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Utilization Of Eggshell Powder Waste As An Added Material To Mortar

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Abstract. *In the development of increasingly developed technology and the demands of the community's needs for infrastructure facilities, it also affects the development of a construction field. This is also no exception in the manufacture of mortar which is used as a non-structural material in buildings. In making mortar itself, it is also influenced by developing technological developments, one of the types affected is pozzolan mortar. Pozzolan mortar has added materials derived from nature or industrial waste. In Indonesia, waste from eggshells is increasing every year, because eggshells are one of the people's favorite food ingredients. The eggshells have contain calcium carbonate (CaCO3) compound which is an element than cement. The materials of making the mortar itself are water, cement, and sand. This research aims to utilize egg shell waste as an added material in mortar with variations in the percentage of 0%, 5%, 10%, and 15% eggshell powder. From the results obtained, the addition of eggshell powder at maximum compressive strength lies at a percentage of 15% of 300 MPa.*

Keywords: *Mortar, Compressive Strength Mortar, Utilization Of Eggshell Waste*

INTRODUCTION

Mortar is defined as a mixture of materials consisting of fine aggregate (sand), adhesive materials (clay, lime, portland cement) and water with a certain composition (SNI 03-6825-2002). In the development of technology in this modern era and the demands of the community's needs for infrastructure facilities, also affect the development of a construction sector. This is also no exception in the manufacture of mortar which is used as a non-structural material in buildings.

The first time mortar was made of mud and clay because the supply of stone was very lacking. Based on the early history of mortar building capabilities appeared in Greece. The mortar is made with limestone with the addition of volcanic ash that allows it to harden in water commonly called pozzolanate (hydraulic cement). Over time there

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are several types of mortar such as ancient mortar, cement mortar, lime mortar, polymer mortar, and pozzolan mortar (Rudi, 2010).

In the industrial utilization of chemical materials Calcium carbonate (CaCO3) is widely used in various materials such as paper, plastic, paint, building materials and construction, aglygulture, and in the field of health. In the construction industry, calcium carbonate is one of the most important materials, one of which is as an additional material for cement (Saktika G., 2022).

Therefore, Indonesia is one of the countries where the majority of the population consumes eggs as a source of animal protein that is cheaper than meat. In Indonesia, waste from eggshells itself is recorded in data of nearly 170 thousand tons produced annually (Novalius F, 2019). Today, the human mindset is also getting more advanced. In the past, waste was usually wasted, but waste can now be treated with current technology. One of the materials that can be used is eggshells for addition to mortar. The eggshell itself has a calcium content of 98.94% (Ca) and calcium oxide of 98.50% (CaO).

In a previous research (Anto A.F., 2020) used waste from eggshells as an added material for normal concrete compressive strength with a percentage of 0%, 5%, 10%. According to the results of his research, each addition of egg shells multiples of 5% increases the compressive strength of concrete. At a percentage of 5% it gets 22.05 MPa and a percentage of 10% reaches a power of 24.1 MPa. In his research it was proven that eggshells increase compressive strength in concrete. Because eggshells have calcium carbonate compounds which are also elements of a semen.

Therefore, in this research the author is interested in using eggshells as an added ingredient in mortar because eggshells have contain calcium carbonate which is quite high, and adding 15% eggshell powder in this research which is expected to increase the compressive strength value of mortar. Eggshells themselves are waste that is easily obtained from traditional markets, cake shops, and in households. This reseearch used a percentage of 0%, 5%, 10%, 15% eggshell powder. With a aged of 7, 14, and 28 days.

