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The Effect of Adding Hair Waste on Making Plastic Paving Blocks

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ABSTRACT: *Plastic paving blocks use concrete sand, plastic waste with and hair waste. This study aims to see the effect of adding hair waste to the strength of the product. The method used is an experimental method by conducting several tests on samples made using laboratory equipment. The addition of hair waste in the manufacture of plastic paving blocks shows a lowering effect on the compressive strength of the product. The more hair waste added to the manufacture of plastic paving blocks, the lower the compressive strength value obtained. The downward trend is depicted in the form of a parabola. The correlation between the data formed is very strong with a correlation coefficient value (r) of 0.9895 which means that the relationship or correlation between the addition of hair and the compressive strength of the product has a very strong relationship, with a negative value. The conclusion of this study is that the addition of hair waste in the manufacture of plastic paving blocks has a negative effect.*
KEYWORDS *compressive strength, hair waste, paving blocks.*

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I. INTRODUCTION

Various efforts have been made to overcome the problem of plastic waste which is proven to pollute nature and can disrupt the ecosystem. As reported by several media that animals that accidentally consume them die, for example fish in waters and land animals such as cats, goats and others. Efforts are intensively encouraged is to reuse plastic waste as recycling. Plastic waste can be recycled into the same products as before, and can also be processed into different products.

Previously, it had been tried to use plastic waste to make paving blocks and when the product is commercialized, plastic waste can be reduced significantly [1] and [2]. The results showed that the plastic paving blocks met the quality standards as outlined by SNI. Quality standards used include product strength, product resistance to weather changes (density and absorption) and heat. Another advantage of this product is it looks neater than conventional paving blocks which often crack or break at the corners. Plastic paving blocks have almost the same strength as conventional paving blocks, according to research results [3]. The strength of plastic paving blocks can increase with the addition of plastic up to a certain portion and is proven to be stronger than conventional paving blocks [4].

Beside that plastic waste is difficult to decompose by nature, there is also hair waste that is still not utilized. Hair waste is produced daily from barbershops. As is known, the habit of men in Indonesia are short hair and every month they will cut their hair to maintain neatness. Hair waste in the form of strands in the form of fibers raises the thought of adding it in the manufacture of plastic paving blocks in the hope of increasing product strength such as other fiber properties that are used as additives in the manufacture of construction materials such as research results [5] and [6]. That is the background of this research.

Based on previous tests on plastic paving block products using PET type plastic waste, the resulting quality is D quality in accordance with SNI quality standards. The recommended composition is the use of plastic 60% of the overall weight of the material. By using the job mix, other ingredients are added in the form of hair waste with a length range of 0.5 cm to 2.0 cm. The effect of the addition of hair waste still has to be tested to ensure its suitability as a construction material. The research problem is formulated as follows; how is the effect of adding hair waste on the strength of plastic paving block products.

The original job mix used was in accordance with the results of research from [7] in the manufacture of plastic paving blocks using PET plastic waste and added hair waste, so the purpose of this study was to see the effect of the addition of the hair waste on the strength of the product. If the effect is positive with a marked increase in product strength, then this addition can be recommended. If the addition is negative with a decrease in the compressive strength of the product, it can be ascertained that hair cannot be recommended for the manufacture of construction materials.

II. RESEARCH METHODS

2.1. Research Method

This research was conducted in a workshop for the manufacture of product samples to be tested and a laboratory for sample testing. The method used is an experimental method in which several tests are carried out on samples made using laboratory equipment. Product strength is the focus of research so all samples used must pass a compressive strength test.

The results of the test are reported in written form. The report describes what happened and what was obtained from the trials carried out. The presentation was carried out as what was observed and, in this case, used a descriptive method in reporting the research results.

2.2. Research Equipment and Materials

Plastic paving blocks are made by heating. To heat the materials used, some equipment is needed. Because this research was done manually, the equipment needed was a gas stove, gas cylinder, cauldron, spatula and mold. The mold used is a paving block with dimensions of 8 cm x 10 cm x 20 cm.

The materials used for making the samples consisted of concrete sand imported from Ujung Tanjung, plastic waste from the type of PET (Polyethylene Terephthalate) that had been chopped, hair waste that had been cut into pieces with sizes of 0.5 cm to 2.0 cm and gas as a fuel to mix all the materials used before being put into the mold.

