Effects of Gasoline Exposed to Magnetic Field to the Exhaust Emissions

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***Abstract*—Excessive increase in environmental pollution due to the use of fuels derived from petroleum in internal combustion engines will make it mandatory the widespread use of alternative fuels or economically usage of existing fuels. Studies are focused on the issues of using available resources in the most efficient way, because of the world's oil reserves began to decline. In this study, the changes in the exhaust emissions of an internal combustion engine that works using gasoline exposed to a magnetic field were investigated. Results of this study are compared with other studies and reports which were made for this issue. The magnetic field device used in this study led to the fall of the hydrocarbons and carbon monoxide emissions and improved the lambda value.**

***Index Terms*—air-fuel ratio, engine, exhaust emissions, greenhouse gas, magnetic field device**

I. Introduction

The researchers focused on the following topics to prolong the remaining life of the world oil reserves and to prevent the negative impacts of the vehicle to the environment because of economic crisis, energy crisis and automobile emissions; to discover alternative fuels, petroleum-based fuels and to use available resources in the most efficient manner. When the criteria such as availability of fuel, emissions, cost, storing, transport etc. are taken into consideration, finding a suitable alternative fuel for internal combustion engines is revealed as a high cost of research topic. Vehicles which pollute the environment represent a major problem particularly in metropolitan cities. Researchers are trying to reduce the fuel consumption and exhaust emissions of vehicles in road traffic by economic methods on the development or improvements of existing vehicle systems [1], [2].

Most fuels for internal combustion engine are liquid and liquid fuels are mixture of organic chemical compounds predominantly consist of carbon and hydrogen atoms (hydrocarbons-HC). The fuels vaporize and mix with air in combustion chamber of an engine and the mixture burn in the engine chamber. At the end of the combustion burnt gases called exhaust emissions are released from the vehicle exhaust system. Vehicle exhaust emissions consist of water vapor, Carbon Dioxide (CO_2), unburned Hydrocarbons (HC), Carbon Monoxide (CO) and Nitrogen Oxides (NOx) etc. Especially unburned emissions react in the atmosphere and they are harmful to human health and the environment [3].

Car manufacturers have to give importance to the increase in engine performance by reducing of fuel consumption and exhaust emissions of vehicle thanks to the new systems. Therefore, manufacturers can make their vehicles more attractive for consumers. On the other hand, the studies about vehicles on the road have focused on fuel consumption and emissions particular due to the large numbers of older vehicles on the road [4].

Nowadays, there are a lot of different devices with different types and working principles to reduce fuel consumption and emission values of vehicles on road. The device producers are promised that the low cost reduces fuel consumption and exhaust emissions, and increases the engine performance. Although these devices are outnumbered and due to scientific studies have small number, we do not have enough information on the efficiency of these devices [4].

One of the treatment work about fuel consumption and exhaust emissions of vehicles is on the fuels exposed to a magnetic field. Diamagnetic atoms have only paired electrons, whereas paramagnetic atoms, which can be made magnetic, have at least one unpaired electron (Fig. 1). Paramagnetism is a form of magnetism whereby certain materials are attracted by an externally applied magnetic field. In the presence of a magnetic field this effect causes the fluid to be drawn in the direction of increasing magnetic field strength. On the contrary, if the electrons are already paired, the atoms resist the formation of a dipole and this resistance causes the atoms to move in the direction of decreasing magnetic field strength, known as diamagnetism. Paramagnetic behavior is about three orders of magnitude larger than the diamagnetic behavior. Oxygen and air are examples of paramagnetic substance and are drawn towards higher

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magnetic field strengths. Nitrogen, carbon dioxide and most hydrocarbon fuels are examples of diamagnetic substances and are repelled by stronger magnetic fields [5], [6].

