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Effect of Surian Wood Powder Addition as Fine Aggregate on the Compressive Strength of K-250 Concrete

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Abstract
This thesis is titled "The Effect of Adding Surian Wood Powder as Fine Aggregate on the Compressive Strength of K-250 Concrete." This paper was written because the author wanted to study how concrete made with surian wood powder affects the compressive strength of concrete. The high density of concrete can also affect the size or dimensions of concrete structures, leading to high construction costs. From this, the following problems arise that need to be analyzed: How does the addition of Surian wood powder as fine aggregate affect t h e quality of concrete? The method applied in this study is the experimental method. The results of the study indicate that the addition of Surian wood powder as aggregate has varying effects on concrete quality depending on the amount of mixture in the mortar. A mixture of 5% Surian wood powder with a compressive strength of 301.08 MPa achieved the highest compressive strength. If more Surian wood powder is added, the average compressive strength of the concrete decreases. These test results indicate that Surian wood powder should not be used in excessive amounts, as the appropriate mixture composition must be used.

Keywords: Surian Wood Powder, Fine Aggregate, Compressive Strength of K-250 Concrete

1. Introduction

Concrete is a building material composed of sand (fine aggregate), gravel (coarse aggregate), cement and water. Concrete has the advantage of good compressive strength so that concrete is used as the main structural builder of construction and improving the quality of concrete will be constantly carried out in various studies. The quality and characteristics of concrete are greatly influenced by its constituent materials. The planning of the concrete mixture will determine the compressive strength of the concrete, the ease of working and the amount of creep and shrinkage of the concrete. The specific gravity of normal concrete is between 2200-2500 kg/m3made using broken or unbroken natural aggregate, while the specific gravity of lightweight concrete is below 1900 kg/m(3) (SNI 03-2834-2000, Articles 3.14 and 3.18, procedures for calculating concrete structures for building buildings). The large specific gravity of concrete affects the size or dimensions of the concrete structure so that this results in expensive construction costs as well. According to data from the Central Statistics Agency in 2021, it is known that the percentage of people Indonesia who have businesses in wood crafts is as much as 12.5%.

From the results of the industry, a lot of sawing residue is found which is waste from cutting wood. The rest of the sawmill is usually not utilized and has only been destroyed by burning. Sawdust is waste that is obtained from sawing wood using machines or manual methods of calculating concrete structures for building buildings). A concrete plant, also known as a batch plant or batching plant or a concrete batching plant, is equipment that combines various ingredients to form concrete. Therefore, it is necessary to research the type of lightweight material that is suitable for concrete.

According to data from the Central Bureau of Statistics in 2021, it is known that the percentage of Indonesian people who have a business in wood crafts is 12.5%. From the results of the industry, a lot of sawing residue is found which is waste from cutting wood. The remaining sawdust is usually not utilized and has only been destroyed by burning. Sawdust is waste obtained from sawing wood using machines or manually. In every frame depot or wood processing factory, sawing residue is often found, which is sawdust waste. Sawdust waste causes problems in handling, namely left to rot, piled up, and burned, all of which have a negative impact on the environment. From this situation, the author wishes to research and utilize the sawdust into something that has value and benefits. Wood powder is relatively cheap and easy to get. Wood dust is generally only used as fuel that can be replaced as kerosene, growing media for ornamental plants or just thrown away in the open. Therefore, recently it has begun to develop the utilization of sawdust in various fields, one of which is the construction field. (Sulaiman, *et al*. 2018) [9].

The effectiveness of the use of sawdust as an additive has been proven through research by Mochamad Syarifudin (2020) [10] with the title Analysis of the Effect of Addition of Sawdust Remnants on Concrete Compressive Strength, using sawdust as much as 1kg and 2 kg as an additive, with concrete age research 7, 14, and 28 days.

In the South Sumatra region, there is a lot of use of Surian wood or often known as Suren wood as a raw material for the wood industry. In Surian wood powder there are levels of cellulose and hemicellulose which, when added to a mixture of cement and sand mixture in the form of concrete, these compounds will be absorbed on the surface of minerals / particles and provide bonding density between particles due to their adhesion and dispersion properties, and inhibit the diffusion of water in the material.

