalooob, Hazim Mohammad, Hayder Jasim, Jaafar Sadeq, Ali Salim, Aws Abas, “Effects of Magnetic Field on Fuel Consumption and Exhaust, Emissions in Two-Stroke Engine”, *Energy Procedia 18 (2012) 327 – 338 www.sciencedirect.com*
- [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 2320-6349*
- [8] H. Guo, Z. Liu, Y. Chen and R. Yao,"A Study of Magnetic effects on the Physicochemical Properties of Individual Hydrocarbons" *Logistical Engineering College, Chongqing 400042, P.R China(1994), pp.216-220*
- [9] Website: www.aferinc.com/afer-system.php