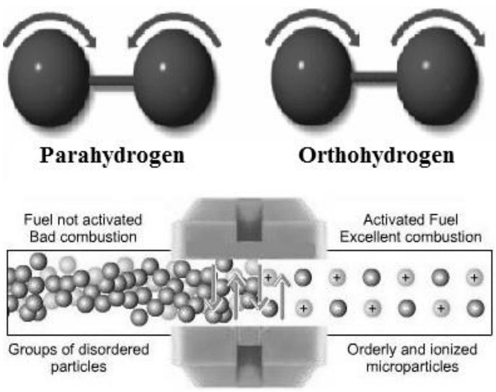

Figure 1. Spin isomers of hydrogen and to effect of magnetic field over the fuel molecules [7], [8].

Magnetization of fuel breaks down the bonds between hydrocarbon chains which results in decreased density, surface tension and, hence smaller particulars and droplets during atomization or injection within an internal combustion engine (Fig. 1). Smaller particles and droplets causes increased evaporation rates, improved mixing of fuel and oxidizer, and improved promotion of oxidation. The use of strong magnetic charge from the magnet put into the fuel line gives a complete and clean burn so that power is increased with reduced operating expenses. Many of experimental studies which present evidences of the benefits of magnetic treatment were carried out. For pollution due to automobile emissions, it is of great concern more particularly in metropolitan cities [9].

Experiments conducted using a $252cm^3$, 4.5 horsepower (HP) single-cylindered diesel engine, measured the effects of fuel passing through the magnetic field to the engine performance. It is noted that the magnetic field device don't have a significant contribution to fuel economy [10].

Aydın *et al.* (2003) experimentally investigated the effects of magnetic field to the fuel economy and exhaust emissions of internal combustion engines such as two-stroke, four-stroke gasoline and diesel engines. Magnetic field intensity used in the experiments is provided with the fixed magnet, 12-volt coil, 24-volt coil, and 48-volt coil. Maximum benefit is obtained with the four-stroke gasoline engine type [11].

The experiments using of permanent magnets with four different intensities exhaust emission tests showed a good result. As a result of study, exhaust gases such as CO, HC were decreased and CO_2 emissions increased up [3].

This study was conducted to determine the effect of the magnetic field device to the engine exhaust emissions and fuel consumption values of a carbureted internal combustion engine. Device manufacturers argue that the device can reduce fuel consumption and exhaust emissions of vehicles in traffic economically. The experimental setup was prepared in accordance with previous scientific studies on the subject and the data obtained from the experiments were compared.

II. Materials and Methods

The magnetic field device which is a magnetic frequency resonator, can easily mounted to the carburetor fuel inlet pipe on an internal combustion engine. The magnetic field device has 3000 Gauss magnetic field intensity because it is made from Neodymium-Iron-Boron. The fuel molecules passing through the magnetic field generated by the device enter the combustion chamber of internal combustion engine in a specific sequence as shown in Fig. 1 and thus fuel molecules within the combustion chamber contact with more oxygen and so that the combustion reaction approaches the theoretical combustion.

Descriptions of the three major automotive terms used in study about fuel consumption and exhaust emissions are as follows: The Air-Fuel Ratio (AFR) is the most common reference term used for mixtures in internal combustion engines. AFR is the mass ratio of air to fuel present in a combustion process in an internal combustion engine. If exactly enough air is provided to completely burn all of the fuel, the ratio is known as the stoichiometric mixture. The stoichiometric mixture for a gasoline engine is the ideal ratio of air to fuel that burns all fuel with no excess air and the stoichiometric mixture is approximately 14.7:1. Air-Fuel equivalence ratio, (λ-lambda), is the ratio of actual AFR to stoichiometry for a given mixture. $\lambda=1$ is at stoichiometry, rich mixtures $\lambda<1$, and lean mixtures $\lambda>1$. Carbon Monoxide (CO) and Hydrocarbon (HC) emissions result from incomplete combustion of fuel in combustion chamber. When combustion does not take place all, as with a misfire, HC and CO emissions are emitted from the combustion chamber [12], [13].

