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Activation of Natural Zeolite Mixture and Coal Flyash Using Microwave as Air Filter for the Improvement of Gasoline Four-Stroke Motorcycle Engine Acceleration

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Abstract: Combustion is a chemical process between fuel and oxygen utilizing heat. Ambient air contains a variety of gases such as nitrogen, oxygen, and other gases, causing incomplete combustion in the combustion chamber of a 4-stroke petrol engine. The use of artificial air filters with zeolite-flyash composition activated by microwave can adsorb the air that enters the combustion chamber. So that it can improve the quality of combustion. Zeolite is a mineral that is found in limestone mountainous areas, while coal flyash is material from coal combustion at PLTU. Both of these materials have the ability to adsorb molecular sized particles such as nitrogen, CO and water vapor in the air, so the use of both materials is able to produce air with rich oxygen. The performance of the 4-stroke petrol engine is influenced by a decrease in fuel consumption, able to increase acceleration, and reduce exhaust emissions containing CO and HC. To find out the effect of the use of activated zeolite-flyash filters on engine performance, an acceleration test of 0-60 kph was performed. Filter being activated by Microwave with 80% power, 6 minutes activation time, and density (variation in the number of pellets in the filter) 50%, 75%, 100%, and use the Z0: F100, Z25: F75, Z50: F50, Z75: F25, Z100: F0. The best filter is the composition of Z100:F0 with a compactness of 50% able to increase acceleration by 7.17%, followed by filter with composition of Z25:F75 with a compactness of 50% able to increase acceleration by 4,04%.

Keywords: Zeolites, Coal Flyash, Petrol Engine, Air Filters

1. Introduction

Combustion is a chemical reaction between fuel components (carbon and hydrogen) with air components (oxygen) that takes place very quickly and requires initial heat to produce much greater heat so as to increase the temperature and pressure of combustion gases [6]. Oxygen on earth is most common which amounts to 20.9% of the air, and almost 79% of the air (in the absence of oxygen) is nitrogen, and the rest is other elements. The composition of the air if it enters the combustion chamber, it will have an impact on incomplete combustion so that it reduces the acceleration ability of the motorcycle engine. Efforts that can be made to improve engine performance are to use air filters made

from zeolite and physically activated coal flyash using microwave. The function of this air filter is to filter the air entering the combustion chamber.

Zeolite is a type of rock that has the ability to absorb (adsorbent) CO, CO2, N2 and NO gases. Zeolite is a mineral mining product that is soft and easy to dry. the color of zeolite is grayish white. Zeolites that have been physically activated cause the crystals in the zeolite has been dehydrated, thus increasing the ability of selective adsorbents and have a high effectiveness of absorbing the molecules that are polar (hydrophilic) [1].

Coal flyash is a material that has a fine grain size and is obtained from the combustion of coal [5]. In coal combustion in PLTU, there is solid waste, namely flyash and bottom ash. The main components of coal fly ash from power plants are silica 0%-60% (SiO2), alumina 20%-30% (Al2O3), and iron oxide 4%-10% (Fe2O3), the rest are carbon, calcium, magnesium, and sulfur [4]. Flyash has a fairly high silica and alumina content and low carbon flyash has the ability to absorb water vapor content, so flyash can be used as an adsorbent to capture water vapor in the air and can be equated with zeolite.

Before being used as a motorcycle air filter, zeolite and flyash need to be physically activated to increase their absorption ability using microwave. So that this artificial air filter can produce oxygen-rich air into the combustion chamber. Improving the performance of a 4-stroke gasoline motorcycle engine includes reducing fuel consumption, increasing acceleration, and reducing exhaust gases containing harmful gases. The effect of using a physically activated zeolite and flyash mixture filter on the performance of a 100-cc motorcycle engine can increase acceleration by 15.23% compared to without using a zeolite-flyash filter [2,3].

The purpose of this study was to determine the effect of a physically activated zeolite-flyash filter using microwave and to determine the effect of filter composition and zeolite-flyash pellet density on the acceleration of a 4-stroke gasoline engine motorcycle.

2. Materials and Methods

2.1. Zeolite-Flyash Filter Manufacturing

The materials used to make zeolite-flyash filters include zeolite, flyash, adhesive (tapioca starch), and mineral water. The tools used are mash, sieve with mesh size 100, scales, pan, stove, mould, streaming wire and microwave [3]. Making filters begins with smoothing zeolite and flyash separately, by pounding and then sieving with a size of 100 mesh, as on Figure 1.. Making dough and molding pellets, the composition of the pellet dough is 4% (4 grams) adhesive, 42% (42 grams) mineral water, and 54% (54 grams) zeolite-flyash with the ratio Z100%: F0% Z75%: F25%, Z50%: F50%, Z25%: F75% Z0%: F100%, the total amount is 100 grams per dough. The finished dough was then flattened using ampia to a thickness of 3 mm and printed with a diameter of 10 mm.

Printing the finished pellets, then allowed to stand for 24 hours at room temperature. Activation of zeolite pellets using microwave with 80% power, time variation is 6 minutes. After activation, the pellets were packed using streaming wire. This packaging aims to make it easier to install the pellets on the motorcycle air filter. The pellet packaging container has the same size as the motorcycle air filter used in the study. At the time of packaging, the number of pellets is counted, where the number of pellets when the container is full is 72 grains. This study uses variations in the number of pellets 100% (72 grains), 75% (54 grains), and 50% (36 grains).



Figure 1. Manufacturing process of zeolite-flyash filter

2.2. Vehicle Test

This study uses a Honda Karisma x 125 motorcycle with an engine capacity of 124.9 cc, presented on figure 2.



