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Improving Performance of Diesel Engine with Reduction of Emissions by Applying Magnetic Field

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Abstract- I.C. engine used in automobiles has a problem of pollutant emission, which mainly depends on combustion process occurs in I.C. engines. Incomplete combustion produces large amount of emission gases & gives lower efficiency. To tackle these issues new way of fuel conditioner are developed called as Magnetic Fuel Conditioner (MFC). The research report describes the mechanism of MFC, objectives & the parameter which affects the efficiency of MFC. A permanent magnet can be mounted in path of fuel lines. Mounting magnets in fuel line enhance fuel properties such as it aligns & orients, hydrocarbon molecules, better atomization of fuel etc. On experimental trials on Single Cylinder Four Stroke Diesel engine, the magnetic field applied along the fuel line immediately before fuel injector. It has been recorded that magnetic field helps to improve 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. The effects of magnetic field on the engine performance parameters such as specific fuel consumption, break thermal efficiency, exhaust emissions etc. are analyzed by applying the magnetic field along the fuel line immediately before fuel injector.
Keywords: Magnetic Fuel Conditioners, Emission, Efficiency, Combustion, Atomization, Disintegration, Performance.

I. 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 by CO), unburned hydrocarbons, oxides of nitrogen, commonly called NOx and sulphur dioxide. This gaseous are lead to hotter exhaust gas emission. Extensive researches and studies are underway all around the world to develop and implement a sustainable energy generation source that can literally power the future world. Fossil fuels account for more than 65% of the energy generated all around the world. These fuels include petroleum, natural gas, and coal. The disastrous effect of the current usage of fossil fuels is well known. Even if the usage of fossil fuels stopped today, the pollutants already emitted till date will continue to affect the world for centuries. Hydrogen is considered as the fuel of the future. But a hydrogen economy will only come into sustainable existence in 2064. If the current usage trend of fossil fuels continues till then, the resulting degradation to the earth will not be the only problem we will face.

Today's hydrocarbon fuels leave a natural deposit of carbon residue that clogs carburettor, fuel injector, leading to reduced efficiency and wasted fuel. Pinging, stalling, loss of horsepower and greatly decreased mileage on cars are very noticeable. The same is true of home heating units where improper combustion wasted fuel and cost, money in poor efficiency and repairs due to build up. Most fuels for internal combustion engine are liquid, fuels do not combust until they are vaporized and mixed with air. Most emission motor vehicle consists of unburned hydrocarbons, carbon monoxide and oxides of nitrogen. Unburned hydrocarbon and oxides of nitrogen react in the atmosphere and create smog. Smog is prime cause of eye and throat irritation, noxious smell and decreased visibility. Oxides of Nitrogen are also toxic. A fuel magnet is a device that is strapped to the fuel line in your engine or each injector line on a diesel engine and makes the fuel more receptive to oxygen, thus producing a leaner more efficient combustion with less exhaust waste.

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II. STUDY OF 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. Hydrocarbon molecules form clusters. 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. Fig.1 shows the clusters of hydrocarbons changed with the influence of magnetic field and they are more dispersed. An object of the magnet is to provide significantly improved molecular excitement and turbulence in a petroleum/diesel based fuel so that re-polymerization is more effectively resisted and improved fuel efficiency is achieved. It also significantly achieves improved fuel turbulence so that the premature production of sludge is prevented and the fuel is pumped and burned much more cleanly and successfully. It is particularly effective for improving the combustion efficiency of diesel (due to more re- polymerization) fuel.