Thus, stronger and relatively impermeable concrete can be produced, which can be used as a construction material for special purposes (Gargulak, 2001) [3]. In this research, Surian sawdust is used as an additive in concrete, this is possible because it is expected that sawdust can reinforce concrete with sawdust that is evenly distributed in the concrete mixture with a random orientation, so that premature cracking in concrete, both due to heat of hydration and by loading can be prevented. With the prevention of premature cracking with the prevention of premature cracking, the ability of the material to (axial, flexural and shear) that occurs will be much greater and can overcome the weakness of concrete properties that are very brittle in accepting tensile stresses and are also expected to increase the compressive strength of the concrete.

2. Materials and Methods

2.1 Materials

This research utilized several materials to produce and test concrete using recycled components. The main binder used was baturaja cement which served as the main cementitious material to ensure proper bonding and strength development in the concrete mix. For coarse aggregate, crushed stone was used to represent conventional coarse filler, providing a basis for comparison with recycled concrete.

Surian wood powder was introduced as a partial replacement for natural coarse aggregate that can be used as an additive for the compressive strength of concrete. This material, obtained from crushed and processed wood waste, was the main variable tested in this study to assess its impact on concrete performance.

Fine aggregate in the form of natural sand was used as a filler material to achieve the desired gradation and compactness in the mix. Clean water was added to t h e concrete mix to initiate the cement hydration process, ensuring the development of the required strength and durability characteristics.

To improve the workability and consistency of fresh concrete, chemical admixtures - 25 percent water by weight of cement alone - are added. This excess water is used as a lubricant. In addition, the excess water in the concrete will mix and together come to the surface of the freshly poured concrete mixture (bleeding) which then becomes frothy and constitutes a thin layer called laitance (thin membrane). This thin film will reduce the adhesion between the layers of concrete and is a weak connection area. If there is a mold leak, water together with cement can also go outside, resulting in small nests. A concrete plant, also known as a batch plant or batching plant or a concrete batching plant, is equipment that combines various ingredients to form concrete.

2.2 Methods

This research uses an experimental method approach, which aims to investigate the causal relationship between the variables involved, specifically the effect of using surian wood powder on the corrosion rate of K-250 reinforced concrete. The experimental method was chosen because it provides a clear and measurable picture of how certain treatments affect an object - in this case the quality of reinforced concrete tested through variations in material composition and corrosive environments.

The research was conducted in a systematic and planned manner, starting from material preparation, casting reinforced concrete samples, curing, and ending with corrosion testing of steel reinforcement. The reinforced concrete used in this study was reinforced concrete of K-250 grade, where some of the coarse aggregate was replaced with recycled crushed concrete. crushed recycled concrete. The addition of wood admixture was varied at 0%, 3%, 5%, 7%, 10%, 13% by weight of cement to see its direct effect on concrete properties and corrosion resistance.

Corrosion rate testing was conducted using the testing electrochemical testing method (such as potentiodynamic or half-cell potential methods, depending on the equipment available) to obtain quantitative data on the rate of degradation of steel reinforcement in concrete. Each sample was immersed in a chloride-containing solution to simulate a corrosive environment similar to extreme field conditions. All experimental procedures refer to applicable standards for concrete and corrosion testing (such as SNI, ASTM, or other international standards) to ensure the reliability and validity of the results obtained. The collected data were comparatively analyzed to determine the effect of each treatment on the corrosion rate, and to draw conclusions regarding the most optimal composition to reduce the corrosion rate of reinforced concrete based on recycled materials.

Location and Time

This research was conducted at the Construction Material Technology Laboratory, Faculty of Engineering, Universitas Muhammadiyah Palembang, from May to September 2023.

Research Tools

To support the experimental procedures in this study, various tools and equipment were used to ensure accurate results and proper testing conditions. Concrete specimens were prepared using cylinder and block molds, which are essential for forming samples with standard dimensions for compressive and flexural strength testing. These molds help maintain consistency in shape and size, which is critical for reliable comparisons across test groups.

The Concrete Press Test Machine is used to measure the compressive strength of concrete samples at different curing ages, namely at 1, 3, 7, 14, and 21 days. The machine applies controlled pressure to the specimens until failure, providing quantitative data on the mechanical performance of the concrete over time. High-accuracy digital scales are used to weigh all components of the concrete mix, including cement, aggregate, and water.