It is very beneficial for both the environment and economies to reduce exhaust emissions of vehicles in traffic without major modifications in the vehicles. In this study, Neodymium magnetic field device (Fig. 2), OVLT brand exhaust emissions tester and 4-cylinder, 1.6-liter, 80HP, carbureted engine, 1991 model Toyota Corolla brand vehicle, are used and the gasoline fuel obtained from the same filling station as needed. Exhaust emissions test device was calibrated to be authorized firm before experiments. After the magnetic field device was placed to the closest location to the carburetor, vehicle was driven approximately 100km. At the end of each experiment, the moisture filter of the emission tester has replaced. Experiments were performed with the vehicle on chassis dynamometer at various engine speeds of the vehicle. Experiments were repeated 3 times and the results in tables and figures are average values.

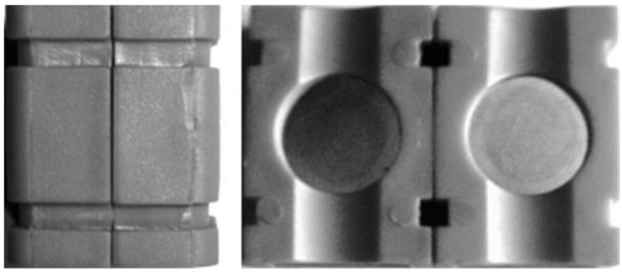

Figure 2. Image of the magnetic field device [4].

III. RESULTS AND DISCUSSION

If the lambda value is more than 1.02, excess air molecules in the combustion chamber absorb a portion of the heat present and then temperature end of combustion process drops a small amount. In actuality, an increase in the initial pressure during combustion can greatly alter the way the fuel burns. Higher pressure in a limited volume means that the temperature in the cylinder is higher and that the fuel and air molecules are more reactive. The mixture burns faster, so the burn duration becomes shorter. Under higher inlet pressure, the gases in the cylinder are hotter throughout combustion and the combustion, which is an oxidation reaction, occurs faster. The heat of combustion is the energy released as heat when a compound undergoes complete combustion with oxygen under standard conditions.

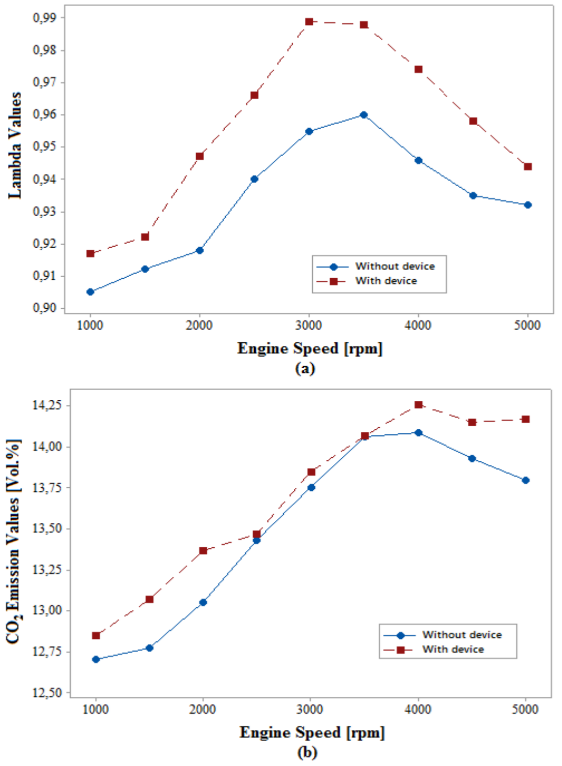

Figure 3. Experimental results of CO_2 and Lambda values in graphically.

Lambda values obtained from experiments given in Fig. 3(a). While the engine is 1000rpm, lambda values test results are 0.905 and 0.917 for without device and with device, respectively. Lambda values on without the device and with device tests were reached the maximum level at 3000-4000rpm range. In experiments conducted with the device lambda values are close to the ideal stoichiometric mixture. When the engine speed increased, the lambda value dropped in both cases. In experiments conducted with the device, the decrease rate of lambda values are more than the other.

In experiments conducted without the device CO emission values [Vol.%] at low engine speeds are more than the values with the device test results (Fig. 4(d)). CO emission values decreased between 1000-4000rpm, but after 4000rpm CO emission values began to increase.