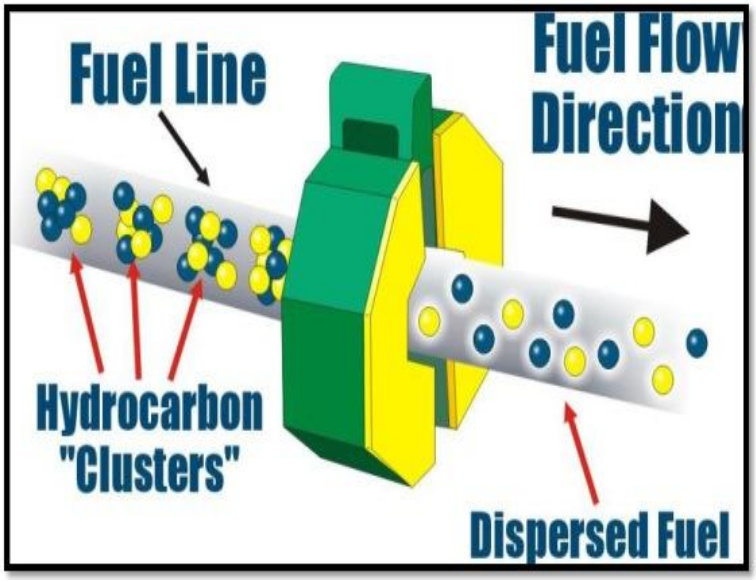
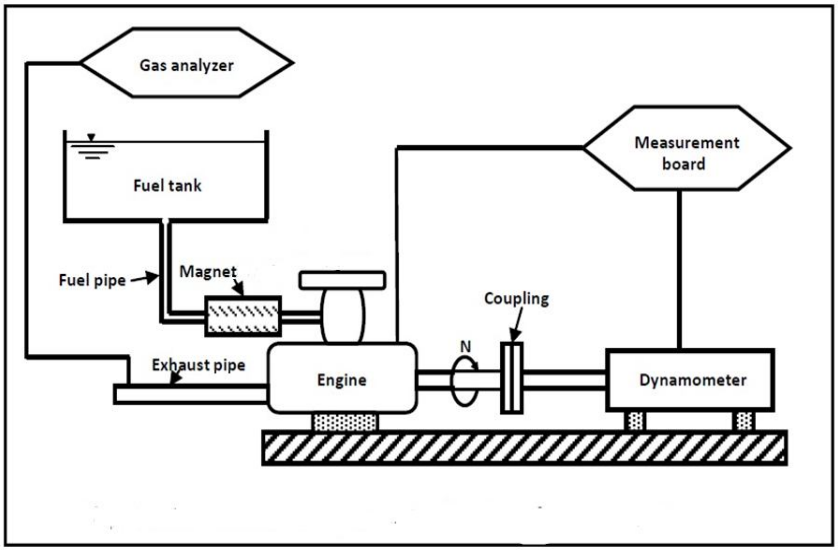


Fig No 1. Changes in Fuel after Passing Through Magnetic Field [7]

III. METHODOLOGY

As shown in Fig No 2 the four stroke single cylinder diesel engine test rig will be prepared to run for all test. The setup consists of an engine, hydraulic dynamometer, and an exhaust gas analyser. Magnetic setup can be just installed before the injector on inlet pipe or housing for maximum alignment & maximum effect. This will be done with aid of permanent magnet 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 can be 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 will be studied using leaded gasoline with magnetic effect and without magnetic effects. This procedure will be done twice; one for without magnet installation and other for with magnet installation and results will be compared. The magnet for producing the magnetic field is oriented so that its South Pole is located adjacent the fuel line and its North Pole to be 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 is able to reduce the diesel consumption in the diesel engine.



Block Diagram of Experimental Setup [3]

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 are 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. In other words, magnetic field actually disperses the molecules into more tiny particles and making the fuel less viscous. [3]

IV. SELECTION PARAMETER OF MAGNET

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

B. *Polarity of magnet:* Fuel line is magnetized by South Pole and air fuel line is magnetized by North Pole. Such type of opposite polarity burns more completely, producing higher engine output, better fuel economy, and more power and most important reduces the amount of pollutants. The main benefit of such opposite polarity dissolves the carbon built up in carburetor jet, spark plug electrode, injector nozzles and combustion chamber help to clean up the engine parts and maintains the clean condition. Therefore the life of engine parts also increases.