2.3. Jobmix Testing

Jobmix is a reference in making samples. The basic jobmix used is in accordance with the previous study [7], which is 60% plastic and 40% concrete sand. The addition of hair waste in small portions because its function is only as an addition to fill the gaps that are formed. The addition of hair waste is adjusted to the amount of plastic waste used. The test jobmix carried out to make samples are as follows:

Table 1. Paving block sample variations

No	Ingredients Ratio			Number of Sample (pcs)
	Plastic (%)	Sand (%)	Hair (%)	
1	60	40	0	3
2	60	40	5	3
3	60	40	10	3
4	60	40	15	3
5	60	40	20	3

2.4. Method of Conducting Research

The research steps are structured to facilitate the implementation and give effect to work efficiency. The stages of implementing this research are as follows.

2.4.1. Sample making

The work steps in making research samples will be carried out as follows:

- Prepare the workplace.
- Prepare equipment.
- Prepare materials; plastic waste comes from the waste bank at Lancang Kuning University and hair waste comes from a barber shop.
- Weighing of materials according to temporary jobmix.
- Mix the ingredients and heat it on a gas stove with a temperature above 200 ^{o}Cuntil the plastic melts completely.
- After the plastic melts and all the ingredients are well mixed, the mixture is put into the mold
- A few minutes later, ±15 minutes the sample made can be removed from the mold.
- Samples were left at room temperature for 28 days.

2.4.2. Laboratory test

After the sample was 28 days old (treated like a concrete material because it uses one of the ingredients for making concrete) a test was carried out to measure the compressive strength of each sample. The samples were grouped based on the percentage of the use of hair waste as an additive. The compressive strength value indicated on the instrument's manometer is recorded.

2.4.3. Make a research report

The compressive strength values obtained from several samples in each group are sought for the average value achieved. From the assessment of the average compressive strength of each group, it will be seen how the effect of adding hair waste to plastic paving block products will be seen. There are several provisions that must be considered in making paving block samples. The provisions in accordance with the limitation [8] are:

Table 2. Paving block physical strength

Quality	Function	Compressive Strength (MPa)		Average Porosity (%)
		Average	Min	
A	Road pavement	40	35,0	3
B	Car parking lot	20	17,0	6
C	Pedestrian	15	12,5	8
D	City Park	10	8,5	10

The formulations used in the test are:

- Compressive strength test using equation [9] :

$$fc' = \frac{P}{A} \quad (1)$$

III. RESULTS AND DISCUSSION

The composition of plastic waste and concrete sand used was as recommended in previous studies, namely 60% PET plastic waste and 40% concrete sand. With the original jobmix, the strength of the plastic paving blocks produced is of D quality, suitable for use in city parks with an average compressive strength of at least 8.5 MPa. The average strength achieved before the addition of hair waste in this study was 9.18 MPa which confirmed that the previous test had indeed included the product in D quality as outlined by SNI. The maximum strength that can be achieved in the sample before adding additional hair waste is 9.22 MPa and the lowest strength is 9.13 MPa.

Hair waste which is used as an added material is used in small portions, namely 5%, 10%, 15% and 20% of the weight of the plastic waste used. For each percentage, three samples were made for testing the compressive strength of the product. The value of the compressive strength determines the quality of the product because it is related to the strength to withstand the load.

Plastic paving blocks made from added hair waste as much as 5% with 3 samples obtained a compressive strength value of 6.05 MPa; 6.73 MPa and 5.65 MPa. The compressive strength values obtained have a fairly small difference from one another. The value used is the average value of the three samples, which is 6.14 MPa. The average compressive strength of plastic paving blocks with the addition of 5% hair waste is 3.04 MPa, which is lower than plastic paving blocks without the addition of other materials. The obtained compressive strength value of this sample is below the D quality standard of SNI.

The next sample group is plastic paving blocks with an additional 10% of hair waste. After 28 days, the compressive strength was tested, the value was 4.00 MPa; 3.64 MPa; 4.05 MPa. The average compressive strength of this result is 3.90 MPa. Product strength is back down. This fact places the product not in accordance with the standards set by SNI.