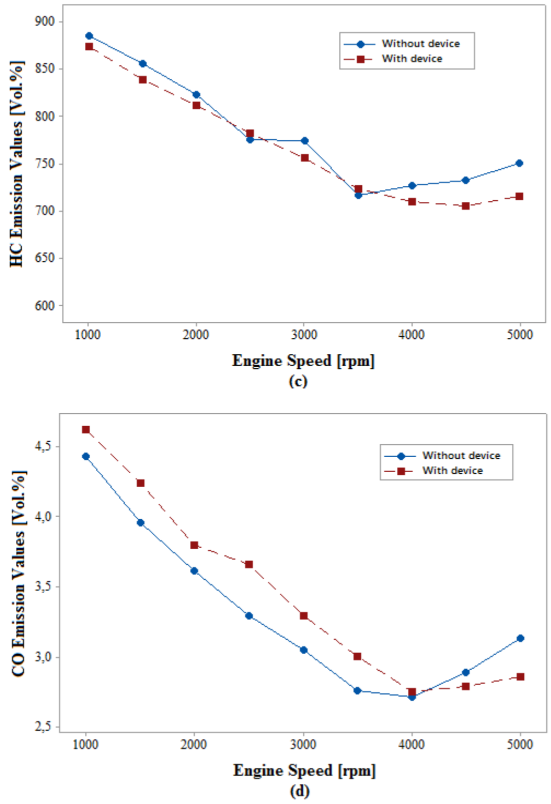

Figure 4. Experimental results of CO and HC emissions in graphically.

CO_2 emission values increased between 1000-4000rpm and after 4000rpm CO_2 emission values [Vol.%] began to decrease. The graphics of CO emission values and CO_2 emission values are compatible with each other. CO_2 emission values began to decrease. In experiments conducted with the device, CO_2 emission values are more than other because better combustion reaction has occurred.

TABLE I. THE TEST RESULTS ACCORDING TO ENGINE SPEED

Emission	Engine Speed (rpm)								
	1000	1500	2000	2500	3000	3500	400	4500	5000
CO (without device) [Vol.%]	4.43	3.96	3.61	3.29	3.05	2.76	2.71	2.89	3.13
CO_2 (without device) [Vol.%]	12.70	12.77	13.05	13.43	13.75	14.06	14.09	13.93	13.80
HC (without device) [ppm]	885.50	856.00	823.30	775.80	774.00	716.80	726.80	733.00	750.50
Lambda (without device)	0.91	0.91	0.92	0.94	0.96	0.96	0.95	0.94	0.93
CO (with device) [Vol.%]	4.62	4.24	3.80	3.66	3.29	3.00	2.75	2.79	2.86
CO_2 (with device) [Vol.%]	12.85	13.07	13.37	13.47	13.85	14.07	14.26	14.15	14.17
HC (with device) [ppm]	874.00	839.30	811.30	782.70	756.70	723.30	710.30	705.70	715.70
Lambda (with device)	0.92	0.92	0.95	0.97	0.99	0.99	0.97	0.96	0.94

There is no significant difference in the HC emissions values [ppm]. When engine speed increased, HC emission values dropped for both cases. HC emission values are 874 and 885.5 at 1000rpm, and 715.7 and 750.5 at 5000rpm for with device and without device, respectively. The test results given graphically above are presented in the Table I.

IV. Conclusions

According to the results of present study:

- When fuel is exposed to a magnetic field, exhaust emission values of vehicle are changed.
- While the magnetic field device plugged, the most change occurred in lambda values. In experiments conducted with the device lambda values are changed between 0.90 to 0.96 ranges and after the device is plugged on the carburetor, lambda values are up to 0.92-0.99 ranges.
- When CO_2 emission values increased up to 4000rpm, CO emission values decreased.
- HC emissions values are the same for all rpm.
- The magnetic field devices have the potential to reduce exhaust emissions and fuel consumption by taking into consideration CO and CO_2 emission values and lambda values.
- Magnetic treatment is economically feasible to reduce exhaust emissions values and fuel consumption because of does not need energy.

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