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Paving Block Investigation Using Waste Plastic, Used Oil, And Styrofoam with Different Variables

St. Nugroho Kristono[1,*], Muhammad Malik Arifandi[2], Yudi Dermawan[3], Istianto Budhi Rahardja[4], Ahmad Mahfud[5]
[1,2,3,4,5]Plantation Product Processing Technology, Politeknik Kelapa Sawit Citra Widya Edukasi, Bekasi, Indonesia.

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ABSTRACT

Paving block is a composition of building materials made from a mixture of portlandcement or similar hydraulic adhesives, which are components of building materials that are very commonly used. But besides that, the dependence on the use of cement as an adhesive for Paving Blocks is still high. Therefore, the solution taken is to use waste plastic, Styrofoam, and used oil as materials for making Paving Blocks. Based on the results of data processing, it can be concluded that the manufacture of paving blocks using a mixture of plastic, used oil, and styrofoam has several stages, namely the stages of preparing tools and materials, taking and collecting plastic waste, used oil , and styrofoam, heating stages, mixing stages, the printing stage, the release stage and the drying stage, and the laboratory testing stage. This study uses 6 comparisons of mixed materials. The results of the trial of making paving blocks using a good mixture of plastic waste and used oil, namely with a composition of 67%: 33% with an average compressive strength of 63.2 MPa and water absorption capacity of 2.4% entered into quality A used for roads while paving blocks with plastic waste materials, used oil, and styrofoam have the best compressive strength value, which is 26.0 MPa with a composition of 40%:50%:10% and the absorption power obtained is 5.2%. B quality is used for parking lots.

INTRODUCTION*

Concrete is a component of a building material that is very commonly used. The development of technology and the natural situation demands that the construction of buildings be carried out with lightweight materials but does not have an impact on increasing the cost of building construction. Using lightweight materials as construction materials will reduce the total weight of the building, thereby reducing the load carried by the foundation [1-4]. Concrete brick (paving block) or conblock is a composition of building materials made from a mixture of portland cement or similar hydraulic adhesive materials, water and aggregates with or without other additives that do not reduce the quality of the concrete brick itself (SNI 03-0691-1996). But besides that, the dependence on the use of cement as an adhesive in Paving Blocks is still high. It is well known that excessive use of cement can lead to pollution and the reduction of the basic ingredients for cement production, plus the production process is not environmentally friendly [5-8]. Therefore, a solution is needed to reduce the use of cement. The solution taken is to use plastic waste, styrofoam , and used oil as materials for making Paving Blocks. One of the factors that cause environmental damage which is still a big "PR" for the Indonesian people is the factor of disposing of plastic waste, styrofoam, and used oil. The benefits of these wastes are that they can save energy, reduce pollution, reduce land damage and greenhouse gas emissions from the process of making new goods. For this reason, this research will utilize plastic waste and used oil

* Corresponding author.
E-mail address: istianto.rahardja@gmail.com
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waste. The use of plastic waste will later be used as material for making paving blocks, the reason for making plastic waste as the main ingredient is to reduce the generation of plastic waste which can later cause pollution to the environment [9-14].

Based on the background that has been written above, the author is interested in making a final project entitled: "Investigating Paving Blocks Using Plastic Waste, Used Oil, and Styrofoam With Different Variables". The quality of the paving blocks produced from this research is expected to meet the load quality requirements in accordance with SNI 03-0691-1996.

EXPERIMENTAL METHOD

Research Design

The method used in this research is the Conventional Method and laboratory tests: Paving Block Investigation Using Plastic Waste, Used Oil, and Styrofoam with Different Variables carried out by using a gablokan tool with a compaction load that affects the power of the people working on it.

Data Analysis

Experimental data is processed using test data and then displayed in tabular form to make it easier to convey data and draw conclusions.

