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THE EFFECT OF IRON SAND (WALE) ON THE COMPRESSIVE STRENGTH OF QUALITY CONCRETE f'c 26.4 MPa

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KEY W O R D S
concrete, Compressive strength,iron sand

A B S T R A C T
Concrete is the most widely used building material in construction, both building and bridge construction. This is supported by the ease of the concrete making process that can be made by various groups, both those who understand concrete mix design and those who have no understanding of concrete at all. The difference between the two is only in the quality and quality of the concrete made. The effect of iron sand on normal concrete constituent materials is carried out using percentages of 0.5%, 5% and 20% of the total volume of natural sand used.
In this study, iron sand additives were used to determine the most optimal percentage that affects the compressive strength of concrete with the addition of iron sand material of 0.5%, 5% and 20% of the total volume of natural sand. The review of the analysis of this study is compressive strength with a cylindrical test piece with a diameter of 15 cm and a height of 30 cm. From this study, it can be known that the strength of the concrete produced by the use of iron sand mixture is 0.5%, 5% and 20% of the total volume of natural sand.

1. INTRODUCTION

Concrete is the most widely used building material in construction due to its ease of production, accessible even to those without deep knowledge of concrete mix design. This has spurred engineers to research and innovate to enhance concrete quality. Research focuses on improving the elements that make up concrete—cement, aggregates, additives, and water—since the quality of concrete largely depends on these materials.

A significant innovation involves substituting natural aggregates, whose availability is diminishing, with alternative materials like construction waste or other suitable resources. One such alternative is iron sand, a natural resource in Indonesia, typically used in the iron and steel industry but also applicable in cement production.

The study explores the use of iron sand as a partial replacement for natural sand in concrete mixtures. Iron sand is introduced at varying percentages (0.5%, 5%, and 20%) of the total volume of natural sand in normal concrete. The goal is to avoid excessive concrete weight and manage segregation, as iron sand has a different specific gravity compared to natural sand, potentially leading to faster segregation. By carefully selecting the percentage of iron sand,

the study aims to maintain the balance between concrete performance and weight.

his study aims to determine whether the use of iron sand in concrete affects its compressive strength and to identify the optimal percentage of iron sand (0.5%, 5%, or 20% of the natural sand volume) that yields the highest compressive strength.

The study is limited to investigating a concrete mixture with a target compressive strength of F'c-26.4 MPa, using iron sand as a partial replacement for natural sand at 0.5%, 5%, and 20%, compared to normal concrete with 0% iron sand. The materials for the test are sourced from Tabanga District, specifically using Wale iron sand. The tests are conducted on cylindrical samples with dimensions of 15 cm in diameter and 30 cm in height, with compressive strength tested at 7, 14, and 28 days.

This research demonstrates that iron sand can be used as a fine aggregate in concrete, influencing compressive strength. It identifies the optimal percentage of iron sand (0.5%, 5%, or 20%) for concrete strength and serves as a reference for future innovations in concrete production, encouraging new ideas and methods.

2. METHOD

This research was conducted at the Civil Engineering Structure Laboratory of the University of Muhammadiyah North Maluku, focusing on the effect of adding iron sand as a fine aggregate on the compressive strength of concrete with a target strength of f'c 26.4 MPa. The study used iron sand from Wale Village as an additive at varying percentages (0.5%, 5%, and 20%) to replace natural sand, with testing done at 28 days. The fine and coarse aggregates were sourced from Tabanga District.

The experiment involved 36 test specimens, divided into groups for testing at 7, 14, and 28 days. The research analyzed the compressive strength of concrete with different iron sand mixtures, following ASTM standards for specific gravity, sieve analysis, and other material properties. The specimens were cured by soaking in water for 7 days to ensure proper cement hydration. Compressive strength tests were conducted by gradually applying load until failure to determine the maximum load each concrete mix could withstand. The data was then analyzed statistically to evaluate the effects of the iron sand on the concrete's compressive strength.

