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Effect Of Additive Zeolite Materials On The Strength Of Red Brick Post Burning

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ABSTRACT

This research aims to find out how to make bricks with additive Zeolite with a composition of 14%, 16%, 18%, and 20%. This research method using the experimental method, this research concludes that red bricks are added with additive Zeolite with variations in the addition of 14%, 16%, 18%, and 20%. 2 samples were made for each additional percentage of Zeolite Additive, with the mold size according to the fabrication length 21 cm x 10 cm x 5 cm. By going through the drying process for approximately 14 days and burning for approximately 3 days. The resulting increase in compressive strength even though some of the variants experienced a decrease. The addition of the red brick variant with a composition of 0% produces an average compressive strength of 30.95 kg / cm^2 . The 14% variant produces an average compressive strength of 35.71 kg / cm2, the 16% variant produces an average compressive strength of 40.48 kg / cm2, 18% and 20% variants produces an average compressive strength of 33.33 kg / cm2. The highest increase in compressive strength is the 16% variant, with an average compressive strength value of 40.48 kg / cm2.

1. Introduction

In the present times, the brick industry many of us have encountered in various regions in Indonesia, both in cities and villages [1]. Brick is a building material that has long been known and commonly used by the community to increase population development. The need for bricks plays a very important role in the building field, while the brick's quality still needs to be improved. There are many which crack after the combustion process [2]. Bricks are materials made of clay with or without additives that go through several processes and stages. This process includes drying by drying it in the sun and then burning it at high temperature so that the bricks harden and do not crumble when immersed in water.

Zeolite is a mineral formed from volcanic rock crystals that occur due to magma deposits resulting from volcanic eruptions millions of years ago. A zeolite is a mineral group in the sense of a non-metallic mineral. Zeolite can be used as a mixture in brick making so that Zeolite is not wasted, but can increase the bricks' strength and produce bricks of good quality.

The goal is the most important thing from a study so that researchers can direct their research intent. The purpose of this study was to determine how much added the compressive strength of the bat stone after Zeolite and to determine the physical and mechanical properties of the soil originating from Jagran Village, Karanggeneng District, Lamongan Regency. Which is one of the producers of red bricks in Lamongan district and almost all of the surrounding communities make a living as brick makers, but as the development of red bricks cannot compete with similar products with red bricks which are cheaper in terms of price, such as brick and mortar. As light bricks.

2. Literature Review

2.1 Definition of Bricks

Redbrick is one of the materials used for making walls. The bricks are made of baked clay until they are reddish. Along with technological developments, the use of bricks is decreasing due to the emergence of new materials such as gypsum, bamboo, lightweight bricks, that have been processed so that people tend to prefer these new materials because they have prices that tend to be cheaper and in terms of more beautiful architecture [3]. The definition of brick, according to SNI 15-2094-2000, is a building element intended for building construction and made of land with or without the mixture of other ingredients that is burned high enough not to crush again when immersed in water [4].

2.2 Standard of Bricks

Making bricks must have standardization because brick making is an absolute requirement and becomes an important reference for industry, especially in Indonesia. According to the International Organization (ISO), standardization is the process of compiling and using rules to regularly carry out an activity for the benefit and cooperation of all interested parties, especially to improve the overall economy optimally by taking into account functional conditions security requirements. The requirements for bricks in SNI 15-2094-2000 and SII-0021-78 include several aspects such as:

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a. Visible Properties

Red bricks must be in the form of a rectangular prism, have sharp and angled edges, the sides must be flat, not showing cracks.

b. Size and Tolerance

Standard of Red Brick in Indonesia by BSN (National Standardization Body) number 15-2094-2000 stipulates a standard size for red brick as follows:

(1) 240 mm long, 115 mm wide, and 52 mm thick.

