The Effect of the use of Silica Sand Before and After Physical Activation on Acceleration of 4-Step Gasoline Motorcycle Engine

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Abstract

This research was conducted with the aim of knowing the Effect of using silica sand before and after physical activation on the acceleration of a 4-stroke gasoline motorcycle engine. This research was conducted by testing the acceleration 0 – 80 km/hour and 40 – 80 km/hour with variations in the composition of tapioca in the pellet mixture (1%, 2%, and 3%) and variations in temperature activation (150°C, 200°). C, and 250°C). The silica sand pellets used in this study were 10 mm in diameter with a thickness of 3 mm, which had been activated for 60 minutes. The results showed that the use of silica sand had an effect on the acceleration of a 4-stroke gasoline motorcycle. The best composition of silica sand pellets occurs in the amount of tapioca 3% and with an activation temperature of 250°C, which can increase the acceleration by 12.45% at an acceleration of 0 – 80 km/hour,

Keywords: silica sand, silica sand pellets, machine performance.

I. INTRODUCTION

The delay in the construction of mass public transportation facilities in major cities in Indonesia and the large number of dealers and financing institutions that provide easy credit for motorcycle ownership is one of the problems with the uncontrolled growth of two-wheeled vehicles in the country. The growth rate of motorcycles in Indonesia is the highest compared to ASEAN countries, which is 13.2% compared to other modes of transportation.

Air pollution arises as a result of sources of pollution, both natural and human activities. Some definitions of physical disturbances such as noise pollution, heat pollution, radiation pollution and light pollution are considered as part of air pollution. Naturally, the air in the Earth'sEarth's atmosphere is a combination of nitrogen gas (78%), oxygen gas (21%), argon gas (about 1%), CO2 (0.0035%) and water vapour [4]. The ambient air sucked in for the combustion process consists of various gases such as nitrogen, oxygen, water vapour, carbon dioxide, carbon monoxide, and other gases. At the same time, the gas needed in the combustion process is oxygen to burn fuel containing carbon and hydrogen molecules [3]. Silica is the name given to a group of minerals consisting of silicon and oxygen. These two elements are the most abundant in the Earth'sEarth's crust. Silica is found generally in crystalline form and rarely in an amorphous state. This is because silica consists of bonds between one silicon atom and two oxygen atoms, the chemical formula of silica is SiO2.

Air filters, in general, can only filter dust or other particles. However, the nitrogen content and other gases in the air also enter the combustion chamber. For this reason, it is necessary to have an air filter that can bind these gases so that the gas that enters the combustion chamber is only oxygen, and the combustion becomes more complete.

Silica sand or quartz sand is one of the abundant natural materials in Indonesia; it is recorded that the total silica sand resource is 18 billion tons.

The demand for silica sand with high purity levels to meet industrial needs is very high. In the industrial world, the use of silica sand is currently quite rapid, such as in the tire industry, rubber, glass, cement, concrete, ceramics, textiles, paper, cosmetics, electronics, paints, films, toothpaste, and others [1].

Physical activation is treating objects using hot media to reduce the water content. The hot media is critical to reducing the water content in the thing. This is because water vapour will evaporate when exposed to heat with a temperature exceeding 100^{o}C (boiling point of water).

In the use of silica sand as a filler material for lightweight concrete bricks, the best composition of lightweight concrete bricks, according to SNI standards is that the composition consists of 26% pearlite, 25% silica sand, 15% pumice stone, 15% Portland cement, 12% quicklime, 5% silica fume, 1% aluminium powder, and 1% foaming agent has a compressive strength of 110.87 kg/cm2, a specific gravity of 1167.73 kg/cm3 and a water absorption capacity of 13.27%. From the above research conducted by nicitrisko, et al. that 25% of the silica content can help water absorption by 13.27% [2].

As explained above, the compound content in silica sand has good absorption of water vapour and can be used as an adsorbent for combustion air to reduce the concentration of water vapour entering the combustion chamber. So the authors observed the Effect of using silica sand pellets before and after being physically activated to increase engine acceleration on a 4-stroke gasoline motorcycle.

II. MATERIALS AND METHODS

2.1 Material Preparation

After the material has been prepared, silica sand, water and tapioca flour are first weighed using a digital scale according to the composition of the concentration specified for each pellet specimen. For the moulding of silica sand pellets utilising a mixture of compositions as in table 1.

