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THE UTILIZATION OF HUSK ASH AND SEA-SHELL ASH IN CONCRETE MIX DESIGN

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ABSTRACT

The possible use of waste material such as husk ash and sea-shell ash in concrete production was investigated. 65% of sea-shell ash and 35% of husk ash were mixed together and used to replace cement by weight in different percentage.

The experimental work consisted of casting 5 types of concrete cubes (measuring 150x150x150 mm) i.e.: normal concrete as control mix, concrete incorporating sea-shell husk and husk ash with different percentage i.e.: 5%, 10%, 15% and 20%.Test parameter included compressive strength test at the age of 14, 28, 56, 90, and 120 days.

The result shows that, the concrete strength is not significantly affected when the cement is replaced by 5%, 10%, and 15% of the mixture of sea-shell ash and husk ash. However with 20% cement replacement by waste material, the concrete strength decrease at all ages.

Key word : Husk Ash, Sea-Shell Ash, Concrete strength

1. INTRODUCTION

There have been lots of effort to utilize waste materials as alternative building materials. For example fly ash, waste from coal industry, which can increase the concrete strength and improve the workability of fresh concrete *(Neville, 1994)*. It is known from the previous research that husk ash contains high silica content when heated at controlled temperature. In addition, the sea-shell contains $CaCO_3$ compound which will be *CaO* and release CO_2 to the sky when it is heated . *CaO* and *Si* are the major element for making cement beside Fe_2O_3 dan Al. The combination of *CaO* and *Si* has pozzolanic behaviour which inflluence the concrete strength. These two waste materials available abundant in Bengkulu.

In this research *CaO* from sea-shell ash and *Si* from husk ash will be mixed by percentage i.e 65% *CaO* dan 35% *Si*. Furthermore this mixture will be added to concrete mix by reducing the amount of cement used by weight i.e 15%, 20%, 25% dan 30%. This research will monitor the influence of husk ash and sea-shell ash addition toward the concrete strength.

II. LITERATURE REVIEW

There has been some research of husk ash to be utilized as building materials. Research by *Heru Harsono (2002)* who made silica amorf powder as raw materials for silica gel concluded that the husk ash which is dried by the sun give the optimal silica in comparison with the one which is dried by the oven.

Priyosulistyo et al revealed that the addition of 15% husk ash by cement weight give the optimum strength. This type of concrete is more durable to acid, however the setting time decrease by the husk ash addition to the concrete mix.

Previous research shows that SiO_2, Al_2O_3, Fe_2O_3, are the important compound that can increase the concrete strength *(Andriati Amir Husin, journal 2006)*.

Tabel 1. The chemical composition of husk ash

Component (%)	Result (%)
SiO_2	94.5
Al_2O_3	very small portion
Fe_2O_3	very small portion
CaO	0.25
MgO	0.23
SO_4	1.13
CaO Free	-
Na_2O	0.78
K_2O	1.11

Source : Andriati Amir Husin, journal 2006

The sea-shell could be the waste as well, however very limited research has been done to this materials. The sea-shell made of $CaCO_3$, and the strength are twice of the ceramic strength. Under the electron microscope with 300,000 times enlargement the sea-shell looks like brick wall with protein cement as the glue *(Harun Yahya, 2004)*, these two waste materials are highly potential to be added to concrete mix.

Czernin (1980) says that cement as glue materials in concrete mix, is made of major elements such as *CaO*, *Si*, Fe_2O_3 and *Al*. *CaO* has the highest percentage of them all. The combination of *CaO* and *Si* will form C_3S *(Tricalcium silicate)* and C_2S *(Dicalcium Silicate)* which give effect to concrete strength.

III. RESEARCH METHODOLOGY

The combination of 65% *CaO* and 35% *Si* will be added to concrete mix with different percentage i.e 5%, 10%, 15% and 20%. Furthermore the amount of cement will be reduced as much as *CaO* and *Si* addition. It is expected that C_2S will be formed. To control this mix, normal concrete will be casted.

Every single sample will be tested at the age of 14, 28, 56, 90 and 120 days to see the strength development of each sample.There will be 5 samples for every type on the day of concrete strength test, and the data will be plotted as the average of 5 samples.

Material Used

1. Sea –shell ash *(SA)*

The waste of sea-shell ash from Pulau Baai, Bengkulu were washed, cleaned from any dirt, and dried in the sun before put in the oven.Furthermore the sea-shell were crushed into ash and pass through the sieve no. 100.

