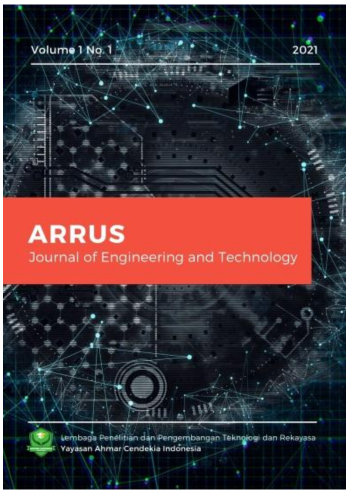
Fransisco, et.al., *ARRUS Journal of Engineering and Technology*, Vol. 5, No. 1 (2025)
https://doi.org/10.35877/jetech3690

OPEN ACCESS

ISSN : 2776-7914 (Print) / 2807-3045 (Online)



RESEARCH ARTICLE

The Effect Of Fineness Of Segabai Rice Husk Ash PCC Cement Substitution In Concecrete Making

Vicky Fransisco* **& Firdaus**

Universitas Bina Darma, Indonesia.

*Corresponding author: Vicky Vicky Fransisco, Universitas Bina Darma

E-mail: vicky.fransisco.01@gmail.com

Abstract: High quality concrete can be produced by increasing the porosity of the concrete. The porosity of concrete is influenced by the aggregate gradation and grain fineness. The limitations of the level of fineness of cement Grains are the main problem in producing high quality concrete , when viewed in terms of porosity for the addition of additional materials to the concrete mixture are used to change , improve the properties of concrete , increase the compressive strength of concrete. The additional materials used can be chemical (chemical admixture) and mineral (admixture additives). South Sumatra Province is an area that is one of the largest rice producers , this can be seen from the results of the Central Statistics Agency of South Sumatra Province in 2021 which showed that rice production in South Sumatra Province reached 2,552.44 thousand tons (BPS South Sumatra Province). The method used is the experimental method by making samples and testing in the laboratory with targets of 0%, 5%, 10%, and 15% of the weight of cement and rice husk ash used . Each variation is made of 3 tests objects each with a size of 10 x 10 x 20 cm, for compressive strength testing at the ages of 7, 14, 28, 56 days . The results of the study on the use of rice husk ash show that the finer the rice husk ash , the compressive strength increases , but more rice husk ash is mixed , the compressive strength also decreases.

Keywords: High Quality Concrete , Rice Husk Ash , Compressive Strength, Refinement.

1. Introduction

Along with the times, the development of concrete structure science continues to increase with the development of science and technology (Chen et al., 2023; Jumini, Madnasri, Cahyono, & Parmin, 2022; Sukmawati, Marzuki, Batubara, Afifah Harahap, & Weraman, 2023). Concrete is a material from a mixture of cement, fine aggregate, coarse aggregate and water with air cavities (Jo, Jo, Cho, & Kim, 2020; Wałach, 2021). With the advancement of science, not a few of the materials that form concrete itself can now be mixed or replaced with materials that have similar properties and characteristics of the material (Huang, Grünewald, Schlangen, & Luković, 2022; Mostafaei, Badarloo, Chamasemani, Rostampour, & Lehner, 2023). So that we can get high quality concrete with materials that have similar characteristics and properties (Abuzyarova et al., 2019; Mostafaei et al., 2023).

High quality concrete can be produced by increasing the porosity of the concrete. The porosity of concrete is influenced by the gradation of aggregates and the fineness of the grains (Bajad, 2020; Golewski, 2023). The limitations of the fineness level of cement grains are the main problem in producing high quality concrete, when viewed in terms of porosity for the addition of additional materials to the concrete mixture is used to change, improve the properties of concrete, increase the compressive strength of concrete (M. J. Rahman, Arfandi, & Pangestu, 2023; Vikas Srivastava et al., 2022). The additional materials used can be chemical

https://doi.org/10.35877/jetech3690

ISSN : 2776-7914 (Print) / 2807-3045 (Online)

(chemical admixture) and minerals (admixture additive) (Almalki, 2023; Marinković, Josa, Braymand, & Tošić, 2023; Pushpakumara & Fernando, 2023). In addition to changing the properties of concrete, the use of additives can reduce the use of cement to make it more economical and the resulting compressive strength can be increased without using a lot of cement (Harris, 2021).

