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Comparison Of Compressive Strength And Water Absorption Parameter Characteristics For Paving Blocks Made From Bottom Ash And Plastic Waste

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Abstract. There is a lot of coal ash waste in Indonesia because most power plants in Indonesia still use coal. And Indonesia produces quite a lot of plastic waste because most people use plastic in their daily lives. Plastic waste and bottom ash can be used as raw materials in the manufacture of paving blocks. **Objectives :** The objective of this study is to find out the quality of paving blocks, comply with SNI 03-0691-1996, and find out whether the composition of the bottom ash and plastic waste affects the compressive strength and water absorption. **Method and result :** The paving blocks to be made are 10 cm X 10 cm X s10 cm with 5 (five) different types of composition, each composition will have 2 (two) paving blocks, and the drying time is 14 days. This final project uses experimental methods, and T-test, analysis of variance (ANOVA). T-test testing is carried out on each type of quality, namely the quality of A, B, C, and D. 5 different types of compositions produce different qualities, namely the average compressive strength of composition 1 to 5 in order are, 4.76 MPa, 11.56 MPa, 11.4 MPa, 7.65 Mpa and 10.13 MPa. And for water absorption the average water absorption in composition 1 to 5 in order are, 2.08%, 2.16%, 2.18%, 3.12%, and 4.14% . From the T-Test result, paving blocks with compositions 2,3, and 5 have D quality because their compressive strength has complied with D quality even though the water absorption has met A quality. It means paving with compositions 2,3, and 5 can be used as building materials for the garden. And paving blocks with compositions 1 and 4 have A quality, so people can be used as materials for roads. Based on the ANOVA result, the factors of plastic waste and bottom ash significantly influence the compressive strength and water absorption quality.

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1 Introduction

Indonesia is a country rich in natural resources, and Indonesia is one of the largest coal and gold-producing countries in the world [1]. One of the most widely used natural resources is coal because most of the power plants in Indonesia are steam power plants [2]. In 2018, 52% of power plants in Indonesia were steam power plants, 18% percent gas and steam power plants, 9% hydroelectric power plants, 9% gas power plants, 8% diesel power plants, and 4% oil and gas power plants [3]. The amount of coal used is not small, because the electricity demand is very large, the need for coal is also very large. From the process of burning coal, it will produce coal waste. The remaining results from burning coal will produce around 600-800 million tons per year [4]. This year, the government estimates that as many as 17 million tons of coal ash waste will be produced and in 2050 it is estimated that it will reach 49 million tons [5]. According to (Government Regulation) PP 101 of 2014, coal ash waste produced by PLTU is a hazardous waste because it contains chemical compounds that can harm the environment and humans [6]. However, currently, coal waste is not classified as hazardous waste, this is stated in (Government Regulation) PP 22 of 2021 [7]. Even so, waste from burning coal ash has a very large amount in Indonesia. Furthermore, the waste that has a very large amount is plastic waste.

