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Acid Effect Sulphate Against Strong Concrete Press Containing Lime As Substitutions of Cement and Glass As Substitution of Coarse Aggregate

Bima Arifian T. R, Syafwandi, Donald Essen, Acep Hidayat
Program Studies Civil Engineering, Faculty of Engineering, Mercubuana University
Jl Raya Kranggan No 6 Jatisampurna Bekasi 17433, Indonesia
arifianbima@gmail.com

Abstract

Lime as a concrete mixture is done because lime contains elements of calcium oxide (CaO) which is the material for the manufacture of cement from 60-65% (Tjokrodimuljo, 2007). Glass waste comes from the waste glass industry has a silica content of 72.20% (Fikriansyah and Tanzil, 2013). The use of these two materials as a concrete mixture of substitution material is expected to reduce the pollution of the CO2 gas environment due to the burning of steam from the manufacture of cement and natural resources exploitation due to excessive aggregate mining. This research aims to determine the influence of sulphuric acid from 2% for strong concrete emphasis that contains glass in lieu of coarse aggregate and lime as a cement substitution. Penelitian ini menggunakan campuran lime dari 7% dan 10% dari berat semen, serta 5% dari limbah glass, dan 9% dari berat kerikil. Compressive strength testing is carried out on the 7th, 14th, 21th, and 28th days. Results of this study showed that the strong emphasis of concrete with a lime mixture of 10% + 5% Glass on 28 days obtained a strong press of 12.13 MPA higher than normal concrete ie 7.68 MPA on the 28th day.

Keywords
Compressive Strength, Concrete, Environmentally Friendly Materials, Waste Glass

1. Introduction

Concrete is a building material that is strong against the pressure, but strong concrete press can be decreased which can be caused by external problems or environmental problems, such as for example such as the environment of acidic rain area industrial areas Cibinong – Citeureup Bogor. Basuki (2013)said that this concrete chemical attack is practically distinguished by five categories, Namely categories of acids, ammonium, magnesium, sulphate and alkali hydroxide. The attack of sulfuric acid in concrete can cause damage to the long term in the structure of buildings, especially building structures such as foundations, and basement.

Departemen Pekerjaan Umum (1991) provides a definition of concrete as a mixture of Portland cement or other hydraulic cement, smooth aggregate, coarse aggregate and water, with or without additional material forming solid mass. The negative impact of cement mill gas disposal is CO2, annually over 4 billion tonnes of cement in production and contributes as much as 8% carbon dioxide emissions (CO2) in the world (Lehne and Preston, 2018). As a result of the increasing impact of CO2 it will result in the effect of global warming or greenhouse effect causing the temperature on the Earth's surface to rise.

In addition to cement, concrete manufacturing materials are gravel and sand. To get it must be done mining that can pollute the environment, the impact that will occur when conducting continuous mining of landslides, lack of water availability, erosion.

In this research will try to substitute the waste of glass with gravel, and substituted lime with cement and then soaked in sulfuric acid water. The glass also contains silica of 72.20% (Fikriansyah and Tanzil, 2013) which can be used as a substitute for concrete mixture. The selection of lime as a concrete mixture is done because lime contains elements of calcium oxide (CaO) which is a material for the manufacture of cement of 60-65%, (Tjokrodimuljo, 2007).

2. Materials and Methods

2.1. Materials

In this research the materials used in concrete mixtures are as follows:

a. The lime used in this study is the lime-calcium powder breaching found in the building store
b. Glass used is a type of tempered glass from the company PT. Aneka Kreasi Glassindo, Cawang, Jakarta timur

c. Sulfuric acid used in the study is a liquid sulphuric acid that can be obtained in the chemical store
d. Cement used in this research is type 1-OPC cement from Gresik cement
e. The water used in this study came from the UMB civil Engineering Laboratotium.
f. The sand used in this study was the sand that originated in Bangka.
g. The gravel used in this study was gravel derived from Bogor.

