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Effects of Using Benzalkonium Chloride (BZK) Disinfectant Against Density and Compressive Strength of Concrete

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Abstract

During the Covid-19 pandemic, where's the number of infections was increasing every day, there were many uses of massive disinfectants as a means of suppressing the spread of viruses in the environment. No exception, buildings, structures, and residential areas are also exposed to disinfectants every day to avoid and kill the growth of invisible viruses around us. The use of chemical disinfectants such as Benzalkonium Chloride contained on floor cleaning products is often used by the public and even disinfection officers because they are easy to get. The purpose of this study was to determine the disinfectant effect of Benzalkonium Chloride with the recommended level of disinfection dissolving spray and soak (penetration) on the density and compressive strength of concrete. The method used in this research was experimental by conducting trial mixes and special treatments that are carried out at the Becakayu Toll Road Concrete Batching Plant Laboratory - PT. Waskita Beton Precast, Tbk. From the results of the study, it was concluded that the decrease in density in the concrete with Benzalkonium Chloride spray treatment and normal water spray had an average density decrease and the concrete with Benzalkonium Chloride spray had a higher reduction value than that of water spray treatment, whereas in the samples the penetration treatment of Benzalkonium Chloride and normal water curing had an average density increase and the penetration treatment of Benzalkonium Chloride had a higher density value than that of normal water curing concrete. For the results of the compressive strength of the test objects at all qualities (K-175, K-300, and K-500), Benzalkonium Chloride spray treatment and water spray experienced an increase in compressive strength at the age of 14 days but the compressive strength decreased again at the age of 28 days, whereas the benzalkonium Chloride spray treatment sample on average has a lower compressive strength than the water sprayed test sample.

Keywords:
Benzalkonium Chloride, Compressive Strength, Density, Disinfectant Concrete.

1. Introduction

The spread of a new virus called SARS CoV-2 or what we usually call the Coronavirus originating from the city of Wuhan, China causes a disease called Covid-19 that has been confirmed by WHO as a world pandemic because of its uncontrollable spread. One of the easiest countermeasures is disinfection of parts of residential structures carried out every day to avoid and prevent possible growth of the virus

The disinfectant contains chloride which in a similar study shows that the chloride reduces the compressive strength of concrete, so it is necessary to study the spraying and penetration of disinfectant in concrete to the density and compressive strength after continuous spraying.

The research results of Meidiani and Septa Hartawan (2017) concluded that the use of acidic water pH, which is the lower the pH value of the water used, the resulting concrete compressive strength decreases from normal concrete compressive strength. In previous research by Sutandar (2016) concluded that maintaining hydration conditions when the concrete experiences hardening by maintaining the immersion method with water will increase the compressive strength of the initial plan concrete. The results of the research Hardianti, Kristiawan, and Wibowo (2017) state that concrete in an acidic environment will be exposed to corrosion more quickly which causes concrete degradation. The higher the percentage of chloride in the concrete, the shorter the service life of the concrete.

Due to the global Corona virus pandemic, massive spraying of disinfectants has continued to be carried out in every place to date, this research is expected to produce knowledge about the effects of disinfection activities on building structures and the assumption of density changes and a decrease in compressive strength in concrete using Benzalkonium Chloride solution.

2. Method

This study uses a trial or experimental method. According to Zulnaidi (2007) it explains that the experimental method is a study conducted to reveal the causal relationship of two or more variables by controlling the influence of the other variables. The independent variable in this study is Benzalkonium Chloride which is assumed to affect the density and compressive strength when sprayed and penetrated into a fixed variable that are concrete with quality variants of K-175, K-300 and K-500 with dimensions of Ø10,85cm x 20cm. The research process and procedures will refer to SNI (Indonesian National Standard), ASTM (American Society for Testing and Materials), and previous journals by related research. SNI 03-2834-2000 (2000), ASTM International (2010a), ASTM International (2010b)

