VOLUME 3 | NUMBER 2 | MARCH 2021
Available online at http://proceedings.worldconference.id.
ISSN: 2656-1174 (online)

Sodium Hypoclorid and Benzalkonium Chloride Usage As A Disinfectant in Residential Area Towards The Durability of Non-Structure Building Materials

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Abstract

It is seen that the world is experiencing health recession due to the coronavirus spread massively which resulting in a COVID-19 pandemic. To prevent and break the chain of coronavirus infecting in Indonesia, The Government and society are actively taking various efforts. One of them is doing a disinfecting process in residential areas. The impact of disinfectants on the structure of building materials is unknown and has never been tested in previous studies. This study aims to test empirically the effect of several chemicals from disinfectant ingredients towards the durability of non-structure building materials which are often used as residential materials. The sample of this study consisted of four group types, that is mortar, brick, hebel stone, and concrete brick. Each type of test object has a total of 6 variations of treatment by spraying or immersing H2O, BZK, and NaCIO chemicals and then testing the compressive strength after the age of the test object reaches 7, 14, and 28 days. The results of the study visually showed that the four types of specimens did not undergo physical changes during the duration of the test. The results of the research data also show that the four types of specimens experience anomalous results in compressive strength. The greatest compressive strength values for 4 types of specimens are not all at the age of 28 days, but at the age of 14 days, the largest compressive strength value for mortar is 30.74 MPa in the 6th variation of chemical immersion of NaCIO at 14 days, on hebel brick the largest compressive strength value is 2.41 MPa in the 3rd variation of spraying with chemical BZK aged 14 days, for red brick the largest compressive strength value is 11.48 MPa in the 4th variation of immersion with chemical BZK aged 14 days, and on the concrete brick the largest compressive strength value is 2.20 MPa in the 3rd variation of spraying with chemical BZK aged 14 days.

Keywords
Benzalkonium Chloride, Compressive Strength, Covid Desinfectan, Residential Home Disinfecting, Sodium Hypochlorite

1. Preliminary

The world is currently experiencing a health recession due to the coronavirus which has spread massively and becomes a COVID-19 pandemic. A new type of coronavirus called SARS-CoV-2 is the cause of the disease. The case of COVID-19 was first detected by the Chinese government in Wuhan City, Hubei Province, China in December 2019. Indonesia experienced a pandemic when there were findings of two positive patients with the coronavirus and announced directly by President Joko Widodo at the Presidential Palace, Jakarta, Monday, March 02, 2020. After periodically monitoring and studying the SARS-CoV-2 coronavirus, which has a very high spread rate in the world, finally on March 11, 2020 it was reported on the official website of the World Health Organization (WHO) officially designated COVID-19 as a global pandemic.

Disinfectants are chemicals used to prevent infection or contamination by microorganisms or drugs to eradicate disease germs (Indonesia. Departemen Pendidikan Nasional.; Pusat Bahasa, 2008). The disinfectant process is carried out in the form of spraying chemical liquids into public places such as malls, offices, restaurants, roads, sidewalks, village access roads, residents' homes, even disinfectants were used to sterilize humans using a special Spray Chamber tool. The widespread practice of spraying disinfectants and alcohol across the sky, on roads, vehicles and personnel has no value; in addition, large amounts of alcohol and disinfectants are potentially harmful to humans and should be avoided (Yonghong and Torok, 2020).

Chemicals that can be used as disinfectant products of various types include chlorine, sodium hypochlorite, benzalkonium chloride, iodine, quartenemer ammonium alcohol, formaldehyde, potassium permanganate, and phenol. Previous studies regarding the effect of several chemicals on concrete have been done before. Concrete that is in an acidic environment will be more quickly exposed to corrosion which causes

concrete degradation. The higher the percentage of chloride in the concrete, the shorter the service life of the concrete (Hardianti, Kristiawan and Wibowo, 2017).

