The Effect of Geothermal Sludge Silica on the Characteristics of Concrete Brick

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Abstract

Concrete brick is a type of brick-shaped building element made from Portland cement, water and aggregate. Along with the times, the need for concrete bricks is increasingly varied, such as the need for lightweight concrete bricks. To produce lightweight concrete in the mix, substitution materials can be used as developers or materials that have a light specific gravity. One of the materials is Silica. Geothermal Sludge has pozzolanic properties because it contains silica minerals, so it can be used as an aggregate in brick mixtures because it has a silica content of 97.3% which is said to be quartz sand. Aggregate greatly affects the properties of bricks, so the selection of aggregates is an important part in the growth of concrete bricks. The method used in this study was mixing Silica, Cement, Pasir, water, and Foam Agent then put into the mold then dry. After the concrete brick is finished, the compressive strength and unit weight tests are carried out. It was found that in one of the samples the compressive strength was 69.54 kg/cm2 and the unit weight value 1.7838 grams/cm³. It can be concluded that the effect of adding Silica Geothermal Sludge to concrete bricks is that it can reduce the unit weight of a concrete brick but can also increase the compressive strength of a concrete brick.

Keywords: Compressive Strength; Concrete Bricks, Geothermal Sludge, Silica

1. Introduction

Concrete brick is a type of brick-shaped building element made from the main ingredients of portland cement, water and aggregate. Along with the times, the needs for concrete bricks are increasingly varied, such as the need for lightweight concrete bricks which are starting to replace conventional concrete bricks. Lightweight concrete has a specific gravity of less than 1,900 kg/m3 (SNI 03-2847-2002). To produce lightweight concrete in the mix, substitution materials can be used as developers or materials that have a light specific gravity. One of the materials is Silica.

Indonesia is one of the countries that produces silica sand (SiO2) in large quantities, approximately 18.05 billion tons which is mineral silica (natural) and silica from other sources, such as solid waste from geothermal power plants (PLTPB).

One method for making concrete bricks is by using Silica from geothermal sludge waste from the Dieng PLTP. According to Nurdiyanto (2010), geothermal mud from the Dieng PLTP has pozzolanic properties because it contains silica minerals, so it can be used as a substitute for cement. In addition, geothermal sludge can also be used as an aggregate or mineral grain which functions as a filler in the brick mixture because

geothermal sludge with a content of 97.3% is said to be quartz sand. Aggregate greatly affects the properties of bricks, so the selection of aggregates is an important part in the growth of concrete bricks.

2. Methods

This study used silica geothermal sludge (as a substitute for gypsum and lime), cement, foaming agent, and water. The tools used are brick printers, screeners, mixers (molen), and buckets. The specified conditions are:

1. Silica Geothermal sludge is dried, to reduce the water content, sieved with a size of 100 mesh to facilitate the mixing process.
2. Size: 60 x 10 x 20
3. Drying Time: 7 days
4. Foam: Water (ml): 1:30.

Research Procedures conducted:

- Silica Geothermal Sludge Synthesis
  1. Geothermal Sludge is sieved with a size of 100 mesh to make the dissolving process easier
- Concrete Brick Making
  1. Cement and sand materials are mixed according to the dosage
  2. The foaming agent is mixed with water and then put into the concrete brick mixture
  3. After obtaining the density according to the plan, the mixture is put into a cylindrical mold
  4. For concrete bricks according to the specified variable. For this reason, mixing is based on a ratio of sea, water and foaming agent having a ratio of 1:30
  5. This foam is mixed with a mixture of cement and sand.

3. Results

In this study, data on the effect of material composition on the volume weight and compressive strength values were obtained as follows:

Table 1. Effect of Material Composition on Concrete Brick Volume Weight.