Figure 1. Lime Calcium

Figure 2. Tempered Glass

2.2. Methode

In this research researchers use experimental methods by mixing free variables and and in the underlying. The free variables in this study were lime (X1) and glass waste (X2), while the company's variables were sulfuric (Y) and strong concrete press [Z]. Both variables are mixed in one concrete mixture with a variation of 7% and 10% of the weight of cement for the variation of lime, 5% and 9% of the weight of gravel for variations of glass waste and then soaked with acid sulfate liquid by 2%

Before conducting the test, there are several necessary steps that prepare the necessary tools and materials. After that the material is tested according to testing standards. If the materials used meet the requirements, the next stage is the calculation of mix design. After the mix design calculation is complete, the next step is to do a trial mix. At trial mix stage required slump test to know the fresh concrete workability. When the slump test is qualified, the concrete can be poured to the mold and wait until dry or ± 24 new hours the mold can be opened. In this research the concrete was printed using a cube mold measuring 15x15x15 cm. The next stage is the curing process at this stage of curing using acid sulphate liquid by 2% by soaking in the water bath until a specified day. The day before a strong test press, the concrete should be removed from the tub and drained first. Powerful test press done on day 7, to 21, to 24 and to 28 life of concrete. After the entire testing phase, the last stage is to analyze and conclude the result of the test.

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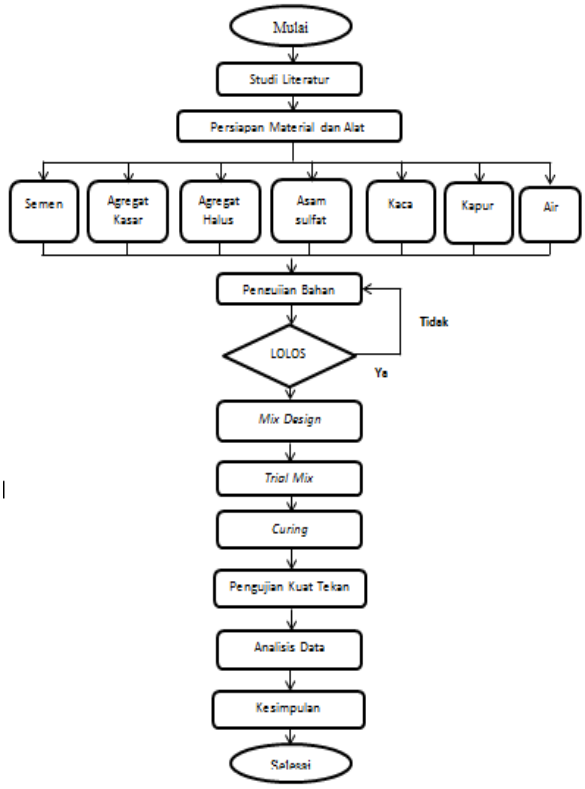

Figure 3. Flowchart

Table 1. Amount of Material Required For 1 m^3 Concrete With Quality K-175

Material	Amount of material ($\boldsymbol{kg/m^3}$)
Cement	75
Water	45
Sand	172
Gravel	258

This research carried out as many as 4 variations of the mixture plus normal concrete as control concrete. Each variation of each day has 3 samples. So, the total of all variations plus normal concrete as much as 60 samples. Here is the amount of material needed for each 15x15x15 cm cube:

Table 2. Amount of Material Required For 1 Mold Cube 15x15x15 Cm

variation		cement	sand	gravel	water	glass	lime
glass	lime	(Kg)	(Kg)	(Kg)	(Kg)	(Kg)	(Kg)
0%	0%	1,2488	2,8620	4,2930	0,7493	0,0000	0,0
5%	7%	1,1613	2,8620	4,0784	0,7493	0,2147	0,087
9%	7%	1,1613	2,8620	3,9066	0,7493	0,3864	0,087
5%	10%	1,1239	2,8620	4,0784	0,7493	0,2147	0,125
9%	10%	1,1239	2,8620	3,9066	0,7493	0,3864	0,125