Accurate measurements are critical to maintaining a consistent mix design and ensuring reproducibility in test results. A concrete mixer was then used to thoroughly mix the materials, promoting uniform material distribution and consistent concrete quality. To evaluate the corrosion performance of steel reinforcement, corrosion test equipment is used, such as a Half-Cell Potential Meter or Potentiostat. These devices detect the potential difference between the embedded steel and a reference electrode, allowing researchers to assess the likelihood and progression of corrosion.

Drying ovens play an important role in preparing surian sawdust. Before being used in the mix, the recycled aggregate is dried to ensure proper moisture content, which is necessary to avoid inaccuracies in the water-cement ratio. Moisture control is very important, especially when using recycled materials with potentially high absorption rates.

To test the workability and consistency of fresh concrete, a slump tester is used. This test gives a direct indication of the flowability of the mix, which is very important when comparing different concrete formulations. Proper workability ensures ease of placement and compaction in the actual construction setting. To prepare the steel reinforcement, a steel reinforcement cutter and stripper is used. These tools help shape the steel according to the dimensions of the mold and remove any excess coating or rust. In addition, a steel wire brush or brush is used to clean the surface of the steel bars before embedding them into the concrete, to ensure better bonding and accurate corrosion test results. Finally, an immersion container filled with a 3-5% sodium chloride (NaCl) solution is used to simulate a corrosive environment. This container creates consistent exposure conditions for the concrete specimens, accelerating the corrosion process and allowing observation of the damage mechanism under a high chloride scenario.

3. Results and Discussion

3.1 Effect of Surian Wood Powder Addition as Fine Aggregate on the Quality of Concrete Quality

This study was designed to evaluate the quality and attributes of fine aggregates.

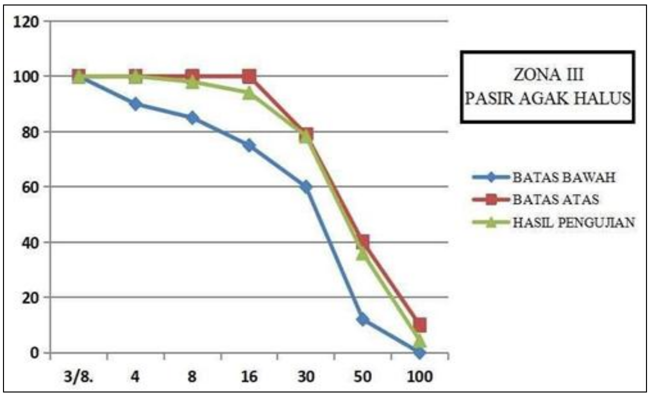
3.1.1 Fine Aggregate Sieve Analysis

The fine aggregate sieve examination aims to determine the appropriate grain size and gradation for the concrete mix. The results of the fine aggregate sieve analysis are presented in the table below.

Table 1: Fine Aggregate Sieve Analysis

Sieve	Weight Retained (gr)	Total Weight Retained	Amount (%)	
			Retained	Via
No.3/8	0	0	0	100
No.4	0	0	0	100
No.8	20	20	1,97	98,03
No.16	40	60	5,91	94,09
No.30	160	220	21,67	78,33
No.50	430	650	64,04	35,96
No. 100	320	970	95,57	4,43
PAN	45	1015	100	0

Source: August 2023 Testing Results



Source: August 2023 Testing Results

Fig 1: Chart of Fine Aggregate Sieve Analysis

The aggregate fineness modulus or Fine Modulus (FM) is calculated by the formula:

$$FM = \frac{(\Sigma \text{persen berat tertahan saringan})}{100}$$

$$FM = \frac{(0\% + 0\% + 1.97\% + 5.91\% + 21.67\% + 64.04\% + 95,57\%)}{100}$$

$$FM = \frac{189,1}{100}$$

$$FM = 1,89$$

3.1.2 Examination of Fine Aggregate Water Content

The moisture content test uses a drying process to determine the moisture content of the fine aggregate (sand) and coarse aggregate (stone). The aggregate moisture content is calculated by dividing the weight of the dry aggregate by the weight of the water in the aggregate. If the moisture content in the concrete mix changes, this test is important to change the amount of water. The table below displays the results of the fine aggregate moisture content test.

