International Journal of Civil Engineering and Infrastructure
Vol. 3, No. 2, October 2023

EFFECT OF THE USE OF WOOD CHARCOAL ASH ON THE COMPRESSIVE STRENGTH OF NORMAL CONCRETE

Martin Richardo William[1], Kristina Sembiring[2], Sempurna Bangun[3], Pio Ranap Tua Naibaho[4]

[1,2,3,4]Civil Engineering Study Program, Tama Jagakarsa University, Jl. TB Simatupang 152 South Jakarta, Indonesia
Correspondence email: martinrichardo81@gmail.com

Received April 12, 2023 | Accepted June 23, 2023

ABSTRACT

Wood charcoal ash is the result of chemical changes from the burning of wood. Wood charcoal contains silica which is a good binder aggregate for concrete mixtures, it is the same as the function of cement in a concrete mixture. Wood charcoal can also be used as a mixture or addition to the manufacture of reactive concrete. Concrete is a mixture of portland cement, fine aggregate, coarse aggregate and water, with or without additives that form a solid mass. Concrete is prepared from coarse aggregate and fine aggregate. Cement and water interact chemically to bind the aggregate particles into a solid mass (George Winter, 1993). Based on the results of research that has been done, the results obtained on normal concrete of 17.98 Mpa at the age of 7 days and increased at the age of 14 days of 20.73 Mpa, and 28 days of 22.94 Mpa. At the time of normal concrete mixed with wood charcoal ash 3% compressive strength of concrete again increased by 20.43 Mpa at the age of 7 days, but at the age of 14 days of concrete with a mixture of wood charcoal ash increased by 20.82 Mpa and again increased at the age of 28 days by 27.07 Mpa. The decrease continued to occur in concrete with a mixture of wood charcoal ash 8% and 13% at the age of 7 Days, 14 days, and 28 days, the increase in the compressive strength of the optimal concrete is in the concrete mixture of wood charcoal ash 3% at the age of 28 days.

Keywords: *Wood Charcoal Ash, Normal Concrete, Concrete Compressive Strength*

1. PRELIMINARY

Indonesia has large forest areas quite extensive, namely around 120 million ha (Ministry Environment & Forestry, 2019) so produces quite a lot of wood potential and various types. Wood has a variety various traits and characteristics, one of which is chemical components of wood. Chemical components of wood has an influence on wood utilization to make it more effective. As known that wood can be used for various purposes needs, including crafts, furniture, building construction and wood derivative products others such as pulp and charcoal for purposes energy, adsorbents and other applications

Many of us know the various types of natural products found in the forest which can be a commodity Expo Indonesia such as wood, resin, rattan, wood charcoal and so forth. In this case, wood charcoal is a waste that we

still encounter a lot, so it is possible that wood charcoal production will continue to increase due to rising fuel oil prices. However, it will produce wood charcoal powder waste whose utilization is not optimal (Ministry of Forestry, 2011). Wood is also still widely used as fuel for cooking, both for food stalls and used to sell along the road. From the combustion of wood charcoal will produce ash.

Wood charcoal ash is the result of chemical changes from the burning of wood. Wood charcoal contains silica which is a good binder aggregate for concrete mixtures, it is the same as the function of cement in a concrete mixture. Wood charcoal can also be used as a mixture or addition to the manufacture of reactive concrete. The addition of wood charcoal powder can also be used as an alternative concrete mix.

Although the weight of concrete itself is quite large, it also has a high compressive strength so that it can accept large loads. The quality of concrete depends on the implementation in the field. Good or bad concrete is basically formed from the same formula and mixture. sometimes also in the process of added additives (additives), fibers or non-chemical mixtures with a certain comparative value. Based on the description above, a study will be conducted on "the effect of adding 3%, 8%, and 13% wood charcoal ash to concrete mixture on concrete compressive strength".

Concrete is the main basic material of planning and design in the structure of buildings and bridges and roads that until now are still very popular we meet in the field, concrete also has its own advantages including, finishing easier, able to adapt or produced according to the surrounding situation and can be designed in various sizes according to the load it receives.

In construction, concrete is a composite building material made from a combination of aggregate and cement binder. The most common form of concrete is Portland cement concrete, which consists of mineral aggregates (usually gravel and sand), cement and water.

