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Performance and Emission Analysis of an IC Engine with and without Magnetic Field

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Abstract: -- Magnetic field generated by a permanent neodymium magnet of 4,000 gauss intensity was used for this research and was applied on the fuel line of a 3 cylinder,4-stroke SI engine to reduce the fuel consumption and even the pollutants of the exhaust gas. This research comprises of various trials conducted on the engine at 3,000 rpm and different loads (100%, 80%, 60%, 40%, 20% and no load). Firstly, the engine was run without the installation of the magnetizer and all the performance parameters and the exhaust gas readings were noted down, and then the same procedure was adopted after installing the magnetizer just before the carburetor. The trials had positive results with maximum of 7.5% decrease in specific fuel consumption and about 4% increase in both mechanical efficiency and brake thermal efficiency. It was also found that there was a significant decrease in exhaust gas emissions with maximum amount of decrease in Carbon monoxide and Hydrocarbons was about 3% and 6% respectively, while there was an increase in Carbon dioxide by about 2%. The results above states that this technique helps in improving the performance and thereby saving the fuel and enhancing the green technology.

Keywords: Efficiency, Emission, Fuel consumption, Magnetizer.

I. INTRODUCTION

India stands on fourth spot in the list of the biggest crude oil consumers in the world. This sign is alarming enough to tell us that conservation of conventional fuels is the foremost issue we need to address. Further this problem turns darker when it is found that around 25-30% of this energy is wasted. A big part of this fuel consumption is acquired by vehicles running on hydrocarbon fuels. Most of the fuels used in IC engine are liquid, these fuels do not combust until they are vaporized and mixed with air. This results in unburned hydrocarbons, carbon monoxide and oxides of nitrogen in motor vehicles. There exists magnetic movements in molecules of the fuel and they have positive and negative charges. However there is tremendous degree of randomness which doesn't help them to interlock with oxygen during combustion. To decrease the randomness of these molecules, they should be ionized and aligned which is done with the help of magnetic field. The ionization of fuel also helps to dissolve the carbon build-up in carburetor, fuel injector and combustion chamber, thereby keeping the engines in clear condition.

II. FUEL CHEMISTRY

Petrol is the product which is obtained by refining of crude oil. Fuel is basically formed by grouping of hydrocarbons. The major constituent of hydrocarbon fuel is hydrogen which is lightest and most basic element. Along with hydrogen carbon, small amount of sulphur and inert gases are also there. Hydrogen can be either diamagnetic or paramagnetic depending on the relative orientation of its nuclear spin. Also it occurs in two distinct isomeric forms, i.e. Ortho form and Para form.

When the spin state of one hydrogen atom is in opposite direction relative to another hydrogen atom then it is diamagnetic and has Para form of hydrogen molecule. And when two hydrogen atoms have same spin state or parallel spin then it is paramagnetic and has Ortho form of hydrogen molecule [1]. Following diagram shows the two forms of hydrogen.

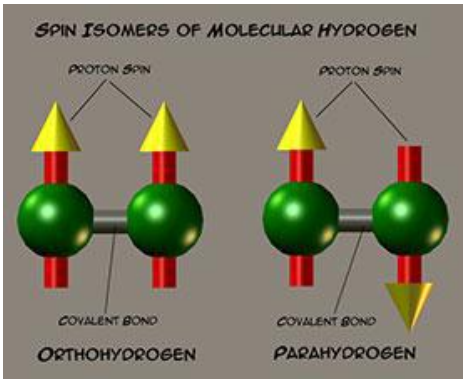

Figure1: Nuclear spin form of Ortho and Para hydrogen [1].

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Out of these two forms, the Ortho hydrogen is more reactive than the Para hydrogen. In the fuel, hydrogen molecules are present in the Para form and thus it will be efficient if we convert them into Ortho form. Studies showed that Para hydrogen under magnetic field changes to Ortho hydrogen.

III. FUEL MAGNETIZER

In this research, to produce magnetic field we have used permanent magnet called as fuel magnetizer.

