Vol. 1 No. 2 Year. 2023

Analysis Of Compressive Strength Of Foam Mortar With The Use Of Teratak Buluh Sand And Ringgit Sand

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Abstract - *The composition of the fine aggregate mix affects the manufacture of foam mortar. The purpose of this study was to determine how the properties of Teratak Buluh Sand and Ringgit Sand affect the Unconfined Compressive Strength value of foam mortar. The research used a quantitative method with an experimental research design conducted in the laboratory. In this study obtained fine aggregate sand teratak buluh has a mud content value of 0.50% while the mud content value of ringgit sand is 1.92%. The test results of slump flow values in both types of sand to cement mixtures meet the specification requirements of 18 ± 2 cm. The highest value of the content weight of Teratak Buluh sand was 781.67 kg/m3 while Ringgit sand was 758.12 kg/m3. The value of Unconfined Compression Strength (UCS) using the highest Teratak Buluh sand of 1253 kPa is superior compared to Ringgit sand of 597.63 kPa.*

Keywords: *teratak buluh sand, ringgit sand, foaming agent, foam mortar,UCS*

I. PRELIMINARY

Riau is the province on the island of Sumatra that has the largest area of peatland, which is 3.89 million hectares out of 6.49 million hectares of total peatland area on the island of Sumatra. Currently, it is estimated that the degraded peatland in Riau Province is around 2,313,561 ha or 59.54% of the total peatland area in the province. However, around 1,037,020 ha of this land is utilized by farmers for the cultivation of oil palm, food crops and horticulture. Peatland is an organic soil environment with high moisture content, low bearing capacity and high acidity. Concrete structures in acidic environments are susceptible to long-term damage from organic and non-organic acids [1].

In the last 10 years, the government has looked at building concrete roads on peatlands instead of paved roads, where paved roads often deteriorate, resulting in bumpy roads and potholes. Concrete is one of the construction materials whose quality is strongly influenced by the type of cement, aggregate size, cement water factor, time and temperature in curing and the presence of intercellular pores and capillary pores. To reduce intercellular pores and capillary pores, it can be done by using additives.

In its development, there are various variants of concrete developed, one of which is lightweight concrete. Lightweight concrete is widely chosen in construction work because it is easy to form and its light weight makes it easy to install. Because Indonesia has peatlands and earthquake-prone areas, the use of lightweight concrete will be very beneficial because it can replace conventional building materials so that the weight of a construction becomes lighter. Because of the advantages of lightweight concrete, when used in high-rise building projects it can significantly reduce the self-weight of the building, which in turn has an impact on foundation calculations. There are several methods that can be used to reduce the weight of concrete contents or in other words make concrete lighter. One of them is by creating gas/air bubbles in the cement mixture so that there are many pores in the concrete. In addition to the bubbles from the foaming agent mixture which is the core material in the manufacture of lightweight concrete (foam mortar), the strength of the mortar is also influenced by the composition of the mixture of fine aggregates.

Suprasman (2012) also stated that fine aggregate from Lake Bingkuang is the material with the best compressive strength value, while teratak buluh material is the fine aggregate material with the closest concrete compressive strength value to fine aggregate material from Lake Bingkuang [2]. The author is interested in conducting the same research on foam mortar with foaming agent using two different types of fine aggregate sources. The fine aggregate used was sourced from Teratak Buluh Sand, Kampar and Ringgit Sand, Indragiri Hulu. Where the end of the stone fine aggregate material has been researched to have good properties in structural concrete mixtures. While the aggregate material from Ringgit sand, the author has not found a research journal about the aggregate used in structural concrete mixtures. Therefore, the purpose of this study is how the properties of the two types of sand affect the Unconfined Compression Strength (UCS) of foam mortar. In general, the objective of this study was to determine the Unconfined Compression Strength (UCS) of foam mortar using two different types of fine aggregate. Specifically, to obtain the properties test values of the two types of fine aggregate mixed composition between teratak buluh sand and ringgit sand by comparing the two types of aggregate, to determine the slump flow value comparison of foam mortar mixed composition between teratak buluh sand and ringgit sand with additional foaming agent in mortar, to analyze the content weight value of foam mortar mixed composition between teratak buluh sand and ringgit sand with additional foaming agent in mortar and to analyze the compressive strength value of foam mortar mixed composition between teratak buluh sand and ringgit sand with additional foaming agent in mortar.

