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THE USE OF SAWDUST WASTE ASH AS CEMENT SUBSTITUTE MATERIAL IN CONTRAST TO THE COMPRESSIVE STRENGTH OF THE K-175 QUALITY CONCRETE

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Abstract

Sawdusts as the waste from home furniture industry are frequently deemed as of low economic value. In attempt to create a healthier and waste-free environment and make use of the waste, many inovations have been being conducted. One is an attempt to create concrete technology that can make use of sawdusts ash into the concrete mix. The main aim of this study is to acknowledge how the effect of the additional sawdusts to concrete mix affect its compressive strength.. Sawdusts used in this study obtained from various kind of woods. Concrete with the additional mix used in different proportions. In this case, the ash used to substitute parts of the cement. Variations used in this study is 0%, 5%, 7%, and 10%. Testing object takes form in cylindre Ø 15 cm x 30 cm and compressive strength plan in fc f'c ± = 14,5 Mpa (K-175). After 7 days of incubation, the testing result obtained in form of 7 days compressive strength which will then correlated into 28 days. The value of compressive strength in additional variation is 0%, 5%, 7%, 10%, respectively on 19,85 Mpa, 16,54 Mpa, 15,36 Mpa, 13,23 Mpa. From the study, it is concluded that sawdusts ash cannot be used in concrete, due to its decreasing nature in compressive strength.

Keywords: ***Mixed concrete, Sawdusts, Compressive Strength, Sawdust waste***

Introduction

As a construction material, concrete used Portland cement as its main filler. One ton production of Portland cement will release around one ton of carbon dioxyde to the atmosphere (Hardjito, 2001). More prodution of cements will release more carbon dioxyde (co2) too, fastening the effect of global warming. According to *International Energy Authority* : *World Energy Outlook,* portland cement industry contributes 7% of overall carbon dyoxide (CO2) released from various sources.Unfortunately, technology for producing cements in Indonesia tend to waste energy and releasing CO2 emission which will then raising the global warming (Sobirno, 2012).

Human needs of woods as a construction material in construction, decoration, or furnitures keep increasing along with the number of inhabitants. In Indonesia, the needs of woods is predicted around 70 millions m^3 a year with average raise of 14,2 % a year, while the production of logs is predicted to be only 25 juta m^3 a year, prompting the deficit around 45 milions m^3 (Priyono, 2001). To these days, sawdusts have been causing many problems because industries tend to just left it out to rot, burned, or abandoned, bringing negative effect towards envionment. One of the methods we can think of to solve this problem is by utilizing it as product with additional value that may align well with applicative technology that can be socialized easily to the community. The main reason for the witer to study sawdusts as a concrete mix is to make use of the sawdusts that usually bring unpleasant scent in the environment.

From there, we gather some problems as follows: how is the effect of sawdusts ash towards concrete compressure strength? In this result, we briefly explain about the aim of this research as follows: to examine the effect of sawdusts ash towards K-175 quality concrete compressure strength . To examine the characteristics of sawdusts as a concrete mix. To examine the best concrete composition by using sawdusts waste ash in accordance with the testing result.

Research method

Research method in this study conducted by arranging tests in the laboratory in accordance with the SNI standard on concrete. Samples made are fresh concretes with mix composition ratio using sawdusts ash as the concrete mix. The type of study is using Test on compressive strength accoding to SNI 03-1974-1990. The research method used is job mix design by using SNI 03-2834-2000 standard with quality concrete.

Regarding technique on data collecting, the tools used to gather the data or facilities used to gather the materials are sawdusts ash, coarse aggregate, fine aggregate, cement, and water. Variables identification in this case is taking research samples and identification during the research in the labiratory, because only in this stage the research conducted will obtain valid datas. In this stage, too, the objects used will be collected and tested in the laboratory to examine the contain inside the objects or materials, fine aggregate, rough aggregate, cement, water, and the mix of sawdusts ash. In this case, mix design planning will be conducted in mix concrete plan. Parameters used in this study include: reasearch and testing on physical objects, concrete compressure strength at age 7 days.

Early stage is preparing the materials such as cement, aggregates, sawdusts ash, continued with the making of object test using cylindre, and after it's dried up will be soaked in 7 days, to then being tested for its compressure strength, and then the evaluation on its compressure strength in 7 days.

