Asian Journal Science and Engineering

Vol. 1, No. 1, June 2022
https://attractivejournal.com/index.php/ajse

The Effect of Strong Magnetic Field and Engine Rotation on Fuel Consumption and Exhaust Gas Emissions for Gasoline Engines

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ARTICLE INFO
Article history:
Received
May 14, 2022
Revised
June 23, 2022
Accepted
June 29, 2022

Abstract

An Iincreasing number of means of transportation in various cities causes air pollution. There have been many studies to reduce air pollution due to motorized vehicles. One of them relates to the fuel line. The purpose of this study was to determine the relationship between the strength of the magnetic field in the fuel line on fuel consumption and exhaust emissions. The research method uses a pure experimental method. The independent variables are magnetic field strength (51, 102, 152, 202, and 249 gauss) in the fuel line and engine speed (1500 rpm, 2500 rpm, 3500 rpm and 4500 rpm). The dependent variable is fuel consumption (ltr/hour) and exhaust emissions. Test was carried *Fourier transform infrared* out to determine the chemical compound group of the fuel. The results showed that the highest concentration of *transmittance* at a wavelength of 2850 cm^{-1} - 2970 cm^{-1} was 77.75% with a magnetic field strength of 249 gauss, when compared to standard conditions it was 33.05%. At a strong magnetic field of 249 gauss with a rotation of 2500 rpm, it can save fuel consumption of 0.2 liters/hour. In addition, it can also reduce the level of exhaust gas O_2 by 4.16% (3500 rpm), CO gas by 1.29% (2500 rpm), CO_2 gas by 5.2% (1500 rpm) and HC gas by 215.66%. (4500 rpm).

Keywords: Strong Magnetic, Fuel Consumtion, Exhaust Gas Emissions

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INTRODUCTION

In Indonesia, population growth is increasing, encouraging a large increase in the use of energy sources, especially in the automotive sector, as can be seen from the large number of fossil fuel motorized transportation equipment. This happens because the consumptive culture of the Indonesian people towards something practical and instant is quite high, so that in one of the conditions it causes air pollution in the resident's environment. According to the Central Statistics Agency (2019), the total number of domestic vehicles in 2010 was 76,907,127 units, then increased dramatically in 2017 with a total of 138,556,669 units. This is reinforced by the high number of motorcycles totaling 113,030,793 units which covers 81.57% of the total number of motorized vehicles in 2017. The increasing number of motorized vehicles, the higher the level of exhaust gases produced from the combustion of vehicle engines, so that cause air pollution. There are several kinds of pollutants produced by motor vehicle exhaust including hydrocarbon compounds (HC), carbon monoxide compounds (CO) nitrogen compounds (NOx), sulfur compounds (SOx), and lead (Pb) mixed with dust particles. Vehicle exhaust is one of the components that support the problem of air pollution in the world (Pulkrabek, 2004), besides that exhaust gas emissions are toxic and have a bad effect on human survival, CO and CO_2 are the main compounds resulting from burning gasoline through an incomplete combustion process. , while HC is an emission gas that arises due to the presence of unburned fuel and comes out together with the rest of the combustion gas. Some of the negative effects of vehicle exhaust gases such as HC and CO with a large percentage cause cancer and death effects.

Therefore, another breakthrough was chosen, namely using an electromagnetic-based magnetization tool. As electromagnetic is a type of artificial magnet that can produce a magnetic field, when a conductor (iron) is wrapped around a copper wire electrified by an electric current. This tool is attached to the fuel line before entering the carburetor. With the strong influence of the magnetic field on the fuel, it causes vibrations so that there is instability in the hydrocarbon bond chain, as a result, hydrocarbon molecules can be more reactive to oxygen. The ideal mixture of fuel and oxygen can result in better and more efficient combustion. The magnitude of the magnetic field strength in a current coil (Solenoid) is formulated as follows:

$$B = \mu . \frac{N.I}{L}$$

Where:

B = Magnetic field strength (Tesla)

= Vacuum permeability

(4*Wb* x 10/Am)

N = Number of turns

I = Electric current (Amperes)

L = Length of solenoid

METHOD

This research was conducted using an experimental method and as the object of the research was a motorcycle with a four stroke gasoline engine with a capacity of 125 cc. The test begins with testing the magnetic field strength and testing the fuel sample using *Fourier Transform Infra Red* (FTIR) at the Faculty of Science and Technology, UIN Maulana Malik Ibrahim Malang. The independent

variables used is the variation of the magnetic field strength of 51, 102, 152, 202, and 249 gauss. Then proceed with the FTIR test to analyze the magnitude of the infrared absorption value of the molecules contained in gasoline before and after being magnetized. For testing fuel consumption and exhaust emissions, each data collection was repeated 3 times at engine speed variations of 1500, 2500, 3500, and 4500 rpm.
Tools used:

1. 1 unit motorcycle
2. *Digital tachometer*
3. *Gas analyzer*
4. Teslameter
5. FTIR spectrophotometer
6. AC-DC voltage inverter
7. Measuring cup
8. Stopwatch Materials used:

1. Conductor pipe (iron)
2. Fuel hose
3. 0.25 mm copper wire
4. Pertalite fuel Electromagnet
5. Cover
6. *Voltage stepdown module* xl4015

The design of the tool used is as follows:

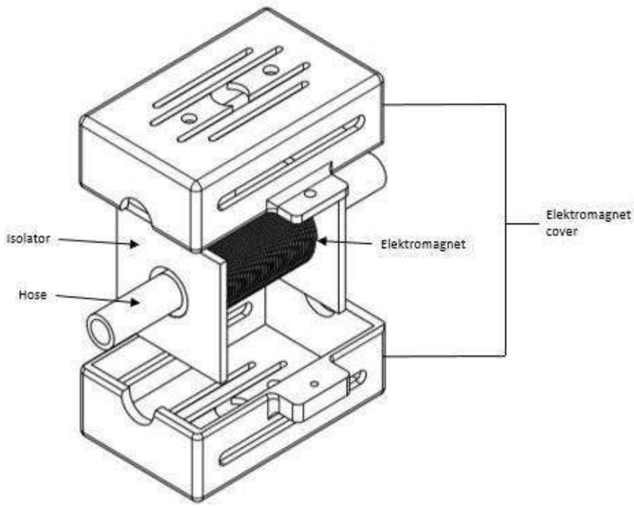

Figure 1 Design of Magnetization Tool

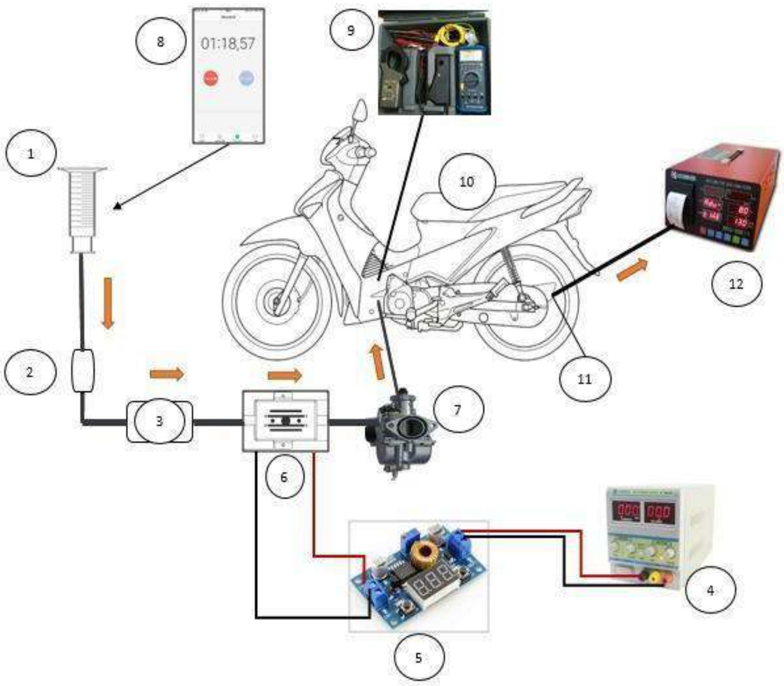

Figure 2 Testing Scheme

Description:

1. Fuel tank Fuel
2. filter
3. Vacuum valve
4. AC-DC voltage inverter
5. *Voltage stepdown XL4015*
6. Electromagnet
7. Carburetor
8. Stopwatch feature Mobile phone
9. *Tachometer*
10. *Motorcycle*
11. exhaust
12. Gas analyzer

RESULT AND DISCUSSION

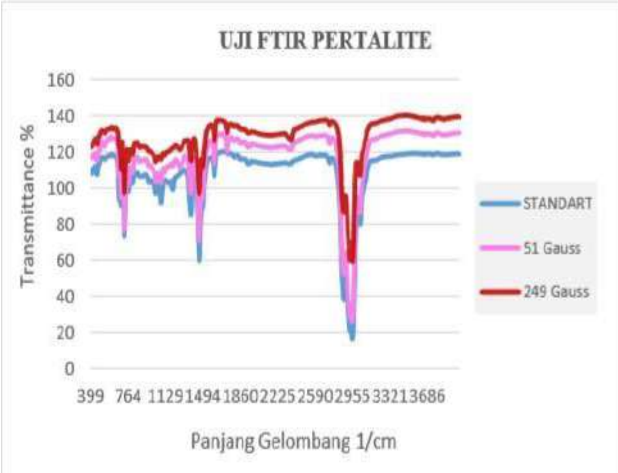

Figure 3 Graph of Test Results FTIR Pertalite

From the graphic representation above, there is a change in the percentage of infrared radiation absorption prices for fuel compounds, this is indicated by the greater the magnetic field strength used, the greater the infrared radiation absorbed by the molecules. So that in Figure 2 shows a significant increase in CH absorption is the emergence of a strong band below 3000 cm^{-1} with alkane compound groups at 2850 cm^{-1} - 2970 cm^{-1} waves. In Figure 3 in detail shows the percentage of absorption (transmittance) CH molecules pertalite fuel at a wavelength of 2850 cm^{-1} - 2970 cm^{-1}, if On average, the percentage of the highest absorption price is given the variation of the magnetic field strength of 249 gauss, which is 77.75% than the standard condition (without magnetization) the absorption price is 33.05%.

This proves that the addition of a larger magnetic field strength can more effectively weaken the energy of molecular bonds by loosening the bonds of hydrocarbon molecules that tend to cluster, so that fuels that experience stretching of bonds in their hydrocarbon molecules have more free space to carry out vibrations in their activities. Under these conditions, when infrared spectroscopy is given, the infrared radiation that is exposed will detect these vibrations and then convert them into a change in the percentage change in the absorption value (*transmittance*) which is increasing.