The volume of plastic waste in Indonesia is increasing, especially with the times that plastic packaging is increasingly being used because it helps humans in daily activities [8]. Plastic waste occupies the second position with the largest volume of waste after organic waste. According to the Ministry of Environment and Forestry, the volume of waste in Indonesia continues to increase from year to year. By 2020 the volume of waste in Indonesia will reach 67.8 tons and plastic waste has a percentage of 16% [9]. Data in 2016, the amount of waste in Indonesia reached 66 million tons. The composition of Indonesian waste is in the form of organic waste (food scraps, leaf twigs) by 57%, plastic waste by 16%, paper waste by 10%, and others (metal, textile fabrics, leather rubber, glass) 17% [10]. Plastic waste and coal waste are wastes that have a very large volume. Plastic is very difficult to decompose and coal waste which is increasing every year needs to be handled properly [11]. There are very few people who care about the environment, most of them just want to make a profit without thinking about the impact that will occur in the future. Plastic waste and bottom ash can be used to become a useful product or item and can generate profits because it can be sold so that many people are interested. This research will utilize plastic waste and bottom ash waste as substitute raw materials in the manufacture of paving blocks. In this case, the type of plastic that will be used is HDPE plastic, because HDPE plastic is stronger, harder, and also more resistant to high temperatures. Plastics have important characteristics that can be used both alone and in composites as construction materials, such as durability, corrosion resistance, good insulators for cold, heat, and sound, energy saving, economy, long life, and lightweight. Bottom ash has been widely used by the community in construction activities because it has a fairly good quality [12]. And In previous research, the use of bottom ash and plastic waste as raw materials in the making of paving blocks was carried out without using sand [13]. By mixing bottom ash and plastic in the making of paving blocks, it is expected to have a positive impact, namely good quality. The use of plastic for construction materials can increase the durability of paving blocks and reduce the density so that the material becomes lighter. In addition, the use of plastic waste is expected to produce building materials at lower prices, reduce the volume of plastic waste and environmental pollution [14]. The objective of this study are to find out the quality of paving blocks, comply with SNI 03-0691-1996 and to find out whether the composition of the bottom ash and plastic waste affects the compressive strength and water absorption.

2 Method

2.1 Experimental Design

There are 5 types of paving block compositions with different percentages of plastic waste and bottom ash with a mixture of cement, sand and water with the same composition in each composition, as shown in **table 1** . The dimensions of the paving block are 10 cm X 10 cm X 10 cm according to Indonesian National Standard [15] [16], with a drying time of 14 days. This experiment uses 2 samples of each composition or duplicate data.

Table 1. Paving Block Composition

Composition	Plastic Waste (%)	Bottom Ash (%)	Cement (%)	Sand (%)	Water (%)
1	0	40	25	25	10
2	10	30	25	25	10
3	20	20	25	25	10
4	30	10	25	25	10
5	40	0	25	25	10

2.2 Experimental Method

Paving block molds are made of GRC board. GRC board has a thickness of about 0.5 cm, so the bottom side must be increased by 0.5 cm on each side to attach the GRC board, shown in **Fig 1**. The size of the paving block to be made is 10 cm X 10 cm x 10 cm. 1 paving block mold can produce 2 paving blocks with the same composition, shown in **Fig 2**. Prepare all the tools and materials that will be needed such as GRC board, acrylic cutter for cutting GRC board, aica aibon glue, ruler and pencil.

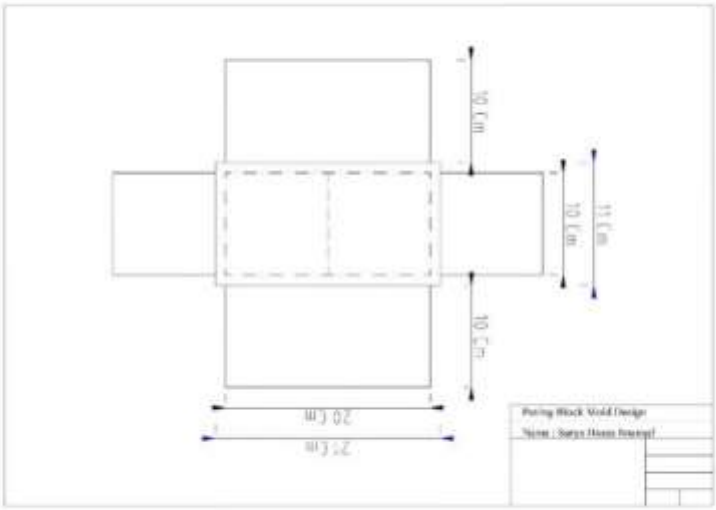

Fig 1. Paving Block Mold Design

Sketch all components of the mold according to the size that has been determined using a pencil and ruler on the GRC board. After that cut out all the mold components using an acrylic cutter and a ruler. After that, smooth the side of the GRC board that has been cut using sandpaper to make it easy to stick with aica aibon glue, as shown in **Fig 2.**