It is commonly believed that concrete dries after mixing and laying. In fact, concrete does not become solid because water evaporates, but cement hydrates, bonding the other components together and eventually forming a rock-like material. Concrete is used to make road pavement, building structures, foundations, roads, pedestrian bridges, parking structures, bases for fences/gates, and cement in brick or block walls. The old name for concrete is liquid rock.

The advantage of concrete is that it can be easily shaped according to construction needs. Apart from that, concrete also has high strength, is resistant to high temperatures and has low maintenance costs.

The downside is that the shape that has been created is difficult to change without damage. In concrete structures, if you want to demolish it, it will be expensive because it cannot be used again. Different from steel structures which remain valuable. Heavy, compared to its strength and great reflective power.

Concrete has high compressive strength but is weak in tensile strength. If the structure is direct and not given enough reinforcement it will easily fail. According to a rough estimate, the tensile strength value is around 9% -5% of the compressive strength. Therefore, reinforcement is very necessary in concrete structures. Common reinforcement is by using steel bones which, when combined, are often called reinforced concrete

2. RESEARCH METHODS

The research method used in this study is an experimental method. Experimental method is a method that is carried out by defining an experiment as a or a set of experiments

carried out through planned changes to the input variables of a process or system so that the causes and factors can be traced so as to bring changes to the output as a response to experiments that have been carried out. (cochran 1957).

The experimental method is a research procedure carried out to reveal the causal relationship of two or more variables, by controlling the influence of the other variable. This method is implemented by giving the independent variable intentionally (induse) to the object of research to determine the consequences in the dependent variable.

In statistics and probability, the standard deviation is a very common statistical distribution. Can also be interpreted as the average distance deviation of data points measured from the average value of the data.

3. RESULTS AND DISCUSSION

Fine Aggregate Inspection Results

From the results of the examination of sand in the laboratory adhimix known that bangka sand used qualified and appropriate grading limits of ASTM C-33 as fine aggregate. Material testing passed sieve No.200 or mud content obtained 2.55% with a maximum of 3% so that this bangka sand can be used as a concrete mixture. The yield of friable volume weight and solid specific gravity are also qualified with a minimum of 1.2 for volume weight and 2.55 for sand specific weight. For the water absorption test obtained by 1.83% with a maximum value of 4% and the grain fineness test results obtained by 2.3-3.1. In addition, the organic content contained in bangka sand enters the organic plate number 3 or older color. This condition is still included in the standard and is still acceptable because the organic plate standard is number 3 still includes the maximum standard of organic content required.

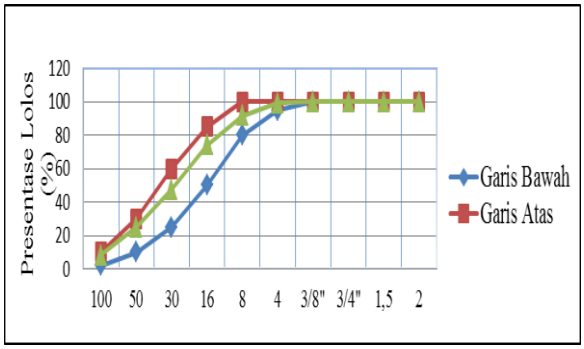

Figure 4.1. Fine Aggregate Grading Graph

Graphic Source: ASTM C-3

Coarse Aggregate Inspection Results

From the results of the examination, the split obtained in Adhimix Laboratory has met the specifications for coarse aggregate based on ASTM C-33, material testing passed sieve No.200 or mud content obtained with a value of 0.93% with a maximum value of 1% mud content, so that the coarse aggregate in Adhimix laboratory is qualified as a concrete mixture. Volume weight and specific gravity of coarse aggregate have also qualified above the maximum value of 1.2 for volume weight and 2.55 for specific gravity. Coarse aggregate absorption examination obtained a value of 2.42% with a maximum aggregate absorption value of 4% and for fine modulus or fineness modulus of coarse aggregate grains from laboratory screening tests between 5.5 - 8.5 has been qualified because the results obtained are 8.14 the greater the modulus value, the greater the aggregate grain. As for the over size or coarse aggregate in the fine aggregate of 4.87% with a maximum value of 5% so that the coarse aggregate is eligible.