Prior to the implementation of making research samples, the materials used will be tested for quality and specifications. The tests carried out for the physical aggregate test are coloid content test (SNI 2816 2014) (Statements and Size 2003), sieve analysis test (Pusat Penelitian dan Pengembangan Jalan dan Jembatan 1990), specific gravity (SNI 1970 2008), absorption (Badan Standarisasi Nasional 1990) (ASTM I n.d.), clay lump test (SNI.03-4141-1996 1996) (ASTM C 142-97 1998), organic impurities for fine aggregates (SNI 2816 2014)(SNI 03-2816-1992 1992), density (International 2003), and abration test(SNI 2417-2008 2008)

The dosage for Benzalkonium Chloride was 0.1% (The International Pharmacopoeia 2019) with a calculation of 0.1% x 1000 ml) /1.25% = 80 ml. The dissolving dose per liter is 80 ml.

3. Materials

Mix design sample made using OPC cement material type 1 (Semen Gresik), soft aggregate ex. Jambi, soft aggregate ex. Leles, coarse aggregate screening size 5 - 10 mm ex. Rumpin, clean water (PAM Aetra), additive type F (Console P200 New) and the use of benzalkonium Chloride concentrate 1.25% in the wipol product variant "Sereh & Jeruk" as a disinfectant and penetration solution.

The selection of concrete mixture materials by quantity or ratio will be presented in the following table:

Table 1. Trial Mix Design

Material	Unit	TM K175 K175 (Kg/m³)	TM K300 K300 (Kg/m³)	TM K500 K500 (Kg/m³)
OPC Type I	Kg/m³	270	350	440
Soft Aggregate Ex. Jambi	Kg/m³	480	429	495
Soft Aggregate Ex. Leles	Kg/m³	476	426	491
coarse Aggregate 5-10 Ex. Rumpin	Kg/m³	879	913	828
Clean Water Aetra	Ltr/m³	175	175	130
Admixture Type F	Ltr/m³	-	-	4,11
W/C Ratio		0,648	0,5	0,295

Source: Research Data, 2020

4. Results and Analysis

Testing and research analysis using Benzalkonium Chloride on concrete density and compressive strength of concrete with concrete qualities of K-175, K-300 and K-500.

In this section are the results of tests and analyzes treated for 7 days, 14 days and 28 days for each concrete quality.

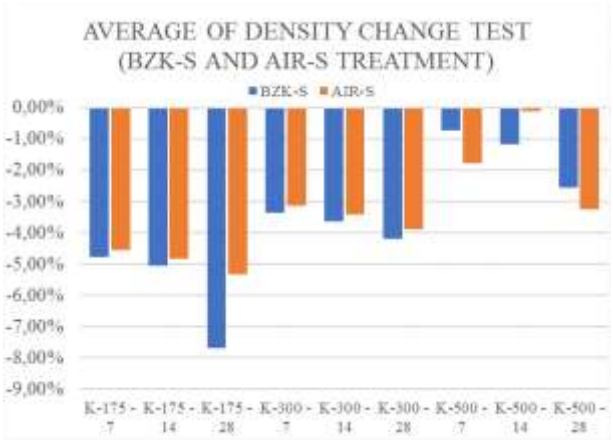

Figure 1. The Result Data Average Density Change of Concrete Treatment BZK-S and AIR-S
Source: Research Data, 2020

The next following is a table of information and details of the data from Figure 1:

Table 2. Result Data Average Density Change of Concrete Treatment BZK-S and AIR-S

Sample Code	BZK-S	AIR-S	Selisih
K-175 - 7	-4,79%	-4,57%	-0,22%
K-175 - 14	-5,06%	-4,83%	-0,23%
K-175 - 28	-7,68%	-5,34%	-2,34%
K-300 - 7	-3,35%	-3,14%	-0,21%
K-300 -14	-3,65%	-3,42%	-0,22%
K-300 -28	-4,20%	-3,88%	-0,32%
K-500 -7	-0,73%	-1,79%	1,06%
K-500 -14	-1,18%	-0,12%	-1,06%
K-500 -28	-2,57%	-3,26%	0,69%

Source: Research Data, 2020

From the data in Figure 1 and Table 1 shows that the samples BZK-S (Benzalkonium Chloride Spray) and AIR-S (Water Spray) make a decrease in density, and the average density reduction of the BZK-S treatment was higher than AIR-S treatment, except for the 7-day K-500 and 28-day K-500 samples.