(2) 230 length mm, width 110 mm, and thickness 50 mm.

c. Compressive Strength

The pressure is defined as the compressive force that acts on a unit of the surface area subjected to a compressive force. The pressure symbol is P. In international units (SI), the unit of pressure is N / m². The unit is also given the name pascal (abbreviated as Pa). so 1 N / m² = 1 Pa. Pascal unit is the pressure applied. The quality of red brick can be divided into three levels in terms of compressive strength according to SNI-10, 1978: 6, namely.

1. Grade I quality red brick with an average compressive strength greater than 100 kg/cm².
2. Red brick with level II quality with an average compressive strength between 80 kg/cm2 to 100 kg / cm².
3. Redbrick quality level III with an average compressive strength of between 80 kg/cm².

2.3 Advantages and Disadvantages of Red Bricks

Red bricks have several advantages or disadvantages as described below:

2.3.1 Advantages of Red Bricks

1. Easy to assemble and install so that it does not require certain skills.
2. Easy to transport due to small size.
3. The price is quite low.
4. Does not require special adhesive (just cement and sand).
5. Heat resistance so that it protects the building longer from fire.

2.3.2 Disadvantages of Red Bricks

1. It is difficult to make neat masonry.
2. Tend to Botros in using adhesive materials.

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3. The material is a material that absorbs heat during the summer and absorbs cold in the winter so that the room temperature in it is unstable.
4. Redbrick is a material that is heavy enough to cause more load on the building structure.

2.4 Materials for Bricks

Material for making bricks are:

2.4.1 Clay

Clay is the basic material in the manufacture of firebrick and clothesline bricks. Clays are made up of microscopic particles and sub-microscopic ones in the form of flat plates and are particles of mica, clay minerals, and other minerals that are very fine, having particles smaller than the size of silt with sizes 0.002 mm or less with a specific weight in the range 2.7-29[5]. The base material for forming bricks depends on the types of bricks and how to manufacture them. Type burned the bricks, and the materials dried used is clay [6]. Soil comes from weathering the chemical elements that make up rocks in the micro-circular and sub-microcosmic sizes with chemical formulas [7].

2.4.2 Water

Water is a liquid with no taste, smell, and color consisting of hydrogen and oxygen with the chemical formula H2O. Because water has properties that can be used for almost anything, water is essential to all forms of life (plants, animals, and humans) to date other than the sun, a source of energy [8]. Definition of Water in Biology and Chemistry (H2O compounds) - The definition of water is compound chemistry, which is the result of the bonding of the element hydrogen (H2), which combines with the element oxygen (O) in this case to form a compound H2O. Water is a chemical compound that is very important for the life of living things on this earth. Other compounds cannot replace the function of water for life. The main use of water and very vital for life is drinking water. This is mainly to meet the needs of water in the human body itself.

2.4.3 Rice Husk

The husk is part of the grain (Cereals) in dry, scaly, and inedible sheets, which protect the inside (Endosperm and Embryo). Husk can be found in almost all grass (Poaceae) members, although in some types of cultivation, there are also variations in the huskless grains (e.g., maize and wheat). In agriculture, the husks can be used as a mixture of

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feed, as a stable, mixed ground as fertilizer, burned, or the charcoal is used as a planting medium [9].

2.4.4 Rice Husk Ash Rice

The husk is the skin covering the rice grains, where the rice husks will separate and become waste or waste. If the rice husk is burned, it will produce rice husk ash. Traditionally, I used rice husk ash as a washing material for kitchen utensils and as fuel in brick making. Rice milling always produces quite many grain husks/rice husks, which will become the residual material. When the grains are milled, 78% of the weight will become rice and will produce 22% by husk weight. This husk can be used as fuel in the production process. The husk consists of 75% combustible material and 25% by weight will turn to ash [10].

This ash is known as Rice Husk Ash (RHA), which has a reactive silica content of around 85% - 90%. In every 1000 kg of milled rice will produce 220 kg (22%) of husk. If the husk is burned in a furnace, it will produce about 55 kg (25%) of RHA. About 20% of the rice weight is rice husk, and varies from 13 to 29% of the husk composition is husk ash, which is generated every time the husks are burned. The most common value of silica content (SiO2) in rice husk ash is 94 - 96%, and if the value is close to or below 90%, the husk sample has likely been contaminated by other substances with low silica content. Rice husk ash, when it is burned in a controlled manner at high temperatures around (500 - 600 ° C) will produce silica ash, which can be used for various chemical processes [11]. Rice husk is a lignocellulosic material like other biomass but contains high silica. The chemical content of rice husks consists of 50% cellulose, 25-30% lignin, and 15-20% silica [12].