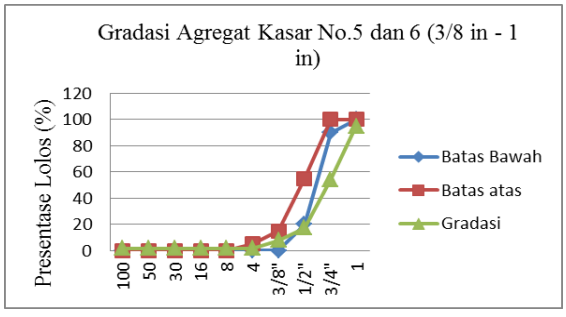

Figure 4.2 Grading Graph Of Coarse Aggregate Grains

Source: ASTM C-33

Slump Test Results

Based on SNI 03-2834-2000 on procedures for making Normal concrete. To obtain easy concrete in the process set slump 12-18 cm. In this study, the concrete slump obtained has not reached the standard requirements for ease of making concrete because the slump obtained is still low. Can be seen in the results of tests conducted, the slump in normal concrete by 17 cm and when added wood charcoal ash by 3% slump concrete decreased to 7cm. For concrete with the addition of wood charcoal ash some percentage variations can be seen that the more wood charcoal ash is added Then the slump value decreases. Because wood charcoal ash has similarities like cement that is easy to absorb water so that the concrete dries quickly.

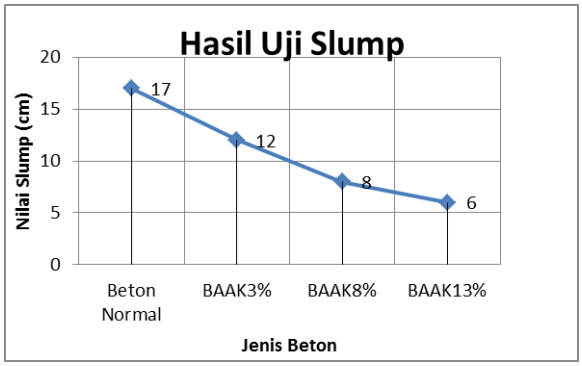

Figure 4.3 Gradation Of Slump Test Results

Source: Lab Results

Concrete Volume Weight Test Results

According to SNI 03-3449-2002, the maximum weight of concrete volume is 1850 kg/m3. As for the concrete mixed with wood charcoal ash is still 3%, 8% and 13% is still not categorized as lightweight concrete because the volume of concrete that exceeds 1850 kg/m3.

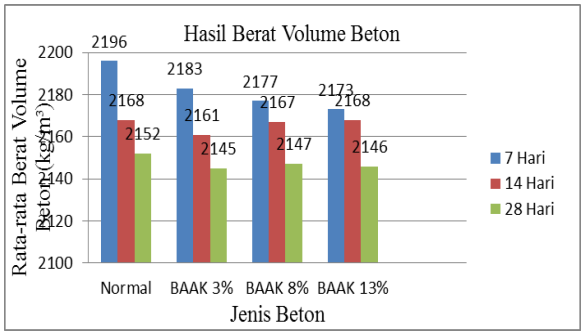

Figure 4.4 concrete volume weight yield chart

Source: Lab Results

Normal Concrete Compressive Strength Test Results

Based on the results obtained, the compressive strength of normal concrete at the age of 7 days of 17.98 Mpa increased at the age of 14 days of 20.73 Mpa, and at the age of 28 days of 22.94 Mpa.

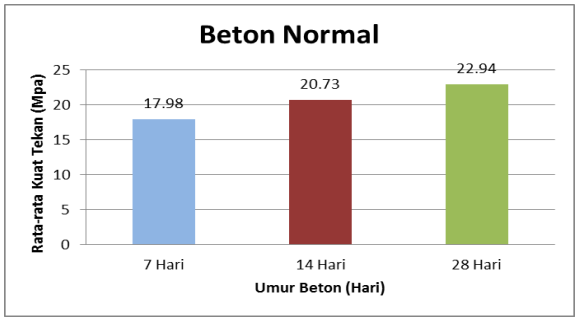

Figure 4.5 Graph Of Normal Concrete Compressive Strength Results

Source: Lab Results

Yield Compressive Strength Of Wood Charcoal Ash Concrete 3%

From the results of this study, the compressive strength obtained in the concrete mixture of wood charcoal ash with the age of 7 days of 20.43 Mpa and increased at the age of 14 days of 20.82 Mpa and increased again at the age of 28 days of 27.07 Mpa.