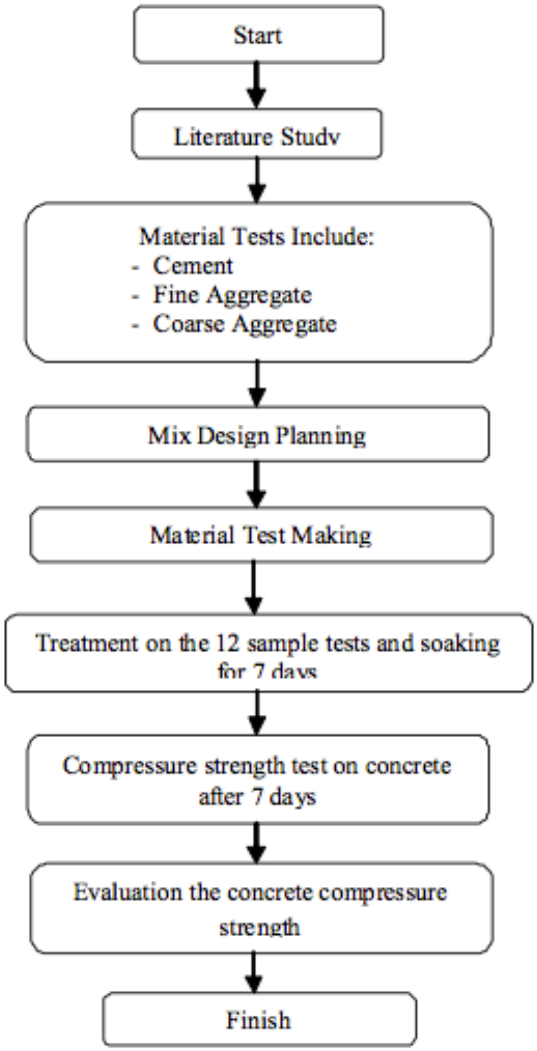

Figure 1. Flowchart of The Study

Research Result and Discussion

This Part s for the reslt of the study and its analysis. This reslt is obtained in a research conducted in the laboratory of faculty of civil engineering, Universitas Islam Lamongan (UNISLA), and will be compared to the standard required (ASTM C 192 – 90A) about the making of concrete mix. Materials used in this study is Portland cement, fine aggregate, coarse aggregate, sawdusts ash waste of 5%, 7%, 10%.

- **Materials Evaluation**

a. Cement

Testing result on cement in the laboratory of faculty of Civil Engineering Universitas Islam Lamongan (Unisla) is as follows :

1. The testing result on cement consistency filled the standard required (ASTM C 187-86), with 10 mm decline and with 80cc of water. To acquire the standard condition of the paste wetness. Consistency result is equal with all the testing because the formula for the consistency results are taken from

$$Normal\ Consistency = \frac{\text{Water weight x100}}{Cement\ weight}$$

   So there's no definite difference with the former test.
2. The testing on bonding time and normal cement hardening without addiitonal mix needs 120 minutes for standard, and this result is to acquire the time needed by the cement during the bonding time.
3. From the testing on the density of the cement it obtained an average value 2.328 gr. According to the requirements by SNI 15-2531-1991 the weight mass of the cement is around 3,00 – 3,20 t/m^3, so the weight mass of the said cement doesn't qualify for the standard required..
4. From the testing on weight mass of the cement with 5% additional mix of sawdusts ash, an average value of 2.366 gr was obtained. According to the requirements SNI 15-2531-1991 weight mass for cement must be around 3,00 – 3,20 t/m^3, hence this information indicated thatthis sample doesn't qualify the standards required.
5. From the testing of the cement mass weight with 7% additonal mix of sawdusts ash it is obtained the average value 1.851 gr. According to SNI 15-2531-1991 weight mass for cement is around 3,00 – 3,20 t/^{m3}, so the weight mass for cement doesn't qualify for the standard required.
6. From the testing of the weight mass on cement with additional 10% of sawdusts ash, it is obtained the average value of 1.454 gr. According to the standard by SNI 15-2531-1991 weight mass for cement is around 3,00 – 3,20 t/m^3, soit doesn't fit the standard required.

b. Fine Aggregate

Physical test on fine aggregate was conducted in the laboratory of faculty of civil engineering, Universitas Islam Lamongan (UNISLA) as follows:

1. The average moisture of the sand is 5.605%. This value exceeds the requirement stated in ASTM C 566 – 89 that allows sand moisture around <0.1%, hence this fine aggregate doesn't qualify for the standard required in ASTM C 566 – 89.
2. The testing on the weight mass of the fine aggregate obtained an average value from the two testings: 2.62 gr/dm^3. According to the standard (ASTM C 128 – 78) the weight mass of the sand required is the one around 2.4 – 2.7 gr/dm^3. Hence, the said sand doesn't qualify for the standard (ASTM C 128 – 78).
3. From the result of the water catchment in fine aggregate it is obtained that the average value of the two testings is 2,78%.
4. Average value of the result of weight mass testing in sand volume within its normal state, with rojokan, and with ketukan, is 1.359 gr/lt. This value is still below the minimal standard limit 1.2 gr/lt (SII No 52 – 1980)
5. The result of the filtered data and testing analysis of fine aggregate it is obtained that FM = 2.705%, and this value fits the required standard (SK SNI S 04 1989 F) 1.5 – 3.8%. Hence, this fine aggregate gradation is in the Zone 2.

c. Coarse Aggregate

Physical test on the coarse aggregate is conducted in the laboratory of the faculty of Civil Engineering Universitas Islam Lamongan (UNISLA) as follows:

1. From the result of the testing in coarse aggregate mixture it is obtained the value of the gravels moisture in average = 1.265%. Since it is not in the quality standard (ASTM C 566-89), then the moisture obtained can be used in mix design.
2. From the testing of the weight mass of the rough aggregate it is known that the the average value of the gravels = 2,37 gr. According to the requirement standard on gravels weight mass (ASTM C 127-88-93) the value around 2.2 gr – 2.7 gr is allowed. So, the aforementioned gravels fit the requirements to be used.
3. From the testing on water catchment in coarse aggrgate it is obtained the average value for the gravels' water catchment = 1.88 gr. According to the quality standard on water catchment in gravels (ASTM C 127-8893) value ranged from 1 – 4% is allowed. Hence, the aforementioned gravels can be used.
4. Dari hasil pengujian berat volume agregat kasar diperoleh nilai berat rata – rata volume agregat kasar dari percobaan dengan kondisi biasa, dengan rojokan, dengan ketukan yaitu 1.432 kg. Syarat standart volume batu pecah menurut (ASTM C 127 88 – 93) antara 1.4 – 1.7. Jadi berat volume agregat dalam percobaan di atas memenuhi standart mutu.
5. From the result of testing analysis in filtering coarse filtered data of analysis testing obtained FM value = 4.458%, and this value doesn't qualify for the quality standard (ASTM C 33 – 98), 6 – 7%. Hence, this coarse aggregate gradation tends to be flat/not coarse enough.

- **Evaluation on Concrete Compressure Strength by Age 7 Days**
- **Table 1 Result of Compressure Strength in Age 7 Days Concrete**

Concrete Code	Size (cm)	Sectional Area (cm^2)	Age (hari)	Weight (kg)	Concrete Cylindre Weight (m^3)	Concrete BJ (kg/m^3)	Crushing Compressure (kg)	Result of Compressure test sb'I (kg/cm2)	Crushing tension in Days(Mpa)	Average
Normal Concrete	F 15-30	176,625	7	12,6	0,5300	23,77	30000	169,85	13.830	
Normal Concrete	F 15-30	176,625	7	12,38	0,5300	23,36	28000	158,53	12.908	12.91
Normal Concrete	F 15-30	176,625	7	12,49	0,5300	23,57	26000	147,20	11.986	
B 5	F 15-30	176,625	7	12,52	0,5300	23,62	25000	141,54	11.525	
B 5	F 15-30	176,625	7	12,4	0,5300	23,40	24000	135,88	11.064	10.76
B 5	F 15-30	176,625	7	12,55	0,5300	23,68	21000	118,90	9.681	
B 7	F 15-30	176,625	7	12,45	0,5300	23,49	21000	118,90	9.681	
B 7	F 15-30	176,625	7	12,43	0,5300	23,45	22000	124,56	10.142	9.99
B 7	F 15-30	176,625	7	12,32	0,5300	23,25	22000	124,56	10.142	
B 10	F 15-30	176,625	7	12,25	0,5300	23,11	20000	113,23	9.220	
B 10	F 15-30	176,625	7	12,28	0,5300	23,17	18000	101,91	8.298	8.61
B 10	F 15-30	176,625	7	12,23	0,5300	23,08	18000	101,91	8.298	

Source: Result of the Study

From the study it is obtained that the test on compressure strength shows that by age 7 days, there's a variation of use in sawdust ash with 0%, 5%, 7%, concentration as follows: From the result of normal concrete compressure strength without addiitonal mix in age 7 days it is obtained that average value from 3 samples around 12,91 Mpa.

For the mix of 5% sawdust ash in age 7 dats it is obtained the average value from 3 samples is 10,76 Mpa. Meanwhile, for the mix of sawdust concrete ash with 7% concentration in age 7 days it is obtained a value from 3 samples 9,99Mpa. And for the mix 10% concentration of sawdust ash in age 7 days the average value from 3 samples is 8,61Mpa.