Table 2: Fine Aggregate Moisture Content Testing Table

S. No	Observation Data	Unit	Sample
1	Wet Aggregate Weight (W1)	gr	1500
2	Dry Aggregate Weight (W2)	gr	1430
3	Water Weight (W1 - W2)	gr	70
4	Water Content % ($\frac{W1-W2}{W2}$ x 100%)	%	4,89

Source: Testing Results July-August 2023

3.1.3 Examination of Specific Gravity and Water Absorption of Fine Aggregates

The purpose of this test is to determine the specific gravity of fine aggregates including dry specific gravity, dry surface saturated specific gravity, and apparent specific gravity as well as their water absorption capacity. The table below shows the results of the specific gravity and water absorption tests of fine aggregates.

Table 3

Pemeriksaan	Nilai (Gr)
Berat Benda Uji Kering Permukaan Jenuh **(SSD)**	500
Bera Benda Uji Kering **(BK)**	495
Berat Piknometer Berisi Air (25°)**(B)**	705
Berat Piknometer + Benda Uji (SSD) +Air (25°) **(Bt)**	1000
Berat Jenis Semu (Apparent Specific Gravity) = $\frac{Bk}{B+Bk-Bt}$	2,51
Berat Jenis Permukaan Jenuh (Saturated Surface Dry) = $\frac{500}{B+500-Bt}$	2,44
Berat Jenis (Bulk Specific Gravity) = $\frac{Bk}{B+500-Bt}$	2,39
Penyerapan = $\frac{500-bk}{Bk}$ x 100%	1,01

Source: July-August 2023 Test Results

Berat benda uji kering (Bk) = 495 gram
Berat benda uji kering permukaan jenuh (SSD) = 500 gram
Berat piknometer berisi air (25°) (B) = 705 gram
Berat piknometer + benda uji (SSD) + Air (25°) (Bt) = 1000 gram

1. Berat Jenis Semu $= \frac{Bk}{B+Bk-Bt} = \frac{495}{705+495-1000} = 2{,}47$
2. Berat Jenis Permukaan Jenuh $= \frac{500}{B+500-Bt} = \frac{500}{705+500-1000} = 2{,}44$
3. Berat Jenis $= \frac{Bk}{B+500-Bt} = \frac{495}{705+500-1000} = 2{,}41$
4. Penyerapan $= \frac{500-bk}{Bk}$ x 100% $= \frac{500-495}{495}$ x 100% = 1,01%

3.1.4 Submission of Fine Aggregate Mud Content

The fine aggregate mud content test aims to determine the percentage of mud clumps and powder grains attached to the sand. The results of the fine aggregate silt content test are described in the table below.

Table 4: Table of Fine Aggregate Mud Content Testing Results

Examination	Test Material (gr)
Dry Weight Before Washing	500
Dry Weight After Washing	495
Sludge Percentage = $\frac{500-w}{500} x\ 100\ \%$	1%

Source: Testing Results July-August 2023

Unknown:
1. Sample weight before washing (gr): 500 gr
2. Sample weight after washing (gr): 495 gr

a. Percent Sludge

$$= \frac{Berat\ sample - Berat\ sample\ sesudah\ dicuci}{berat\ sampe} x\ 100\ \%$$

$$= \frac{500-495}{500} x\ 100\ \%$$

$$= 1\%$$

The percentage of mud content that has been tested is 1%. With a mud content below 5%, these fine aggregates are eligible for concrete manufacture.

3.1.5 Testing the Organic Matter Content of Fine Aggregates

Using a calorimeter is one way t o determine the presence of biological elements in fine aggregates. A 3% NaOH solution is used to neutralize the organic matter in this measurement. After standing for approximately one day, the resulting hue is then contrasted with the standard.

Fig 2: Color Measurement Table

Description:
1-2: For low mud content 3: for normal mud content 4-5: For high mud content.

Fig 3: Solution Results

After 24 hours, the color of the solution was equivalent to level 2 on the Standard Color Taster. This indicates that the fine aggregate has low organic content and is safe for high strength concrete mixes.