Sodium hypochlorite (NaCIO) and benzalkonium chloride (BZK, BKC, BAK, BAC) are mixtures contained in-floor cleaning products or clothes bleach that are easily available on the market. Both products contain chloride chemicals, as reviewed in previous studies concluded that these materials can reduce the compressive strength of concrete. A study is needed whether repeated exposure to BZK and NaCIO materials to non-structural building materials within a certain period can make physical changes and reduce the value of the compressive strength of each of these materials. Of course, it will be a dangerous thing for human safety in the house when scientific evidence is proven that BZK and NaCIO can reduce the value of compressive strength and change the physical form of building materials.

Of the many previous studies on the effect of chloride on the compressive strength of concrete, there has never been a study on the effect of exposure to chloride contained in disinfectants, namely sodium hypochlorite (NaCIO) and benzalkonium chloride (BZK, BKC, BAK, BAC) on physical changes. and the compressive strength of non-structural building materials. In this case, the study will discuss the use of sodium hypochlorite and benzalkonium chloride as a disinfectant against physical changes and the compressive strength of non-structural building materials.

2. Literature Review

2.1. Mortar

Cement mortar is a hydraulic cement similar to paired cement, but the specifications for cement mortar require lower air content and include the requirements for flexural adhesiveness (Badan Standarisasi Nasional, 2014). Mortar is one of the building materials used in the construction world both in small-scale residential houses to large-scale multi-story building projects. Mortar consists of a mixture of cement, water, sand. Mortar is a building material product as an "adhesive" for making non-structural buildings as well as a protective layer for walls.

2.2. Light Brick AAC

Light brick AAC lightweight bricks are cellular concrete where the air bubbles in the finished brick product are caused by a chemical reaction, AAC dough generally consists of lime, quartz sand, water, cement, a little gypsum, and aluminum paste as a developer (chemical filling of air into the product). After the dough is perfectly mixed, it will expand for 7-8 hours. The aluminum paste used in the dough, apart from functioning as a developer, plays a role in influencing the hardness of the concrete. The volume of this aluminum paste ranges from 5-8 percent of the dough that is made, depending on the desired density.

AAC light brick making material uses special sand, namely silica (> 95% SiO2), and must be ground to micro size. Just like in bread making in AAC, the expansion rate of the dough cannot be controlled precisely so that it will usually expand out of the mold. Therefore it must be cut to get the required dimensions. The relatively large number of air bubbles allows the production of AAC with a low density, which is around 700 - 800 kg / m^3 (Karijanto, Wijaya and Sugiharto, 2013).

2.3. Redbrick

Redbrick is one of the basic materials for structural and non-structural building construction that is often found and used in Indonesia. The existence of red brick products has been going on for decades. Badan Standarisasi Nasional (2000) explains that red brick is a building material in the form of a rectangular prism. Solid or perforated with a maximum volume of 15% and is used for the construction of building walls, which are made of clay with or without mixed active ingredients and burned at a certain temperature. Red bricks were made from molded clay, then burned. Not all clay can be used. Only consisting of certain sand content.

Redbricks on the market generally have sizes: length 17-23 cm, width 7-11 cm, thickness 3-6 cm. Average weight 3 kg / pcs (depending on the brand and origin of manufacture). The raw materials needed for red brick masonry plastering are cement and sieve sand. For watertight walls, a 1: 2 or 1: 3 mixture is needed (that is, 1 part cement combined with 3 parts sifted sand). Meanwhile, for walls that do not have to be waterproof, a ratio of 1: 4 to 1: 6 sand cement can be used.