2. Husk ash (*HA*)

The waste of husk from the rice mill were dried in the sun, burnt convensionally in a drum. It needs more than 12 hours to turn the husk into ash. The tests performed are, checking the physical properties of coarse aggregate and fine aggregate and concrete strength test for all type of concrete casting.

Casting of Test Specimen

The properties of fine aggregate from Curup Bengkulu, and coarse aggregate with nominal size of 10 mm and 20 mm from North Bengkulu can be seen from the table 2 below :

Table 2. Mechanical Properties of aggregate

Type of tests	Result	
	Fine agg	Coarse agg
Fine Modulus (Fm)	3.97874	4.03741
Water content	6.415%.	1.6%
Specific gravity	2.24	2.625
SSD Absorpsion	4.1%	1.5%
Bulk Density	1.5295 gr/cm^3	1.5995 gr/cm^3

Based on the mechanical properties of coarse aggregate , fine aggregate and 32 MPa for target strength, the comparison of cement: fine Aggregate : coarse Aggregate are 1:2:3.3. It is planned that the slump value will be 180 mm.

IV. RESULT AND DISCUSSION

Slump

The slump value for each type of concrete are tabulated below:

Table 3. Slump value for each mix

Concrete type	Slump (mm)
Normal concrete	160
5% HA + SA	30
10% HA + SA	10
15% HA + SA	0
20% HA + SA +0.5 Kg water	50

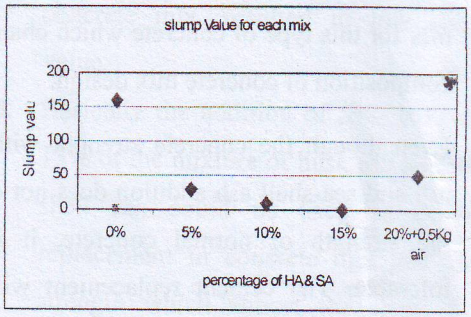

Figure 1. Development of Slump Value

The addition of Husk ash and sea-shell ash to concrete mix makes the slump value below the one which is planned before. This occur because the Husk ash and sea-shell ash absorbed lots of water. For concrete type with 5%, 10% and 15% addition of husk ash and sea-shell ash the slump value was below the planned slump however with this slump value this type of concrete still have good workability. Nevertheless for concrete type with 20% addition of husk ash and sea-shell ash, the amount of water available does not give any workability, so 0.5 kg of water was added to this type of concrete. The cube specimen measuring in 15x15x15 cm were cast, demoulded after 24 hours and cured in the curing tank to avoid the crack until the day of testing.

Concrete strength

a. Concrete strength based on concrete age

The concrete strength test was carried out at day 14, 28, 56, 90 and 120 of concrete age. This aimed to see the effect of cement replacement with mixture of husk ash and sea-shell ash to the concrete strength at different age. The results which obtained from the average strength of specimens on each testing day can be seen in the table below:

Table 4. concrete strength development with curing age

% addition of HA and SA	Concrete age (day)				
	14	28	56	90	120
	Compressive strength (Mpa)				
0	20.9	24.05	28.82	34.28	37.8
5	19.97	21.02	29.16	32.29	34.2
10	17.06	19.6	20.34	27.5	33.1
15	20.16	19.84	30.13	31.93	34.7
20	9.1	12.32	17.17	19.55	20.2

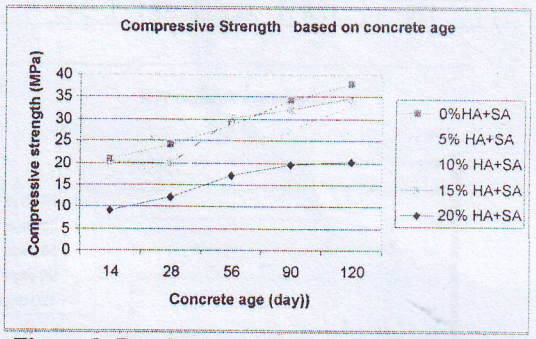

Figure 2. Development of concrete strength by age

The concrete will gain strength at the age of 28 days. The strengh keeps increasing by the increasing time. This trend occur in this

research for all type of conrete casting. This trend can be seen clearly from table 3 At the age of 120, normal concrete reach 37.8 Mpa, while concrete strengthe with addition of husk ash and sea-shell ash by 5%, 10%, 15%, and 20% were 34.2 MPa, 33.1MPa, 34.7 MPa, 20.2 MPa respectively. Concrete with 20% husk ash and sea-shell ash gain the lowest strength at any age.

b. Concrete strength based on different type of husk ash and sea-shell ash addition

This discussion aim to combine the graph of concrete strength based on age and different type of concrete mix with husk ash and sea-shell ash addition as cement replacement, so that the concrete strength development of each type of concrete can be seen clearly.

