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Utilisation Of Clamshells As Aggregate Substitute In Paving Blocks

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ABSTRACT

Paving blocks are becoming more popular among consumers because they are environmentally friendly, can save groundwater, are easy to install and maintain, and have many shapes that add aesthetic value. This study aims to determine the difference of shells on the water absorption capacity of paving blocks and the strength of paving blocks. Experiments were conducted at the structure and materials laboratory of Muhammadiyah University of Parepare from August to October 2023 for this research method. The results showed that the water absorption of paving blocks was influenced by the addition of seashells. The water absorption values of the 0%, 5%, 10%, and 25% variations were 1.4 percent, 2 percent, 3.4 percent, and 3.7 percent for the 7-day treatment period; 0.6 percent, 1.7 percent, 2.4 percent, and 3.3 percent for the 14-day treatment period; and 1.3%, 2.8 percent, 3.0 percent, and 4.6 percent for the 28-day treatment period. According to the above results, the more clamshells added, the greater the water absorption. The compressive strength shows that the addition of clamshells affects the compressive strength of block paving. The compressive strength values were 23.841 Mpa, 9.365 Mpa, 21.587 Mpa, and 11.429 Mpa at the 28-day curing age, respectively. The more clamshells added, the lower the compressive strength.

Keywords: *Compressive Strength; Clamshell; Stone Ash*

INTRODUCTION

Paving block is one of the building materials used as the top layer of road structures other than asphalt and concrete. Nowadays, many people choose paving blocks over other pavements such as cast concrete or asphalt (Badan Standarisasi Nasional, 1996). The utilisation of shell waste is lacking, as it is only used as decoration, animal feed and cosmetics. Meanwhile, the presence of shells is increasingly disturbing the environment of the fishing village and damaging the beauty of the beach . (Budiarini, 2004). If waste is disposed of continuously without maximum treatment, it can cause a disturbance of balance, thereby causing the environment not to function in the sense of health, welfare, and biological safety.

Clamshell waste is a powder produced from grinding crushed clamshells, this powder can be used as a mixture or addition to the manufacture of concrete (Kusuma et al., 2012). The addition of homogency clamshell powder will make the mixture more reactive. Clamshell powder contains pozzolanic chemical compounds containing lime (CaO), alumina and silica compounds that are suitable for use as concrete raw materials (Siregar et al., 2009). Most of the fishermen's yards near the coast are almost covered with shell waste, therefore, to minimise the shell waste that is produced every day, in this study the shells will be used as an aggregate mixture (substitution) with some sand in the manufacture of paving blocks (concrete bricks) (Anggiani, 2022).

Based on research by Siregar (2009), clamshells contain pozzolanic chemical compounds containing lime (CaO), alumina and silica compounds that are suitable for use as a cement reducing agent. The advantages of clamshells can be utilised to make clamshells as raw material for making paving blocks. Clamshell waste is abundant in the Pecemengan area because people dispose of clamshell waste carelessly. By utilising this waste, it is expected to reduce the amount of waste and get alternative materials that can reduce the use of cement in making paving blocks (Ulfiyanti et al., 2019).

The advantages of paving blocks have led to the increasing use of paving blocks in construction projects. The increasing demand for paving block materials has led to innovations in material engineering to improve the quality of paving blocks. Concrete is the main material for construction that is widely used throughout the world. The more widespread use of concrete indicates also the more demand for concrete in the future. The development of the times in this era of rapid globalisation has resulted in an increasing amount of used goods/waste whose existence can be a problem for life, one of which is the existence of shell waste. For this reason, many things have been done in order to recycle in order to overcome the problem of the existence of this waste. One of them is the use of clamshell ash. In this study, shell ash was used as a substitute for cement by weight in the mix variation and compared with the use of lime as a substitute for cement to determine the value of compressive strength and split tensile strength that is better and expected to improve the quality of concrete (Rezeki, 2013). The addition of clamshell powder waste material is one method to improve the quality of paving blocks and reduce production costs.