South Sumatra Province is one of the largest rice producing areas, this can be seen from the results of the Central Statistics Agency of South Sumatra Province in 2021 which showed that rice production in South Sumatra Province reached 2,552.44 thousand tons (BPS South Sumatra Province) (A. Rahman, Sirojuzilam, Lubis, & Pratomo, 2023). With a fairly large rice production, the production of rice husk ash must also be large, so the author tried to utilize rice husk ash which is the remains of burning rice husks as a substitute for some cement in the concrete mixture (Anggreani et al., 2023). Concrete is made from a mixture of fine aggregate, coarse aggregate, water, and binding materials in the form of cement or lime which can be used to adhere or bind concrete materials, because of the important function of cement as a construction material, it is necessary to conduct research on how to increase the compressive strength of concrete by utilizing rice husk waste (Erwan & Al, 2019; Ramadhan & Fahmi, 2023).

2. Research Method and Materials

The method used in this study is an experimental method conducted at the Civil Engineering Laboratory of Bina Darma University, Palembang. The experimental method in this study was conducted to determine the effect of the compressive strength of concrete produced due to the fineness factor of rice husk ash which is used as a substitute for cement used in the concrete mixture. The percentage of rice husk ash used as a substitute for cement is 5%, 10%, and 15%. Rice husk ash is divided into several zones, namely zone 0, zone 1, zone 2, and zone 3 according to different levels of fineness. This test was carried out on compressive strength at the age of 7 days, 14 days, 28 days, and 56 days. The concrete components in this study were composed of various mixtures of coarse aggregate, fine aggregate, water, cement, rice husk ash, and superplasticizer. Equipment used to test concrete materials such as water content testing, volume weight testing on materials in solid and loose conditions, SSD (Saturated Surface Dry) testing. Aggregate sieve analysis testing, mud content and organic content testing. The equipment used in this study were pans, cylindrical steel containers, scales, ovens, sieves, vibrators, coarse aggregate SSD testing tools (scales, iron basket hanging tools, iron baskets), fine aggregate SSD testing tools (large pans, spurted cones , pycnometers, pounders, and basins). The tools prepared are aggregate sieve, scales, mixer, material testing tool, slump, concrete mold, concrete compressive strength testing tool. While the materials that must be prepared are cement, fine aggregate, coarse aggregate, rice husk ash, water, and superplasticizer. The stages of mixing the material by mixing it with a concrete mixer to get good fresh concrete so that the material is evenly mixed, then after that the workability test is carried out. After that, a slump test is carried out, which can be seen in Figure 3.15. This test is carried out to determine the impact of the level of fineness of rice husk ash in several zones as a substitute for cement material. After testing, the sample is printed in cylindrical formwork measuring 10 cm x 20 cm. After being molded, the concrete will be cured by being soaked in water The next stage is concrete testing, after the concrete reaches the specified age, a concrete test will be carried out. The concrete ages tested are 7, 14, 28, and 56 days. After the results of the concrete test are obtained, data analysis and compilation will be carried out and a comparison will be made of each test object. The materials tested are fine aggregate and coarse aggregate in the material testing process, the materials tested are fine aggregate or sand obtained from the batching plan where the sand used is Tanjung Raja sand and coarse aggregate / 10-20 mm split stone obtained from the batching plan where the split stone used is Martapura stone.The results of the coarse aggregate material characteristic test meet the SNI requirements so that the material can be used as a concrete mixing material based on the fine aggregate sieve analysis graph that passes sieve no. 50 mm by 100%, sieve no. 37.5 by 100%, sieve no. 25 mm by 100%, sieve no. 19 mm by 82.32%, sieve no. 12.5 mm by 38.09%, sieve no. 9.5 mm by 15.22%, sieve no. 4.75 mm by 0.17%, and sieve no. 2.36 by 0.06% and table 4.2 shows that the split stone material used in the concrete composition meets the specified requirements.

3. Results and Discussion

When the concrete has been mixed in the mixer, a slump test will be carried out before being put into the formwork mold. This aims to determine the workability or ease of the concrete being poured into the mold.