Selection of permanent magnet: After referring the research papers on this topic, out of the stated optimal range of 2,000-10,000 gauss we have selected the permanent magnet of intensity 4,000 gauss. Detailed specifications are as follows:

Type of magnet: Rectangular
Material of magnet: NbFeB
Gauss value: 4000 Gauss
Curie temperature: 250 oC- 300 oC

Figure 2: Fuel Magnetizer used for experimentation

IV. ENGINE TEST SETUP

Figure 3: IC Engine test setup

The setup consists of three cylinders, four stroke Petrol (MPFI) engine connected to Hydraulic type dynamometer for loading.

The set-up has stand-alone panel box consisting of air box, fuel tank, manometer, fuel measuring unit, transmitters for air and fuel flow measurements, process indicator, load indicator and engine indicator. Rotameters are provided for cooling water and calorimeter water flow measurement.

The setup enables study of engine performance for brake power, indicated power, frictional power, BMEP, IMEP, brake thermal efficiency, indicated thermal efficiency, Mechanical efficiency, volumetric efficiency, specific fuel consumption, A/F ratio and heat balance. Engine Performance Analysis software package "EnginesoftLV" is provided for performance evaluation.

Engine Specifications:

Engine - Maruti 800 model
Type - 3 Cylinder, 4 Stroke, Petrol (MPFI), and water cooled
Capacity – 796 cc
Power - 27.6 Kw at 5000 rpm
Torque - 59 Nm at 2500 rpm
Compression ratio – 9.2
Software - EnginesoftLV (Engine performance analysis software)

V. METHODOLOGY

The computer was connected to the engine on which 'EnginesoftLV' software was installed. Firstly water pump was started and then the engine was started. 'EnginesoftLV' software was started in the computer. Speed of the engine was increased by varying the throttle valve till 3,000 rpm and simultaneously load was increased till 20 Kg. "Log on" button in the software was clicked and then the knob of fuel measuring unit was switched to "Measuring". After waiting for 2-3 min. the knob of fuel measuring unit was turned to "Tank". Results along with graphs were saved. The same process was repeated for 16 kg, 12 kg, 8 kg, 4 kg and no load conditions keeping speed of engine 3,000 rpm as constant to get the first set of readings without using magnetizer. Now, the magnetizer was clamped on the fuel line within one meter from the carburettor. Nextly, the engine was run for 20 to 30 minutes at no load condition. The same procedure was then

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Vol 2, Issue 5, May 2017

repeated and a new set of readings were obtained using magnetizer. Readings were compared and graphs were plotted.

VI. OBSERVATIONS AND RESULTS

[1] Following were the observations in performance parameters from the trials conducted –

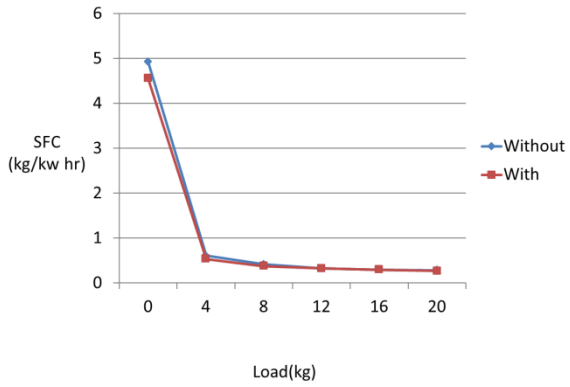
Table 1- Observation table without using magnetizer

Sr. No	Load (Kg)	IP (KW)	BP (KW)	Bthe (%)	Mech. Effi. (%)	Fuel Flow (Kg/hr)	SFC (Kg/ KWhr)
1.	20	22.88	12.57	28.8	57.71	3.69	0.29
2.	16	18.98	10.28	27.1	51.89	3.20	0.30
3.	12	17.30	7.87	25.0	47.09	2.66	0.33
4.	8	3.76	5.22	20.7	42.78	2.18	0.42
5.	4	4.69	2.83	14.3	40.4	1.73	0.61
6.	0	1.42	0.26	1.66	39.4	1.29	4.93