Recently, the use of materials is very high, accompanied by the rapid development of development in Indonesia. One example is the use of paving blocks that we can see in various places. So in this study, the authors utilised clam shell waste as a substitute for fine aggregate in paving blocks. The purpose of this research is to analyse the use of clamshells on the water absorption of paving blocks, as well as the analysis of mechanical properties with the addition of clamshells affecting the compressive strength of paving blocks.

METHOD

1. Type of Research

This research method uses experimental research methods, namely by comparing between 4 mixture variations to find out how the compressive strength and water absorption of paving blocks. This research was conducted in the Civil Engineering laboratory of the Faculty of Engineering, Muhammadiyah University of Parepare. As for some of the materials used during the research, namely: Aggregate, Cement, Water, Shell Waste. This research focuses on variations in the mixture of shell waste that will be used as a substitute for some fine aggregates. The number of samples required in each variation is Normal paving block, paving block + 5% clamshell, paving block + 10% clamshell, paving block + 25% clamshell.

2. Data Analysis Methods

The data analysis method used in this study uses descriptive parametric analysis. Data from the concrete compressive strength test results obtained from the division between the maximum load of the test specimen and the cross-sectional area of the test specimen, presented in the form of tables and graphs. The steps taken are:

- Weigh the weight of the test specimen before measuring the compressive strength.
- Dimension measure and calculate the volume and surface area of test specimens

- Test the compressive strength of the specimens at the age of 7 & 28 days with a UTM tool
- Analyses the data of test specimen testing results
- Discussion of the characteristics of the test specimens according to the data analysis of the test results

3. Flowchart of Research

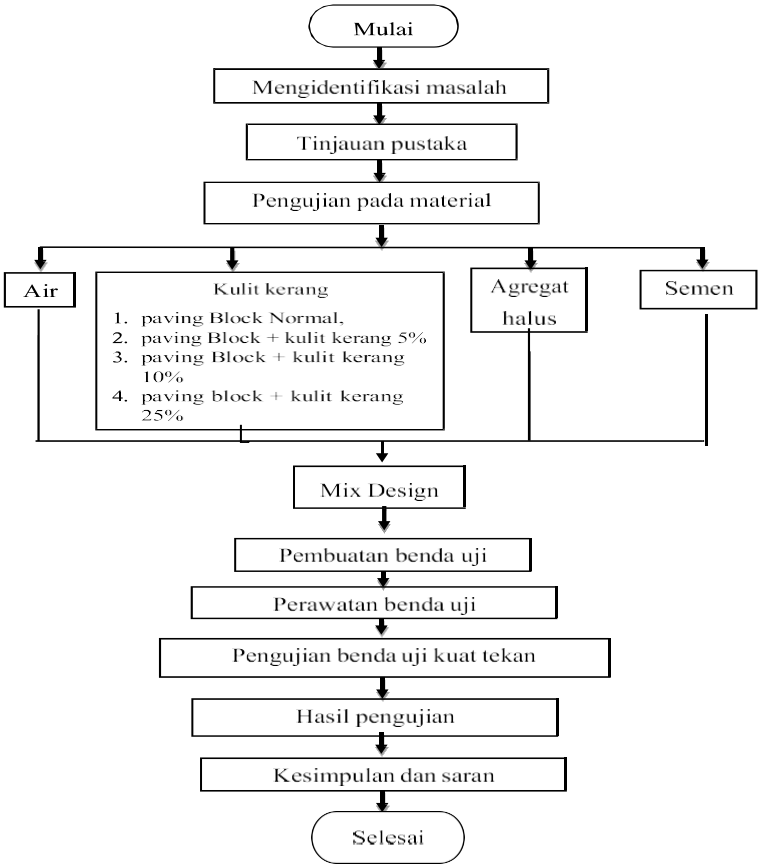

Figure 1: Flowchart of the research

RESULTS AND DISCUSSION

1. Characteristics Aggregate

Testing of aggregates based on (ASTM C33/C33M-18) and SNI (Indonesian National Standard) was carried out on fine aggregates and shell