Table1. Variation of pellet composition

Variant	Mass Composition(%)		
	Silica sand	Water	Tapioca
1	71	28	1
2	70	28	2
3	69	28	3

2.2 Silica Sand Activation Procedure

The following are the physical activation steps for silica sand pellets, namely:

1. Mixing mineral water with tapioca is cooked for about 5 minutes until the mixture forms like glue.
2. Stir the mixture with silica sand until evenly distributed.
3. Printing silica sand pellets with a diameter of 10 mm wide and 3 mm thick. The resulting silica sand pellets were left at room temperature (naturally) until they silica sand pellets were dry.
4. Packing silica sand pellets with an additional tool in the form of strain wire.
5. Put the packed silica sand pellets into the motorcycle air filter. The mass of silica sand pellets used is 75%. Physical activation of pellets with temperature variations of 150^{o}C, 200^{o}C, and 250^{o}C.

2.3 Testing Procedure

The testing procedure is as follows:

1. Perform routine service (tune up) beforehand so that the motorcycle has a prime condition.
2. Heating the motorcycle engine for 5minute.
3. Performing acceleration testing with a speed of 0-80 km/h.*Stopwatch*starts at the same time as the start of the test.
4. When it reaches a speed of 80 km/h, the stopwatch is stopped and the time taken to reach a speed of 80 km/h is recorded. Then repeat the test up to 3 times.
5. Doing the same test with an acceleration of 40 – 80 km/h.

2.4 Data Collection

This test is carried out to determine the travel time of the motorcycle in reaching a certain speed. In this test, the specified speed is 0-80 km/hour and 40-80 km/hour. Test result data is recordeding the table.

III. RESULTS AND DISCUSSIONS

The acceleration test is divided into testing with a speed of 0 80 km/h and a speed of 40 - 80 km/h.

1. Acceleration 0 – 80 km/hour

After testing with variations in tapioca composition and the same variation in temperature activation, the results are shown in Table 2.

Table 2. Acceleration test results 0 – 80 km/hour

Activation temperature (°C)	Travel Time (Second)		
	1%	2%	3%
Standard	12.91	12.91	12.91
Experience	11.14	11.38	10.99
150°C	10.81	11.45	11.10
200°C	10.86	11.11	11.35
250°C	10.93	11.47	11.08

The test result data is displayed in the form of a graph, as shown in Figure 1, and then the analysis is carried out.

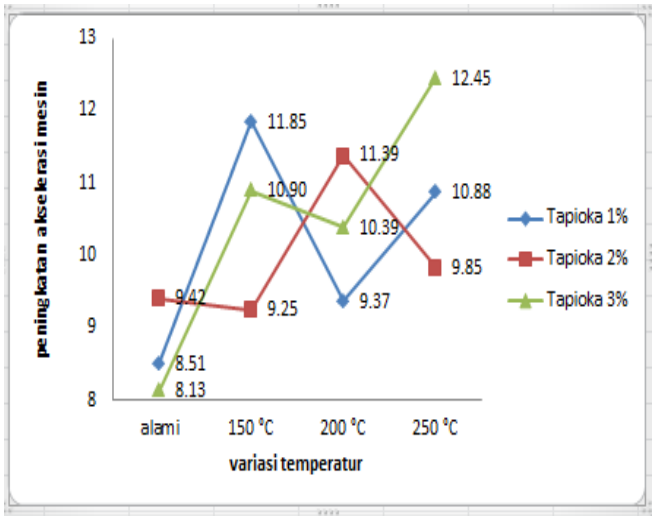

Figure 1. Acceleration test results 0 – 80 km/hour

Improved engine acceleration (on picture1) with an activation temperature of 250oC with 3% tapioca adhesive is the best, with an increase in engine acceleration of 12.45% (2.52 seconds) on the composition of tapioca 3%, 10.88% (2.2 seconds) with 1% tapioca, and 9.85% (1.99 seconds) with 2% tapioca. Meanwhile, at natural temperature activation, the best results were with 2% tapioca adhesive of 9.42 (1.91 seconds); after that, at temperature activation150°C the best results are with 1% tapioca adhesive of 11.85% (2.40 seconds), and at an activation temperature of 200oC the best results are with 2% tapioca adhesive of 11.39 (2.31 seconds).