Table 1 Concrete Slump Test Results

Code	Rice Husk Ash (%)	Cement (%)	Slump Test (cm)	SP (%)
Normal Concrete	0	100	10	2
Z0-5	5	95	9	2
Z0-10	10	90	8	2
Z0-15	15	85	8	2
Z1-5	5	95	9	2
Z1-10	10	90	8	2
Z1-15	15	85	8	2
Z2-5	5	95	9	2
Z2-10	10	90	8	2
Z2-15	15	85	8	2
Z3-5	5	95	8	2
Z3-10	10	90	8	2
Z3-15	15	85	8	2

Based on the results of the slump test on concrete contained in table 4.3. it can be seen that the slump value of standard concrete without being mixed with rice husk ash is better than the slump test value of concrete that has been mixed with rice husk ash. The results of the slump test with the optimum value occurred at the rice husk ash fineness level Zone 0. Concrete that has a rice husk ash fineness level Zone 3 has less workability than the Zone above it. So the conclusion is that the slump test value or workability of concrete is getting worse if the rice husk ash fineness level is higher. This is because it is in accordance with the nature of rice husk ash, where the smoother the surface of the rice husk ash, the more water absorption.

3.1. *Concrete Weight*

The concrete results that have been printed and cured will then be weighed to determine the weight of the concrete. This is done in order to determine the weight of each concrete that has been divided per zone and then analyzed the effect of the fineness of rice husk ash on the weight of the concrete. This concrete weight data is taken from the average sample that will later be tested for compressive strength. Concrete weight data was taken at the age of 56 days before the compressive strength test was carried out which is contained.

Table 2 Concrete weight data at 56 days

Code	Rice Husk Ash (%)	PCC (%)	Concrete Weight (kg)	Average (kg)	SP (%)	Change (%)
	0	100	10.92		2	
Normal Concrete	0	100	10.51	10.61	2	0
	0	100	10.40		2	
	5	95	10.11		2	
Z0-5	5	95	10.18	10.12	2	1.07
	5	95	10.08		2	
	10	90	9.90		2	
Z0-10	10	90	9.85	9.82	2	1.04
	10	90	9.70		2	
	15	85	9.41		2	
Z0-15	15	85	9.33	9.34	2	0.99
	15	85	9.27		2	
	5	95	10.32		2	
Z1-5	5	95	10.12	10.15	2	1.08

https://doi.org/10.35877/jetech3690

ISSN : 2776-7914 (Print) / 2807-3045 (Online)

	5	95	10.02		2	
Z1-10	10	90	10.02	9.97	2	1.06
	10	90	9.97		2	
	10	90	9.91		2	
Z1-15	15	85	9.66	9.48	2	1.01
	15	85	9.48		2	
	15	85	9.30		2	
Z2-5	5	95	10.3	10.25	2	1.06
	5	95	10.26		2	
	5	95	10.18		2	
Z2-10	10	90	10.05	10.02	2	1.03
	10	90	10.12		2	
	10	90	9.9		2	
Z2-15	15	85	9.6	9.52	2	1.01
	15	85	9.55		2	
	15	85	9.41		2	
Z3-5	5	95	10.39	10.33	2	1.05
	5	95	10.32		2	
	5	95	10.27		2	
Z3-10	10	90	10.1	10.18	2	1.02
	10	90	10.2		2	
	10	90	10.25		2	
Z3-15	15	85	9.73	9.82	2	1.00
	15	85	9.82		2	
	15	85	9.32		2	

Based on the concrete weight data above contained in the table and graph, it can be seen that the concrete weight is greatly influenced by the level of fineness of the rice husk ash. The normal concrete weight produces a weight of 13.89 kg and is the lightest when compared to concrete using rice husk ash. The influence of rice husk ash is also very influential and produces different concrete weights in each zone. Zone 0 concrete has a lighter concrete weight than zones 2 and 3 because the higher the level of fineness of the rice husk ash, the denser and heavier the concrete will be.

3.2. *Concrete Compressive Strength Results*

At the age of concrete reaching 7, 14, 28, and 56 days, concrete compressive strength testing will be carried out. The purpose of compressive strength testing is to analyze the effect of rice husk ash fineness on compressive strength and will be compared with normal concrete that is not given rice husk ash. The tool used in compressive strength testing is the Universal Testing Machine (UTM). When the sample is loaded, a reading will be taken on the UTM tool and the maximum load will be seen when the concrete sample is destroyed.