RESEARCH METHODS

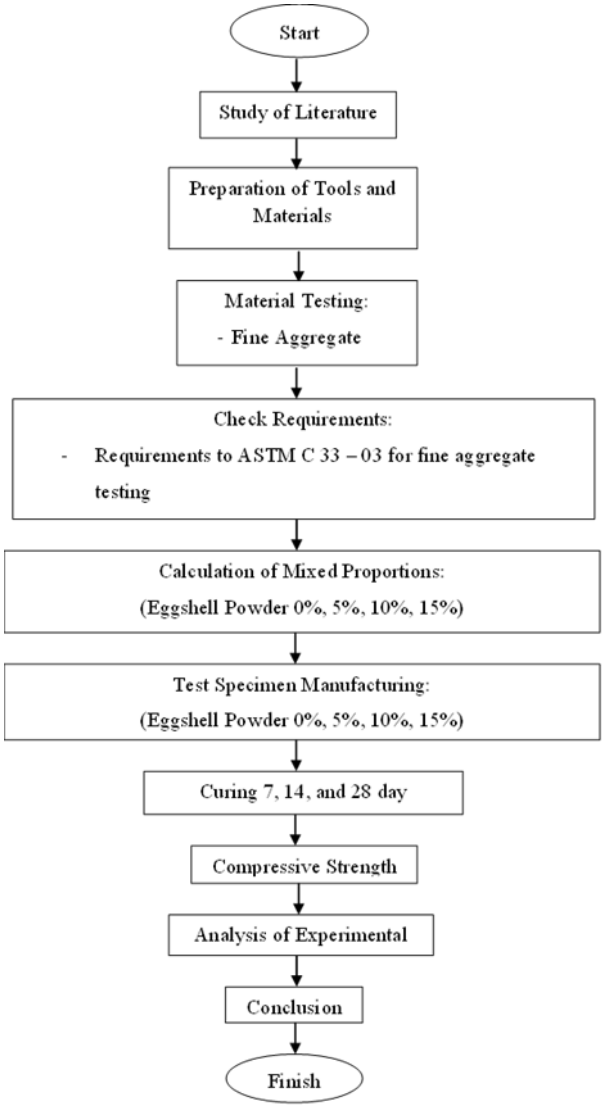

Figure 1. Flow Chart

The materials used in making mortar are:

1. Cement, cement used Portland cement (PCC)
2. Fine aggregate, using sand from lumajang
3. Water PDAM, water for mixture in mortar from Civil Engineering laboratory Untag Surabaya 1945
4. Eggshells, obtained from community waste

Figure 2 Eggshell

Table 1 The composition of eggshell powder

Contain	Eggshell Powder (%)
S	0,47
Ca	98,94
Fe	0,080
Co	0,11
Cu	0,055
Mo	0,2
Lu	0,16
SO_3	1,1
CaO	98,50
Fe_2O_3	0,077
Co_3O_4	0,099
CuO	0,046
MoO_3	0,10
Lu_2O_3	0,12

RESULTS AND DISCUSSION

1. Test specimen planning

In this research, the planning of test specimens has several variations in the percentage of mixtures, namely 0%, 5%, 10%, and 15%. Each percentage has three specimens. The size of the specimen itself has each side 5x5x5 cm.

Table 2 Planning of Test Specimens and Percentage of Eggshell Powder

Test Specimen Name	Eggshell Powder (%)	Compressive Strength		
		7 Day	14 Day	28 Day
ESP0	0	3	3	3
ESP5	5	3	3	3
ESP10	10	3	3	3
ESP15	15	3	3	3
Total		**36 Test Specimen**		

2. Research Results

Mortars that have gone through an aged plan of 7 days, 14 days, and 28 days will be tested for compressive strength on the mortar.

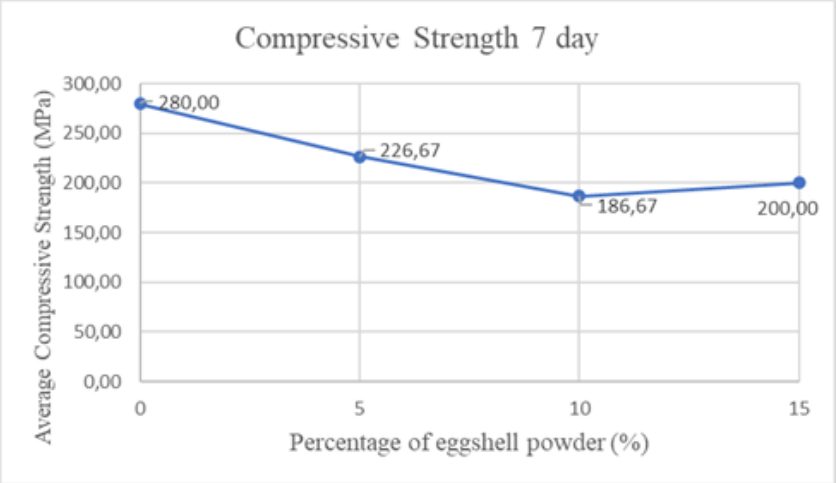

Figure 3 Compressive Strength 7 day

In mortar aged 7days, compressive strength decreases. At the percentage of 0% the highest value of the other percentages with a value of 280 MPa, then the percentage of 5% decreased by 226,667 MPa, the next percentage of 10% also decreased by 186,667 Mpa. But at a percentage of 15% experienced a slight increase of 200 MPa.

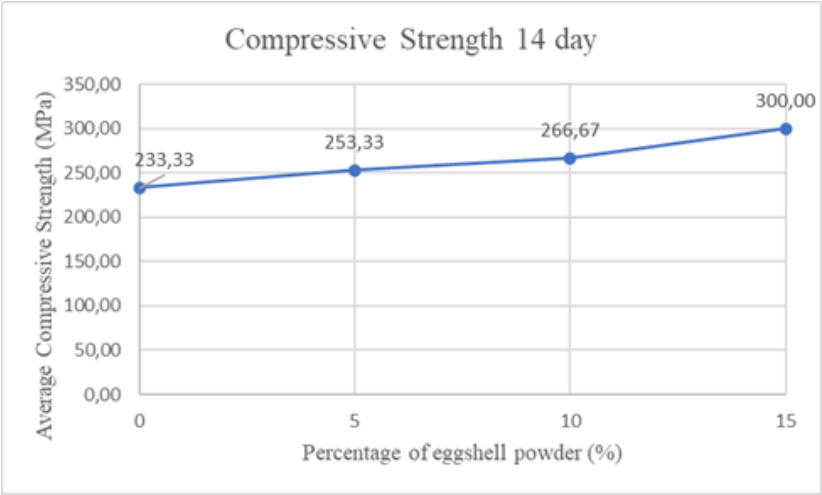

Figure 4 Compressive Strength 14 day

In mortar aged of 14 days has increased significantly. At a percentage of 0% got a value of 233,333 MPa, then a percentage of 5% increased with a value of 253,333 MPa, then a percentage of 10% increased by 266,667 MPa, and the last percentage was at 15% increased by 300 MPa.

