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Effect of Magnetic Field Strength on Hydrocarbon Fuel Viscosity and Engine Performance

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Abstract-
This paper tries to analyse experimentally effect of magnetic field on hydrocarbon fuel flow. It has been reported that the viscosity of the flowing hydrocarbon fluids decreases on application of magnetic field. Declustering of the Hydrocarbon fuel molecules has been observed resulting in better atomization of the fuel, better mixing of the fuel-air mixture lowering the amount of un-burnt fuel and thus enhancing the thermal efficiency of the I. C. Engine. This improves the fuel economy of I. C. Engines and automobiles. The work in particular is very significant on account of its impact on the global automobile market resulting in lower fuel consumptions and hence ensuring non-renewable fuel conservation, the complete combustion of the fuel also reduces the CO percentages in the exhaust gases. The experiments in current research comprise the using of permanent magnets with different field intensity (2000, 4000, 6000, 8000 Gauss), which is installed on the fuel line of the petrol/diesel engine in order to study its impact on gasoline consumption.

Index terms- Diamagnetism, susceptibility, IC Engine.

1. INTRODUCTION

Magnets have their own unique magnetic fields viz. the invisible lines of forces which can be detected by a magnetic compass and measured using a gauss-meter.A magnetic field is set up when some body, for example an iron bar magnet or the Earth's core, has a lot of unpaired electrons, spinning in the same direction. The energy influence of these unpaired electrons is transmitted through space to affect other electrons in other bodies. A magnetic field extends into a finite space [2]. The electrons in the atoms of matter coming into this magnetic field might be affected by the energy of the magnetic field in a remote transfer of energy.

2. DIAMAGNETISM

Diamagnetism is characterized by negative susceptibility. This can be understood on the basis of Faraday Induction acting on the orbital motions in atoms or ions whereby the electron is in a circular motion around the nucleus. If a field is introduced perpendicular to that circuit, according to Faraday`s law, there will be an electro-motive-force acting on the electron. The EMF has the effect of changing the nature of the circulating motion of atomic orbits.

As a result of this field the electron will be accelerated according to Newton`s Law. With an accelerated electron spin the behaviour is altered. Regardless of the radius of the electrons orbit it`s stability is reduced and thus the ion`s affinity for other stable electrons is increased. It can therefore be stated that a diamagnetic ion, subsequent to magnetism, displays a net positive charge or positive ionization. Nuclear alignment allows hydrocarbons (fuel) to flow more evenly and therefore burn more efficiently. Positive ionization allows hydrocarbons (fuel) to attract and bond with negatively charged oxygen. This encourages more complete carbon/oxygen bonding and therefore a more complete and efficient combustion.

3. IMPACT OF MAGNETIC FIELD ON HYDROCARBON FUELS (PETROL/DIESEL)

A hydrocarbon fuel consists of molecules made from atoms of carbon and hydrogen, which are collected by covalent bonds.
Normally the two electrons in each covalent bond have balanced opposite spins.Non-polar molecules such as the hydrocarbons in gasoline, diesel fuel and related materials presuppose such electron spin-balanced chemical bonds.
Consider Diesel fuel with number of large molecules, which are associated as incipient solids in the liquid mixture, being placed into a strong magnetic field. The energy of the magnetic field will cause opposite spinning electrons to have parallel spins. The molecules with the parallel spin components will seem strange to the molecules next to them and they will not as easily nestle next each other. Thus the solidification process will be interrupted.
Same fuel when pumped into a combustion chamber already somewhat activated molecules with some parallel spinning electrons, inclined to oxidize more rapidly than the same kind of molecule with all the paired electrons spinning opposite directions. Hence test equipment shows lower consumption of fuel to achieve a given horsepower production.