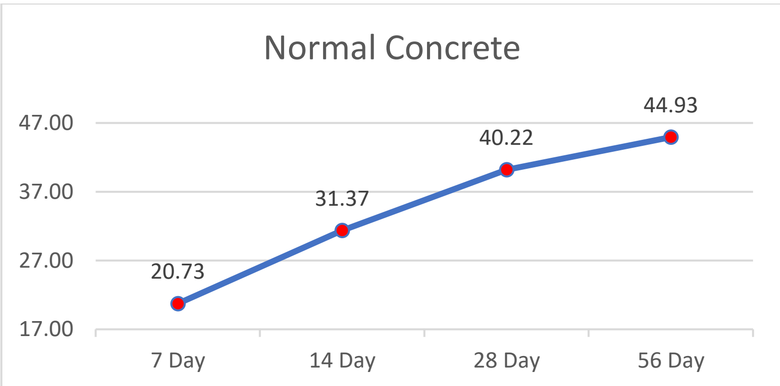


Figure 1 Normal Concrete Compressive Strength Graph

In the normal concrete compressive strength chart at 7 days the value is 20.73 Mpa , at 14 days the value is 31.37 Mpa , at 28 days the value is 40.22 Mpa , and at 56 days the value is 44.93 Mpa .

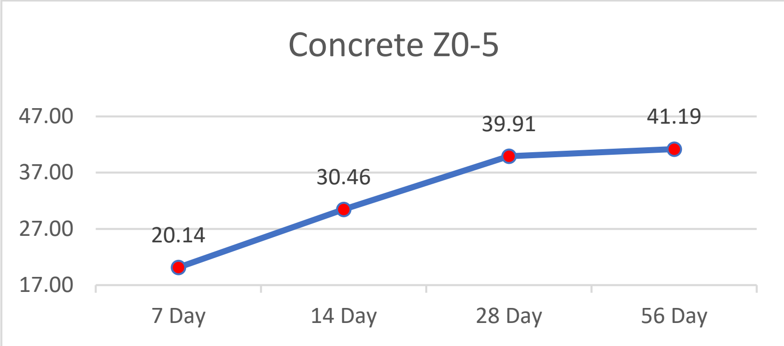


Figure 2 Concrete Compressive Strength Graph Z0-5

In the graphic, the compressive strength of concrete Z0-5 at 7 days is 20.14 Mpa , at 14 days it is 30.46 Mpa , at 28 days it is 39.91 Mpa , and at 56 days it is 41.19 Mpa .

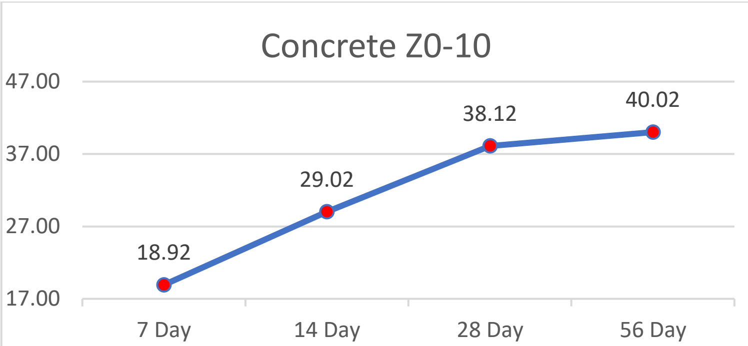


Figure 3 Concrete Compressive Strength Graph Z0-10

In the graphic, the compressive strength of Z0-10 concrete at 7 days is 18.92 MPa, at 14 days it is 29.02 MPa , at 28 days it is 38.12 MPa , and at 56 days it is 40.02 MPa .

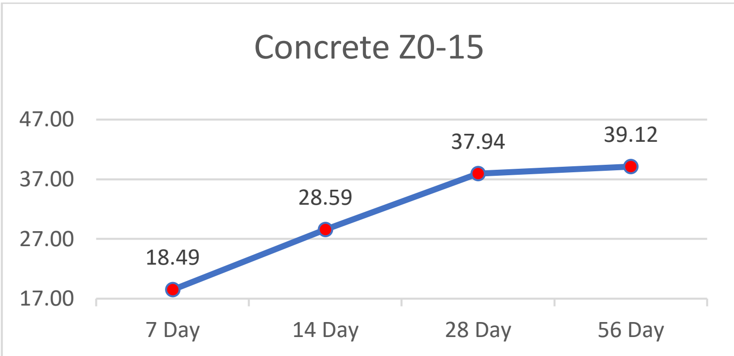


Figure 4 Concrete Compressive Strength Graph Z0-15

In the graphic, the compressive strength of concrete Z0-15 at 7 days is 18.49 Mpa, at 14 days it is 28.59 Mpa , at 28 days it is 37.94 Mpa , and at 56 days it is 39.12 Mpa .