- **Evaluation on Concrete Compressure Strength ay Age 28 Days After Correlation**

Table 2 Concrete Compressure Strength at Age 28 Days

Code	Age	Correlation Value	Crushing Tension (kg/cm^2)	28 Days Tension (kg/cm2)	Dimension Correction Factor	Crushing Tension 14 Days (Mpa)	Average Value
Normal Concrete	7 days	0,65	169,85	261,308	1.000	21,276	19,858
Normal Concrete	7 days	0,65	158,53	243,892	1.000	19,858	
Normal Concrete	7 days	0,65	147,2	226,462	1.000	18,439	
B 5	7 days	0,65	141,54	217,754	1.000	17,730	16,548
B 5	7 days	0,65	135,88	209,046	1.000	17,021	
B 5	7 Days	0,65	118,9	182,923	1.000	14,894	
B 7	7	0,65	118,9	182,923	1.000	14,894	
B 7	7	0,65	124,56	191,631	1.000	15,603	15,367
B 7	7	0,65	124,56	191,631	1.000	15,603	
B 10	7	0,65	113,23	174,2	1.000	14,184	
B 10	7	0,65	101,91	156,785	1.000	12,766	13,239
B 10	7	0,65	101,91	156,785	1.000	12,766	

Source: Result of the Research

From the research it is obtained that the test on compressure strength in concrete shows that by age 14 days in variations of use of sawdusts ash in 0%, 5%, 7%, and 10% concentration is as follows: from the test in compressure strength at normal concrete without additional mix by age 28 days it is obtained an average value from 3 samples around 19,858Mpa. This value doesn't qualify the (ASTM C 832 – 75) requirements as a K-175 quality concrete compressure strength. From the result of test in compressure strength in sawdusts ash in 5% by age 28 Days an average value 16.548 Mpa from 3 samples had obtained. This value fits the requirements (ASTM C 832 – 75) as a K-175 quality concrete compressure strength. Meanwhile, for the test on compressure strength in sawdusts ash of 7% concentration at age 28 days, an average value from 3 samples is 15..367 Mpa. This value fits the requirements for (ASTM C 832 – 75) as compressure strength for K-175 quality concrete. For the test in compressure strength for concrete 10% mix of sawdusts ash at age 28 days from 3 samples, the average value is 13.239 Mpa. This value doesn't qualify for the (ASTM C 832 – 75) as a K-175 quality concrete strength compossure

From the Picture 2 we can see the compressure strength of a concrete at age 7-28 days that was already correlated. At age 7 days, concrete with 0% mix has 13,91 Mpa value, 5% has 10,76 Mpa value, and 7% gets 9,99 Mpa value, 10% has 8,61 Mpa.

For concrete at age 14 days that was correlatred, concrete with 0% mixture has 14m66 Mpa, 5% has 12,22 Mpa, and 7% has 11,35 Mpa, while 10% has 9,77 Mpa.

Concrete with 28 days correlation and 0% mix has 19,85 Mpa, 5% has 16,54 Mpa, 7% has 15,36 Mpa, 10% has 13,23 Mpa.

a. Hence, comcrete that doesn't qualify for the the K-175 quality standard is only concrete with 10% sawdust mix with 13,23 Mpa. Because the requirement for K – 175 concrete is at minimum 14,5 Mpa (PBA,1987).

Conclusion and Recommendation

From the results of tests and explanations above it can be concluded that test on compressure strength in K-175 concrete shows that at age 28 days correlation in variations of sawdusts ash use in 5%, 7%, and 10% concentration is:

Table 2: Percentage in Sawdusts Ash Mix

Age	Percentage in Sawdust Ash Mix			
	B 0%	B 5%	B 7%	B 10%

Age 7 Days	13,91	10,76	9,99	8,61
Age 14 Days	14,66	12,22	11,35	9,77
Age 28 Days	19,85	16,54	15,36	13,23

Source: Research Result

The use of sawdust waste ash of 0% concentration 0% bears compressure strength of 19,85 Mpa. The use of 5% sawdust use bears compressure strenthg as much as 16,54 Mpa. Meanwhile, 7% use of sawdust ash mix results in 15,36 Mpa compressure strength. The use of 0% sawdiusts has 13,23 Mpa.

Of all, the use of sawdusts ash that almost fits the compressure strength requirement for K-175 Quality Concrete is the variety that use 0%, 5%, and 7% mix of sawdusts ashm due to 14m5 the minimal standard.

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