II. RELATED RESEARCH

Febrianto in his research entitled "Research on the Compressive Strength and Specific Weight of Mortar for Wall Panels by Comparing the Use of Bangka Sand and Baturaja Sand with Additional Foaming Agent and Silica Fume". In this study, a foaming agent will be used, which is a type of chemical that when mixed with water will produce a stable foam and can produce a lighter mortar for wall panels. In this study, foaming agent is used, which is a type of chemical that is mixed with water to produce stable foam and can produce lighter mortar. And in this research also used silica fume. [3]

Research from Muhammad Arief Rizqy & Nursyami "Manufacture of Lightweight Concrete Aggregate Waste Plastic High Density Polyethylene (HDPE) with the Addition of Silica Fume". The purpose of this research is to know how to process HDPE plastic waste into artificial coarse aggregate for lightweight concrete mixes, to know the mechanical behavior of lightweight concrete with plastic waste aggregates using silica fume additives, and to know the effect of different gradations of coarse aggregate on lightweight concrete. In this study, three types of coarse aggregate gradation variations were used, namely 25-4.75 mm (zone I), 19-4.75 mm (zone II), and 12.5-4.75 mm (zone III). The use of different gradations of coarse aggregate is intended to determine the effect of different gradations of coarse aggregate on lightweight concrete. From the results of this study, it was obtained that the maximum compressive strength occurred in concrete using coarse aggregate zone II, which amounted to 9.17 MPa. The maximum split tensile strength also occurs in concrete using coarse aggregate zone II, which is 0.88 MPa. The average content weight of lightweight concrete in this study was 1575 kg/m. With such a content weight, it can be categorized into structural lightweight concrete because the content weight requirement is in the range of 1400-1850 kg/m^3. However, the strength cannot be categorized into structural lightweight concrete because it does not meet the minimum compressive strength requirement of 17.24 MPa.[4]

Research on the use of admixture accelerators as chemical additives in foam mortars that function to accelerate the bonding and hardening process. The admixture accelerator added is Beton Mix. Foam mortar is a mixture of water, cement, sand and foaming agent. The results of this study show that there is a strong influence of the addition of accelerator substances on the compressive strength, length of hardening time and shrinkage of foam mortar.[5]

III. RESEARCH METHODS

The research methodology used quantitative methods with an experimental research design conducted in a laboratory. From the results of pre-research with variations in the cement water factor, the minimum average value of the Unconfined Compression Strength (UCS) of the plan is 1253.73 kPa with a consistency that meets the requirements of the value a = (100 ± 15) % is a cement water factor of 0.50. So that the ratio for cement: sand: water in type N mortar paste mixture is 1 Cement: 3 Sand or known as mortar 1: 3.Foaming agent is used to make foam. foam is produced from a mixture of foaming agent: water with a ratio of 1: 25

In this study, the size of the test specimen for the Unconfined Compression Strength test (UCS) uses a cylindrical steel mold measuring 10 cm in diameter and 20 cm in height. The design of test specimens used for testing the compressive strength of concrete tested at the age of 14 days with a total of 27 test specimens, namely 15 test specimens using teratak buluh sand and 15 test specimens using ringgit sand.

The stages carried out in this research are, testing the properties of fine aggregates, making foam mortar materials, making and molding test specimens, removing and treating test specimens and testing the compressive strength of mortar

IV. RESULTS AND DISCUSSION

To plan a lightweight foam mortar mix with a minimum compressive strength (14 days) of 800 kPa refers to the circular issued by the Ministry of Public Works and Public Housing Number: 44 / SE / M / 2015 concerning Guidelines for Designing Lightweight Material Mixtures with Foam Mortar for Road Construction. Based on the testing and calculation of the mix design (Job Mix Design) of the foam mortar mixture, the Unconfined Compression Strength value of 1,000 kPa is obtained, this value is used as a reference for researchers as the minimum value of the Unconfined Compression Strength value of foam mortar. then the composition of material requirements for 1 m^3 of lightweight foam mortar material shown in Table 1:

Table 1. Design of 1,000 kPa Foam Mortar Mix for 1 m^3

No	Material	Volume of Each Mixture Composition (Kg)				
		18/82%	16/84%	15/85%	14/86%	12/88%
1	Cement	400.00	400.00	400.00	400.00	400.00
2	Sand	310.37	275.88	258.64	241.40	206.91
3	Water	200.00	200.00	200.00	200.00	200.00
4	Foam Weight	35.87	36.75	37.18	37.62	38.50
Total		946.24	912.63	895.82	879.02	845.41

A. Testing Results of Slump Flow Value

There are 2 types of sand used in this study, namely teratak buluh sand and ringgit sand. Teratak buluh sand has a content weight value of 1.623 gr/cc while ringgit sand has a content weight value of 1. 626 gr/cc, teratak buluh sand has a dry weight content value of 2.621 gr/cc while ringgit sand has a dry weight content value of 2.538 gr/cc, teratak buluh sand has an SSD weight content value of 2.653 gr/cc while ringgit sand has an SSD weight content value of 2.575 gr/cc, teratak buluh sand has an apparent weight content value of 2.708 gr/cc while ringgit sand has an apparent weight content value of 2.675 gr/cc, teratak buluh sand has an apparent weight content value of 2.708 gr/cc while ringgit sand has an apparent weight content value of 2.575 gr/cc. and the water absorption rate of teratak buluh sand has a value of 1.215% while the water absorption value of ringgit sand has a value of 1.441%. The water absorption values meet the requirements of a maximum absorption value of 5%.

The fine aggregate of teratak buluh has a mud content value of 0.50% while the mud content value of ringgi sand is higher with a mud content percentage value of 1.92% where the maximum mud content value is 3%. So that teratak buluh sand and ringgit sand are suitable for use as mixed materials in lightweight foam mortar materials.

B. Testing Results of Slump Flow Value

Testing the slump flow value was carried out at the time of mixing the foam mortar lightweight material, from the test results that have been carried out, the flow value is obtained in Table 2.

Table 2. Slump Flow Value Testing Results

No.	Sand Type	Average Flow Value (cm)				
		18/82	16/84	15/85	14/86	12/88
1	Teratak Buluh	17.00	18.00	18.50	19.00	18.50
2	Ringgit	18.00	17.00	18.30	18.50	19.00

Table 4. shows the results of the examination of the average flow value in the two types of sand studied have differences in flow values that are not too far away. In teratak bulu sand, the highest value is shown in a mixture of 14/86% with a flow value of 19.00 cm while in ringgit sand the highest is shown in a mixture of 12/88% at 19.00 cm.

The results of testing the slump flow value of both types of sand meet the specification requirements of 18 ± 2 cm. The effect of high and low flow values affects the workability of lightweight foam mortar. The higher the flow value, the easier it is to stir, pour and spread, but if the flow value is low, the more difficult it is to work with lightweight foam mortar.

C. Comparison of Weight Content of Foam Mortar Between Teratak Buluh Sand and Ringgit Sand

From the tests carried out on the mixture of teratak buluh sand and ringgit sand, the test obtained the average value of the weight content of lightweight foam mortar material in the following table 3.

Tabel 3. Comparison of Weight Content of Foam Mortar Between Teratak Buluh Sand and Ringgit Sand

No.	Composition/Mix (%)	Average Fine Aggregate Type (Kg/M^3)	
		Teratak Buluh	Ringgit
1	18/82	765.76	754.52
2	16/84	765.55	757.06
3	15/85	768.30	755.58
4	14/86	781.67	755.79
5	12/88	780.61	758.12

From table 3. above, it can be seen that the value of the weight of the lightweight material content of foam mortar in the teratak reed sand mixture of the five types of mixture has a higher value than the value of the weight of the lightweight material content of foam mortar in the ringgit sand mixture.

D. Summary of Unconfined Compression Strength (UCS) of Foam Mortar Lightweight Material

After conducting experiments in each sand composition ratio, the results of the Unconfined Compression Strength (UCS) of the foam mortar rebar material were obtained with various compressive strength values. The author summarizes the average Unconfined Compression Strength (UCS) values into the following table 4

Table 4. Average Unconfined Compression Strength (UCS) Value of Morta Foam Using Teratak Buluh Sand With Ringgit Sandggit

No.	Types of Cement	Unit	Composition Comparison Sand: Foam				
			18/82	16/84	15/85	14/86	12/88
1	Pasir Teratak Buluh	kPa	591.14	610.63	1253.73	1136.80	1175.78
2	Pasir Ringgit	kPa	233.86	357.28	539.17	110.43	597.63