2.4. Batako

Batako is a brick made from a mixture of hydraulic adhesive added with fine aggregate and water with or without other additives and has a hole cross-sectional area of more than 25% of the cross-section of the brick and the hole contents of more than 25% of the brick content (Pusat Penelitian dan Pengembangan Pemukiman, 1982). Brick material is made from a mixture of cement and coarse sand which is solidly molded or pressed. In addition, there are also those who make it from a mixture of tras, lime and water. Even now also circulating bricks made of a mixture of cement, sand and coal. With the manufacturing materials described above, bricks

have a lower compressive strength than red bricks, so they tend to crack the brick walls due to excessive forces, especially if the blanks are not filled with mixed species. The use of brick material for walls also makes buildings warmer and even tends to be stuffy and hot, unlike red bricks made of earth material. Brick tends to be lighter than red brick. The texture also looks smoother than red brick.

3. Research Place

The methods applied in this study are experimental and was Held out in the Becakayu Batching Plant laboratory, PT. Waskita Beton Precast, Jln. Raya Pondok Kelapa Selatan No. 26 003/005, Pondok Kelapa, Duren Sawit, East Jakarta.

4. Method

The methods applied in this study are experimental. The variable referred to here is anything that will be the object of observation. The independent variable in this study is the mortar with the composition of SNI materials and several manufacturing standard building materials or general raw materials that are sold freely in the market, namely, light brick type AAC, red brick, and brick which are purchased at a building shop around the test site. All materials will be grouped according to the research design and strong data will be taken.

Mortar specimens are printed in cubes with dimensions of 5 cm x 5 cm x 5 cm, The need for samples of cube white brick objects is 10 x 10 x 10 cm, The need for samples of cube red bricks is 4 x 4 x 4 cm in size and the last one The sample of concrete brick specimens, due to the uniqueness of the brick shape, was cut into 3 pieces in the form of blocks, namely the right part, the left side, and the middle part with an average dimension of 12 cm x 7 cm x 36 cm.

All processes or procedures in conducting this research refer to SNI (Indonesian National Standard), ASTM (American Society for Testing and Materials), and previous research journals related to this research. Before the implementation of fresh mortar production, the preparation of materials and equipment that will be used will be carried out. The tests carried out are physical aggregate testing, colloid content test, sieve analysis test, specific gravity, absorption, clay lump test, organic impurities for fine aggregates, density. Mortar mixture planning refers to (Badan Standarisasi Nasional, 2015).

The compressive strength test for all materials (compressive strength) will refer to (Badan Standarsisasi Nasional, 2002) the method of testing the compressive strength of Portland cement mortar for civil works.

Table 1. Research Design

VARIATION	MATERIALS	Mortar Plester	Light Brick	Red Brick	Batako
TEST	Days To	7, 14, 28	7, 14, 28	7, 14, 28	7, 14, 28
TREATMENT	SOAK	WATER	WATER	WATER	WATER
		BZK (0,1 %)	BZK (0,1 %)	BZK (0,1 %)	BZK (0,1 %)
		NaCIO (0,1 %)	NaCIO (0,1 %)	NaCIO (0,1 %)	NaCIO (0,1 %)
TREATMENT	SPRAY	AIR	AIR	AIR	AIR
		BZK (0,1 %)	BZK (0,1 %)	BZK (0,1 %)	BZK (0,1 %)
		NaCIO (0,1 %)	NaCIO (0,1 %)	NaCIO (0,1 %)	NaCIO (0,1 %)
SAMPLE QUANTI	SOAK WATER 7 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SOAK WATER 14 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SOAK WATER 28 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SOAK BZK 7 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SOAK BZK 14 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SOAK BZK 28 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SOAK NaCIO 7 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SOAK NaCIO 14 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SOAK NaCIO 28 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
SAMPLE QUANTI	SPRAY WATER 7 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SPRAY WATER 14 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SPRAY WATER 28 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SPRAY BZK 7 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SPRAY BZK 14 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SPRAY BZK 28 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SPRAY NaCIO 7 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SPRAY NaCIO 14 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
	SPRAY NaCIO 28 DAYS	5 pcs	5 pcs	5 pcs	5 pcs
ALL SAMPLE QUANTITY		90 pcs	90 pcs	90 pcs	90 pcs
		360 pcs			