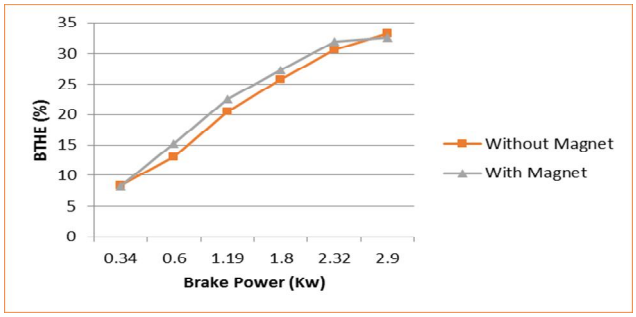
C. *Diameter of Magnet:* Maximum result is being obtained, if diameter is same or close to the system piping.

D. *Length of Magnet:* It will depend upon the volume of fluid to be treated and intensity of treatment. It is generally varied from 12 to 48cm.

E. *Magnetic flux:* Magnetic flux density which is varies differently on flat surface, core surface. It is observed that maximum effect at center.

V. RESULTS AND DISCUSION

A. *Effect of magnet on Brake Thermal Efficiency*



Brake Power VS Brake Thermal Efficiency

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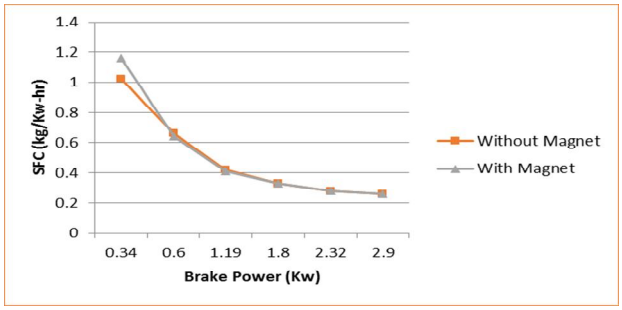
Figure represents brake thermal efficiency with brake power for effect of magnet and without magnet. Graph indicates, magnetization on fuel line with 1500 Gauss gives better efficiency about 0.34 to 1.435%.

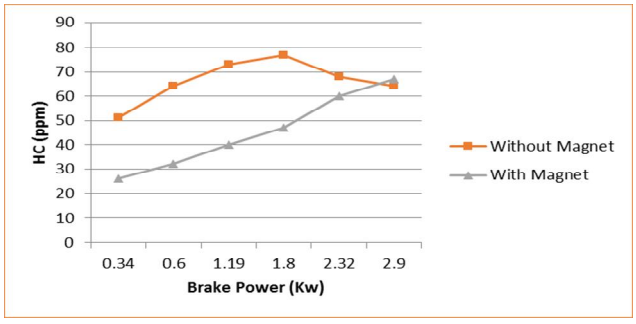
B. Effect of magnet on specific fuel consumption



Brake Power VS SFC in kg/hr. KW

The experimental results show that the fuel consumption of engine was less when the engine with fuel magnet than that without fuel magnet. These mechanisms are 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. It is clear that the fuel consumption is reduced to about 10%. The result is better fuel economy.

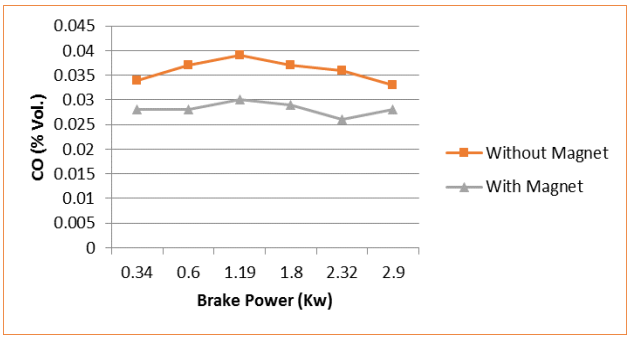
C. Effect on HC emissions



Brake Power VS HC Emissions

Figure represents graph of hydrocarbon with brake power. As brake power increases the emissions of HC also increases. But due to magnetized fuel HC reduction is near about 10-12%.

D. Effect on CO emissions



Brake Power VS CO Emissions

Figure represents the graph of Carbon Monoxide with brake power. CO emissions are almost constant for both magnetized and non-magnetized fuel. But magnetization reduces CO about 0.6 to 1.1%.