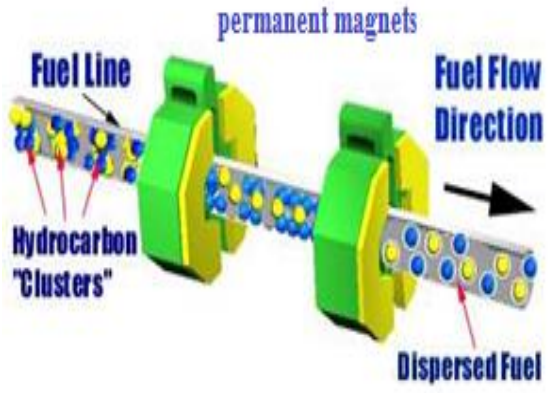


Figure 1 Declustering of hydrocarbon molecules

4. EXPERIMENTAL RESULTS OF EFFECT OF MAGNETIC FIELD ON VISCOSITY OF FUEL (PETROL)

Crude oil and refinery petroleum oils are all mixtures of many different molecules [1]. Among them, some molecules are much larger than others.The small ones are the majority, forming the base liquid and the large ones, suspended in the base liquid, are called “particles”. The viscosity of petroleum oil is thus clearly related to the viscosity of liquid suspensions.The assembled clusters are thus of limited size, viz. micro meters. While the particle volume fraction remains the same, the average size of new “particles” is increased. This leads to the reduction of apparent viscosity.

4.1 Experimental Setup

1. While performing an experiment on effect of magnetic field on the viscosity on the gasoline fuel (petrol), 1 lit. Of the petrol is taken in the container bottle.
2. The bottle is hung to certain height; the pipe carrying fuel leads the fuel to the bottom where it is collected in measuring flask.
3. On opening the valve fuel flows to the flask through an orifice, time required to collect 20 ml of fuel in the flask is measured.
4. An experiment is repeated 3 times for each reading to ensure repeatability.
5. First reading is taken without applying any magnetic field around the pipe carrying fuel and next reading are taken by applying increasing magnetic field strength (2000,4000,6000 gauss).
6. The setup during all the experiments kept as it is. Set up is made of non-metal to ensure no residual magnetic field stays from the previous experiment.

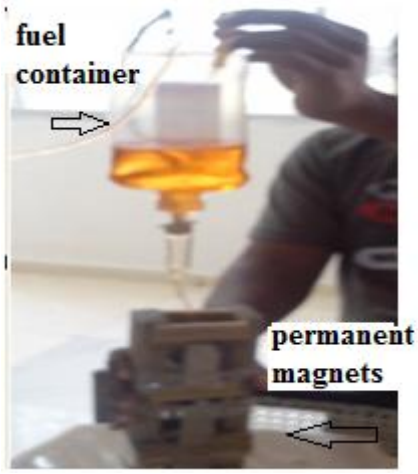
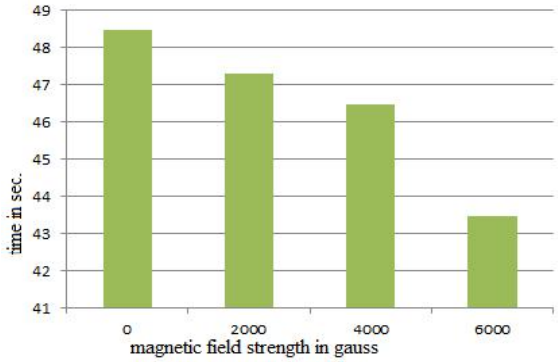


Figure 2 Experimental setup for analysis of effect of magnetic field on the viscosity of petrol

4.2 Results

SR.NO	magnetic field strength (in gauss)	time in sec. to collect 20 ml of petrol in flask			average time
1	0	48.2	48.5	48.4	48.5
2	2000	47.5	47.3	47.4	47.3
3	4000	46.4	46.4	46.7	46.5
4	6000	43.6	43.5	43.5	43.5

Table 1.Time required to collect 20 ml petrol in a flask for different magnetic fields.



Graph 1. Magnetic field strength vs. fuel flow time

Above graph clearly shows that the time taken by 20ml of fuel to collect in the flask with magnetic field is less as compare to time taken without magnetic field and time goes on reducing as the field strength applied to fuel flow increases.
For the magnetic field of 2000 gauss the % decrease in the requiredtime is 2.47%, for the magnetic field of 4000 gauss it is 4.12% and for 6000 gauss it is 10.30%
Since the flow rate increases which indicatesdecrease in the fuel viscosity with increase in the magnetic field.