Source: Data in Research, 2020

VOLUME 3 | NUMBER 2 | MARCH 2021
Available online at http://proceedings.worldconference.id.
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Figure 1. Process of Manufacturing and Testing Sample
Source: Data in Research, 2020

5. Result

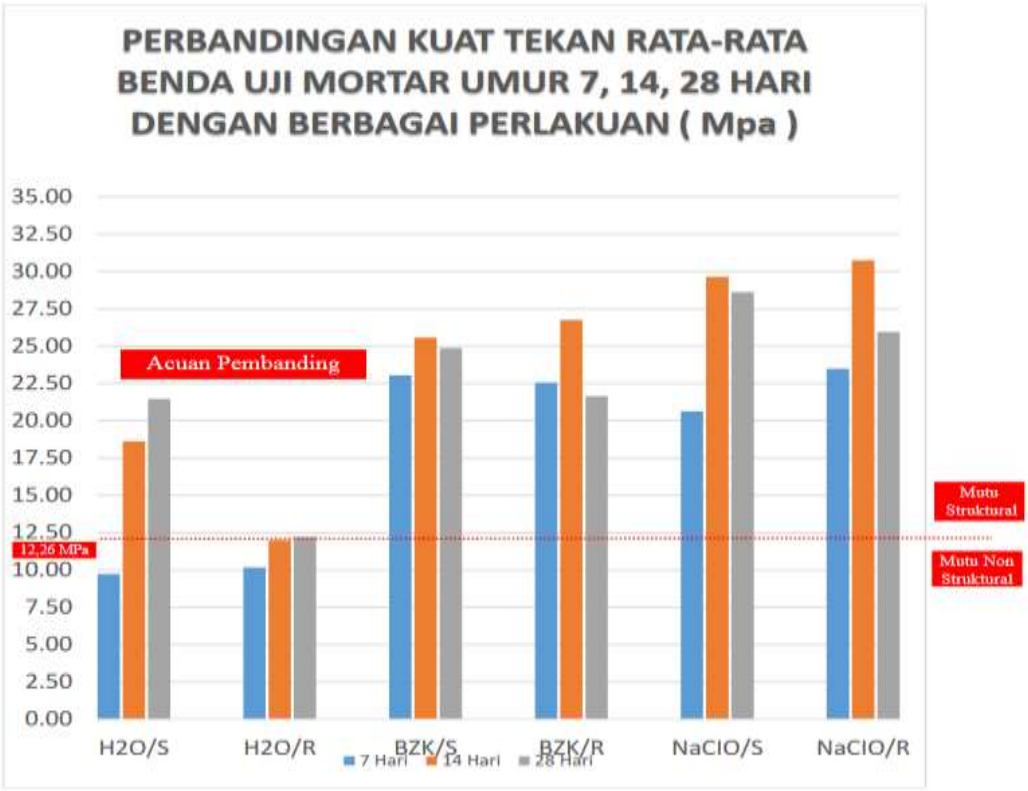

Figure 2. Histogram Comparison of The Average Compressive Strength of All Variations Mortar At Each Age
Source: Data in Research, 2020

Tabel 2. Comparison Results of Average Compressive Strength of All Mortar Variations at Each Age

	Type	Water		BENZALKONIUM		NaCIO	
	No.	1	2	3	4	5	6
	Unit	(MPa)	(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
	Date / kode	H_2O/S (reference)	H_2O/R (reference)	BZK/S	BZK/R	NaClO/S	NaClO/R
a	7 Days	9,72	10,16	23,04	22,54	20,62	23,48
b	14 Days	18,62	11,99	25,57	26,74	29,65	30,74
c	28 Days	21,45	12,21	24,86	21,63	28,62	25,93