Fig 2. Paving Block Mold Making Process

After making paving block molds, we can make a mixture to make paving blocks according to a predetermined composition. The process of making paving blocks is as follows, as shown in **Fig 3**. The first thing to do is prepare all the materials and tools needed. The tools needed are paving block molds, cement spoons, and sieves. And the materials needed are chopped plastic, bottom ash, cement, sand, and water. Bottom ash must be filtered before use, because bottom ash has a coarse texture and must be filtered first to make it easier to blend with the mixture. Then start the mixing process, mixing the existing materials such as chopped plastic, bottom ash, sand, cement and water according to the composition. After the mixing process, the mixture will be molded in paving blocks and dried for 14 days

Fig 3. Paving Block Making Process

In this experiment, there are 2 parameters to be analyzed, which are compressive strength and water absorption based on SNI 03-0691-1996 [16]. The compressive strength test is carried out to determine the quality of the compressive strength of a paving block, whether the paving block can be used and is in accordance with SNI 03-0691-1996 standards [16]. The paving block to be tested for compressive strength must be in the form of a cube [16]. There are several levels of compressive strength quality of paving blocks, which paving blocks can be used in any field or even cannot be used. The compressive strength test is carried out on the paving block samples using a pressing machine that can be adjusted to the strength of the pressure, the paving blocks will be pressed until the paving blocks are crushed in about 1 until 2 minutes.

And for water absorption analysis, paving blocks will be put in a sodium sulfate solution, the sodium sulfate solution has a specific gravity of about 1.151 to 1.174. Paving blocks will be put into sodium sulfate solution for 16 hours until 18 hours, after that paving block will be removed and drained, then weighed. The next step is the paving block will be dried with a drying machine with a temperature of about 105 degrees Celsius for about 2 hours, after drying it will be weighed and calculatedthe value of water absorption level based on the formula contained in SNI 03-0691-1996 [16]. The water absorption level test is carried out to determine the quality of the water absorption level of a paving block, whether the paving block can be used and is in accordance with Indonesia National standards [16]. There are several levels of water absorption quality of paving blocks, which paving blocks can be used in any field or even cannot be used.

2.3 Data Analysis Method

2.3.1 Analysis of Variance (ANOVA)

This research use ANOVA to analyze the result. Analysis of Variance (ANOVA) was carried out on the observational data, which aims to test whether there are differences between compositions on the experimental parameters, including compressive strength and water absorption. By comparing the F-test with the F-table and the significance level that used in this final project is 5% ($\alpha = 0.05$). The decision rules that must be taken are as follows:

1. If the F-test ≤ F-table value, accepted the null hypothesis and It means the composition means that **are not significantly different**. And it means that the treatment factor does not have a significant influence on the parameters observed

2. If the F-test > F-table value, rejected the null hypothesis and It means there is one or more of the treatment means that are **significantly different**. And it means that different composition factors have a significant influence on the parameters observed.

2.3.2 T-Test

T-test will be used to analyze the experimental laboratory data for compressive strength and water absorption. Laboratory test results will be analyzed to prove that laboratory measurements of paving blokcs quality produced comply the Indonesian National Standard. The null hypothesis for the t-test in this study is that the population mean must be higher than or equal to the minimum parameter standard in the SNI 03-0691-1996, as shown in **Table 2.**

Table 2. Paving Block Quality Standard

Level of Quality	Compressive Strength (Mpa)		Max Average Water Absorption
	Average	Minimum	%
A	40	35	3
B	30	17	6
C	20	12.5	8
D	10	8.5	10

The detail of the hypothesis for compressive strength and water absorption are:

Table 3. Hypothesis Table

Quality		Hypothesis
Compressive Strength	A	H_o : μ compressive strength ≤ 40 Mpa
		H_a : μ compressive strength > 40 Mpa
	B	H_o : μ compressive strength ≤ 30 Mpa
		H_a : μ compressive strength > 30 Mpa
	C	H_o : μ compressive strength ≤ 20 Mpa
		H_a : μ compressive strength > 20 Mpa
	D	H_o : μ compressive strength ≤ 10 Mpa
		H_a : μ compressive strength > 10 Mpa
Water Absorption	A	H_o : μ water absorption ≥ 10 %
		H_a : μ water absorption < 10 %
	B	H_o : μ water absorption ≥ 8 %
		H_a : μ water absorption < 8 %
	C	H_o : μ water absorption ≥ 6 %
		H_a : μ water absorption < 6 %
	D	H_o : μ water absorption ≥ 3 %
		H_a : μ water absorption < 3 %

The test will give a P (T <= t) one-tail value. This P (T <= t) one-tail value must be compared with alpha (α = 0.05). The P (T <= t) one-tail value must be bigger than alpha (α = 0.05) to accept the null hypothesis.

3 Results and Discussion

3.1 Compressive Strength Quality

Paving blocks to be made have standards that have been determined by the government based on SNI 03-0691-1996 [15]. Parameters to be measured are compressive strength and water absorption, and also for the size of the paving blocks as a test object has a standard size based on SK SNI T-04-1990-F [15]. The test is carried out using the duplo method or two repetitions, where each composition 1 to 5 will be repeated and divided into A and B with the same composition. Then the laboratory result will be obtained, as shown in **Table 4.**

Table 4. Paving Block Laboratory Result

Composition	Compressive Strength (Mpa)		Average (Mpa)	Water Absorption (%)		Average (%)
	Trial A	Trial B		Trial A	Trial B	
1	4.32	5.21	4.77	2.06	2.11	2.09
2	13.08	10.05	11.57	2.01	2.32	2.17
3	10.60	12.20	11.40	2.29	2.07	2.18
4	7.47	7.83	7.65	3.13	3.11	3.12
5	10.60	9.67	10.14	4.13	4.15	4.14

3.1.1 Compressive Strength D Quality

P(T<=t) one tail value will be used to check the compressive strength quality have complied with the standard or not, as shown in **Table 5**.

Table 5. T-test Result For Compressive Strength D Quality

Composition	Mean	Variance	t Stat	P(T<=t) One Tail	T Critical one tail
1	4.765	0.39605	-11.76404	0.003574212	2.91998558
2	11.565	4.59045	1.0330033	0.205077408	2.91998558
3	11.4	1.28	1.75	0.111111111	2.91998558
4	7.65	0.0648	-13.055555	0.002907888	2.91998558
5	10.135	0.43245	0.290322581	0.399452324	2.91998558

Table 5. shows the results of the t-test. Based on the results, some one tail P(T<=t) values are higher than alpha (α = 0.05). Therefore, the null hypothesis on compositions 2,3 and 5 is accepted (H_o : μ compressive strength $\leq$ 10 Mpa). Because Ho is accepted, it is proven that the treatment on the compressive strength parameter has complied with D quality. And for compositions 1 and 4 accept the Ha, it means the quality of compositions 1 and 4 is more than 10 Mpa (Ha: μ compressive strength > 10 Mpa)

3.1.2 Compressive Strength C Quality

P(T<=t) one tail value will be used to check the compressive strength quality have complied with the standard or not, as shown in **Table 6**.

Table 6. T-test Result For Compressive Strength C Quality

Composition	Mean	Variance	t Stat	P(T<=t) One Tail	T Critical one tail
1	4.765	0.39605	-34.235955	0.000426039	2.91998558
2	11.565	4.59045	-5.56765677	0.015388883	2.91998558
3	11.4	1.28	-10.75	0.004271301	2.91998558
4	7.65	0.0648	-68.6111111	0.00010618	2.91998558
5	10.135	0.43245	-21.2150537	0.001107229	2.91998558

Table 6. shows the results of the t-test. Based on the results, all of one tail P(T<=t) values are smaller than alpha ($\alpha = 0.05$). Therefore the null hypothesis is rejected, it means the compressive strength quality for all compositions is more than 20 Mpa (Ha: μ compressive strength > 20 Mpa).