Research Steps

The stages of research on making paving blocks consist of:

1. The process of making paving blocks

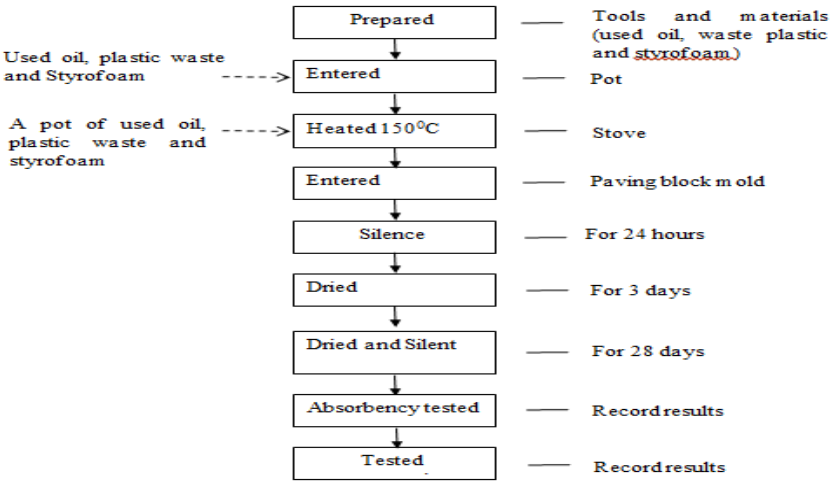

Figure 1. Process flow diagram producing paving blocks

RESULTS AND DISCUSSION

The design used in this study is a design consisting of 2 treatments where each treatment has its own comparison, namely the first treatment 33 %: 67% (495 grams of plastic and 1,005 grams of oil), 50%: 50% (750 grams of plastic and 750 grams of plastic). oil), 67% : 33% (1,005 grams of plastic and 495 grams of oil). Second 50 % : 33% : 17% (750 grams of plastic, 495 grams of oil, and 255 grams of Styrofoam), 40%: 50%: 10% (600 grams of plastic, 750 grams of oil, and 150 grams of Styrofoam), 26%: 67% : 7% (390 grams of plastic, 1,005 grams of oil, and 105 grams of Styrofoam) .

Table 3. Percentage of Material Composition for Paving Block Pembuatan

No	Ingredients (%)		
	Plastic	Used oil	*Styrofoam*
1	33	67	-
2	50	50	-
3	67	33	-
4	50	33	17
5	40	50	10
6	26	67	7

Water Absorption Test

The water absorption test aims to determine how much the *paving is* able to absorb water. Based on SNI 03-0691-1996 water absorption test conducted by way of analyzing the samples dried after soaking, (Then Syamsul., 2016) suggests the immersion of the *paving blocks* are for approximately 24 hours or 3 days. This test will be carried out at the Materials and Construction Laboratory of PT Sofoco, South Jakarta. The water absorption test can be calculated by the equation:

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$$\text{Water Absorption} = \frac{A - B}{B} X\ 100\%$$

Information:
A = weight of wet *paving block*
B = dry *paving block* weight

The results of the observations showed a compressive test and a water absorption test of *paving blocks* . As can be seen from the following table.

Table 4. Water Absorption Test Results for *Paving Blocks* Made from Plastic Waste and Used Oil

Composition of waste plastic and used oil (%)	Wet sample weight (gr)			Dry sample weight (gr)			Percentage of water absorption test (%)			Average percentage of water absorption (%)
	I	II	III	I	II	III	I	II	III	
33 : 67	986	624,2	758,6	924	581,2	717,6	6,7	7,3	5,7	6,5
50 : 50	658,6	771,4	804	618,6	745,4	776	6,4	3,4	3,6	4,4
67 : 33	844	819,6	801,1	819	801,6	782,6	3	2,1	2,3	2,4