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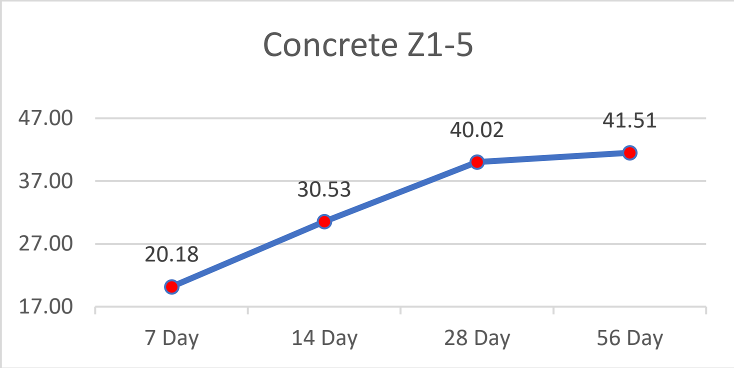

Figure 5 Concrete Compressive Strength Graph Z1-5

In the graphic, the compressive strength of concrete Z1-5 at 7 days is 20.18 Mpa, at 14 days it is 30.53 Mpa , at 28 days it is 40.02 Mpa , and at 56 days it is 41.51 Mpa.

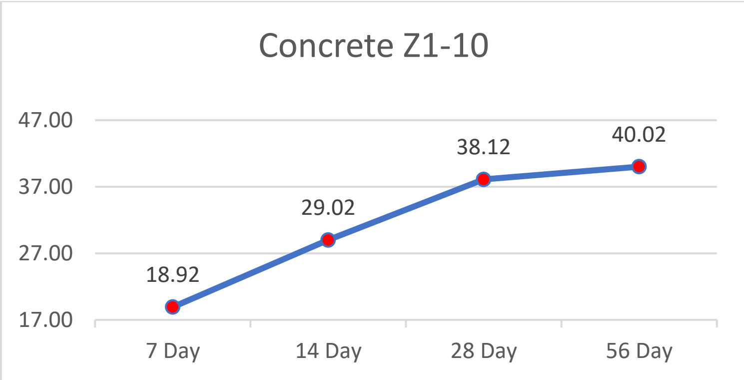

Figure 6 Concrete Compressive Strength Graph Z1-10

In the graphic, the compressive strength of concrete Z1-10 at 7 days is 18.92 MPa, at 14 days it is 29.02 MPa , at 28 days it is 38.12 MPa , and at 56 days it is 40.02 MPa .

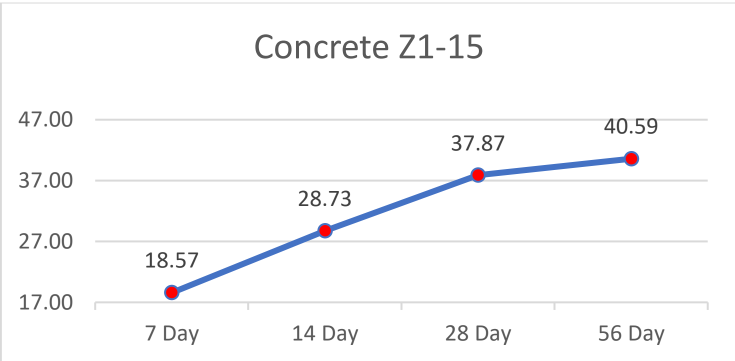

Figure 7 Concrete Compressive Strength Graph Z1-15

In the graphic, the compressive strength of concrete Z1-15 at 7 days is 18.57 Mpa, at 14 days it is 28.73 Mpa , at 28 days it is 37.87 Mpa , and at 56 days it is 40.59 Mpa .