Source: Data in Research, 2020

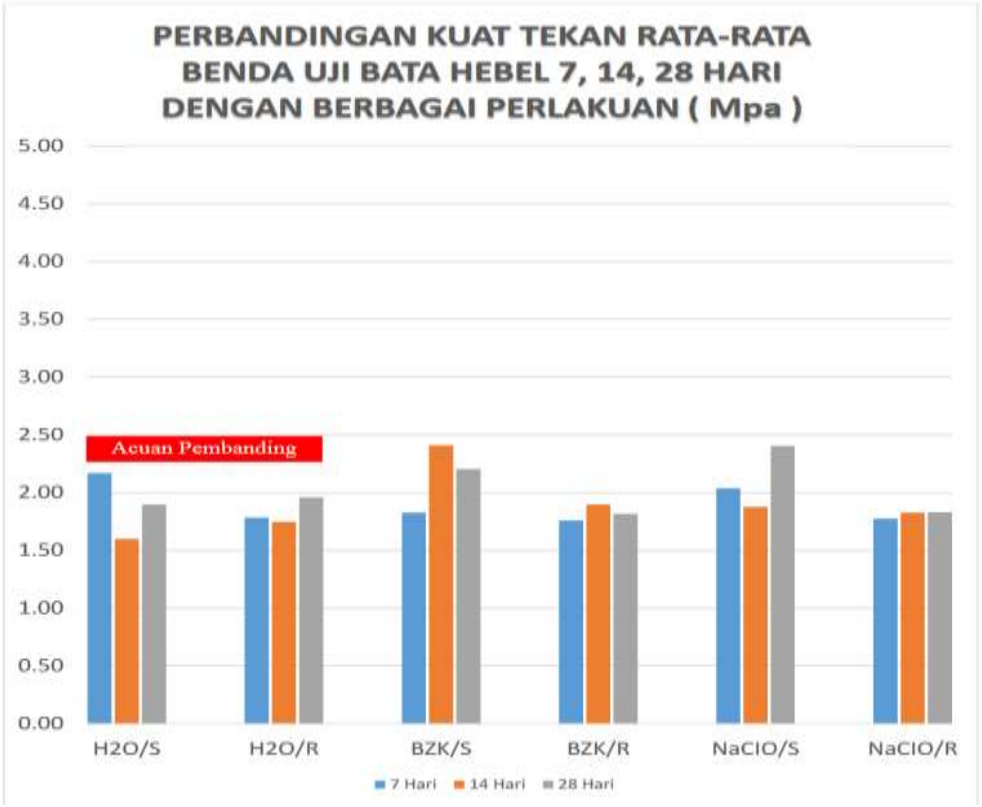

Figure 3. Histogam comparison of the average compressive strength of all variations Hebel Brick at each age
Source: Data in Research, 2020

Table 3. Comparison Results of Average Compressive Strength of All Mortar Variations at Each Age

	Type	Water		BENZALKONIUM		NaClO	
	No.	1	2	3	4	5	6
	Unit	(MPa)	(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
	Date / kode	H_2O/S (reference)	H_2O/R (reference)	BZK/S	BZK/R	NaClO/S	NaClO/R
a	7 Days	2,17	1,78	1,83	1,76	2,04	1,77
b	14 Days	1,60	1,75	2,41	1,90	1,87	1,83
c	28 Days	1,90	1,96	2,20	1,82	2,40	1,83