2. Acceleration 40 – 80 km/hour

Acceleration testing was also carried out at an acceleration of 40 – 80 km/hour, and the results are shown in Table 3.

Activation temperature (°C)	Travel Time (Second)		
	1%	2%	3%
Standard	20.25	20.25	20.25
Experience	18.52	18.34	18.60
150°C	17.85	18.37	18.04
200°C	18.25	17.94	18.14
250°C	18.04	18.25	17.73

Table 3. Acceleration test results 40 – 80 km/hour

The test result data is displayed in the form of a graph, as shown in Figure 2, and then the analysis is carried out.

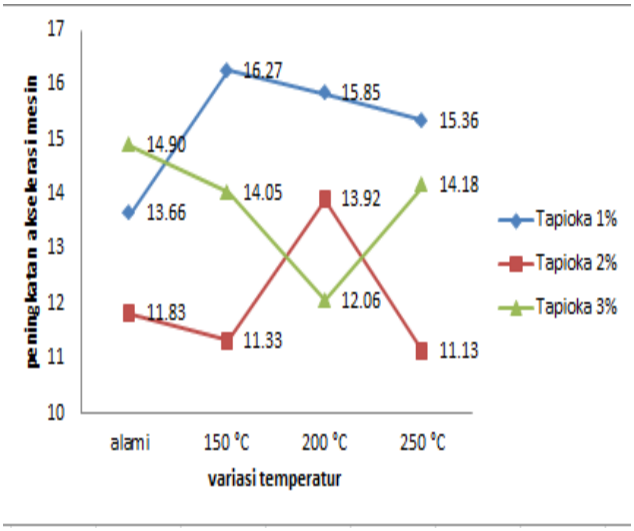

Figure 2. Acceleration test results 40 – 80 km/hour

Different from before (picture1), in the 40 – 80 km/h acceleration test (picture2) the best result is the activation temperature of 150 °C with 1% tapioca adhesive of 16.27 (2.1 seconds). The best results at natural temperature activation with 3% tapioca adhesive were 14.90% (1.92 seconds), while the best results at 200oC activation temperature with 1% tapioca adhesive were 15.85 (2.05 seconds), while the best results at the activation temperature of 250 °C with 1% tapioca adhesive of 15.36% (1.98 seconds).

After testing the acceleration of 0 – 80 km/hour and acceleration of 40 – 80 km/hour, the activated silica sand pellets experienced a significant increase compared to those before activation. This is because

the activated pellet will reduce the water content in the pellet and open small cavities in the pellet. The composition of tapioca also has an effect, namely, the higher the composition of tapioca, the higher the increase in engine acceleration that occurs.

IV. CONCLUSIONS

Based on the test results obtained, some conclusions can be drawn as follows:

1. The more the amount of tapioca adhesive in the pellet composition mixture, the higher the adhesive power of the pellets. However, the higher the activation temperature given to the pellets, the lower the adhesion of the pellets will be.
2. In using silica sand pellets before and after physical activation as air adsorbent, activated silica sand pellets showed a higher increase than before activation.
3. Silica sand pellets can increase engine acceleration by 12.45% (2.52 seconds) at 0 – 80 km/h and 16.27% (2.1 seconds) at 40 – 80 km/h.
4. The highest increase in engine acceleration occurs at 0-80 km/hour acceleration.

V. REFERENCES

[1] Isiqomah. 2013. “Physical Properties and Phases of Silica Sand-MgO-Based Ceramic Composites”. Undergraduate Thesis Journal, Department of Physics, Faculty of Science, Sepuluh November Institute of Technology. Surabaya

[2] Trisko, N and et al. 2013. "Determination of Silica Content from Mining Waste Sand and Utilization of Waste Sand as Filling Material for Concrete Brick". Department of Chemistry, Faculty of Mathematics and Natural Sciences, Padjadjaran University. Jatinangor.

[3] Warden, H. 2004. 4-Step Fuel Motor Learning Module. Department of Mechanical Engineering - Lampung University. Bandar Lampung:

[4] Guerrero, T. 2015. “Causes of Air Pollution”.http://www.ebiologi.com/2015/07/pencemaran-air-pengertian-sebab.html. Accessed on 10 January 2017