3.1.3 Compressive Strength B Quality

P(T<=t) one tail value will be used to check the compressive strength quality have complied with the standard or not, as shown in **Table 7.**

Table 7. T-test Result For Compressive Strength B Quality

Composition	Mean	Variance	t Stat	P(T<=t) One Tail	T Critical one tail
1	4.765	0.39605	-56.707865	0.000155411	2.91998558
2	11.565	4.59045	-12.1683168	0.003343	2.91998558
3	11.4	1.28	-23.25	0.000922404	2.91998558
4	7.65	0.0648	-124.166666	3.24278E-05	2.91998558
5	10.135	0.43245	-42.7204301	0.000273742	2.91998558

Table 7. shows the results of the t-test. Based on the results, all of one tail P(T<=t) values are smaller than alpha ($\alpha = 0.05$). Therefore the null hypothesis is rejected, it means the compressive strength quality for all compositions is more than 30 Mpa (Ha: compressive strength > 30 Mpa).

3.1.4 Compressive Strength A Quality

P(T<=t) one tail value will be used to check the compressive strength quality have complied with the standard or not, as shown in **Table 8.**

Table 8. T-test Result For Compressive Strength A Quality

Composition	Mean	Variance	t Stat	P(T<=t) One Tail	T Critical one tail
1	4.765	0.39605	-79.179775	7.97329E-05	2.91998558
2	11.565	4.59045	-18.7689769	0.001413333	2.91998558
3	11.4	1.28	-35.75	0.000390759	2.91998558
4	7.65	0.0648	-179.722222	1.54791E-05	2.91998558
5	10.135	0.43245	-64.2258064	0.000121169	2.91998558

Table 8. shows the results of the t-test. Based on the results, all of one tail P(T<=t) values are smaller than alpha ($\alpha = 0.05$). Therefore the null hypothesis is rejected, it means the compressive strength quality for all compositions is more than 40 Mpa (Ha: µ compressive strength > 40 Mpa)

From all compositions, the result was continued with the ANOVA test to see whether there are any statistically significant differences between the means of independent groups.

Table 9. Anova Table For Compressive Strength

Source of Variation	SS	df	MS	F-test	P-value	F-table
Plastic Waste	13.3329	4	3.33321	12.32014	1.139E-05	2.75871
Bottom Ash	13.3329	4	3.33321	12.32014	1.139E-05	2.75871
Interaction	702.915	16	43.9322	162.3811	3.232E-21	2.75871

The ANOVA test in **Table 9**. shows the results of the F test and F table of each compositions. All of the F test's value more than the F table's value at the significance level of 5% ($\alpha = 0.05$). Therefore, the decision taken is to reject Ho, which is said to be one or more of the treatment means that are significantly different. It means that there are differences between the composition that influences the compressive strength results.

3.2 Water Absorption Result

3.2.1 Water Absorption D Quality

P(T<=t) one tail value will be used to check the compressive strength quality have complied with the standard or not, as shown in **Table 10**.

Table 10. T-test Result For Water Absorption D Quality

Composition	Mean	Variance	t Stat	P(T<=t) One Tail	T Critical one tail
1	2.085	0.00125	-316.6	4.98818E-06	2.91998558
2	2.165	0.04805	-50.5483871	0.000195569	2.91998558
3	2.18	0.0242	-71.090909	9.8038E-05	2.91998558
4	3.12	0.0002	-688	1.05631E-06	2.91998558
5	4.14	0.0002	-586	1.45604E-06	2.91998558

Table 10. shows the results of the t-test. Based on the results, all of one tail P(T<=t) values are smaller than alpha (α = 0.05). Therefore the null hypothesis is rejected, it means the water absorption quality for all compositions is less than 10% (H_a : µ compressive strength < 10 %).

3.2.2 Water Absorption C Quality

P(T<=t) one tail value will be used to check the compressive strength quality have complied with the standard or not, as shown in **Table 11**.