Table 1. Test results of fine aggregates

No.	Characteristics Aggregate	Eligibility	Results
1	Sludge content	Maks 5%	2.30%
2	Organic content	< No. 3	1
3	Water content	2% - 5%	2.25%
4	Weight of loose volume	1,4 - 1,9 kg/liter	1.44
5	Weight of solid volume	1,4 - 1,9 kg/liter	1.61
6	Absorption	0,2% - 2%	1.63%
7	Specific gravity	1,6 - 3,3	3.09
8	Fineness modulus	1,50 - 3,80	3.77

2. Paving block mix design

Concrete mix planning is calculated using the (Badan Standar Nasional Sni 7656:2012, 2012) method.as shown in table 2.

Table 2. Mixture Requirement of Each percentage for 1 m3 Paving block

Materials	BN	Percentage of shells		
		5%	10%	25%
W cement	2.15	2.15	2.15	2.15
W Stone dust	5.87	5.58	5.29	4.41
W Clam shells	0	0.23	0.47	1.16
W water	0.75	0.75	0.75	0.75

Figure 2. Concrete mix planning

2. Absorption Test

Figure 2 shows the results of the study, the average absorption (ASTM D570) and SNI (Indonesian National Standard) of paving blocks aged 7, 14, 28 days obtained in testing normal variations, 0%, 5%, 10%, and 25% of shells.

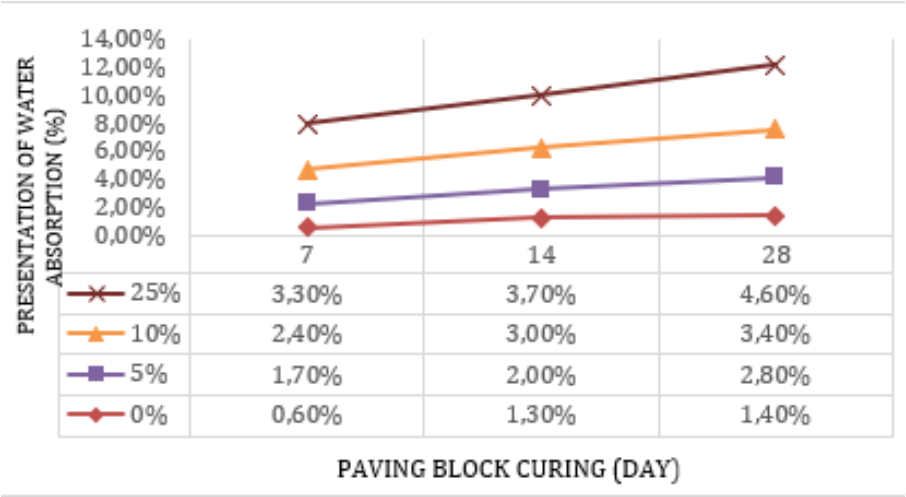

Figure 3. Relationship of water absorption to duration of paving block curing da Figure 3, shows a recapitulation of the combined water absorption of paving blocks above, it can be seen that the lowest absorption value is obtained from a percentage of 0% at 1.40%, while the highest is found at a percentage of 25% with a curing period of 28 days, which is 4.60%. The results of testing the water absorption of 21x10x8 cm paving blocks also show that the addition of seashells affects the absorption of paving blocks with percentages of 0%, 5%, 10% and 25% having water absorption values of 1.4%,
2.0%, 3.4%, and 3.7% for a 7-day curing period, 0.6%, 1.7%,
2.4%, and 3.30% for a14-day curing period, 1.3%, 2.8%, 3.0%, and 4.60% for a28-day curing period.