Results of Testing Fuel Consumption

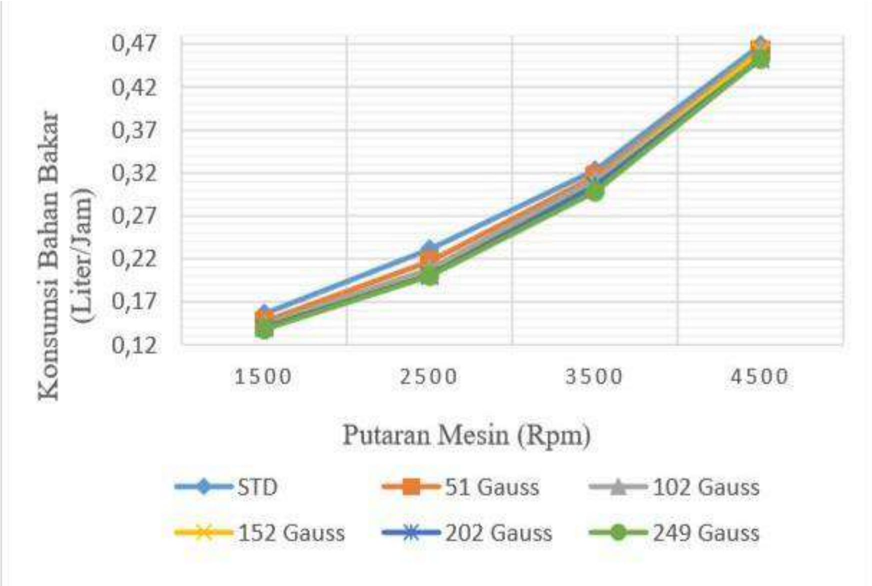

Figure 5 Graph of the Effect of Strong Magnetic Field and Engine Speed on Fuel Consumption

In the graph above, it can be concluded that the higher the engine speed, the more fuel is used. Fuel consumption experienced the highest savings occurred at 2500 rpm rotation with a magnetic field strength of 249 gauss which was 0.2 liters/hour compared to standard conditions of 0.231 liters/hour. This is because at 2500 rpm the fuel flow rate is neither too slow nor too fast, with the addition of a greater magnetic field strength it can be more effective at loosening the bonds of hydrocarbon molecules that tend to cluster, so that the fuel molecules are magnetized effectively

Graph of the Effect of Variations in Magnetic Field Strength and Engine Rotation on O Exhaust Gas

There is a significant decrease in O_2 exhaust gas emissions. The higher the engine speed, the exhaust gas content of O_2 will experience a decrease in value, but the lowest level of exhaust gas O occurs at 3500 rpm with a variation of the magnetic field strength of 249 gauss where the O_2 level is 4.16% compared to the standard condition of 6.75%. and the highest level of exhaust gas O_2 was at 1500 rpm engine speed with a magnetic field strength variation of 249 gauss of 5.61%, much lower than the standard condition of 7.41 %. The occurrence of a decrease in exhaust gas O_2 at each engine speed is caused by the influence of a strong magnetic field which weakens the attractive energy between hydrocarbon molecules, so that when the oxidation process takes place the amount of oxygen

(O_2) captured in hydrocarbon molecules is more ideal. This is why a decrease in O_2 gas levels indicates a better engine combustion compared to standard conditions.

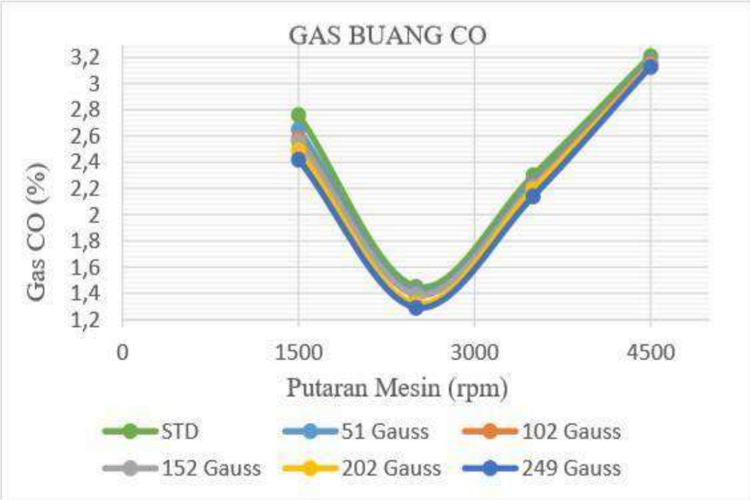

Figure 6 Graph of the Effect of Variations in Magnetic Field Strength and Engine Rotation on CO Exhaust

