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The Effect Of Adding Cement Waste On The Quality Of Concrete Compressive

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ABSTRACT

The demand for concrete is increasing which causes the need for cement to increase as well. It can be seen from the raw material, cement is a type of concrete constituent material that is classified as a non-renewable natural resource. The authors conducted research on the effect of adding cement waste to the compressive strength of concrete. This study used an experimental method with a total of 24 test objects. The test object is in the form of a concrete cylinder with a diameter of 15 cm and a height of 30 cm and uses variations in the composition of the addition of cement waste cement as a substitute for fine aggregate, namely 0%, 2%, 4%, and 6% (K200). The compressive strength test was carried out at the age of 7 days and 28 days. The test results show that the use of waste as a partial substitute for fine aggregate results in a decrease in the compressive strength of each mixture. at the age of 7 days, the variation of 2% is 16.84 MPa, 4% is 11.32 MPa and for a mixture of 6% is 6.68 MPa. Meanwhile, the compressive strength test value of 28 days old concrete in each mixture decreased by ± 6 MPa. The conclusion is cement waste cannot be used as a substitute for fine aggregate in fc' 16.6 MPa (K200) quality concrete because the value is lower than the specified minimum.



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1. Introduction

Infrastructure development is one of the important aspects of the progress of a country where most of the constituents of infrastructure are concrete. The most important constituent of concrete is cement because its function is to bind other concrete materials so that it can form a hard mass [1].

With the rampant development in the construction world, the demand for concrete is increasing which causes the need for cement to increase as well. It can be seen from the raw material, cement is a type of concrete constituent material which is classified as a non-renewable natural resource. So the use of cement as a type of concrete building material that is needed in large quantities will disrupt the environmental balance considering the existence of a cement production process, to simplify: 1 ton of cement can produce 1 ton of carbon dioxide (CO₂) [2]

In this study, the author intends to conduct research on the effect of using cement waste as a mixture additive in the manufacture of concrete. One of the waste materials that are often found, especially in residential areas and residential developments. With so many residential developments, the use of cement as a building material will leave quite a lot of cement bags. Zak semen waste can be a blessing if it is used but can also be a disaster, if it is not used and managed properly, because it can cause problems in the form of environmental pollution and animal nesting places.

2. Literature Review

The main objective of this study was to find out and analyze how much the influence of the coconut shell charcoal had on changes in compressive strength and water absorption in the K-175 paving block. The conversion value of compressive strength of specimens at the age of 7 days to 28 days from specimens N, 5%, 10%, 15% and 20% is 271,80 kg/cm², 205,12 kg/cm², 102,57 kg/cm², 76,92 kg/cm² and 64,11 kg/cm² respectively. In the normal test code, the paving block is classified as class B quality, while the 5% specimen code is classified as class B quality, for the test object code 10%, 15%, and 20% do not meet the paving block quality standards. The results of the water absorption test increased in paving blocks with a combination of coconut shell charcoal. All of them have increased water infiltration on paving blocks. [3]

The addition of paper grains to the concrete mixture reduces the compressive strength of concrete (compared to normal concrete) and according to a journal entitled "Alternatives for Using Paper Mill Waste as a Partial Replacement for Cement (Cementitious) in "Concrete Making" in the journal uses the proportions added to the cement

mixture in the concrete by 0%, 5%, and 10%. So the author concludes make the proportion less than 10% [4].

In a previous study using newspaper waste [5], it was found that newsprint material could not be used as a mixture, this was evident from the results of the trial of 3 samples. From the results of the normal concrete compressive strength test with 7 days of age converted to 28 days, the average value of 3 samples with a 3% percentage is 18.4 MPa, 5% percentage is 8.6 Mpa, and 10% percentage is 5.8 MPa. From the results of the compressive strength test of paper waste concrete with an age of 7 days converted to 28 days, the composition of 3% is suitable for use. So the 3% percentage of paper waste meets the requirements to be made into fine aggregate in concrete.