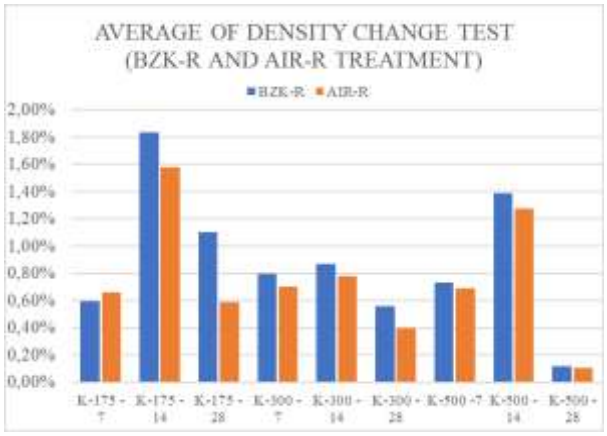

Figure 2. The Result Data Average Density Change of Concrete Treatment BZK-R and AIR-R
Source: Research Data, 2020

The next following is a table of information and details of the data from Figure 2:

Table 3. Result Data Average Density Change of Concrete Treatment BZK-R and AIR-R

Sample Code	BZK-R	AIR-R	Selisih
K-175 - 7	0,60%	0,66%	-0,07%
K-175 - 14	1,84%	1,58%	0,26%
K-175 - 28	1,10%	0,59%	0,52%
K-300 - 7	0,80%	0,70%	0,10%
K-300 -14	0,87%	0,78%	0,08%
K-300 -28	0,56%	0,40%	0,16%
K-500 -7	0,73%	0,69%	0,04%
K-500 -14	1,39%	1,27%	0,12%
K-500 -28	0,12%	0,11%	0,01%

Source: Research Data, 2020

From the data in Figure 2 and Table 3 shows that the sample BZK-R (Benzalkonium Chloride penetration) and AIR-R (water curing) make an increase in density and the average density increase in BZK-R treatment was higher than AIR-R treatment, except for the 7-day old K-175 sample.

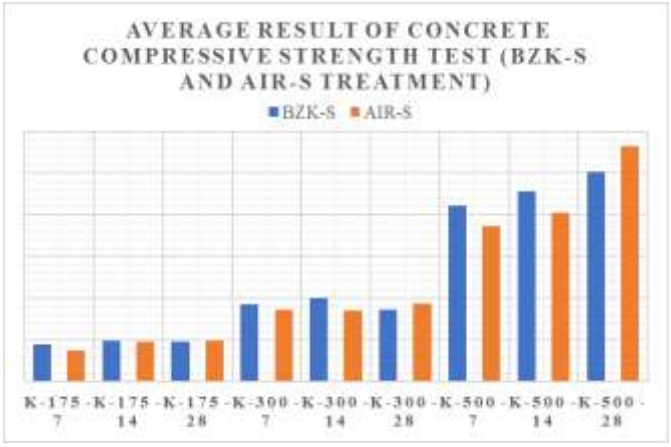

Figure 3. Average Results of Concrete Compressive Strength Tests for BZK-S and AIR-S Treatment
Source: Research Data, 2020

The next following is a table of information and details of the data from Figure 3:

Table 4. Data of Average Compressive Strength of BZK-S and AIR-S Treatment Objects