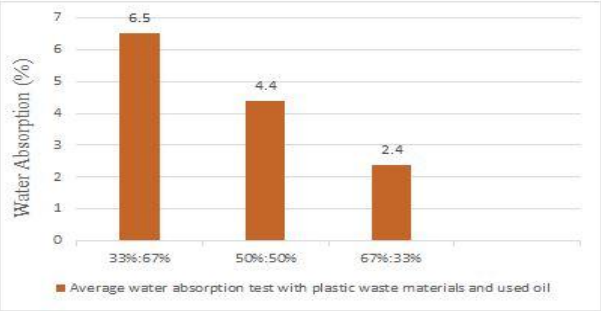

Figure 2 . Graph of average water absorption test with materials waste plastic and used oil

The data shows that in the control treatment with a composition of 33% and 67% of plastic waste used oil obtained average value of water absorption is high at 6 , 5 %. From the results of the average water absorption in the control treatment can be classified into quality C based on SNI 03-0691-1996 and can be used as a pedestrian. While on the other criteria and the treatment of different quality are: treatment of 50% and 50% of plastic waste used oil obtained an average value of 4 , 4 % and into quality B perlataran means can be used for parking. While the ratio of 67% of plastic waste and 33% of used oil is classified as A and can be used for roads because of its water absorption capacity of 2.4%.

Table 5. Water Absorption Test Results for *Paving Blocks* Made from Plastic Waste, Used Oil, and *Styrofoam*

Composition of waste plastic and used oil (%)	Wet sample weight (gr)			Dry sample weight (gr)			Percentage of water absorption test (%)			Average percentage of water absorption (%)
	I	II	III	I	II	III	I	II	III	
50 : 33 : 17	860,8	807	856,2	788,8	745	793,2	9,1	8,3	7,9	8,4
40 : 50 : 10	788,2	745	439,5	746,2	710,8	419,5	5,6	4,8	5,4	5,2
26 : 67 : 7	412,2	720	390	395,2	683	372	4,3	4,7	4,8	4,6

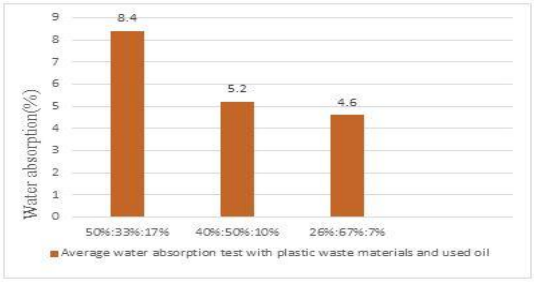

Figure 3. Graph of the average water absorption test with plastic waste , used oil, and *styrofoam*

While in table 5 shows the average water absorption value of *paving blocks* with various waste plastic, used oil, and *styrofoam* materials. For *example*, *paving blocks with a* composition of 50 %: 33%: 17% with an average value of 8.4% water absorption into D quality is used for gardens. *The* next *paving block* with a composition of 40 %: 50: 10% obtained an average value of 5.2% water absorption into quality B used for the parking lot. And *paving blocks* with a composition of 26 %: 67%: 7% obtained an average value of 4.6% water absorption into quality B used for parking lots. Each of these

criteria based on the reference from SNI 03-0691-1996 can be seen in table 7 below which shows the physical properties of paving blocks:

Table 6. Physical properties

Quality	Compressive strength (MPa)		Water absorption Max average (%)
	Average	Min	
A	40	35	3
B	20	17	6
C	15	12.5	8
D	10	8.5	10

Source: National Standardization Body BSN SNI 03-0691-1996

The findings in this study indicate that in each comparison this experiment has a good water absorption value, namely the composition of 33% plastic waste and 67% used oil obtaining an average value of 6.5%, the less use of plastic waste, the more water absorption. good. So from a series of water absorption tests, it can be concluded that the greater the substitution material used in this case is plastic waste, the smaller the percentage of water absorption from *paving blocks* . Meanwhile, *paving blocks* made from plastic waste, used oil, and *styrofoam* obtained a good average water absorption value of 8.4% with a composition of 50% plastic waste, 33% used oil, and 17% *styrofoam.* More and more use of *styrofam* water absorption, the better, because the *styrofoam* can be considered as airspaces. The advantage of using *styrofoam* compared to air voids in hollow concrete is that *styrofoam* has tensile strength, density, or specific gravity with a *styrofoam* mixture that can be adjusted by controlling the amount of *styrofoam* mixture in concrete (*paving blocks*) (Dharmagiri, IB, et al, 2008).