Burning rice husks using conventional methods such as fluidized bed combustors produces CO emissions between 200-2000 mg / Nm3 and NOx emissions between 200 - 300mg / Nm3. The method of burning rice husks developed by COGEN-AIT can reduce the potential for CO2 emissions by 14,762 tons, CH4 by 74 tons, and NO2 by 0.16 tons per year from burning rice husks of 34,919 tons per year [13].

The combustion process due to heat that occurs will result in changes in the silica structure, which affect two things, namely the level of activity of the pozzolan and fineness of the ash grains. In the early stages of combustion, the rice husk ash loses weight at 100 ° C, when many substances from the rice husk are lost. At 300 ° C, the volatile substances begin to burn and increase weight loss. The greatest weight loss occurs at temperatures between 400 ° C-500 ° C. At this stage, carbon oxide is also formed. Above 600 ° C, several quartz crystal

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formations are found. If the temperature is increased, the husks turn into crystalline silica. Currently, rice husks have been developed as raw material to produce ash which is known in the world as RHA (Rice Husk Ash). Rice husk ash produced from burning rice husks at 400-500 ° C will become amorphous silica and at temperatures greater than 1,000 ° C will become crystalline silica. Amorphous silica produced from rice husk ash is an important source for producing pure silicon, silicon carbide, and nitride silicon flour [14].

2.5 The Process of Making Bricks

Making bricks goes through several stages, including extracting raw materials, processing materials, forming, drying, burning, cooling, and selecting (selection). The stages of making bricks are as follows [15].

2.5.1 Extracting Raw Materials It

It is best to find soil that is not too plastic but a soil that contains a little sand to avoid shrinkage. Excavation is carried out in the top layer of soil about 40-50 cm thick. Previously the soil is cleaned of tree roots, plastics, leaves, etc. so that it does not get carried away. Then dig down to a depth of 1.5-2.5 meters or depending on soil conditions. Soil that has been excavated is collected and stored in a protected place. The longer the clay is stored, the better it is because it is rotten. This stage is intended to decompose the organisms present in the clay [16].

2.5.2 Processing of raw materials

Clay, before making, must mix red bricks evenly, called a milling job, by adding a little water. The water used in the brick-making process must be clean, the water must not contain salt that dissolves in water, such as table salt, the water used is about 20% of the other ingredients, kneading can be done by foot or stirring with hand. The mixed material added during processing must be completely mixed with the clay evenly. Before being formed with a mold, this ready-made raw material is first left for 2 to 3 days to allow the clay particles to absorb water so that they become more stable so that if they are formed, there will be even shrinkage [16].

2.5.3 Press / Print Bricks

Brick mold made of this woodblock first soaked in water so that the brick is molded, not sticky when removed from the mold to dry. The material mix of printed and brick samples

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be held slowly until filling all corners of the mold and are completely solid, then the bricks are removed slowly out of the mold. The print result was marked according to the variation of the mixture [17]. Determine the forming water content which will be used. Water added in the mix of bricks is constant for each ingredient. Process this is called work dozing by adding educate water. The brick-making process must be clean water and does not contain water-soluble salt like table salt. The ingredients are mixed in a manner equal (homogeneous), namely with a squeeze or crush with hands or feet. Mix added with water that has been determined a little by little until it becomes a dough, which is quite tough. This step is done so that mixing between these can be more homogeneous so that the expected results obtained the maximum [18]. Put quality soil into the press machine then cut and transported to dry, before being put into the press machine, the soil is mixed with used rice bran or you can call it coarse dedek and a little blend of mill oil + diesel for good results, not easily destroyed when burned and strong. The process of making red bricks can be seen in **figure 1.**