Sample Code	BZK-S	AIR-S	Difference (%)
K-175 - 7	89,61	75,47	18,75%
K-175 - 14	98,72	95,73	3,12%
K-175 - 28	95	98,65	-3,70%
K-300 - 7	184,68	172,5	7,06%
K-300 -14	200,55	171,52	16,92%
K-300 -28	171,92	187,87	-8,49%
K-500 -7	421,3	372,14	13,21%
K-500 -14	455,51	406,02	12,19%
K-500 -28	502,48	565,06	-11,07%

Source: Research Data, 2020

From the data in Figure 3 and Table 4 shows that the compressive strength of the test objects at all qualities (K-175, K-300 and K-500) treatment of BZK-S (Benzalkonium Chloride Spray) and AIR-S (Spray Water) made an increase in compressive strength at the age of 14 days but the compressive strength decreased at the age of 28 days.

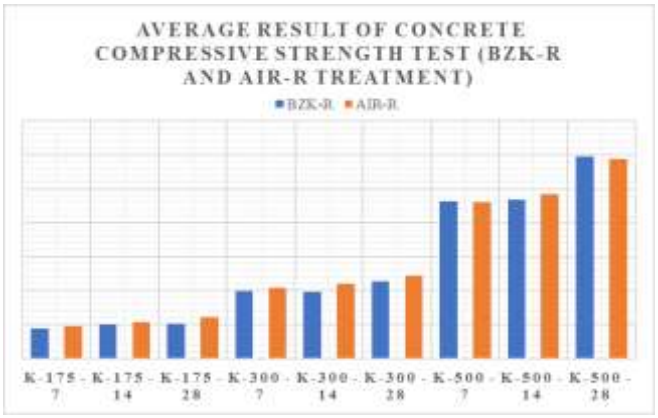

Figure 4. Average Results of Concrete Compressive Strength Tests for BZK-R and AIR-R Treatment
Source: Research Data, 2020

The next following is a table of information and details of the data from Figure 4:

Table 5. Data of Average Compressive Strength of BZK-S and AIR-S Treatment Objects

Sample Code	BZK-R	AIR-R	Diference (%)
K-175 - 7	87,11	95,26	-8,55%
K-175 - 14	100,84	106,95	-5,71%
K-175 - 28	1 03,7	122,96	-15,67%
K-300 - 7	198,3	209,39	-5,30%
K-300 -14	195,84	220,55	-11,20%
K-300 -28	228,52	243,34	-6,09%
K-500 -7	462,76	460,7	0,45%
K-500 -14	467,41	484,61	-3,55%
K-500 -28	595,95	587,11	1,50%

Source: Research Data, 2020

From the data in Figure 4 and Table 5 above, it shows that the BZK-R (Benzalkonium Chloride penetration) treatment sample on average makes a lower compressive strength compared to the treatment of the AIR-R (water curing) sample, except for the 7-days old K-500 sample 28-days old K-500.

5. Conclusions

The experimental results of BZK-S (Benzalkonium Chloride spray) and AIR-S (water spray) treatment made a decrease in density and concrete treatment with BZK-S had a higher reduction value than the AIR-S treatment concrete, whereas the BZK-R (Benzalkonium Chloride penetration) and AIR-R (water curing) treatment samples made the density increase, and the treated concrete with BZK-R had a higher density increase value than the AIR-R treated concrete.

The results of the compressive strength of the samples at all qualities concrete (K-175, K-300 and K-500) of the BZK-S (Benzalkonium Chloride spray) and AIR-S (water spray) treatment made an increase in compressive strength at the age of 14-days but compressive strength decreased at the age of 28-days, while the BZK-R (Benzalkonium Chloride penetration) treatment sample on average has a lower compressive strength compared to the treatment with AIR-R (water curing) sample.

The effect of Benzalkonium Chloride disinfectant liquid dissolved according to the rules of disinfection can reduce the compressive strength of concrete but it is not very significant because the percentage effect on compressive strength and density is not too much compared to normal water treatment.

6. Acknowledgment

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