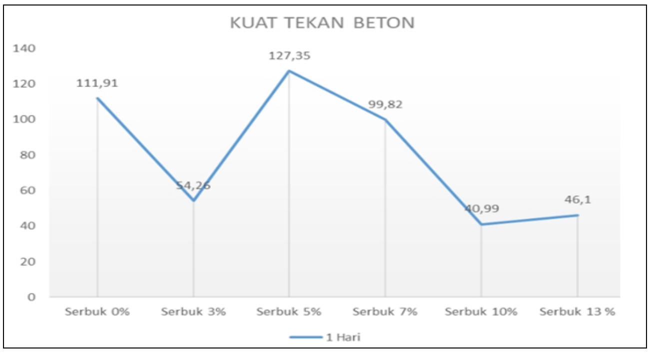


Fig 4: Graph of compressive strength of 1-day-old concrete

The results show that the compressive strength of concrete at 1 day varies depending on the proportion of sawdust. Normal concrete without sawdust admixture had a compressive strength of 111.91 MPa. With the addition of sawdust, the optimum compressive strength was reached at 5% admixture which was 127.35 MPa. However, the addition of sawdust at other proportions, such as 3% (54.26 MPa), 7% (99.82 MPa), 10% (40.99 MPa), and 13% (46.10 MPa), resulted in lower compressive strength.

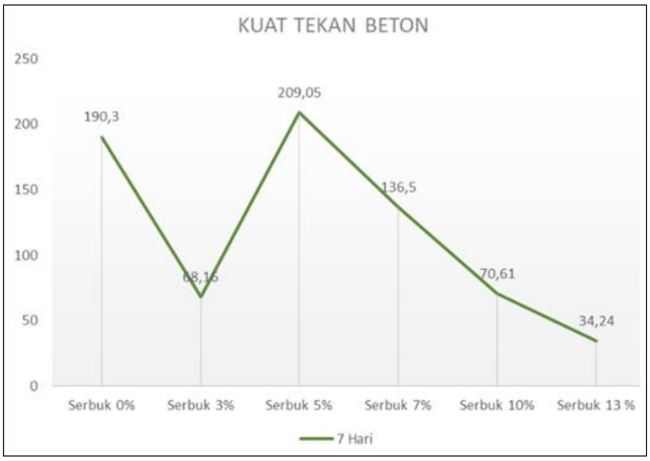


Fig 5: Compressive Strength Chart of 7-Day-old Concrete

From the results of the study, "normal concrete without sawdust mixture at the age of 7 days gave a compressive strength of 190.30 MPA, at 3% sawdust trial mix at the age of 7 days concrete gave a maximum compressive strength of 68.16 MPA, with a 5% mixture resulting in a concrete compressive strength of 209.05 MPA, in contrast to 7% and 10% sawdust mixes which produced compressive strengths of 136.50 MPA and 70.61 MPA, while for concrete with the most sawdust mixture of 13% at the age of 7 days concrete gave a compressive strength of 34.24 MPA."

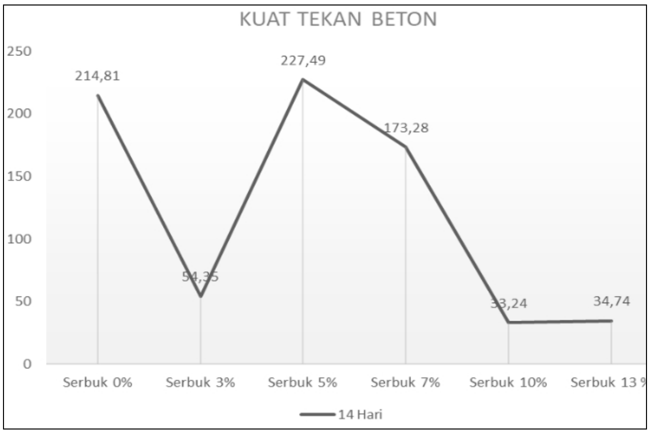


Fig 6: Compressive Strength Chart of 14-Day-old Concrete

From the results of this 14-day age concrete compressive strength study, "normal concrete without sawdust mixture at the age of 14 days gives a compressive strength of 214.81 MPA, at 3% sawdust trial mix at the age of concrete 14 days gives a compressive strength of 54.35 MPA, with a 5% mixture producing a concrete compressive strength of 227.49 MPA, in contrast to 7% and 10% sawdust mixture which produces a compressive strength of 173.28 MPA and 33.24 MPA, while for concrete with the most sawdust mixture of 13% at the age of 14 days concrete gives a compressive strength of 34.74 MPA."