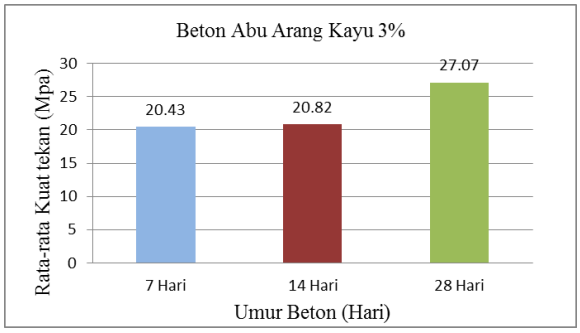

Figure 4.6 Wood Charcoal Ash Concrete Compressive Strength Chart 3%

Source: Lab Results

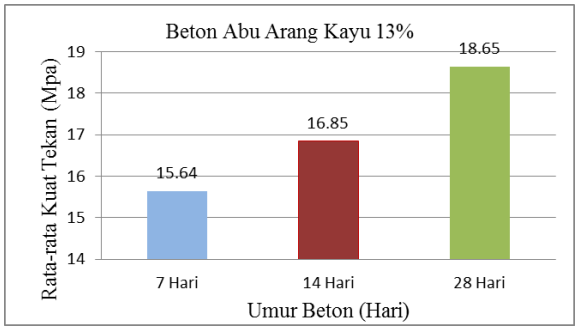

Figure 4.8 Wood Charcoal Ash Concrete Compressive Strength Chart 13%

Source: Lab Results

Yield compressive strength of wood charcoal ash concrete 8%

Based on the results of this study, the compressive strength of concrete with a mixture of 8% wood charcoal ash decreased when compared with a mixture of 3% wood charcoal ash.

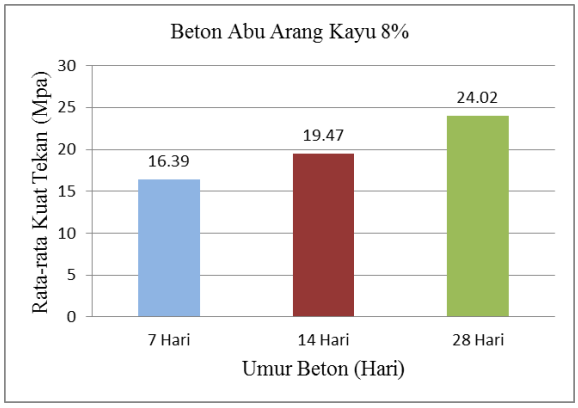

Figure 4.7 Wood Charcoal Ash Concrete Compressive Strength Chart 8%

Source: Lab Results

Concrete compressive strength results of wood charcoal ash mixture 13%

From the results of this study, the compressive strength of concrete with a mixture of wood charcoal ash 13% decreased compressive strength due to its many additions of wood charcoal ash used.

Overall Yield Compressive Strength Of Concrete

Based on the results of research that has been done, the results obtained on normal concrete of 17.98 Mpa at the age of 7 days and decreased at the age of 14 days of 20.73 Mpa, and 28 days of 22.94 Mpa. At the time of normal concrete mixed with wood charcoal ash 3% compressive strength of concrete again decreased by 20.43 Mpa at the age of 7 days, but at the age of 14 days of concrete with a mixture of wood charcoal ash increased by 20.82 Mpa and again decreased at the age of 28 days by 27.07 Mpa. The decrease continued to occur in concrete with a mixture of wood charcoal ash 8% and 13% at the age of 7 Days, 14 days, and 28 days, the increase in compressive strength of the optimal concrete is in the concrete mixture of wood charcoal ash 3% at the age of 28 days.