Table 5. Concrete strength based on different percentage of husk ash and sea-shell ash addition.

Concrete age (day)	Percentage of cement replacement with HA and SA				
	0%	5%	10%	15%	20%
	Compressive strength (Mpa)				
14	20.9	19.97	17.06	20.16	9.1
28	24.05	21.02	19.6	19.84	12.32
56	28.82	29.16	20.34	30.13	17.17
90	34.28	32.29	27.5	31.93	19.55
120	37.8	34.2	33.1	34.7	20.2

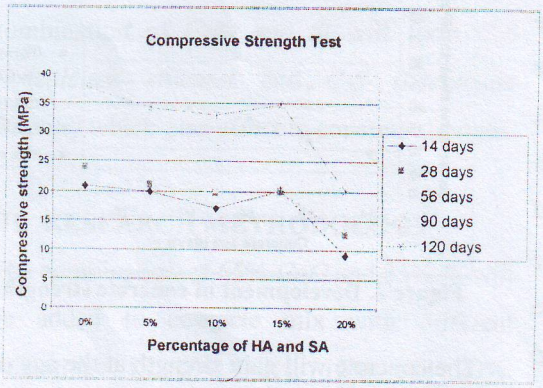

Figure 3. Development of concrete strength by different percentage of HA&SA

It is obvious from the result that 5% and 15% addition of ash and sea-shell ash give the optimum value which give similar result to normal concrete. At the age of 56 days Concrete with 5% and 15% addition of husk ash and sea-shell ash gain the strength 29.16 MPa and 30.13 MPa respectively which is above the strength of normal concrete(28.82 MPa). Basically the 10% addition of husk ash and sea-shell ash still give good result in comparison with normal concrete. However Concrete with 20% addition of husk ash and sea-shell ash has the lowest concrete strength. This could be caused by the high water absorption of husk ash and this type of concrete does not have any workability at all, so the 0.5 kg of water should be added to the mix for this type of concrete which change the composition of concrete mix design.

Even though the concrete strength with husk ash and sea-shell ash addition does not exceed the strength of normal concrete, it is still tolerable. The cement replacement will give the economy value and the utilization of waste will be one of solution to overcome the environmental problem. On the other hand , the concrete strength are above the characteristic strength (20 MPa) and nearly the same as the strength of normal concrete with target strength 32 MPa. The conventional burning process of husk ash might cause the decreasing of silica content and give effect to the strength of concrete with husk ash and sea-shell ash addition.

V. Conclusion and Recommendation

Conclusion

a. Waste from husk and sea-shell which was burnt and turn into ash can be utilize in concrete mix design, as cement replacement , so the amount of cement used can be reduced.

b. 5% and 15% addition of ash and sea-shell ash give the optimum value which give similar result to normal concrete 10% addition of husk ash and sea-shell ash still give good result in comparison with normal concrete. However Concrete with 20% addition of husk ash and sea-shell ash has the lowest concrete strength .

c. The husk ash absorb lots of water in concrete mix, resulted in low slump value.

d. Basically the addition of 5%, 10% dan 15% of the mixture of husk ash and sea-shell ash could be used as cement replacement in concrete mix and gain strength which almost the same with normal concrete.

Recommendation

a. Future research might use oven to turn husk into ash, so that the silica content might be higher.

b. Special treatment is needed to utilize waste from husk and sea-shell as alternative building materials, so this will support the environmentally friendly programme.

References

[1]. Amir, A.H, 2006. "Pemanfaatan Limbah Pertanian dan Limbah Industri untuk Bahan Bangunan". Pusat Penelitian dan Pengembangan Pemukiman, Bandung Vol. 3 No. 2.

[2]. Czernin, Wolfgang. 1980. "Cement Chemistry and Physics for Civil Engineers". 2nd edition. London.

[3]. Harsono, Heru. 2002. "Pembuatan Silika Amorf dari Limbah Sekam Padi", Jurnal Ilmu Dasar.

[4]. Neville, A.M. 2004 .Properties of Concrete, 4th edition, Pearson Education Limited, England.

[5]. Priyosulistyo, dkk,. "Pemanfaatan Limbah Abu Sekam Padi untuk Meningkatkan Mutu Beton", Teknik Sipil, UGM.

[6]. Yahya, Harun. 2004. "Biomimetics: Technology Immitates Nature" VCD Harun Yahya series. PT Nada Cipta Raya. Jakarta.