2.3. Place and Time of Research

a. place : Laboratotium Structure and Materials Building of Civil Engineering study Program, Faculty of Engineering, University of MERCU Buana Bekasi campus D.
b. Time : may 2020 s.d July 2020

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3. Results and Discussion

3.1. Gravel Gradation Testing

Figure 4. Gravel
Source : Research Data

Gravel gradation Testing aims to determine the gradation of gravel grains. Please note that gravel grains are held in the No. 4 sieve. Here are the results of gravel gradation testing:

Table 3. Gravel Gradation Testing

Heavy dry material : 1000 gr

Filter	Heavy restrained (gram)	Amount of weight held (gram)	amount percent	
			Stuck	Escape
50.80 (2")	0	0		
36.10 (1 1/2")	0	0		100,00
25.40 (1")	0	0	0,00	100,00
19.10 (3/4")	440	440	44,00	56,00
6.3 (1/4")	370	810	81,00	19,00
No. 4	190	1000	100,00	0,00
No. 8	0	1000	100,00	-
No. 12	0	1000	100,00	-
No. 16	0	1000	100,00	-
No. 30	0	1000	100,00	-
No. 50	0	1000	100,00	-
No. 100	0	1000	100,00	-
No. 200	0	1000	100,00	-
PAN	0	1000	100,00	0,00

Fineness Modulus = 7,25

Source : Research Data

3.2. Sand Gradation Testing

Figure 5. Sand
Source : Research Data

Sand gradation Testing aims to determine the gradation of sand grains. Please note that the grain of sand escapes in the sieve No. 100. Here are the results of sand gradation testing:

Table 4. Pengujian gradasi agregat halus

	heavy dry material :		1000,0	gr
filter	Heavey restrained (gram)	Amount of weight held (gram)	amount percent	
			stuck	escape
50.80 (2")				
25.40 (1")				
19.10 (3/4")				
6.3 (1/4")	-	-	0,00	100,00
No. 4	10	10,00	1,00	99,00
No. 8	30,00	40,00	4,00	96,00
No. 12	45,00	85,00	8,50	91,50
No. 16	55,00	140,00	14,00	86,00
No. 30	255,00	395,00	39,50	60,50
No. 50	350,00	745,00	74,50	25,50
No. 80	220,00	965,00	96,50	3,50
No. 100	20,00	985,00	98,50	1,50
No. 200	15,0	1000,00	100,00	0,00
PAN	0,0	1000,0	100,00	0,00
Fineness Modulus =	3,365			

3.3. Test Slump (Workability)

Slump test is needed to find out the level of fresh concrete agility. The higher the value of slump then the concrete is more dilute and easy to work, likewise vice versa. In this research researchers plan a slump value of 60-180 mm

Table 5. Test Stump

	Variation	Slump value
N	lime (0%) + Glass (0%)	11,3
A	Lime (7%) + Glass (5%)	10,4
B	Lime (7%) + Glass (9%)	9,8
C	Lime (10%) + Glass (5%)	11,3
D	Lime (10%) + Glass (9%)	10