5. EFFECT OF MAGNETIC FIELD ONTHEPERFORMANCE OF A DIESEL ENGINE.

The present work reports experimental results of application of magnetic field to fuel flow line of a Diesel and a Petrol engine [3]. The fuel consumption rate has been measured and found to reduce for the same load on application of the magnetic field on account of better mixing of fuel & air ensuring increased combustion and decreased amount of un burnt fuel.

5.1 Engine Specifications

- **Type**- 1 Cylinder , 4- Stroke Diesel Engine
- **Cooling**- Water cooled
- **Power**- 5.2Kw
- **Speed** -1500RPM
- **DynamometerType**- Eddy Current Type Water Cooled

5.2 Experimental Procedure

1.Tests have been carried out at fixed load condition i.e. only the frictional power on account of mechanical friction offered by various moving components. For the fixed load time required by the engine to completely consume 10 ml of fuel is measured.
2. Three reading were measured for the same condition to ensure repeatability and avoid any error in observation.
3. After first set of reading (i.e. without magnetic field applied to fuel line), engine is stopped. 1st magnetic pair of 2000 gauss is connected on the fuel line.
4. Same procedure is repeated for the magnetic field of 4000, 6000 and 8000 gauss and time required for consumption of 10 ml is measured for each case.

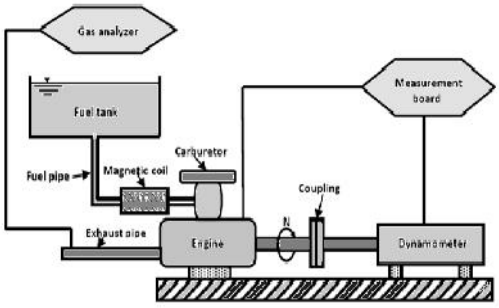


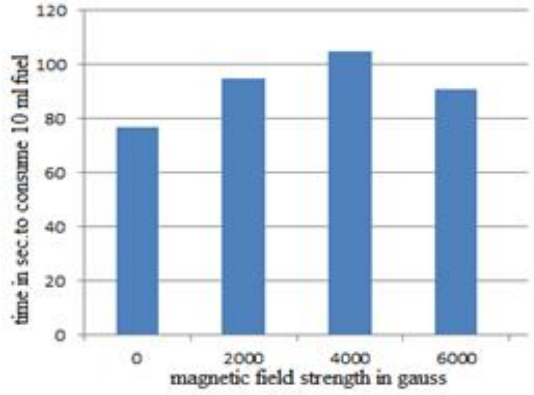
Figure 3. A line diagram for the diesel engine testing setup

Figure 4.Diesel engine testing setup

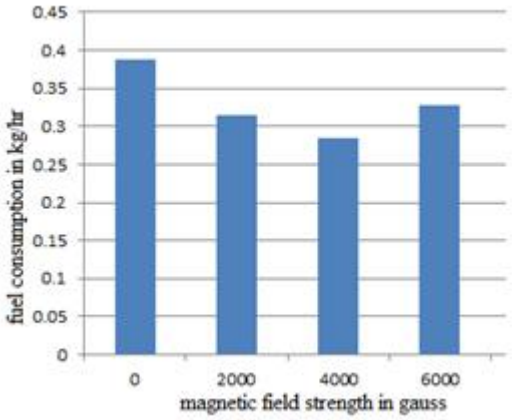
5.3 Results

Sr.No	magnetic field strength (in gauss)	time in sec to consume 10 ml of fuel	fuel consumption in kg/hr	% saving of fuel
1	0	77	0.388	0
2	2000	95	0.314	19.07
3	4000	105	0.284	26.8
4	6000	91	0.328	15.46

Table 2.Effect of magnetic field on time required for consumption of 10 ml of diesel in diesel engine for fixed engine load.



Graph 2. Magnetic field strength vs. Fuel consumption time



Graph 3.Magnetic field strength vs. fuel consumption in kg/hr.

Graph no 2 shows that the time required for 10 ml fuel consumption increases as the amount of magnetic field strength increases. This means that the fuel consumption rate decreases and it leads to increased fuel economy.
Maximum amount of change is observed at 4000 gauss.
In graph no 3 shows the fuel consumption rate in kg/hr and it is decreases as the magnetic field strength increases. It has been observed that as the magnetic field increases time required for diesel consumption also increases for fixed load (Up to 4000 gauss). Beyond 4000 gauss the effect gets flat i.e. no further improvement is observed which indicates saturation of the magnetic field effect on performance.
The diesel consumption decreases till 4000 gauss and deteriorates beyond 4000 gauss. Magnetic field 4000 gauss degrades the engine performance. This could be due to other effects coming in picture post 4000 gauss field viz. viscous heating of the fuel on account of very high magnetic field strength.