From the graphic above shows that the standard condition (without magnetization) of CO exhaust gas emissions has increased, namely at 4500 rpm engine speed with CO levels of 3.21% and the lowest levels CO occurs at 2500 rpm engine speed of 1.45%. With the treatment of the magnetic field strength in the fuel flow, the level of CO exhaust gas produced decreased significantly, but the lowest CO exhaust gas content occurred at 2500 rpm engine speed using a magnetic field strength of 249 gauss of 1.29% and exhaust gas levels. The highest CO is at 4500 rpm engine speed using a magnetic field strength of 249 gauss of 3.13%. This can be explained because the giving of the highest variation of the magnetic field strength to the fuel molecules has a greater chance of receiving magnetic field energy. So that resonance occurs which results in an attractive bond condition between unstable hydrocarbon molecules and undergoes bond stretching which allows fast binding of oxygen during oxidation, so that after combustion produces low CO gas levels due to an efficient air and fuel mixture. Lower CO exhaust gas levels indicate better combustion. So that the use of a strong magnetic field can improve the quality of combustion that occurs in the combustion chamber.

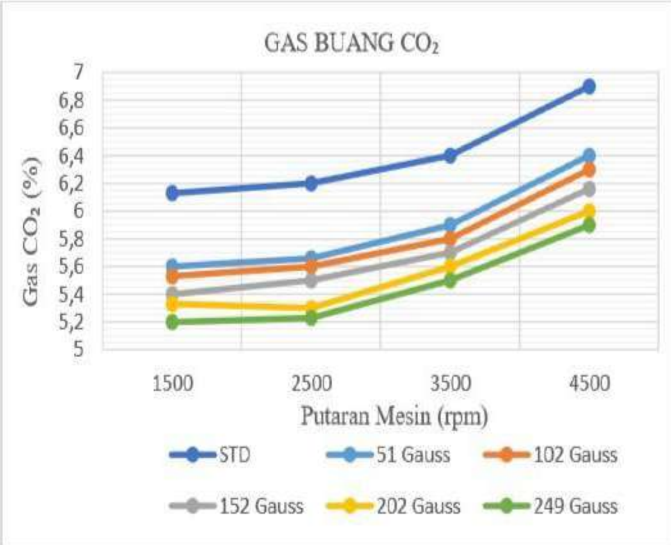

Figure 7 Graph of the Effect of Variations in Magnetic Field Strength and Engine Speed on CO_2 Exhaust

In Figure 7 shows a graph of the relationship between engine speed and carbon dioxide (CO) exhaust gas emissions. At standard conditions at 1500 rpm engine speed has the lowest CO_2 gas content of 6.13% and the highest at 4500 rpm engine speed of 6.9%. The use of variations in field strength makes the level of CO_2 exhaust gas produced gradually decreases, with the lowest CO_2 gas content at the use of a magnetic field strength of 249 gauss at 1500 rpm engine speed of 5.2% and the highest CO_2 exhaust gas content occurring at 4500 rpm rotation of 5.9%, when the average field strength of 249 gauss gives a decrease in the percentage of CO_2 exhaust gas content of 14.84% from standard conditions (without magnetization). The presence of greater use of magnetic energy results in a decrease in the attractive force of attraction for hydrocarbon bonds so that when the fuel oxidation process will bind more oxygen (O_2) and the resulting combustion output is more perfect than the standard conditions.