From Table 6, it can be seen that the Unconfined Compression Strength (UCS) value of lightweight foam mortar material on teratak buluh sand has a Unconfined Compression Strength (UCS) value that reaches the minimum reference limit of the Unconfined Compression Strength (UCS) plan of 1000 kPa. While ringgit sand has a Unconfined Compression Strength (UCS) value far below the minimum reference limit of the Unconfined Compression Strength (UCS) plan so that it is classified under the value does not meet the minimum reference of the Unconfined Compression Strength (UCS) plan and the SE-PUPR-46-SE-M-2015 specification which is 800 kPa.

In teratak buluh sand, mixtures of 14/86% and 12/88% have a Unconfined Compression Strength (UCS) value that meets the minimum compressive strength value plan requirement of 1000 kPa while in mixtures of 18/82% and 16/84% in teratak buluh sand and mixtures of 18/82%, 16/84%, 15/85% 14/86% and 12/88% in ringgit sand do not meet the minimum reference Unconfined Compression Strength (UCS) plan of 1000 kPa and the SE-PUPR-46-SE-M-2015 specification of 800 kPa.

V. CONCLUSION

From the test results and data analysis, it can be concluded that Teratak buluh fine aggregate has a mud content value of 0.50% lower than the mud content value of ringgit sand higher with a mud content percentage value of 1.92% where the maximum mud content value is 3%. So it can be concluded that teratak buluh sand is better than ringgit sand because the mud content value of teratak buluh is lower than ringgit sand.

In the 18/82% mixture, the flow value of reed teratak sand is 17 cm lower than that of ringgit sand with a flow value of 18 cm, in the 16/84% mixture, the flow value of reed teratak sand is higher with a flow value of 18 cm compared to ringgit sand which only reaches a value of 17 cm, in the job mix design (JMD) mixture of 15/85%, the test sample using reed teratak sand type has a value of 18 cm. 5 cm while ringgit sand has a flow value of 18.3 cm, in the 14/86% mixture the flow value of teratak reed sand has a higher value of 19 cm while ringgit sand only reaches a flow value of 18.5 cm and in the last mixture, namely the 12/88% mixture, the flow value of ringgit sand is higher at 19 cm than the flow value of ringgit sand only reaches 18.5 cm. The results of testing the slump flow value of both types of cement meet the specification requirements of 18 ± 2 cm.

In the mixture of 18/82 teratak reed, the content weight value is higher at 781.67 kg/m^3 than in the mixture of 18/82 ringgit sand, the content weight value is lower at 754.52 kg/m^3. In the mixture of 16/84 teratak reed, the content weight value is higher at 765.55 kg/m^3 than the mixture of 16/84 ringgit sand which has a lower content weight value of 757.06 kg/m^3. In the mixture of JMD 15/85 teratak reed, the content weight value is higher at 768.30 kg/m^3 than the mixture of JMD 15/85 ringgit sand which has a lower content weight value of 755.58 Kg/M3. In the 16/84 teratak reed sand mixture, the content weight value is higher at 781.67 kg/m^3 than the 16/84 ringgit sand mixture, which has a lower content weight value of 755.79 Kg/M3. In the 12/88 sand mixture, the content weight value is higher at 780.61 kg/m^3 than the 12/88 ringgit sand mixture, the content weight value is lower at 758.12 kg/m^3.

The average value of Unconfined Compression Strength (UCS) of lightweight foam mortar material from the use of teratak buluh sand obtained foam: sand mixture with a mixture ratio of 14/86% of 1136.80 kPa and 12/88% of 1175.78 kPa has the highest value of Unconfined Compression Strength (UCS) which is close to the compressive strength value of the 15/85% mixture of 1253.73. The 18/82%, 16/84%, 15/85%, 14/86% and 12/88% ringgit sand mixes had the lowest Unconfined Compression Strength (UCS) values ranging from 0 kPa -597.63 kPa. The average value of Unconfined Compression Strength (UCS) of the foam mortar lightweight material does not meet the minimum plan compressive strength requirement of 1000 kPa and does not meet the minimum subbase compressive strength value requirement of 800 kPa according to the SE-PUPR-46-SE-M-2015 specification rules[6].

THANK-YOU NOTE

I would like to thank my colleagues, students who helped in this research..

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