Compressive Strength Test

Compressive strength testing aims to determine how much the *paving is* able to withstand the load. At the age of 28 days. *Paving blocks* show various compressive strength ratios . As can be seen in the following table:

Table 7. Compressive Strength Test Data on *Paving Blocks* With Plastic Waste Materials and Used Oil

Composition of waste plastic and used oil (%)	Dry sample weight (gr)			Compressive strength (kg/cm²)		
	I	II	III	I	II	III
33 : 67	924	581.2	717.6	18.6	40.5	27.5
50 : 50	618.6	745.4	776	18.3	80.2	30.2
67 : 33	819	801.6	782.6	25	96.4	72.7

Table 8. Average Compressive Strength Test on *Paving Blocks* With Plastic Waste Materials and Used Oil

No	Composition of waste plastic and used oil (%)	Average dry weight (gr)	Size(cm)	Average compressive strength (MPa)
1	33 : 67	740.9	19x10x5	28.3
2	50 : 50	713.3	19x10x5	42.0
3	67 : 33	801	19x10x5	63.2

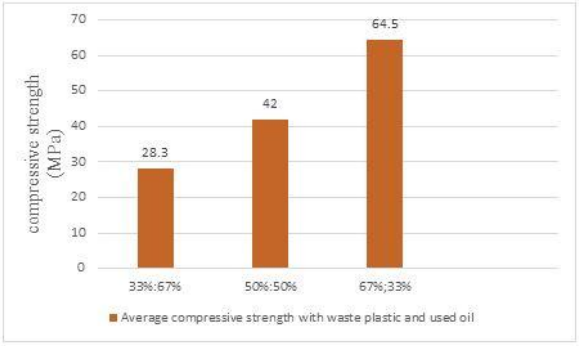

Figure 4. Graph of the average compressive strength test with materials waste plastic and used oil

From the graph above, we can see the results of the compressive strength test on *paving blocks* with a mixture of plastic waste and used oil with 3 varying compositions where each treatment shows different results, as in the *paving block* treatment the composition of 33%: 67% average value Its compressive strength reaches 28.3 MPa, which is classified as B grade, and is used as a parking lot, while *paving blocks* with a composition of 50%: 50% obtained an average compressive strength of 42.0 MPa, which is used as a road, and *paving blocks with a* composition of 67. % : 33% the result is that 63.2 MPa is included in the grade A used as a road. Even without cement in the mixture of *paving blocks*, it does not reduce the compressive strength of the *paving blocks* themselves. Because keep in mind the used

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plastic fibers are *fibers* that have many functions such as:

1. Increase the tensile strength of concrete,
2. Increasing resistance to cracking due to the low tensile strength of concrete will cause the concrete to crack easily. (Syamsul., 2016)

In addition to *paving blocks* made from used oil and plastic, the following are *paving blocks* made from waste plastic, used oil, and *styrofoam*, *which* show various comparisons of compressive strength. As can be seen in the following table:

Table 9. Compressive Strength Test Data on *Paving Blocks* With Plastic Waste Materials, Used Oil, and *Styrofoam*

Composition of used oil, plastic waste, and *styrofoam* (%)	Dry sample weight (gr)			Compressive strength (kg/cm²)		
	I	II	III	I	II	III
50 : 33 : 17	788.8	745	793.2	50.2	18.1	20.3
40 : 50 : 10	746.2	710.8	683	22.7	32.2	25.0
26 : 67 : 7	395.2	419.5	372	10.7	18.7	15.4