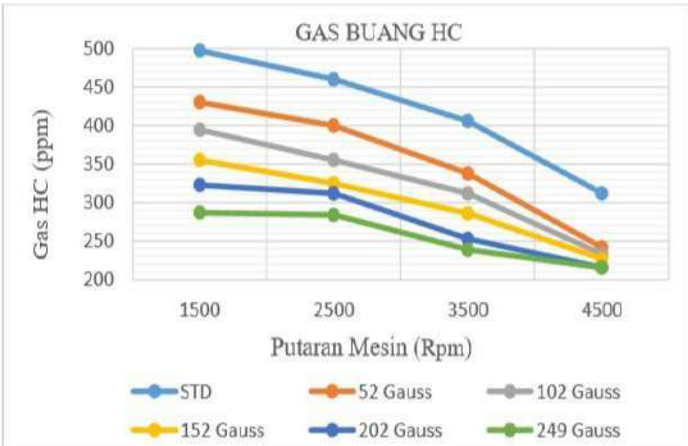

Figure 8 Graph of the Effect of Variations in Magnetic Field Strength and Engine Speed on HC Exhaust

The graphic above shows the relationship between engine speed and hydrocarbon exhaust gas emissions (HC). It can be explained that the higher the engine speed, the lower the HC exhaust gas content, but under standard conditions the highest HC exhaust gas was at 1500 rpm at 497.33 ppm and gradually decreased at 4500 rpm with HC levels at 312 ppm. If the concentration of HC in the flue gas is high, it indicates an incomplete combustion, where the homogeneity of the fuel with oxygen affects the flash point during combustion (burning). When given the influence of variations in the strength of the magnetic field there is a significant decrease in each engine speed. And the highest HC exhaust gas content is 287 ppm at 1500 rpm engine speed using a strong magnetic field of 249 gauss, continuing to 4500 rpm at 215.66 ppm.

At 4500 rpm engine speed the influence of variations in the magnetic field strength on the fuel decreases, this is because the fuel flow rate is faster and the length of time for the fuel to be magnetized is relatively shorter. If the average decrease in the level of HC exhaust gas from standard conditions with variations in the magnetic field strength of 249 gauss is 38.14%, it indicates that the combustion process is getting better, more and more hydrocarbon molecules are capturing the energy of the magnetic field so that the attractiveness becomes weak and when The oxidation process has free space for oxygen elements to react with each other to bind.

CONCLUSSION

From the results of the research that has been carried out, the following conclusions can be drawn: From the FTIR test, it shows an increase in the percentage of the absorption price of the CH molecule pertalite fuel at a wavelength of 2850 cm^{-1} - 2970 cm^{-1}, on average the highest percentage absorption price is in the variation magnetic field strength of 249 gauss which is 77.75% than the standard condition (without magnetization) the absorption price is 33.05 %. The variation of magnetic field strength in the fuel line to reduce fuel consumption has a significant effect. Fuel consumption experienced the highest savings occurred at 2500 rpm with a magnetic field strength of 249 gauss which was 0.2 liters/hour compared to standard conditions of 0.231 liters/hour. The higher the variation of the magnetic field strength used, the more efficient fuel consumption. By providing a variation of the magnetic field strength in the fuel line, there is a significant improvement in exhaust gas emission levels of O_2, CO, CO_2 and HC. The best improvement in exhaust gas levels is by using a variation of the magnetic field strength of 249 gauss. The lowest level of exhaust gas O_2 occurs at 3500 rpm engine rotation with a magnetic field strength variation of 249 gauss, O_2 content of 4.16% and the highest level of exhaust gas O is at 1500 rpm with a variation of magnetic field strength of 249 gauss at 5.61 % much decreased compared to the standard condition of 7.41%. For CO gas levels, the lowest levels occur at 2500 rpm engine speed using a magnetic field strength variation of 249 gauss of 1.29% and the highest level of CO exhaust gas at 4500 rpm with a variation of 249 gauss magnetic field strength of 3.13%. Then the CO_2 exhaust gas content decreased with the lowest level at a magnetic field strength variation of 249 gauss at 1500 rpm engine speed of 5.2% and the highest CO_2 exhaust gas content occurred at 4500 rpm rotation of 5.9%. Then the highest HC exhaust gas content is 287 ppm at 1500 rpm engine speed using a magnetic field strength of 249 gauss, continuing to 4500 rpm rotation with a magnetic field strength variation of 249 gauss at 215.66 ppm.

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