Source: Data in Research, 2020

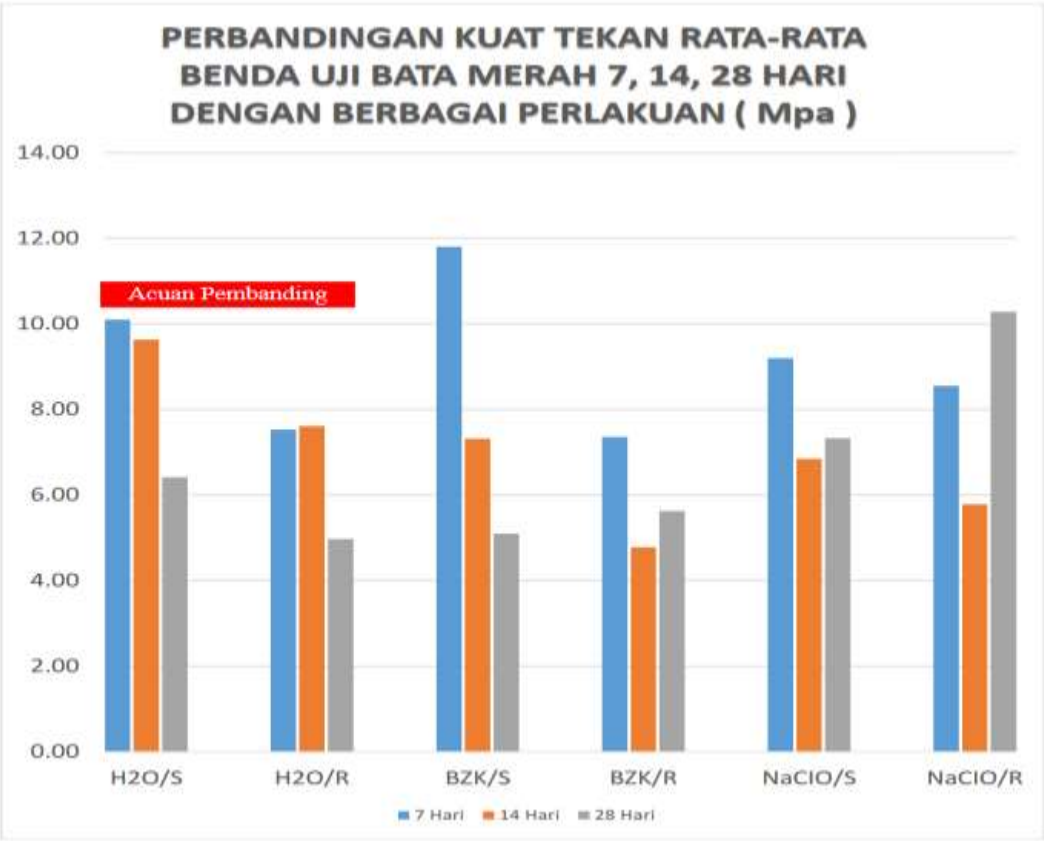

Figure 4. Histogram comparison of the average compressive strength of all variations Red Brick at each age
Source: Data in Research, 2020

Table 4. Comparison Results of Average Compressive Strength of All Red Brick Variations at Each Age

No	Type	Water		BENZALKONIUM		NaCIO	
	No.	1	2	3	4	5	6
	Unit	(MPa)	(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
	Date / kode	H_2O/S (reference)	H_2O/R (reference)	BZK/S	BZK/R	NaCIO/S	NaCIO/R
a	7 Days	10,10	7,53	11,80	7,36	9,20	8,55
b	14 Days	9,63	7,61	7,32	4,78	6,84	5,78
c	28 Days	6,41	4,97	5,09	5,62	7,32	10,28