Table 10. Average Compressive Strength Test on *Paving Blocks* With Plastic Waste Materials, Used Oil, and *Styrofoam*

No	Composition of used oil, plastic waste, and *styrofoam* (%)	Average dry weight (gr)	Size (cm)	Average compressive strength (MPa)
1	50 : 33 : 17	775.6	19x10x5	28.9
2	40 : 50 : 10	713.3	19x10x5	26.0
3	26 : 67 : 7	395.5	19x10x5	14.6

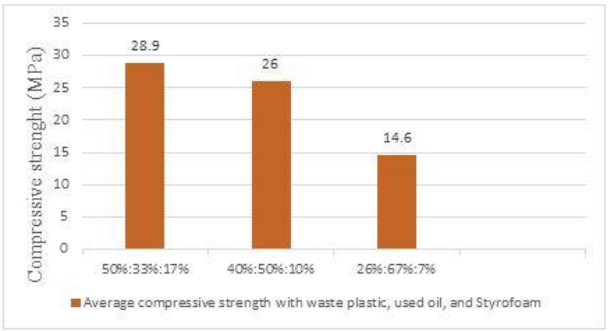

Figure 5. Graph of average compressive strength test with materials plastic waste , used oil, and *styrofoam*

Based on the results of the *paving block* compression test using a mixture of plastic waste, used oil, and *styrofoam* with 3 ratios (50 % : 33% : 17%, 40% : 50% : 10%, and 26% : 67% : 7%). We can see the average compressive strength in each comparison in table 9, from that table we can know the value in each comparison. Where in the sample comparison of 50%: 33%: 17% it reaches a value of 28.9 Mpa which is included in the B quality which can be used for parking lots, the sample ratio of 40%: 50%: 10% reaches 26.0 Mpa and enters the B quality. used for the parking lot, the third ratio is 26%: 67%: 7% the average compressive strength of 14.6 Mpa is included in the grade C which can be used for pedestrians. So it can be concluded that *styrofoam* can reduce the compressive strength of *paving blocks.*

(Pramiati, 2016) stated that *Paving blocks* can be classified based on the value of their compressive strength and water absorption:

1. *Paving block* quality A: used for roads.
2. *Paving block* quality B: used for parking equipment.
3. *Paving block* grade C: for pedestrians.
4. *Paving block* grade D: used for gardens and other uses.

This research has advantages such as being able to be an *alternative* to reduce the amount of plastic waste and used oil as a construction material,

namely *paving blocks* that are environmentally friendly and can be used as paving roads, parks and parking lots. In addition to the advantages, the researcher also realizes that there are still many shortcomings that become obstacles in the progress of making *paving blocks,* one of which is the lack of equipment used by researchers so that it takes quite a long time.

CONCLUSION

It can be concluded that the manufacture of *paving blocks* using a mixture of plastic, used oil, and *styrofoam* has several stages, namely the stages of preparing tools and materials, taking and collecting plastic waste, used oil, and *styrofoam* , heating stages, mixing stages, printing stages, release stages and drying stage, and laboratory testing stage. This study uses 6 comparisons of mixed materials. The average compressive strength produced by *paving blocks* made from plastic waste and used oil is 628.3 MPa, 42.0 MPa, and 63.2 MPa with water absorption capacity of each composition on average 6.5%, 4 .4%, and 2.4%. Meanwhile, *Paving blocks* made from waste plastic, used oil, and *Styrofoam* averaged 28.9 MPa, 26.0 MPa, and 14.6 MPa with water absorption capacity of 8.4%, 5%, respectively. 2%, and 4.6%. %. The results of the trial of making *paving blocks* using a good mixture of plastic waste and used oil, namely with a composition of 67%: 33% with an average compressive strength of 63.2 MPa and water absorption capacity of 2.4% entered into quality A used for roads while *paving blocks* with plastic waste materials, used oil, and *styrofoam* have the best compressive strength value of 26.0 MPa with a composition of 40%:50%:10% and the absorption power obtained is 5.2%.

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