Table 2 – Observation table using magnetizer

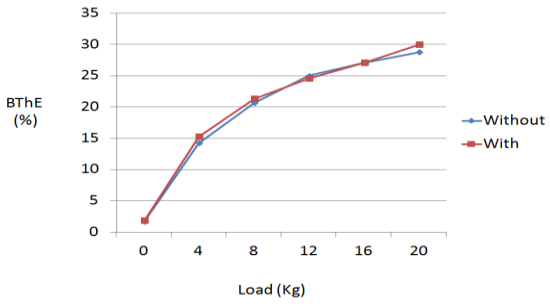
Sr. No.	Load (Kg)	IP (KW)	BP (KW)	Bthe (%)	Mech Eff. (%)	Fuel Flow (kg/h)	SFC (kg/ KWhr)
1.	20	21.77	12.82	29.96	58.26	3.64	0.27
2.	16	20.38	10.28	27.07	54.16	3.11	0.30
3.	12	17.30	7.87	24.59	45.51	2.61	0.33
4.	8	5.62	5.43	21.3	43.60	2.09	0.38
5.	4	3.13	2.97	15.27	41.21	1.69	0.54
6.	0	0.5	0.3	1.79	39.53	1.38	4.56

Following graphs shows the comparison between both the trials



Graph No. 1- Specific Fuel Consumption (Kg/kWhr) Vs Load (Kg)

- Specific Fuel Consumption at no load was found to be quite high which gradually decreased with the load.
- After applying magnetic field the maximum decrease in Specific Fuel Consumption was found to be around 7.5%.



Graph No. 2- Brake Thermal Efficiency (%) Vs Load (Kg)

- It was found that Brake thermal efficiency increases with the load
- After applying the magnetic field, the maximum increase in Brake Thermal Efficiency was found to be around 4%.

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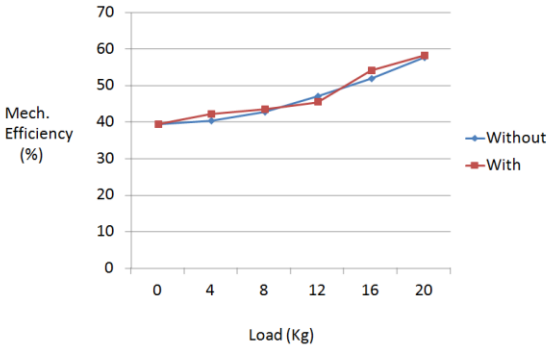


Graph No.3- Mechanical Efficiency (%) Vs Load (Kg)

- It was found that Mechanical efficiency increases with load.
- After applying magnetic field, the maximum increase in mechanical efficiency was found to be around 4%.

[2] Following were the observations in exhaust gas parameters from the trials conducted –

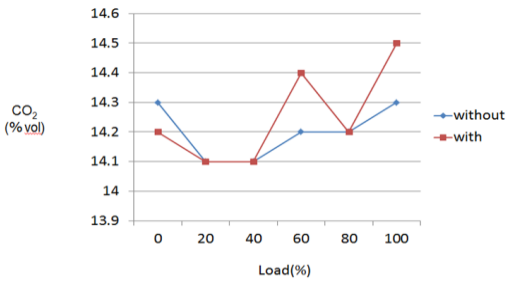
Table 3 - Observations without using magnetize

Load (Kg)	COMPONENTS OF FLUE GASES		
	Carbon Monoxide (CO) (% Volume)	Hydrocarbons (HC) (ppm)	Carbon Dioxide (CO_2) (% Volume)
20	0.59	49	14.30
16	0.64	53	14.20
12	0.62	52	14.20
8	0.61	53	14.10
4	0.59	55	14.10
0	0.59	52	14.30