6. EFFECT OF MAGNETIC FIELD ON THE PERFORMANCE OF THE PETROL ENGINE

In this experiment the performance of a petrol engine under the influence of magnetic field is shown. The performance is studied in the form of distance travelled by the petrol bike for a specified amount of the fuel when provided with and without magnetic field on the fuel line.

6.1Engine Specifications

- **Type**- 1 Cylinder , 4- Stroke petrol Engine
- **Cooling**- air cooled
- **Power**- 15.4 PS
- **Engine Displacement (CC)** -159.7
- **Torque**-13.1 Nm

6.2 Experimental Procedure

1. A motor bike is attached with an external fuel tank where exact 100 ml of fuel (petrol) is filled into it.
2. A fuel line taken from new fuel tank is attached to the engine.
3. The bike is rode on an even consistent track for all the readings at constant speed and same gear engaged until all the fuel is consumed, initial and final readings on the speedometer are noted down to determine the total driven distance by the vehicle with and without application of magnetic field.
4. A magnetic field of ascending field strength is applied to the fuel line and the procedure is repeated
5. Distance travelled by the bike with and without magnetic field is compared to analyse the effect of the magnetic field.

Figure 5.Separate fuel supply system attached to bike

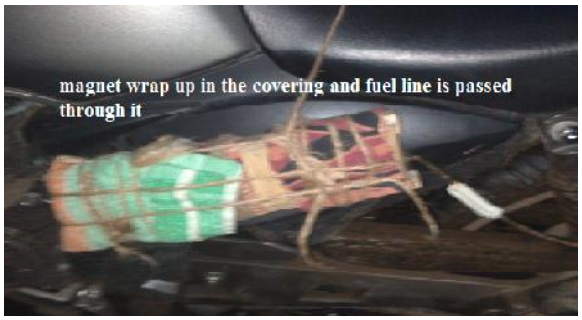
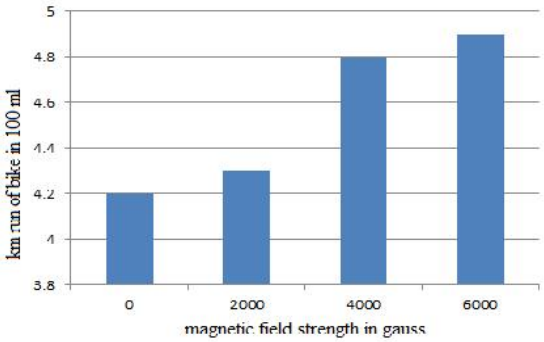


Figure 6.location of permanent magnet and fuel line

6.3 Results

Sr.No	magnetic field strength (in gauss)	speedometer reading	km run for 100 ml	km run for 1 lit	improvement per lit.
1	0	6302.5-6306.7	4.2	42	0
2	2000	6308.4-6312.7	4.3	43	1
3	4000	6322.4-6327.2	4.8	48	6
4	6000	6317.4-6322.3	4.9	49	7

Table 3 effect of magnetic field on km run of bike for 100 ml



Graph 4. Magnetic field strength vs. km runs of bike

Above graph shows as the magnetic field strength increases the mileage of a petrol bike increases.
For the magnetic field of 6000 gauss bike drove for 7 km more compared to the without magnetic field drive. Graph 1 also confirms the same i.e. viscosity decreases till 6000 gauss, the performance improves till 6000 gauss. This proves the effect of the drop in viscosity on engine performance.

7. CONCLUSIONS

The paper has experimentally measured effect of magnetic field on hydrocarbon fuel. The viscosity of the hydrocarbon decreases i. e. the fuel gets thinner on application of magnetic field.
This improves the atomization of the fuel, better mixing ensuring complete combustion or no loss of energy. This is the main reason for improving the I. C. Engine performance. Tests were carried out on a Diesel engine as well as on Petrol engine which confirmed the above effect.

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