Samples of plastic paving blocks added with 15% hair waste still showed a decreasing trend of strength. Although not significantly decreased, only 0.56 MPa. The obtained compressive strength value is 3.28 MPa; 3.15 MPa and 3.60 MPa. The average compressive strength in this composition is 3.34 MPa. This means that the addition of hair waste as much as 15% makes the strength of the plastic paving block decreases and further leaves the standard quality value.

The use of 20% hair waste in a mixture of plastic paving blocks still shows a decrease in product strength. The average compressive strength value obtained is only 1.30 MPa. The compressive strength values obtained for these three samples were very small, some were even under 1.00 MPa, more precisely the compressive strength values obtained from each sample were 1.17 MPa; 0.78 MPa and 1.95 MPa.

The results of the compressive strength tests carried out on five variations of the sample can be seen in Table 3 below.

Table 3. Average compressive strength of paving blocks.

No	Sample Variation Plastic : Sand : Hair (%)	Age (Day)	Average Compressive Strength (MPa)	Quality
1	60 : 40 : 0	28	9,18	D
2	60 : 40 : 5	28	6,14	-
3	60 : 40 : 10	28	3,90	-
4	60 : 40 : 15	28	3,34	-
5	60 : 40 : 20	28	1,30	-

Plastic paving blocks that use PET plastic waste materials with a variation of 60% plastic: 40% concrete sand puts the product at D quality, which can be used for city parks. Some concrete products when added with additional material to fill or as a filler usually the strength of the product can increase, such as the results of research [10] the addition of palm midrib fiber can increase the compressive strength of lightweight bricks or Cellular Lightweight Concrete (CLC). These results did not occur in the addition of hair waste that looks like fiber with fine sheets in the manufacture of plastic paving blocks.

The compressive strength test of plastic paving blocks added with hair waste with a percentage of 5% to 20% of the weight of hair waste showed a decreasing trend of strength. The more additional hair waste used, the smaller the compressive strength value obtained. This is shown in the following graph.