Figure 2. Test Vehicle

Before testing the test vehicle, periodic tune-ups have been carried out so that at the time of testing the vehicle is in the best performance state, so as to obtain valid test results

2.3. Testing Procedure

Acceleration testing is carried out at a speed of (0-60 Km / J), vehicle acceleration testing aims to find out how much time it takes for the vehicle to stop until it runs to the desired speed (0-60 Km / J) by using an artificial filter (zeolite-flyash coal filter). The path needed for acceleration testing is about 100-150 m. Prepare the artificial fuel tank, fuel, and filter to be used.

The motor engine is warmed up before testing in order to obtain the same engine condition at the time of testing. Installation of filters (standard filter and zeolite-flyash filter). Then restart the motor and position it on the prepared track. When the gas is pulled (from a standstill) turn on the stopwatch, after reaching the desired speed (60 Km/hr) turn off the stopwatch and record the time written on the stopwatch. In each test, the rider must pull the gas regularly and stably. These steps were repeated 3 times for each test of artificial filters with the composition of Z100%:F0% Z75%:F25%, Z50%:F50%, Z25%:F75% Z0%:F100% or not using artificial filters.

In the test, it was found that using an air filter made from zeolite-flyash with a composition of Z100: F0 and a filter density of 50% can increase the acceleration ability of a motorcycle by a percentage of 7.17%, or take an average time of 6.82 seconds (0.53 seconds faster than using a standard motorcycle filter of 7.35 seconds). In the Z25:F75 filter composition with 50% filter density, the average travel time is 7.05 seconds or 4.04% better than the standard filter

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Research manuscripts reporting large datasets that are deposited in a publicly available database should specify where the data have been deposited and provide the relevant accession numbers. If the accession numbers have not yet been obtained at the time of submission, please state that they will be provided during review. They must be provided prior to publication.

Intervention studies which are involving animals or humans, and other studies require ethical approval must list the authority that provided approval and the corresponding ethical approval code.

3. Results and Discussions

Acceleration travel time testing was conducted to determine the effect of physically activated zeolite-flyash composition using microwave, and the effect of zeolite-flyash pellet density on acceleration travel time (0-60 km/h) of a 4-stroke gasoline motorcycle. Figure 3 is the acceleration travel time test data that has been done, see Figure 3.

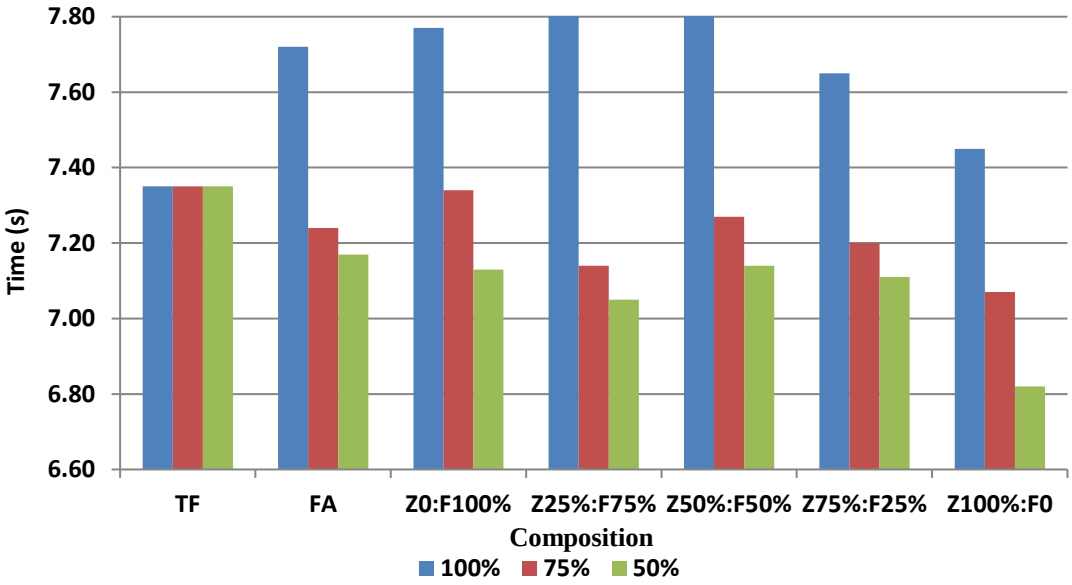


Figure 3. Effect of zeolite-flyash filter density and composition on acceleration travel time.

The use of air filters made from zeolite-flyash has been proven to improve engine performance with acceleration testing. Filter with Z100:F0 composition variation with 50% density becomes the filter with the best acceleration travel time obtaining a record time of 6.82 seconds, the result is 0.53 seconds faster than the test without using the filter (7.35 seconds). The use of the Z25:F75 composition filter can cut the travel time to 7.05 seconds (4.04%) faster than the standard filter [4,5].

This is because the density (number of pellets in the filter) which is tenuous has less air resistance compared to the tight pellet arrangement and the air entering the combustion chamber is rich in oxygen because it is filtered by the zeolite-flyash filter. The use of zeolite-flyash filters is proven to be able to increase vehicle power, because zeolite-flyash filters absorb water vapor, nitrogen and other substances that inhibit combustion. So that the air entering the combustion chamber contains more oxygen, making combustion more perfect, as also presented in other results [6].

4. Conclusions

The zeolite-flyash filter composition has been tested to improve the ability of motorcycles to accelerate. The less the number of pellets (density) in the zeolite-flyash filter, the better the acceleration of the motorcycle. It is proven that the Z100:F0 50% density composition can increase acceleration by 7.17%, followed by a filter with a composition of Z25:F75 50% density increasing acceleration by 4.04%. This results open more potential application of the zeolite-flyash in chemical and automotive industries.

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