3. Compressive Strength

Figure 3, shows the results of compressive strength testing on normal paving blocks and clam shell percentage paving blocks with a curing age of 7, 14 and 28 days.

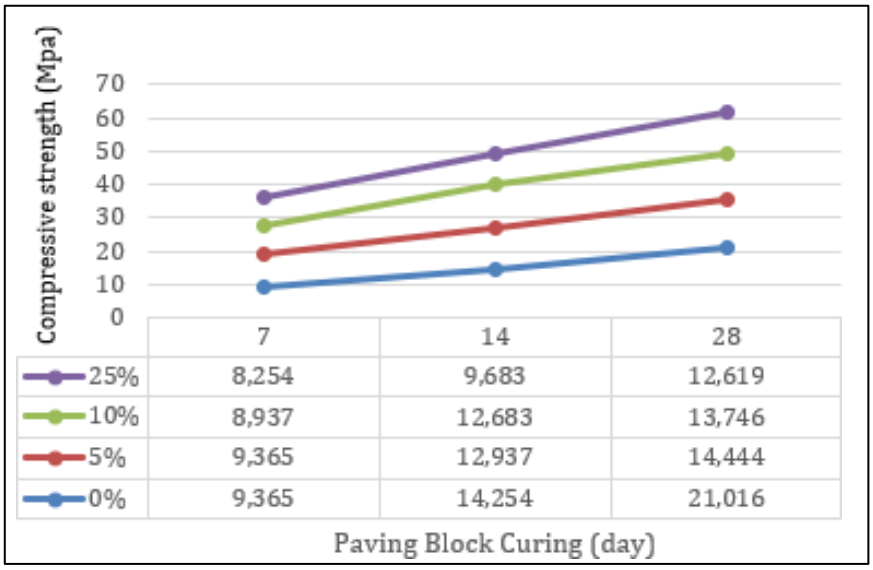

Figure 4: Relationship between compressive strength and curing days of paving blocks

Figure 5: Testing process of compressive strength of paving blocks

Figure 4, shows is the compressive strength of 21x10x8 cm paving blocks. The lowest compressive strength value is found in the 25% clamshell variation with a compressive strength value of 8.254 Mpa, at a treatment period of 28 days while the highest value is obtained at 0% with a compressive strength value of 21.016 Mpa at a treatment period of 28 days. The graph above also explains that the higher the percentage of added shells, the less the compressive strength value. The addition of shells to the concrete mix affects the compressive strength of paving blocks. The compressive strength values for variations of 0%, 5%, 10% and 25% for the 7-day treatment age are 9.365 MPa, 14.444 MPa, 13.746 MPa and 12.619 MPa. The 14-day treatment age is 14.254 MPa, 12.937 MPa, 12.683 MPa and 9.524 MPa. The 28-day maintenance age is 21.016 MPa, 9.365 MPa, 8.937 MPa and 8.254 MPa. So know that the higher the water absorption, the less the compressive strength value of the paving block with a mixture of shells.

CONCLUSIONS

Based on the percentage of clamshell utilisation on the water absorption of paving blocks. The value of water absorption of paving blocks shows that the addition of seashells affects the absorption of paving blocks. Water absorption with a percentage of clamshell content of 0%, 5%, 10%, and 25% with a curing age of 7 days consecutively water absorption of 1.4%, 2.0%, 3.4%, and 3.7%. Water absorption with a curing age of 14 days consecutively water absorption of 0.6%, 1.7%, 2.4%, and 3.30%. Furthermore, the water absorption with a curing 28 days of was 1.3%, 2.8%, 3.0%, and 4.60% respectively. While the results of compressive strength show that the addition of shells affects the compressive strength of paving blocks. The compressive strength value of paving blocks at the age curing of 28 days, the percentage of clamshell content of 0%, 5%, 10%, and 25% is 21.016 MPa, 9.365 MPa, 8.937 MPa and 8.254 MPa respectively.

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