Source : research, 2020

Figure 1. Press / Print Bricks

2.5.4 The Process of Drying the Bricks

The next process of printing the red bricks press, namely the arrangement of bricks to dry quickly for the drying process of bricks, requires equal air and heat to dry to the inside to produce bricks that are strong and not easily destroyed. Furthermore, the drying process is not sure how fast or not dry the bricks are due to the bricks' dryness according to the weather or air and heat. The fastest time if sunny conditions are around 1-3 days, and the longest is 4-7 day.

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The proses of drying the bricks can be seen in **figure 2.**

Source : research, 2020

Figure 2. Process of Drying the Bricks

2.5.5 Red Brick Burning Process

Combustion that is carried out aims to reach a cooling temperature and pay attention to the combustion speed to reach that temperature and the speed to achieve cooling. During the combustion process, there are physical and chemical changes and the mineralogy of the clay. The process of burning bricks must be balanced with the increase in temperature and temperature. Several steps must be considered, namely:

a. The first stage is evaporation (drying), namely the removal of forming water, which occurs up to a temperature of about 120 ° C
b. In the oxidation stage, the burning of plant remains (carbon) in the clay. This process takes place at a temperature of 650 ° C - 800 ° C.
c. Full burning stage. The bricks are burned until cooked, and there is a sintering process until they become solid bricks. The ripe temperature varies between 920 ° C - 1020 ° C, depending on the clay's properties.
d. The containment stage. At this stage, there is temperature holding for 1-2 hours. In stages, a, b, and c, the temperature rise must be slow so that there is no loss in the brick. Among others: cracked, black stain on the brick, development, and others.

The quality of bricks, both bricks, is greatly influenced by the firing temperature. Temperature is useful in the process of drying bricks to obtain good and perfect bricks. In a mixture of clay and water before burning, in its structure, there are still various types of water, namely.

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a. Suspense water (a mixture of water with basic ingredients)
b. Water between particles that occurs when pulverizing basic materials
c. Pore water between particles after shrinkage
d. Water is chemically or physically adsorbed particles
e. Lattice water in its crystal structure.

The fuel used in brick kilns can be wood or rice husks. The temperature that can be achieved when burning using wood is better than using husks, in addition to the higher temperature, there is also the element of carbon so that the brick becomes hard. It is important to know the fuel information used in the real brick. Analysis of the original brick should pay attention to the remains of charcoal burning material, which is often still attached to the brick's surface. Can see the process of red bricks burning in **figure 3.**

Source : research, 2020

Figure 3. Brick Burning Process

2.6 Definition of Zeolite

Zeolite is generally defined as a triple crystal silica-alumina dimension with cavities in it containing metal ions, usually alkalis or alkaline earth, and water molecules that can move freely [19]. Zeolite is a mineral that is formed from volcanic rock crystals that occur due to magma deposits resulting from volcanic eruptions millions of years ago. A zeolite is a mineral group in the sense of a non-metallic mineral. Zeolite comes from the Greek word Zeinlithos. The word Zein means to boil or boil while the word Lithos means rock. These rocks will boil or foam when heated at a temperature of 100 to 350 Celsius. Natural zeolites are found in volcanic areas, riverbanks, seas, and lakes in the form of natural mineral

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sediments, usually in large quantities on the Megaton scale. Natural Zeolite deposits around the world are found in the USA, Japan, Cuba, USSR, Italy, Czechoslovakia, Hungary, Bulgaria, South Africa, Yugoslavia, Mexico, Korea, and Indonesia, with Zeolite contents ranging from 60 - 90%. In Indonesia, natural zeolites are found on various islands, spread across Java, NTT, Irian, Sumatra, Sulawesi, and Kalimantan with abundant deposits [20].