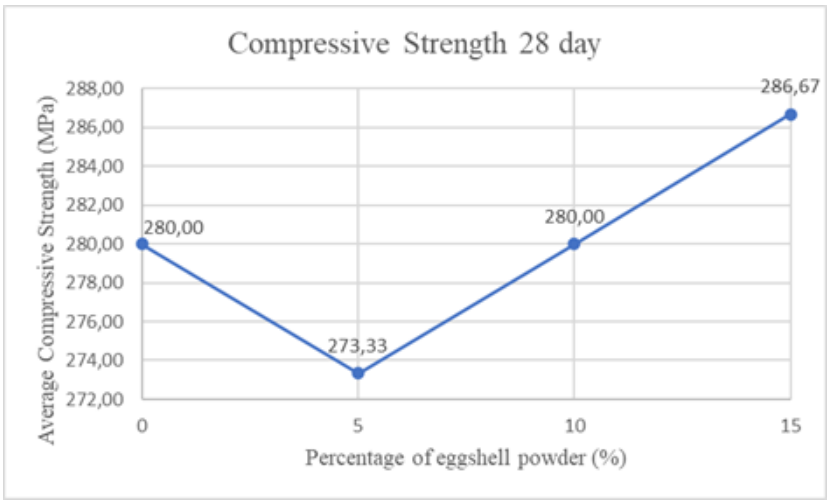

Figure 5 Compressive Strength 28 day

In mortar aged of 28 days, it decreases and increases. The percentage of 0% gets a value of 280 MPa, then the percentage of 5% decreases considerably by getting a value of 273,333 MPa, but at a percentage of 10% it increases by 280 MPa, and at a percentage of 15% gets the highest value in a mortar aged 28 days with a result of 286,667 MPa.

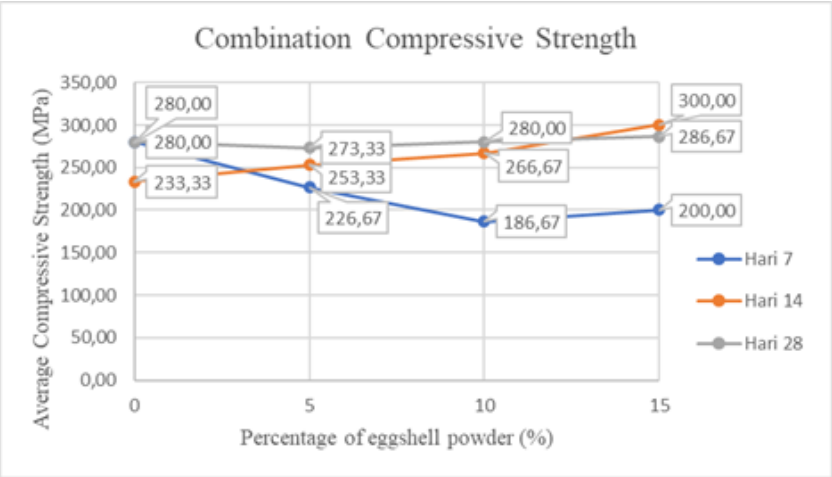

Figure 6 Combination Compressive Strength

In figure 6 of the compressive strength graph of the average aged of 7 days, 14 days, and 28 days, the highest value is located at the age of 14 days percentage of 15% with a value of 300 MPa. However, the lowest MPa value from other ages is located at the age of 7 days, a percentage of 10% by getting a value of 186,667 MPa. At the age of 14 days and 28 days explained that the addition of eggshell powder to cement will increase the compressive strength of concrete. This is because eggshell powder contains calcium carbonate compounds which are quite high and calcium carbonate compounds themselves are elements of cement (Agus Febry Anto, 2020).

CONCLUSION

The results of the research showed that the maximum compressive strength of eggshell powder mixture mortar lies in the planned age of 14 days with a percentage of 15% of 300 MPa. At the age of 14 days, the compressive strength of the eggshell powder mixture mortar experienced a significant increase starting from 0% 233.33 MPa; 5% 253.33 MPa; 10% 266.67 MPa; and 15% at 300 MPa. At the age of 7 days, compressive strength decreased and increased by 0% 280 MPa; 5% 226.67 MPa; 10% 186.67 MPa and 15% 200MPa.

In the addition of eggshell powder, it increases the compressive strength on the mortar, the greater the addition of eggshell powder, the greater the compressive strength on the mortar.

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