Table 11. T-test Result For Water Absorption C Quality

Composition	Mean	Variance	t Stat	P(T<=t) One Tail	T Critical one tail
1	2.085	0.00125	-236.6	8.93159E-06	2.91998558
2	2.165	0.04805	-37.6451612	0.000352446	2.91998558
3	2.18	0.0242	-52.9090909	0.000178516	2.91998558
4	3.12	0.0002	-488	2.09956E-06	2.91998558
5	4.14	0.0002	-386	3.35576E-06	2.91998558

Table 11. shows the results of the t-test. Based on the results, all of one tail P(T<=t) values are smaller than alpha (α = 0.05). Therefore the null hypothesis is rejected, it

means the water absorption quality for all compositions is less than 8% (H_a : µ compressive strength < 8 %).

3.2.3 Water Absorption B Quality

P(T<=t) one tail value will be used to check the compressive strength quality have complied with the standard or not, as shown in **Table 12.**

Table 12. T-test Result For Water Absorption B Quality

Composition	Mean	Variance	t Stat	P(T<=t) One Tail	T Critical one tail
1	2.085	0.00125	-56.707865	0.000155411	2.91998558
2	2.165	0.04805	-12.1683168	0.003343	2.91998558
3	2.18	0.0242	-23.25	0.000922404	2.91998558
4	3.12	0.0002	-124.166666	3.24278E-05	2.91998558
5	4.14	0.0002	-42.7204301	0.000273742	2.91998558

Table 12. shows the results of the t-test. Based on the results, all of one tail P(T<=t) values are smaller than alpha (α = 0.05). Therefore the null hypothesis is rejected, it means the water absorption quality for all compositions is less than 6% (H_a : µ compressive strength < 6 %).

3.2.4 Water Absorption A Quality

P(T<=t) one tail value will be used to check the compressive strength quality have complied with the standard or not, as shown in **Table 13.**

Table 13. T-test Result For Water Absorption A Quality

Composition	Mean	Variance	t Stat	P(T<=t) One Tail	T Critical one tail
1	2.085	0.00125	-36.6	0.000372839	2.91998558
2	2.165	0.04805	-5.38709677	0.016386737	2.91998558
3	2.18	0.0242	-7.45454545	0.008761811	2.91998558
4	3.12	0.0002	12	0.003436467	2.91998558
5	4.14	0.0002	144	3.84689E-05	2.91998558

Table 13. shows the results of the t-test. Based on the results, all of one tail P(T<=t) values are smaller than alpha (α = 0.05). Therefore the null hypothesis is rejected, it

means the water absorption quality for all compositions is less than 3% (H_a : μ compressive strength < 3 %).

From all compositions, the result was continued with the ANOVA test to see whether there are any statistically significant differences between the means of independent groups.

Table 14. Anova Table For Water Absorption

Source of Variation	SS	Df	MS	F-test	P-value	F-table
Plastic Waste	1.271052	4	0.317763	107.4976	2.27E-15	2.75871
Bottom Ash	1.271052	4	0.317763	107.4976	2.27E-15	2.75871
Interaction	63.78631	16	3.986644	1348.662	1.22E-32	2.069088

The ANOVA test in **Table 14**. shows the results of the F test and F table of each composition. All of the F test's value more than the F table's value at the significance level of 5% (α = 0.05). Therefore, the decision taken is to reject Ho, which is said to be one or more of the treatments means that are significantly different. It means that there are differences between the composition that influences the water absorption results.

In compressive strength analysis, paving block with compositions 2,3 and 5 accept the Ho (Ho : μ compressive strength ≤ 10 Mpa). it is proven that the treatment on the compressive strength parameter has complied with compressive strength D quality. In water absorption analysis, paving block with compositions 2,3 and 5 accept the Ha in all type of water absorption quality. It is proven that the treatment on the compressive strength parameter has complied with water absorption A quality. Paving blocks with compositions 2,3 and 5 have D quality because their compressive strength has complied D quality even though the water absorption has met A quality. It means paving with composition 2,3, and 5 can be used as building materials for garden.