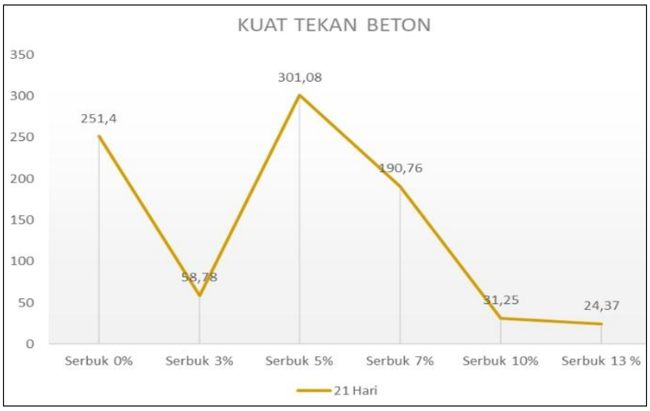


Fig 7: Graph of the compressive strength of concrete aged 21 days

From the results of this 21-day-old concrete compressive strength study, "normal concrete without sawdust mixture at the age of 21 days gives a compressive strength of 251.40 MPA, at 3% sawdust trial mix at the age of 21 days concrete gives a compressive strength of 58.40 MPA. 21 days gives a compressive strength of 58.78 MPA, with a mixture of 5% produced a concrete compressive strength of 301.08 MPA, with a mixture of 7% and 10% sawdust produced a compressive strength of 190.76 MPA and 31.25 MPA, while for concrete with the most wood powder mixture of 13% at the age of 21 days concrete gave a compressive strength of 24.37 MPA."

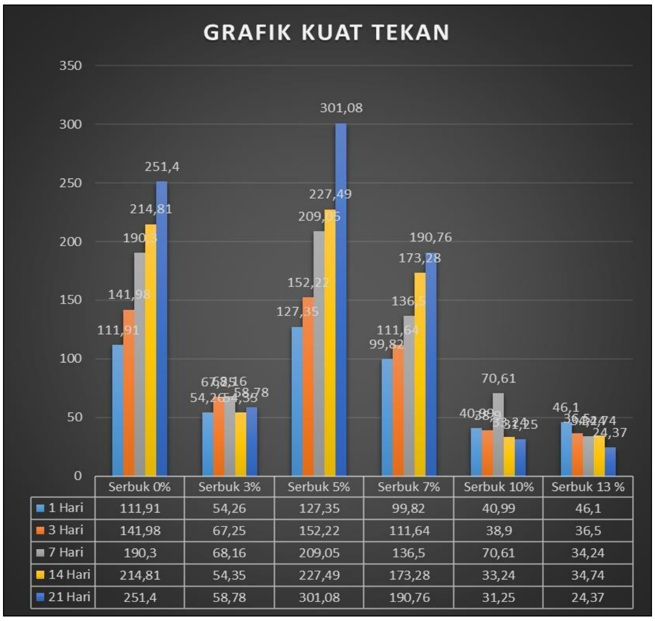


Fig 8: Compressive Strength Chart

Based on the research results, normal concrete provides maximum compressive strength when the age of concrete is 21 days old amounting to 251.4 MPA, and concrete with a mixture of 3% surian sawdust the greatest compressive strength was obtained when the concrete was 7 days old, namely 68.16 MPA. When 5% sawdust is added, the concrete gives the maximum compressive strength when it is 21 days old, namely 301.08 MPA, if 7% sawdust is added, the maximum compressive strength is obtained when the concrete is only 21 days old, namely 190.76 MPA. With a mixture of surian wood as much as 10%, the maximum compressive strength of concrete is obtained when the concrete is 7 days old, namely 70.61 MPA, while with the most surian wood mixture of 13%, the maximum compressive strength of concrete is formed when the concrete is 1 day old at 46.10 MPA. With these results, it can be concluded that the highest compressive strength is obtained by concrete with a 5% mixture of suarian sawdust at the maximum age of 21 days of concrete, namely 301.08 MPA, the compressive strength with a 5% mixture of surian sawdust has a positive effect on the compressive strength of concrete because it causes an increase in compressive strength.