The results of the study showed that the workability of concrete containing waste paper ash decreased. There is a significant increase in the compressive strength of concrete. The replacement of ordinary Portland cement with waste paper ash up to 10% produces a better compressive strength than the convection mixture. An increase of 5.6% & 1.2% was observed for 5%, & 10% of replacement respectively. But the compressive strength decreases with the replacement of waste paper ash which increases by more than 10%. The highest compressive strength of 37.89kN/m² was obtained for concrete containing 5% waste paper as [6]

The addition of industrial by-products is presented as a promising alternative to the addition of more Portland cement in the RAC to improve the quality of the RAC. The results showed that the strength and durability of RAC containing mineral additives in the addition method was higher than the addition of more cement or the replacement method. In particular, PSA greatly improves the mechanical properties of RAC at an early age, and substantially increases the resistance of RAC to acid and sulfuric attack. At 90 days, FA and MK increased the mechanical properties of RAC more than SF and PSA. Among the combinations, the proportions of by-products in RAC 5% PSA, 10% SF, 15% MK and 15% FA can produce the highest RAC performance with 100% recycled concrete coarse aggregate (RCA) [7].

3. Research Method

3.1 Research Plan

This research method is carried out using SNI [8] concrete according to the data from the literature study and the test will be carried out in the UNISLA laboratory. The

sample made is fresh concrete with a mixture composition ratio that uses zak semen waste as a concrete mixture.

The test object is in the form of a cylindrical concrete mold to print concrete to be tested in concrete mix research using Zak Semen waste as a concrete mixture, chemical tests and concrete compressive strength will be carried out to determine the chemical content in the concrete mixture and how strong the concrete is. The test object will be tested within 7 days, within this timeframe the highest value will be known for each test that has been carried out.

3.2 Types of Research

The research method used is trial and error with laboratory tests. With the following types of testing:

1. Test of concrete constituents
 - a. Portland cement test (PC)
 - b. Fine aggregate test
 - c. Coarse aggregate test
2. Analysis of cement waste as a mixture of fine aggregate.
3. Preparation of job mix design using standard SNI 03-2834-2000 with concrete quality.[8]
4. Compressive strength test based on SNI 03-1974-1990.[9]

3.3 Research Sites

This research was conducted at the Civil Engineering Laboratory of the Civil Engineering Study Program, Faculty of Engineering, Universitas Islam Lamongan.

3.4 Data Collection Techniques

The data was carried out by making normal concrete samples with additional variations of 0%, 2%, 4%, 6% cement bags as an added material to the concrete mixture, which was then tested using a pressure test gauge to determine the compressive strength of each mixture variation of the concrete sample.

4. Results and Discussion

4.1 Cement

The results of the cement test conducted at the Civil Engineering laboratory of the Islamic University of Lamongan (UNISLA) are as follows:

1. The results of the cement consistency test meet the standard requirements (ASTM C 187-86) [10], with a decrease of 10 mm with 69 cc of water to determine the standard condition of the wetness of the paste.
2. Testing the time of binding and hardening of normal cement without a mixture takes 225 minutes for the standard, this result is to determine the time required by cement during the binding process [11].
3. From the experiment of testing the specific gravity of cement, an average value of 2.83 gr was obtained. According to the provisions of SNI 15-2531 [12], the specific gravity of cement is between 3.00 – 3.20 t/m³, so the specific gravity of the cement does not meet the standard provisions that have been set.

4.2 Fine Aggregate

The results of the fine aggregate physical test carried out at the Civil Engineering Laboratory of the Islamic University of Lamongan (UNISLA) are as follows:

1. The results of the fine aggregate sieve analysis test data obtained the value of FM = 3.19%, this value meets the quality requirements (SK SNI S 04 1989 F) [13] which is 1.5 – 3.8%. So that this fine aggregate gradation is in Zone 2.
2. Specific gravity testing of fine aggregates obtained the average value of the two tests, namely 2.7 gr/dm³. Based on the standard (ASTM C 128 – 78) [14] the specific gravity of sand required is within the range of 2.4 – 2.7 g/dm³. So the sand above meets the standard requirements.
3. It is known that the average sand moisture is 2.56%. This value is greater than the provisions of ASTM C 566 – 89 which is allowed for sand moisture of <0.1%, then the fine aggregate does not meet the quality standards of ASTM C 566 – 89 [15].
4. From the results of the water content infiltration test of fine aggregate, the average value of the two experiments is 2.78%. This value is greater than the provisions of ASTM C 566 – 89 [15] which is allowed for sand moisture of < 0.1%, so it can be said that the fine aggregate does not meet the requirements.
5. The results of the average value from the results of testing the weight of the volume of sand in ordinary conditions, with kneading, with a knock, are 1.417 gr/lit. According to SNI [16] the permissible value is 1.2 gr/lit. So the sand volume weight test is not suitable [17].

4.3 Coarse Aggregate

The results of the physical test of coarse aggregate carried out at the Civil Engineering Laboratory of the Islamic University of Lamongan (UNISLA) are as follows:

1. The results of the test sieve data analysis of the coarse aggregate sieve obtained the value of FM = 2.79%. this value does not meet the quality requirements (ASTM C 33 – 98)[18] which is 6 – 7%. So that the gradation of coarse aggregate tends to be flat / not coarse [19].
2. From the results of testing the specific gravity of coarse aggregate, it is known that the average specific gravity of gravel = 2.414 gr. Based on the standard quality requirements for testing the specific gravity of gravel (ASTM C 127-88-93) [20] the value of 2.2 gr – 2.7 gr is allowed. So the gravel above is eligible for use.
3. The humidity of coarse aggregate is obtained by the average moisture value of gravel = 1.25%. Because it is not in the quality standard (ASTM C 566-89) [15], the moisture obtained can be used in the mix design.
4. From the results of the coarse aggregate infiltration water test, the average gravel infiltration water value = 1.2%. Based on the standard quality of gravel infiltration water testing requirements (ASTM C 127-88-93) [20] a value of 1 – 4% is allowed. So the gravel above is eligible for use.
5. From the results of testing the weight of the volume of coarse aggregate, it is obtained that the average weight value of the volume of coarse aggregate from the experiment with ordinary conditions, with a knock, with a knock is 1.445 kg. The standard requirement for crushed stone volume according to (ASTM C 127 88 – 93) [20] is between 1.4 – 1.7. So the weight of the aggregate volume in the above experiment meets the quality standard.

From the results of the coarse aggregate sieve analysis test, it can be concluded that the coarse aggregate sieve analysis test data obtained the value of FM = 3.33%, this value does not meet the quality requirements (ASTM C 33 - 98) [18] which is 6 - 7%. So that the gradation of coarse aggregate tends to be flat / not coarse.

4.4 Process of Making Zak Cement Pulp

The used cement waste that has been collected from the remnants of housing development projects as well as the construction of ordinary houses in the Lamongan area is then cleaned from the remaining cement or dirt attached, then torn or cut the cement bag with scissors, if you have prepared a bucket or basin that.



Source: Author's documentation 2021

Figure 1. Semen Zak Waste Cleaning

The next process that will be carried out is the process of soaking the cement sack paper which has been cut into small pieces for the manufacture of paper pulp, in this stage the immersion is carried out by inserting pieces of cement sack paper waste into a bucket or basin filled with water. Wait a few days until the soaked material melts, after the material melts then the drying process. Then dry the cement pulp pulp under the hot sun until it dries. If it is deemed sufficient, what is needed will then be made of concrete with the addition of cement cement pulp which is carried out in the Civil Engineering laboratory, Lamongan Islamic University.