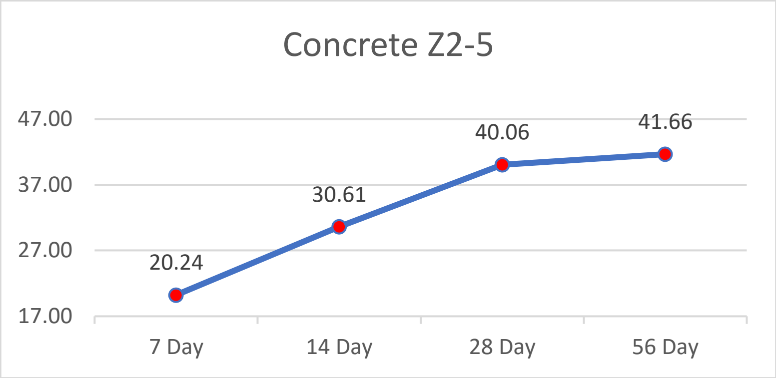

Figure 8 Z2-5 Concrete Compressive Strength Graph

In the graph, the compressive strength of Z2-5 concrete at 7 days is 20.24 Mpa , at 14 days it is 30.61 Mpa , at 28 days it is 40.06 Mpa , and at 56 days it is 41.66 Mpa .

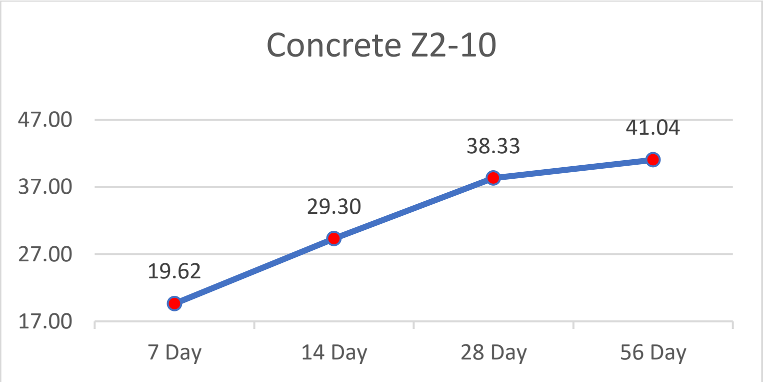

Figure 9 Z2-10 Concrete Compressive Strength Graph

In the graphic, the compressive strength of Z2-10 concrete at 7 days is 19.62 Mpa, at 14 days it is 29.30 Mpa , at 28 days it is 38.33 Mpa , and at 56 days it is 41.04 Mpa .

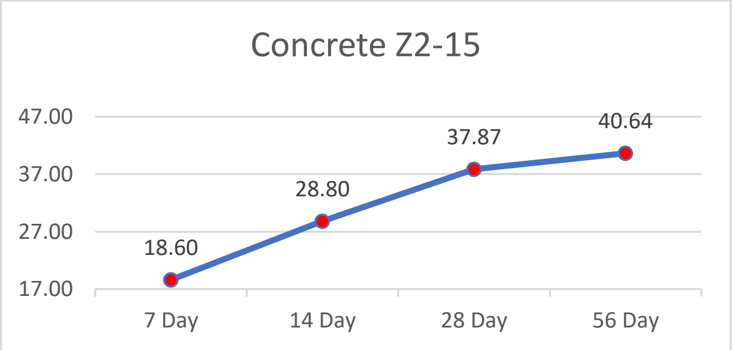

Figure 10 Z2-15 Concrete Compressive Strength Graph

In the graphic, the compressive strength of Z2-15 concrete at 7 days is 18.60 Mpa, at 14 days it is 28.80 Mpa , at 28 days it is 37.87 Mpa , and at 56 days it is 40.64 Mpa .

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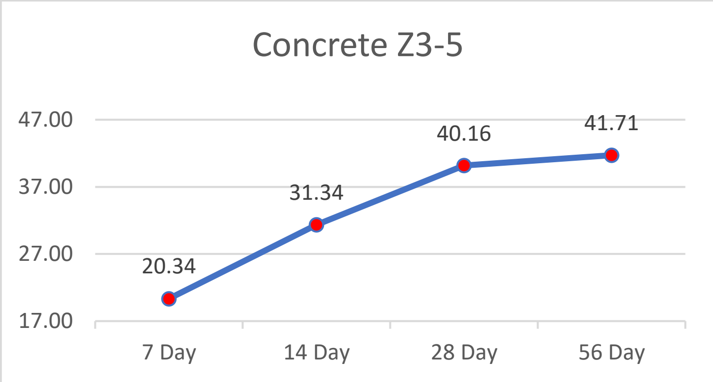
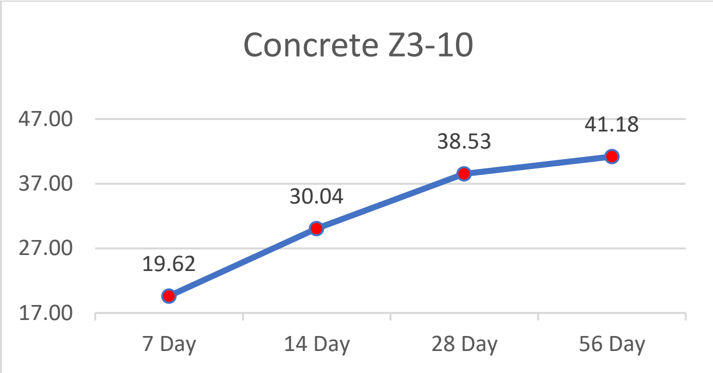