4. Conclusion and Suggestion

4.1 Conclusion

In this study, we examined the effect of the addition of Surian wood powder as a fine aggregate on the quality of concrete, depending on how much of the mixture is used in the mix. With the results of Figure 4.10 previously presented, it can be concluded that the highest compressive strength is achieved by concrete that uses a mixture of 5% surian wood powder with a compressive strength value of 301.08 MPa but if a mixture of surian wood powder is added too much, the compressive strength is achieved by concrete that uses 5% surian wood powder.
surian sawdust too much, the average compressive strength of concrete decreases. The results of this test indicate that sawdust is not recommended to be used too much, it must use the right composition as a mixture in concrete mortar.

4.2 Suggestion

Based on the research conducted that to produce the right mixture, it is recommended to compact the concrete mixture using a vibrating machine. Furthermore, to get better results, further research is needed by using various modifications of sawdust mixtures, reducing sand content in concrete mixtures, and evaluating concrete after 28 days.

5. References

1. Felix Yap KH. Wood Construction. Publisher Bina Cipta. Bandung, 1964.
2. Ferguson Phil M, Bubianto Susanto, Kris Setianto. Fundamentals of Reinforced Concrete SI Version. Fourth Edition. Jakarta: Erlangga, 1991.
3. Gargulak JD, Bushar LL, Sengupta AK. Ammoxidized Lignosulfonate Cement Dispersant. US-Patent: US 6,238,475 B1, 2001.
4. Mulyono T. Concrete Technology, Andi Publisher, Yogyakarta, 2006.
5. Mulyono Tri. Concrete Technology. Yogyakarta: Andi Publisher, 2004.
6. Murdock LJ, Brook KM, Stephanus Hindarko. Concrete Materials and Practice 4th edition: Erlangga Publisher, 1999.
7. Nugraha Paul. Concrete Technology. Yogyakarta: CV. Andi Offset, 2007.
8. Sagel R, *et al*. Guidelines for Concrete Work Based on Sksni T-15-19. Gideon Kusuma, 1994.
9. Sulaiman Wahid. Biodelignification of Coconut Wood Sawdust Using Pleuratus Sapidus. Faculty of Science, Sebelas Maret University, 2018.
10. Syarifudin Mochamad. Effect of Wood Sawdust Addition on Concrete Compressive Strength. Faculty of Engineering, Pengaraian University, 2020.
11. Taylor JR. An Introduction to Error Analysis the Study of Uncertainties in Physical Measurements. 2nd Edition, University Science Books, Sausalito, 1997.
12. Tjokrodimuljo K. Concrete Technology. Yogyakarta: KMTS FT UGM, 2012.
13. Tjokrodimuljo K. Concrete Technology. Department of Civil Engineering, Faculty of Engineering. Gadjah Mada University. Yogyakarta, 1996.
14. ASTM C33 - Standard Specification for Concrete Aggregates.
15. Faber John, Mead Frank. Reinforcement Concrete, ELBS ed., The English Language Book Society and E&F.N. Spon Ltd., 1965, 1-60.
16. Fontana Mars G. Corrosion Engineering, 3-rd ed., McGraw Hill Book Company, 1986, 372-373, 499-502.
17. Mehta PK, Monteiro PJM. Concrete: Microstructure, Properties, and Materials. McGraw-Hill Education, 2014.
18. Mulyono Tri. Concrete Technology. Yogyakarta: Andi Publisher, 2004.
19. Pramudiyanto. Effect of Normal Concrete Blanket Thickness on Corrosion Rate of Reinforcing Steel. Yogyakarta: State University of Yogyakarta, 2011.
20. Wuryati Samekto, Candra Rahmadiyanto. Concrete Technology. Kanisius. Yogjakarta, 2001.