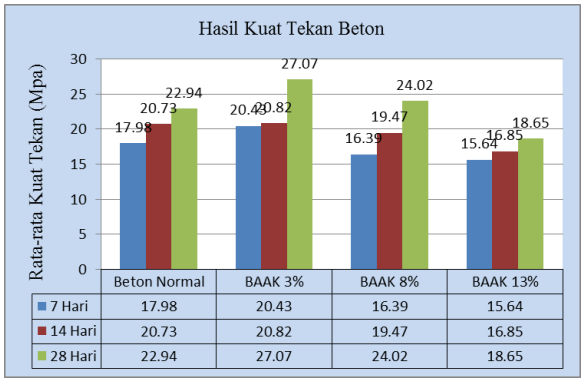

Figure 4.9 Graph Of Concrete Compressive Strength Overall Results

Source: Lab Results

4. CONCLUSIONS AND ADVICE

Conclusion

The following conclusions from the results of research on the compressive strength of concrete with a mixture of wood charcoal ash are as follows:

1. The effect of the use of wood charcoal ash on the compressive strength of concrete at the age of 28 days in the can on normal concrete of 22.94 Mpa, the result of compressive strength of 3% padabeton of 27.07 Mpa, in concrete with a mixture of wood charcoal 8% of 24.02 Mpa, and concrete with a mixture of wood charcoal 13% in the can 18.65 Mpa.

2. The largest percentage of concrete compressive strength with a mixture of wood charcoal ash at the age of 28 days was obtained with a mixture of 3% of 27.07 Mpa, and 8% of 24.02 Mpa.

3. Large percentage of optimal concrete compressive strength obtained with a mixture of wood charcoal ash by 3% with a value of 27.07 Mpa at the age of 28 days

Advice

Based on the research that has been done, suggestions that can be given to testers in the future are as follows :

1. In the process of making beto testers must do maximum care in order to get a good quality concrete.

2. Need good supervision when mixing concrete materials because to get good quality concrete is also needed optimal mixing.

3. At the time of soaking, it is also necessary to check the water content in the concrete tub so that the concrete does not dry out or lack of water intake in the concrete, in order to get optimal results.

REFERENCES

[1] Indonesian Concrete Regulations. (1971). Director General Cipta Karya.

[2] Kardiyono Tjokrodimulyo. 1996. Concrete Technology. Yogyakarta: Nafiri

[3] Mardiaman, M., & Dewita, H. (2022). Effect of Adding Fly Ash and Rice Husk Ash on Compressive Strength to Meet the fc'35 MPa Concrete Quality. Civilla: Journal Of Civil Engineering Lamongan Islamic University, 7 (1), 36.

[4] Mardiaman, M., & Fadly, A. (2022). The Effect Of The Addition Of Granite And Hair As Filler To The Compressive Strength And Bending Of Concrete. Journal of civil and Environmental Engineering-Centech, 3 (1), 11-22. [1]

[5] Mulyono. (2004).Concrete Technology. Yogyakarta: Andi.

[6] Murdock L.J, Brook K.M & Stephanus Hendarko. (1996:96). Concrete materials and practices. Jakarta: Erlangga.

[7] Nawy. (1990). Reinforced Concrete. Jakarta: Erlangga.

[8] P. N. (2007). Concrete Technology. Yogyakarta: C.V Andi Offset.

[9] Samaketo, W. (2001). Concrete Technology. London: Canisius.

[10] SK SNI 15-1990-F. (n.d.). Ordinance On The Specification Of Fly Ash As An Additive To Concrete Mixtures.

[11] SK SNI M-14-1989-E,. (n.d.). In methods of compressive strength testing Bandung: Lpmb Foundation. Concrete.

[12] SK.SNI-15-2049-1994. (Jakarta). Portland Cement.

[13] SKSBI.1.4.53.1989. (Jakarta). Draft Consensus. DPU Department of Public Works.

[14] SK SNI M-14-1989-E,. (n.d.). In methods o SNI 03-1969-90. Testing method of aggregate specific gravity and water absorption. SNI 03-1971-90. The Test Method Of Coarse Aggregate Sieve Analysis.

[15] SNI 03-2847-2002. Procedure For Planning Concrete Structures For Buildings.

[16] SNI 2493. (2011). Procedures for the manufacture and maintenance of concrete specimens in the laboratory.

[17] Terrapreta. (November 29, 2008). Wood Charcoal Ash Test Results. Yogyakarta: Gajah Mada University.

[18] The Forest, K. (2011). Jakarta.

[19] Tjokrodimuljo, K. (1992). Classification Of Aggregates. Yogyakarta: Department of Civil Engineering FT UGM.

[20] Tjokrodimuljo, K. (1996). Concrete Technology. Yogyakarta: Nafiri.

[21] Winter, G. (1993). Planning Of Reinforced Concrete Structures. Jakarta: ITB.