3. Research Method

3.1 Research design

Design is the process of collecting and analyzing research data. This research includes planning and conducting research. Planning begins with observation and evaluation of research carried out and known until the formation of a framework requires further evidence. Implementing the research design includes making experiments and observations and selecting measurement variables, techniques, procedures, data collection, instruments, data analysis, collecting samples, and reporting research results. This study uses experimental laboratory research methods, namely conducting experimental activities to produce a result. The purpose of this experiment is to compare the results obtained in the study with existing conditions.

3.2 Making Samples

The sample made in this research has dimensions of 21 cm x 10 cm x 5 cm. Additive materials used in this test are zeolite with an additional percentage of 0%, 14%, 16%, 18%, 20%. The method of mixing the additive is by adding the percentage of Zeolite to the soil that has been prepared beforehand if the soil sample required is 2500 gr, then the Zeolite will be added 0%, 14%, 16%, 18 %, 20% of the 2500 gr on the soil sample is then leveled, put into the mold and compacted. Sample for Test.

Table 1. Samples for Post-Combustion Compressive Strength Test

Sample	Percentage	Amount
1A	0	2
2A	14%	2
3A	16%	2
4A	18%	2
5A	20%	2
TOTAL		10

Source : Analysis Results, 2020.

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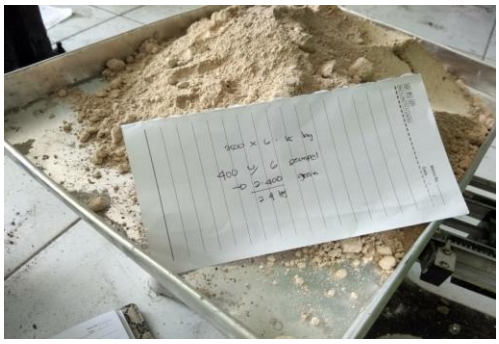

Source : research, 2020

Figure 4. Zeolite Added Material Weighing Process

3.3 Data

Analysis Testing Red Brick. Testing the bricks' compressive strength with the composition of a mixture of soil materials with certain levels to obtain the compressive strength values for the bricks. In this test, each soil sample is made with a Zeolite mixture. then squeezed for seven days. Then burned for one day, two days, and three days, then tested the compressive strength. Testing the Compressive Strength of Red Bricks

The steps in the test are carried out as follows:

1. Prepare the red brick specimen.
2. Determine the level of accuracy of the compressive strength test equipment before use.
3. Measuring dimensions of length, width and height for each sample to be tested for compressive strength.
4. Putting the brick specimen with the specified sample code.
5. Set the needle of the Forney compressive force to the right position of zero.
6. Turn on the compressive strength tool then read the load indicator, while applying compressive load (F) from above slowly until the brick is broken or crushed.
7. Record the value of the maximum compressive load read on the needle of the tool.
8. Record data into measurement table such as table
9. Repeating the same activity to completion.

$$P = \frac{F}{A}$$

Information,

P = compressive strength of material, unit N / m² or kg / cm²

F = maximum compressive load (compressive force), unit (kg or N)

A = area of material (m²)

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Source : research, 2020

Figure 5. Brick weighing process

Source : research, 2020

Figure 6. Testing the Compressive Strength of Red Bricks

3.4 Technical Data Analysis

Techniques Analysis of the data used in this study, namely:

Analysis of the Compressive Strength of the Sample, to calculate the compressive strength of the sample, measured parameters are needed. Namely, it can use the compressive load (compressive force, F) and the sample brick area, A. Determination of the compressive strength of a brick with the equation in on. After testing the sample's compressive strength, then the standard value is compared based on the established reference or national standard. The average compressive strength of bricks can be adjusted as shown in table 2., namely the compressive strength and the permitted variation coefficient of red bricks.

4. Results and Discussions

This research consists of two phases, namely the first phase of making red bricks and the second phase of testing the compressive strength and water absorption in the laboratory.

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The first phase of making red bricks in Jagran Village, Karanggeneng District, Lamongan Regency, while testing the parameters of the compressive strength and water absorption capacity of bricks was carried out at the Lamongan Islamic University Laboratory. The process of making bricks was done by mixing additive Zeolite substances.