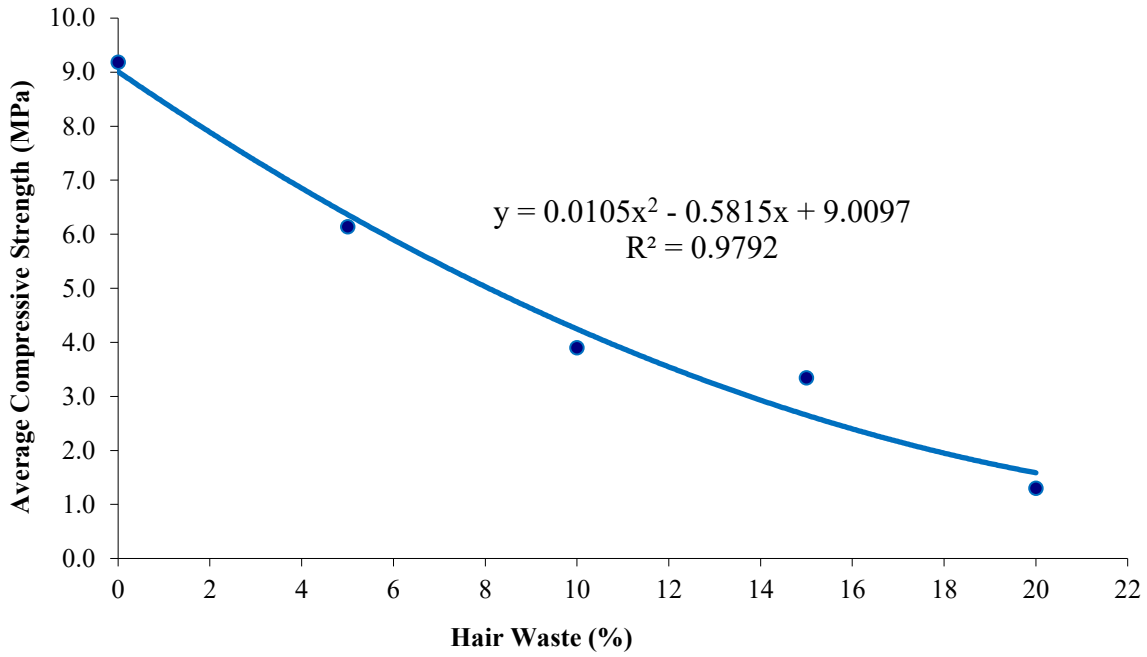

Fig. 1. Graph of the relationship of average compressive strength to hair waste

The addition of hair waste in the manufacture of plastic paving blocks shows a lowering effect on the compressive strength of the product. The more hair waste added to the manufacture of plastic paving blocks, the lower the compressive strength value obtained. The downward trend is depicted in the form of a parabola with the form of a relationship or regression $y = 0.0105x^2 – 0.5815x + 9.0097$. The assessment of the correlation between these variables is in accordance with the criteria that limit the value for each of the following criteria [11]:

- $|0,80 < r < 1,00|$; between variables has a very strong relationship.
- $|0,60 < r < 0,79|$; between variables has a strong relationship.
- $|0,40 < r < 0,59|$; between variables has a sufficient relationship.
- $|0,20 < r < 0,39|$; between variables has a low relationship.
- $|0,00 < r < 0,19|$; between variables has a very low relationship.

The correlation between the data formed is very strong with a correlation coefficient value (r) of 0.9895, which means that the relationship or correlation between the addition of hair and the compressive strength of the

product has a very strong relationship, with a negative value. The negative relationship can be seen from the regression equation obtained, with the intention that if one variable is increased it will cause the other variable to decrease. The value of the determinant (R^2) of 0.9792 means that the decrease in the strength of plastic paving blocks made from 97.92% of added hair waste is indeed caused by the addition of the hair waste. Only slightly, i.e. 2.08% caused by other variables outside the study.

Several studies have shown that the addition of fiber in construction material products made of sand, concrete and cement can increase the compressive strength of the product, such as the results of research [12]. Previous research has also added oil palm midrib fiber to the manufacture of CLC and bricks. The addition of oil palm midrib fiber into the construction material has a positive effect. In certain variations the strength of the material increases beyond the strength of similar conventional materials.

Hair waste strands such as fiber is waste that has not been utilized. As is the local custom that people always straighten their hair, causing hair waste to accumulate in salons or barbershops. Usually, the hair waste is burned which will obviously cause smoke as a form of air pollution. If the hair waste can still be used, it will be better for the environment.

Based on the results of other studies that utilize fiber as an added material to increase the strength of construction materials. It gave rise to the thought of adding hair waste in the manufacture of construction materials. From the results of previous studies that utilize PET type plastic waste in the manufacture of paving blocks. PET plastic waste continues to increase as people switch from drinking tap water to beverages that use packaging made of PET plastic, such as research [13]. To restrain the increasing rate of PET plastic waste [14] has tested and stated that the use of PET plastic and fly ash in the manufacture of paving blocks can increase the strength of the product. This is a concern so Zainuri uses PET plastic in the manufacture of construction materials with heating techniques. With a variation of 60% plastic and 40% concrete sand, the compressive strength value is obtained which is included in the D quality standard according to the provisions of SNI.

The research was continued by adding other ingredients, namely hair to see the effect of adding these ingredients. The variation of hair waste as an additive is small which is intended to fill the pores that are still formed. The additions are 5%, 10%, 15% and 20% of the weight of the plastic waste used. The effect of adding hair waste to the manufacture of PET plastic paving blocks is clearly not as expected. The addition of hair waste actually further reduces the strength of the product. The decrease occurred significantly and there was a very strong relationship, so it cannot be denied that the cause of the decrease in strength was 97.88%. Caused by the addition of hair waste.

The results of this study show that hair waste becomes a nuisance in the manufacture of construction materials, especially in the manufacture of plastic paving blocks whose binding is done by heating or at high temperatures affecting the nature of hair waste by no longer visible hair waste on plastic paving block fragments. The presence of clumping of some hair waste further aggravates the solidity of the material in the formation of the material.

IV. CONCLUSION

The conclusion that can be drawn from this study is that the addition of hair waste in the manufacture of plastic paving blocks has a negative effect with the intention of increasing the addition of hair waste in the mixture of plastic paving block making materials, the strength of the product decreases. Thus, hair is not recommended as an additive but be warned of the waste hair that is scattered in the manufacture of construction materials such as heat-treated plastic paving blocks.

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