Table 4 - Observations using magnetizer

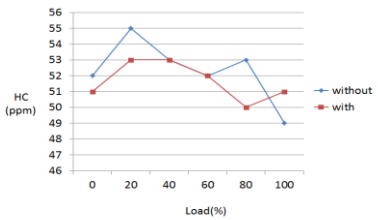
LOAD (Kg)	COMPONENTS OF FLUE GASES		
	Carbon Monoxide (CO) (% Volume)	Hydrocarbons (HC) (ppm)	Carbon Dioxide (CO_2) (% Volume)
20	0.58	51	14.50
16	0.60	50	14.20
12	0.62	52	14.40
8	0.61	53	14.10
4	0.59	53	14.10
0	0.58	51	14.20

Following Graphs shows the comparison between both the trails-



Graph No. 4 - Carbon Monoxide (% Vol) Vs Load (%)

- It was found that the maximum decrease in Carbon Monoxide was around 3%.



Graph No. 5 - Hydrocarbon (ppm) Vs Load (%)

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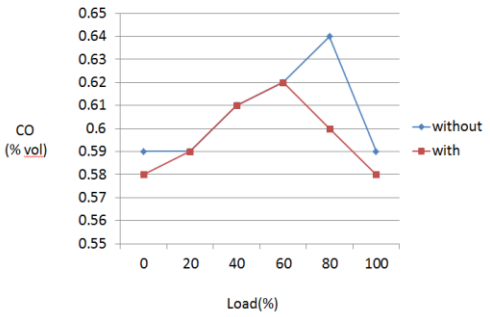
- It was found that the maximum decrease in Hydrocarbons was around 6%.



Graph No. 6 - Carbon dioxide (% Vol) Vs Load (%)

- It was found that the maximum increase in Carbon dioxide was around 2%.
- After applying magnetic field carbon monoxide gets converted into carbon dioxide and hence the amount of carbon dioxide in the exhaust increases slightly.

VII. CONCLUSION

After conducting various trials on the petrol engine it was found that specific fuel consumption decreased up to 7.5% while brake power increased by 2% and mechanical efficiency increased up to 4%.Positive results were also found in exhaust gas emissions as maximum decrease in Carbon monoxide (CO) and Hydrocarbons (HC) were around 3% and 6% respectively due to which Carbon dioxide (CO2) increased by around 2%.

VIII. REFERENCES

[1] Piyush M Patel, Prof. Gaurav P Rathod, Prof. Tushar M Patel, "Effect of magnetic field on performance and emission of single cylinder four stroke diesel engine", IOSR Journal of Engineering, Vol. 04, Issue 05 (May. 2014), ||V5|| PP 28-34.

[2] P Vijay Kumar, Santosh Patro and vedasamhita Pudi, "Experimental Study of Novel magnetic fuel ionisation method in 4-stroke diesel engines", International Journal of Mechanical Engineering and Robotics Research, , Vol. 3, pp 151-159, January 2014, ISSN 2278-0149..

[3] P. Govindasamy and S. Dhandapani, "Performance and emissions achievements by magnetic energizer with a single cylinder two stroke catalytic coated spark ignition engine", Journal of Scientific and Industrial Research, Vol. 66, June 2007, pp. 457 – 463..

[4] Ali S. Farisa, Saadi K. Al-Naserib, Nather Jamal, Raed Isse, Mezher Abed, Zainab Fouad, Akeel Kazim, Nihad Reheem, Ali Chaloob, Hazim Mohammad, Hayder Jasim,Jaafar Sadeq, Ali Salim and Aws Abas, "Effects of Magnetic Field on Fuel Consumption and Exhaust Emissions in Two-Stroke Engine"

[5] "Review on Effect of Fuel Magnetism by Varying Intensity on Performance and Emission of Single Cylinder Four Stroke Diesel Engine", Kushal Chaware.

[6] Nikit B. Patel, Saurabh B. Patel Milan S. Patel and Diptesh Patel, "Reduction in Harmful Exhaust Gas Emission with use of Catalytic Converter and Fuel Magnetizer".

[7] Hejun Guo, Zbizhong Liu, Yunchao Chen, Rujie Yao, "A Study Of Magnetic Effects On The Physicochemical Properties Of Individual Hydrocarbons".

[8] Farrag A.El Fatih, Gad 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.