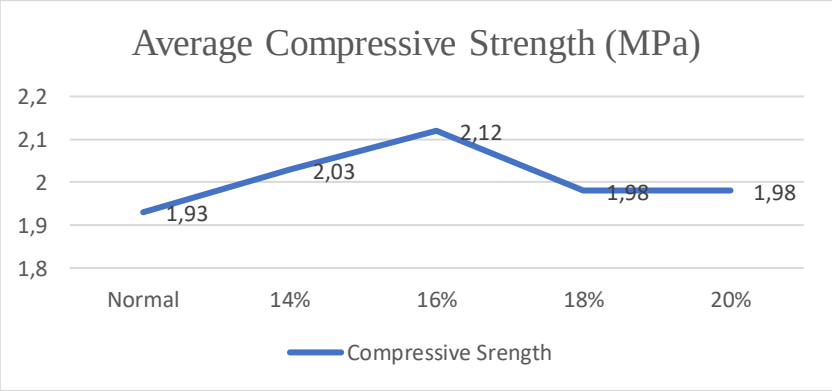
Compressive Strength Test Analysis.

Table 2. Compressive Strength Test Analysis

No	Prosentage (%)	Sample	Area Of Press Field		Area Of (cm^2)	Pressurepress Load (Kg)	Press Strength (Kg/cm^2)	Average (Kg/cm^2)
			Length	Width				
1	0%	I	21	10	210	8000	38.10	30.95
		II	21	10	210	5000	23.81	
2	14%	I	21	10	210	7000	33.33	35.71
		II	21	10	210	8000	38.10	
3	16%	I	21	10	210	8500	40.48	40.48
		II	21	10	210	8500	40.48	
4	18%	I	21	10	210	7000	33.33	33.33
		II	21	10	210	7000	33.33	
5	20%	I	21	10	210	7000	33.33	33.33
		II	21	10	210	7000	33.33	

Source : Research Results, 2020

From table 2 it is obtained that the average compressive strength of normal bricks (0%) is 30.95 kg / cm^2, at 14% Zeolite mixed bricks obtained an average compressive strength of 35.71 kg / cm^2, 16% Zeolite mixed bricks obtained an average compressive strength of 40.48 kg / cm^2, for 18% Zeolite mixed bricks an average compressive strength was obtained 33.33 kg / cm^2, the 20% Zeolite mixture obtained an average compressive strength of 33.33 kg / cm.



Source : Research Results, 2020

Figure 7. Chart of Average Compressive Strength of Bricks

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5. Conclusion and Suggestion

5.1 Conclusion

Based on the chapters above, it is explained that the design of making red bricks using Zeolite Additive Substance has been researched in the Laboratory of the Faculty of Engineering, Civil Engineering Study Program, Islamic University of Lamongan.

1. From the research results, the compressive strength is obtained at the composition of 0%, the average compressive strength value is 30.95 kg / cm², at the composition of 14% the average compressive strength value is 35.71 kg / cm², at the composition of 16% the compressive strength is an average value of 40.48 kg / cm², in the composition 18% -20% get an average compressive strength value of 33.33 kg / cm². It is stated that the addition of Zeolite can increase the compressive strength of red bricks after burning.
2. The percentage increase in the compressive strength test results of red bricks at 14% composition was 0.154%, at 16% composition was 0.308%, at 18% composition and 20% was 0.077%.
3. With the average compressive strength produced in the research, the bricks belong to level III quality.

5.2 Suggestion

From research on the addition of Zeolite additives as an added material for the compressive strength of red bricks after combustion, suggestions that can be found for further research are the care required in the mixing process Zeolite Additive, soil, and water for good results. For the brick molding location, it is better to be more careful in printing, aerating, and burning. So that the bricks that have been printed, when aerated, the brick surface remains flat, not curved. It is necessary to modify more innovative brick printing tools, so that the printed brick can be more efficient or uniform and dense in shape, so that the quality of the bricks is not much different from one another.

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