Source: Author's documentation 2021

Figure 2. Immersion of cement sack waste



Source: Author's documentation 2021

Figure 3. drying of Zak Semen pulp

4.5 Mix Design

The data needed to plan the concrete mix design with SNI 03 – 2834 – 2000 [8] are as follows:

- Cement PC Type 1
- Slump (60-180) mm
- Targeted compressive strength of low strength concrete $f'c$ 16.6 MPa (K200)
- Coarse aggregate of crushed stone max. 20 mm

Table 1. Requirements for Cylindrical Test Object Concrete Materials

No.	Percent	V. Silinder	Noes	Total	Cement (Kg)	Sand (Kg)	Gravel (Kg)	Water	Added Material (Kg)
1	0%	0.0053	4	0.0212	8,36	16,12	22,27	4,35	0,00
2	2%	0.0053	4	0.0212	8,36	15,80	22,27	4,35	0,32
3	4%	0.0053	4	0.0212	8,36	15,17	22,27	4,35	0,63
4	6%	0.0053	4	0.0212	8,36	14,26	22,27	4,35	0,91

Source: Author's Calculation

Table 1 shows the job mix formula to make the concrete sample to be used, there are 4 variations of the concrete mixture, namely the addition of cement bags of 0%, 2%, 4%, and 6%.

4.6 Slump Test

The results of the slump test obtained the following values:

Table 2. Slump Test Results

No	Mix ratio	Percent	Slump 7 days	Slump 28 days
1	Normal	0%	14	13
2	Light Brick Waste	2%	10	10
3	Light Brick Waste	4%	9	8
4	Light Brick Waste	6%	6	6

Source: Research Results 2021



Source: Author's documentation 2021

Figure 4. Slump Test Documentation

The results of the slump test on the sample (table 2) of the test object show that the more mixtures the numbers decrease starting from 0% percent slump test on 7 days are worth 14, and the mixture of 2% becomes 10 and the lowest mixture of 6% becomes 6.

4.7 Compressive Strength Results

Table 3. Results of Compressive Strength of Concrete

	AVERAGE VALUE OF CONCRETE TYPE			
	Normal Concrete	Mix 2%	Mix 4%	Mix 6%
Age 7 Days	17,13	16,84	11,32	6,68
Age 28 Days	17,77	11,89	8,3	5,1

Source: Research Results 2021

From the results of the research (table 3), the results of the compressive strength test of concrete showed that at the age of 7 days and 28 days on normal concrete and cement waste concrete which was carried out at the Civil Engineering Laboratory of the Islamic University of Lamongan (UNISLA) as follows:

1. From the results of the compressive strength test of normal concrete with an age of 7 days, the average value of 3 samples is 17.13 Mpa. For age 28 the average value is 17.77 Mpa
2. From the results of the compressive strength test of concrete with a mixture of 2% cement waste with an age of 7 days and 28 days, the average value of 3 samples is 16.84 MPa. For age 28 the average value is 11.89 Mpa
3. From the results of the compressive strength test of concrete with a mixture of 4% cement waste with an age of 7 days and 28 days, the average value of 3 samples is 16.84 MPa. For age 28 the average value is 8.3 Mpa
4. From the results of the compressive strength test of concrete with a mixture of 6% cement waste with an age of 7 days and 28 days, the average value of 3 samples is 6.68 Mpa. For age 28 the average value is 5.1 Mpa.

5. Conclusion and Suggestion

5.1 Conclusion

The effect of a mixture of cement paper pulp to replace fine aggregate in concrete f_c 16.6 (K200) affects the compressive strength test on the concrete itself from the data that has been carried out research on cement pulp paper has decreased. So that as an additional mixture, cement paper pulp cannot be used as an alternative material, so it can be said that it does not meet the requirements as a concrete added material.

5.1 Suggestion

The suggestions that the author can give in relation to this research are:

1. It is recommended that when testing the concrete mixture, it should be done carefully in order to get a value that matches the standard and get good concrete results
2. It is recommended for further research that this thesis research can be continued further, because in this study there are still many shortcomings, especially in the percentage of aggregates replaced in this study.
3. In this study, the results of concrete with the addition of cement pulp pulp cannot be used for non-structural concrete because the compressive strength value is lower, for the next experiment a different test may be used.
4. In the next research, it may be possible to use other types of paper with different variations of additions and tests.

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