No	Variable	Age (day)	Diamaters	Dimensions h	Volume (cm^3)	Weight of Test Object (gr)	Weight Volume (gr/cm^3)
1.	0:1:1	7	15	30	5,298.75	10,095	1.9051
2.	0.25:1.75:1	7	15	30	5,298.75	9,878	1.8642
3.	0.5:1.5:1	7	15	30	5,298.75	9,763	1.8425
4.	1:1:1	7	15	30	5,298.75	9,452	1.7838

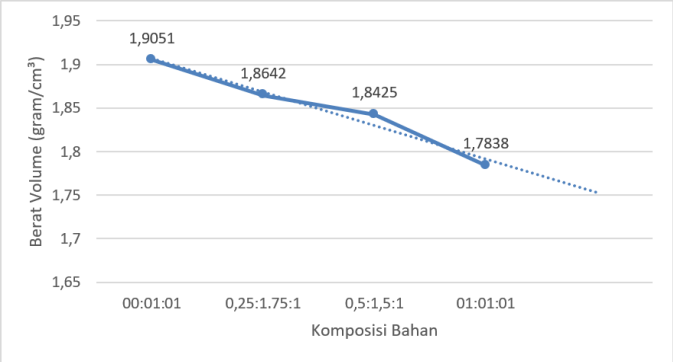

Fig. 1. The Effect of Material Composition on Volume Weight.

Table 2. Effect of Material Composition on Compressive Strength Values.

No	Variable	Age (day)	Press Load (KN)	Weight of Test Object (gr)	Strong Press (kg/cm^3)	Strong Press (Mpa)
1.	0:1:1	7	64	10,095	44.51	3.62
2.	0.25:1.75:1	7	86	9,878	59.80	4.87
3.	0.5:1.5:1	7	90	9,763	62	5.09
4.	1:1:1	7	100	9,452	69.54	5.66

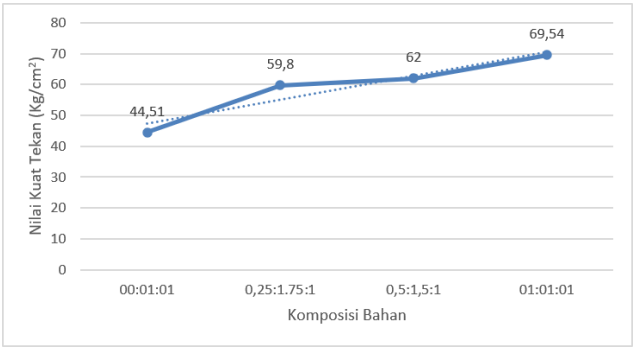

Fig. 2. Effect of Material Composition on Compressive Strength Values.

4. Discussion

Based on the test results as shown in the table and figure above, it was found that the addition of silica sand resulted in a decrease in the volume weight of a concrete brick due to the fact that silica sand has a lighter specific gravity compared to ordinary sand.

For the compressive strength test results, it was found that the addition of silica sand resulted in an increase in the compressive strength value. This happens because nanosilica has high crystallinity so that silica is able to cover the pores formed by the foam agent. If silica reacts with Ca(OH)2 contained in cement, it will become a compound CSH gel, this compound will fill in weak gaps between aggregate and paste. On the nanoscale, silica reacts more easily to form CSH gel and repair weak areas between aggregates and pastes. However, the addition of too much silica can reduce the quality of concrete, due to the absorption of water by silica that is too large so that the water needed for hydration is not enough and the hydration process becomes imperfect resulting in low brick strength.

5. Conclusion

From the research that has been done, it can be concluded that through this research the smallest volume weight value was obtained in the Silica:sand:cement ratio sample of 1:1:1 with a volume weight of 1.7838 gram/cm³. In this study, the highest compressive strength was also obtained in the Silica:sand:cement ratio of 1:1:1 with a compressive strength of 69.54 kg/cm2. So that the specified variable is in accordance with SNI.

And it can also be seen that the effect of adding silica sand to concrete bricks is that it can reduce the unit weight of a concrete brick but can also increase the compressive strength of a concrete brick.

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