In compressive strength analysis, paving block with compositions 1 and 4 reject the Ho and accept the Ha in all type of compressive strength quality. It means that the treatment on the compressive strength parameter has complied with compressive \strength A quality. In water absorption analysis, paving block with compositions 1 and 4 reject the Ho but accept the Ha in all type of water absorption quality. It means that the treatment on the compressive strength parameter has complied with water absorption A quality, it means can be used as materials for roads.

Based on the ANOVA result, the factors of plastic waste and bottom ash significantly influence the compressive strength and water absorption quality. All of the F test's values are more than the F table's value at the significance level of 5% (α = 0.05). Which is said to be one or more of the treatment means that are significantly different. It means that there are differences between the composition that influences the compressive strength and water absorption results.

The composition of plastic waste and bottom ash affects the quality of paving blocks. Bottom ash has a physical appearance similar to sand and can be regarded as an alternative material to replace sand [17]. Several studies have been done previously that can be used as a reference in this study. This study has differences from previous studies, namely differences in the type of waste used and the composition of the waste used as raw material for making paving blocks. These are some of the results of the quality of paving blocks that use bottom ash and plastic waste as raw materials, as shown in **Table 15** :

Table 15. Paving Blocks Quality In Previous Studies

Resources	Composition	Drying Time	Compressive Strength (Mpa)	Water Absorption (%)
	1.5 Bottom Ash : 2 Polyethylene	5 Days	9.9	5.66
		7 Days	12.99	5.66

Resources	Composition	Drying Time	Compressive Strength (Mpa)	Water Absorption (%)
R. Fadhilatul and T.Sulistyaningsih, 2020 [13]	1.5 Bottom Ash : 2 Polyethylene	14 Days	20.28	1.68
		28 Days	25.63	0.53
	1 Bottom Ash : 2 Polyethylene : 0.5 sand	5 Days	10.82	3.66
		7 Days	13.6	1.23
		14 Days	21.58	1.4
		28 Days	26.63	0.56
B. Indrawijaya, A. Wibisana, A. D. Setyowati, D. Iswadi, D. P. Naufal, and D. Pratiwi, 2019 [14]	1 Cement : 1.5 Sand : 3 Gravel : 0.25 Water	28 Days	23.68	
	(1 Cement : 1.5 Sand : 3 Gravel : 0.25 Water) + 10 % of LDPE		23.98	
	(1 Cement : 1.5 Sand : 3 Gravel : 0.25 Water) + 20 % of LDPE		18.21	Not Discussed
	(1 Cement : 1.5 Sand : 3 Gravel : 0.25 Water) + 30 % of LDPE		7.58	
	(1 Cement : 1.5 Sand : 3 Gravel : 0.25 Water) + 40 % of LDPE		5.23	
	(1 Cement : 1.5 Sand : 3 Gravel : 0.25 Water) + 50 % of LDPE		5.99	
Sudarno and M. Qomaruddin, 2017 [18]	1 Cement : 8 Sand : 0 Bottom Ash : 1 Chalk	28 Days	16.714	Not Discussed
	1 Cement : 7 Sand : 1 Bottom Ash : 1 Chalk		13.071	
	1 Cement : 6 Sand : 2 Bottom Ash : 1 Chalk		15.642	
	1 Cement : 5 Sand : 3 Bottom Ash : 1 Chalk		10.928	

	1 Cement : 4 Sand : 4 Bottom Ash : 1 Chalk		14.5	

4 Conclusions

According to the T-Test results, paving blocks with compositions 2,3, and 5 have D quality because their compressive strength has complied with D quality even though the water absorption has met A quality. It means paving with compositions 2,3, and 5 can be used as building materials for the garden. And paving blocks with compositions 1 and 4 have A quality, It means can be used as materials for roads. And based on the ANOVA result, the factors of plastic waste and bottom ash significantly influence the compressive strength and water absorption quality. All of the F test's values are more than the F table's value at the significance level of 5% (α

$= 0.05$). Which is said to be one or more of the treatment means that are significantly different. It signifies that there are differences in composition that have an impact on compressive strength and water absorption.

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