Source: Data in Research, 2020

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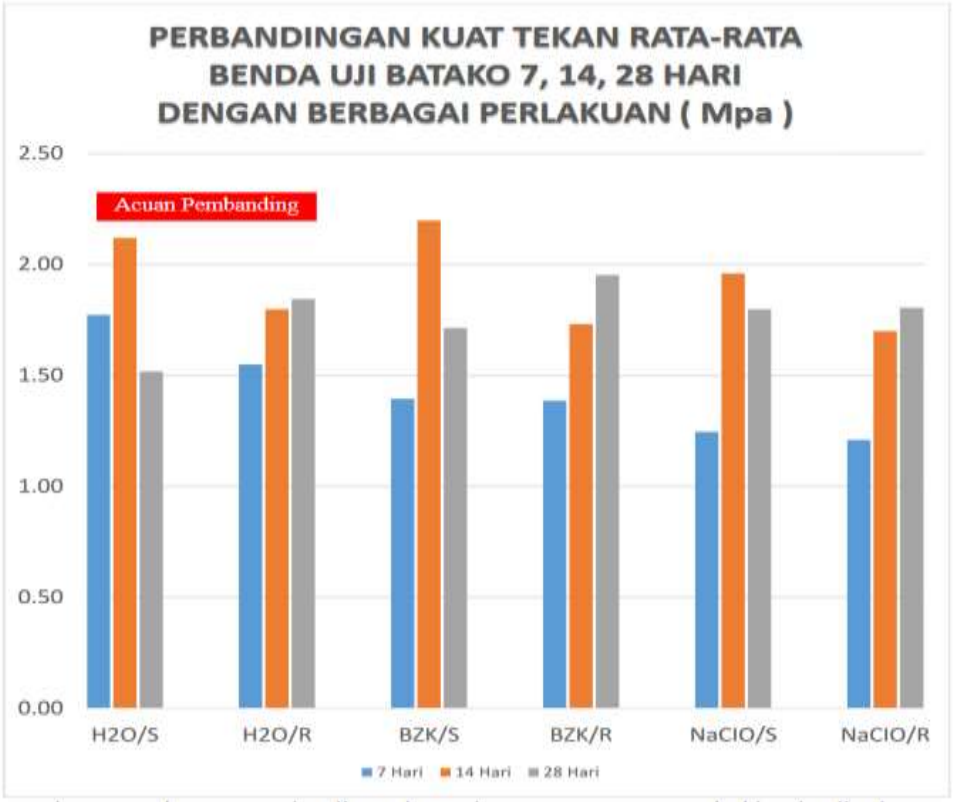

Figure 5. Histogram Comparison of The Average Compressive Strength of All Variations Batako Brick at Each Age
Source: Data in Research, 2020

Table 5. Comparison Results of Average Compressive Strength of All Batako Brick Variations at Each Age

No	Type	Water		BENZALKONIUM		NaClO	
	No.	1	2	3	4	5	6
	Unit	(MPa)	(MPa)	(MPa)	(MPa)	(MPa)	(MPa)
	Date / kode	H_2O/S (reference)	H_2O/R (reference)	BZK/S	BZK/R	NaClO/S	NaClO/R
a	7 Days	1,77	1,55	1,39	1,39	1,25	1,21
b	14 Days	2,12	1,80	2,20	1,73	1,96	1,70
c	28 Days	1,52	1,84	1,71	1,95	1,80	1,81

Source: Data in Research, 2020

6. Conclusions

1. From all photo data and observations of the test object material up to 28 days of treatment, there are no signs of damage either for mortar, white brick, red brick, and brick material
2. From the data above, at the age of 7, 14, and 28 days of specimens it can be concluded that:
   a. The compressive strength of the Mortar specimen group as a whole shows a tendency to increase the maximum compressive strength of 91.59% from the age of 7 days to 14 days and 14 days to 28 days, although some variations are noted to have decreased a maximum of 15.64% from the 14 days against the 28-day specimen.
   b. The compressive strength of the Hebel Bata specimen group as a whole shows a tendency of increasing the maximum compressive strength of 31.96% from the age of 7 days to 14 days and 14 days to 28 days, although some variations are noted to have decreased a maximum of 26.29% from the test object 7 days against the 14-day specimen.

c. The compressive strength of the Mortar specimen group as a whole shows a tendency to decrease in the maximum compressive strength of 38.00% from the age of 7 days to 14 days and 14 days to 28 days, although some variations are noted to have a slight increase in the maximum height of 77.89% of the 14 specimens. days against the test object 28 days.
d. The compressive strength of the Mortar specimen group as a whole shows a tendency to increase in the maximum compressive strength of 57.37% from the age of 7 days to 14 days and 14 days to 28 days, although some variations are noted to have decreased a maximum of 28.41% from 14 days of specimens. against the 28 day specimen.

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