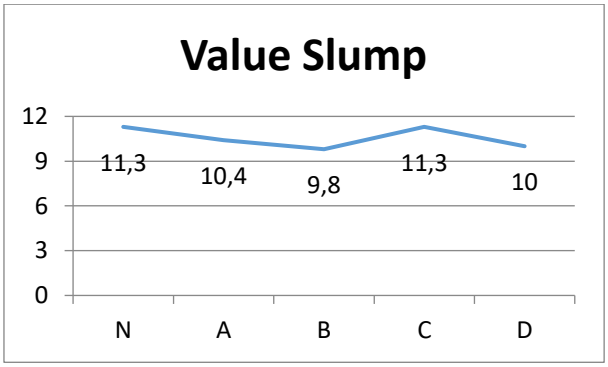
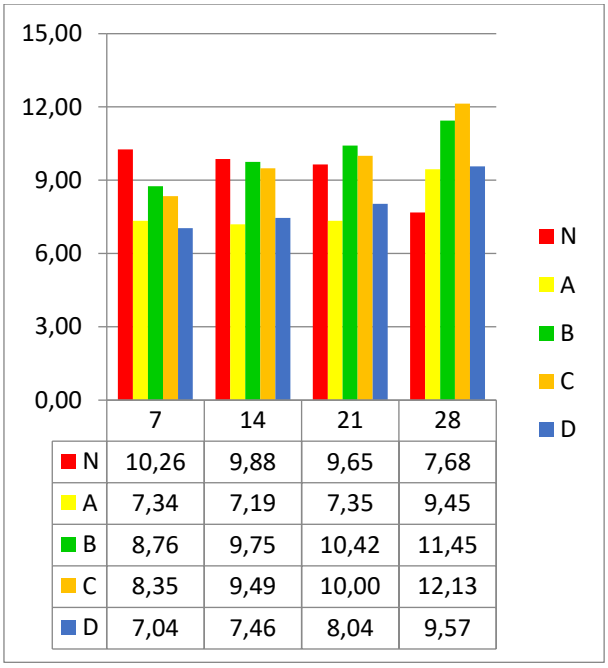


Figure 6. Slump Test Result
Source : Research Data

3.4. Strong Concrete Press Testing

The powerful testing of concrete press is done by using a test press tool with 12 concrete samples of each variation. 3 samples on day 7, to 14, to 21, to 28. Here are the results of a strong press test:



	7	14	21	28
N	10,26	9,88	9,65	7,68
A	7,34	7,19	7,35	9,45
B	8,76	9,75	10,42	11,45
C	8,35	9,49	10,00	12,13
D	7,04	7,46	8,04	9,57

Figure 7. Strong result Concrete Press
Source: Data Penelitian

From a strong test chart press the whole variation, it can be seen that the average strong press on the concrete subsitution of the 7th day, the 14th, the 21st, until the 28th is increased compared to with strong concrete press normal that has decreased from the 7th day to the 14th, 21st, until the 28th. The highest press strength is on day 28 is a concrete variation C with a mixture of Lime 10% + Glass 5% with a strong press of 12.13 Mpa

4. Conclusion

1. Lime as a cement substitution and glass as a gravel substitution that is soaked sulfuric acid can affect the strong press of concrete.
2. In the results of strong test press that has been done, on the 28th day of concrete substitutions are soaked sulfuric acid higher than normal concrete soaked sulfuric acid
3. In the research that has been done strong press highs found in the concrete variation C with a lime mixture 10% + glass 5% on day 28 with a strong press of 12.13 MPA higher than normal concrete ie 7.68 MPA on the 28th day
4. In research that has been done can be concluded that on the 28th day of the use of lime as a subsitution of cement and glass as a subsitution gravel can prevent acid sulfate attack with a rate of 2% compared to normal concrete in the sulfuric acid soak on the 28th day
5. Based on the results of concrete research with substituted material in the form of lime as a material substitution of cement and glass as a substitute material of gravel more efficiently used for the manufacture of non-structural concrete.
6. The increase in concrete substitutions are caused by lime calcium mixed with water during the mixing process due to lime calcium when given water will be lime extinguished or a base compound that is calcium hydroxide (Ca (OH2)) that can react with sulfuric acid compounds (H2SO4) with acid valence and base 2 so as to prevent attacks from the sulfuric acid

4.1. Advice

1. At the time of use of sulfuric acid as research should use PVC gloves and use chemical safety clothes.
2. In the weighing process materials, the scales must be at a weight of 0 Kg to fit the required material weight
3. During the mixing process using the mixer should be observed to make all the materials mixed evenly.
4. In concrete molding process, concrete compaction should be observed so that the resulting concrete is not bone loss that can affect the strong press concrete.

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