Figure 11 Z3-5 Concrete Compressive Strength Graph

In the graphic, the compressive strength of Z3-5 concrete at 7 days is 20.34 Mpa, at 14 days it is 31.34 Mpa , at 28 days it is 40.16 Mpa , and at 56 days it is 41.71 Mpa .



`**Figure 12** Z3-10 Concrete Compressive Strength Graph

In the graphic, the compressive strength of Z3-10 concrete at 7 days is 19.62 Mpa, at 14 days it is 30.04 Mpa , at 28 days it is 38.53 Mpa , and at 56 days it is 41.18 Mpa .

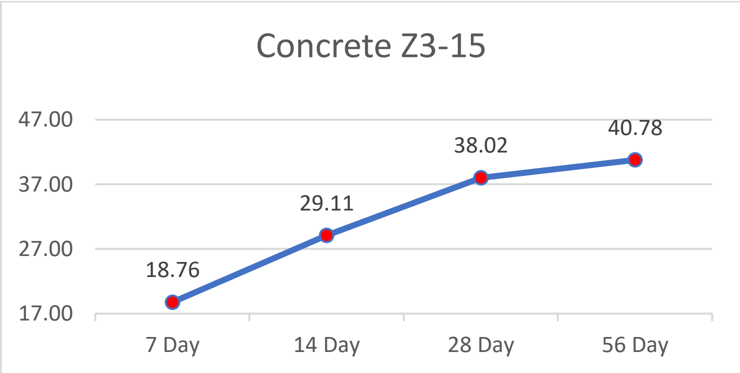


Figure 13 Z3-15 Concrete Compressive Strength Graph

In the graphic, the compressive strength of Z3-15 concrete at 7 days is 18.76 Mpa, at 14 days it is 29.11 Mpa , at 28 days it is 38.02 Mpa , and at 56 days it is 40.78 Mpa .

Based on the graph that we observe from graph 4.15, concrete with zone Z3-5 or zone 3 with a mixture percentage of 5% has a higher compressive strength value with a value of 41.71 Mpa compared to concrete Z0, Z1, and Z2, but normal concrete still has a higher compressive strength compared to concrete that has been mixed with rice husk ash so it can be concluded that the level of fineness of rice husk ash affects the compressive strength of concrete, but the greater the percentage of rice husk ash mixture as a cement substitute, the

ISSN : 2776-7914 (Print) / 2807-3045 (Online)

compressive strength of the concrete decreases but not significantly, which means that rice husk ash can also be used as a cement substitute to reduce dependence on cement.

4. Conclusion

The use of rice husk ash as a cement substitute can reduce the concrete weight value, but the effect of the fineness of the concrete zone also affects the concrete weight, the finer it is, the concrete weight value increases and the more rice husk ash used as a cement substitute, the lower the concrete compressive strength. However, the effect of the fineness of rice husk ash increases the concrete compressive strength because it makes the concrete gaps tighter. At a mixture percentage of 10% and 15%, the compressive strength and weight of the concrete decreased when compared to a mixture of 5%, but the effect of the fineness of zones 0, 1, 2, 3 was very visible, the finer the rice husk ash, the heavier and stronger the concrete, at a percentage of 5% the compressive strength and weight of the concrete increased and the effect of the fineness of zones 0, 1, 2, 3 and the finer the rice husk ash used, the compressive strength of the concrete increased.

The highest compressive strength is found in normal concrete with an average value of 44.93 Mpa , however in concrete mixed with rice husk ash the highest compressive strength is in zone 3 concrete at a percentage of 5% with a value of 41.71 Mpa . The lowest compressive strength is found in zone 0 concrete at a percentage of 15% with a value of 39.12 Mpa .

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