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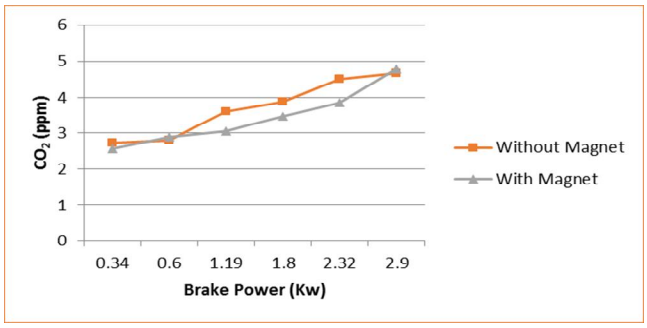
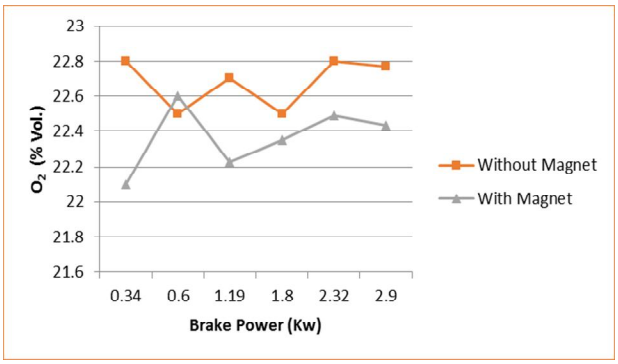
E. Effect on CO_2 emissions



Brake Power vs. CO_2 Emissions

Figure represents the graph of Carbon Monoxide with brake power. CO_2 emissions are almost constant for both magnetized and non-magnetized fuel. But magnetization reduces CO_2 about 10%. Considerable amount of CO_2 is reduced by MFC. But at initial loading CO_2 doesn't get reduced. But after that emissions of CO_2 reduced. CO_2 emissions are causes ozone depletion. Hence its reduction is very essential for clean environment.

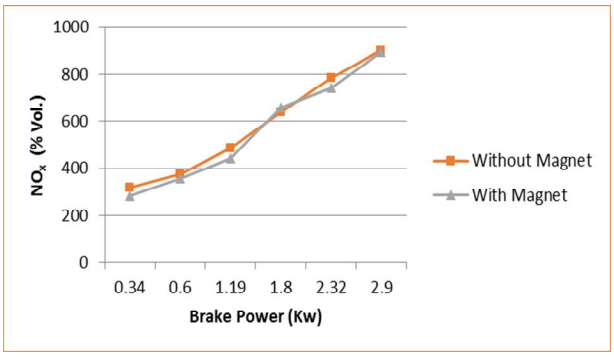
F. Effect on O_2 emissions



Brake Power vs. O_2 Emissions

Figure represents the graph of Oxygen with brake power. O_2 emissions are almost constant for both magnetized and non-magnetized fuel. But magnetization reduces O_2 about 0.6 to 1.1%.

G. Effect on NO_x emissions



Brake Power vs. NO_x Emissions

Figure represents the graph of Nitrogen Oxides with brake power. NO_x emissions are almost constant for both magnetized and non-magnetized fuel. But magnetization reduces NO_x about 0.6 to 1.1%.

VI. BENEFITS

A. By using effective magnetic field the exhaust emission can be controlled to great extent (For example CO, CO_2, NO_X, HC).
B. Formation of uniform air fuel mixture which leads to increase the efficiency.
C. It reduces exhaust emission which may eliminate the use of catalytic converter.

D. The magnets can be replaced easily.

E. It reduces the fuel consumption, ultimately reduces the cost.

F. Maintenance is easy.

VII. CONCLUSION

It is concluded that by using different ranges magnet (1500, 2000, 2500, 3000 Gauss) on four stroke single cylinder diesel engine, it has effect on brake thermal efficiency and exhaust emissions. Fuel consumption gets reduced. The efficiency of diesel engine has increased by 1 to 1.4 %. The pollutants such as HC, CO, CO_2, O_2 & NO_X also reduced by 5 to13 % Finally our set up has been made positive change in diesel engine parameters which will help in future for different applications.

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