3. RESULT AND DISCUSSION

Results of Testing Characteristics of Fine Aggregates and Coarse Aggregates

Table 1. Recapitulation of Fine Aggregate Test Results (Tabanga)

It	Fine Aggregate Inspection or Testing	Fine Aggregate Testing Specification	
		Specifications /intervals	Test Results
1	Up Air	3-5 %	3,65 %
2	Sludge Content	0,2-5 %	2,44 %
3	Volume Weight		
	a. Loose Conditions	1.6-1.9 gr/cm3	1,59 gr/cm3
	b. Solid Conditions	1.6-1.9 gr/cm3	1.60 gr/cm3
4	Specific Gravity and Water Absorption		
	a. Water Absorption	0,2-2 %	0,21 %
	b. Dry Oven Specific Gravity	1,6-3,2 gr/cm3	1.78 gr/cm3
	c. Surface Dry Type Berit, Water Saturated	1,6-3,2 gr/cm3	2.16 gr/cm3
	d. Apparent Specific Gravity	1,6-3,2 gr/cm3	2.86 gr/cm3

5	Sieve Analysis / Modulus of Fineness	1,5-3,8 %	3,34 %

Table 2. Recapitulation of Crude Aggregate Test Results (Tabanga)

No	Fine Aggregate Inspection or Testing	Fine Aggregate Testing Specification	
		Specifications /intervals	Test Results
1	Up Air	3-5 %	0,93 %
2	Sludge Content	0,2-5 %	0,98 %
3	Volume Weight		
	a. Loose Conditions	1,6-1,9 gr/cm3	1.50 gr/cm3
	b. Solid Conditions	1,6-1,9 gr/cm3	1.59 gr/cm3
4	Specific Gravity and Water Absorption		
	a. Water Absorption	0,2-2 %	3,95 %
	b. Dry Oven Specific Gravity	1,6-3,2 gr/cm3	2.30 gr/cm3
	c. Surface Dry Type Berit, Water Saturated	1,6-3,2 gr/cm3	2.39 gr/cm3
	d. Apparent Specific Gravity	1,6-3,2 gr/cm3	2.53 gr/cm3
5	Sieve Analysis / Modulus of Fineness	1,5-3,8 %	7,80 %

Table 3. Recapitulation of Fine Aggregate Test Results (Wale)

No	Fine Aggregate Inspection or Testing	Fine Aggregate Testing Specification	
		Specifications /intervals	Test Results
1	Up Air	3-5 %	4,48 %
2	Sludge Content	0,2-5 %	0,29 %
3	Volume Weight		
	a. Loose Conditions	1,6-1,9 gr/cm3	2,10 gr/cm3
	b. Solid Conditions	1,6-1,9 gr/cm3	2.61 gr/cm3
4	Specific Gravity and Water Absorption		
	a. Water Absorption	0,2-2 %	0,08 %
	b. Dry Oven Specific Gravity	1,6-3,2 gr/cm3	2.95 gr/cm3
	c. Surface Dry Type Berit, Water Saturated	1,6-3,2 gr/cm3	3.18 gr/cm3
	d. Apparent Specific Gravity	1,6-3,2 gr/cm3	3.83 gr/cm3
5	Sieve Analysis / Modulus of Fineness	1,5-3,8 %	1,50 %

Concrete Mix Design

Table 4. Concrete Mix Requirements for 9 Test Pieces.

Name	Sample size	Number of samples	Semen medical history	Air medical history	Pasir medical history	Gravel medical history	Bamboo medical history
0%	15x30	9	19,10	9,21	35,90	36,47	-
0,50%	15x30	9	19,10	9,21	35,90	36,47	0,18
5%	15x30	9	19,10	9,21	35,90	36,47	1,80
20%	15x30	9	19,10	9,21	35,90	36,47	7,18
Sum		36	76,41	36,83	143,60	145,86	9,15

Slump Test Testing

Table 5. The results of the test were for the slump value of FAS 0.5 and FAS 0.6.

Specimen Code	Average Slump Value (cm)
Concrete Normal	12
0,5 %	12
5 %	12
20%	12

Source : Laboratory Test Results

Compressive Strength Test esults

The compressive strength test of concrete was carried out on the test specimen using iron sand mining material using variations of 0.5%, 5% and 20% The test specimen was carried out at the age of 7, 14 and 28 days. The test pieces to be

tested are in the form of cylinders with a diameter of 15 cm and a height of 30 cm as many as 36 test pieces.

Table 6. Average Compressive Strength Test Results

No	Kuat Tekan Rata-rata											
	Beton Normal			Variasi 0,5%			Variasi 5%			Variasi 20%		
1	7	14	28	7	14	28	7	14	28	7	14	28
	30,18	23,19	22,84	20,38	21,15	23,33	27,84	22,82	19,76	25,63	24,07	23,63

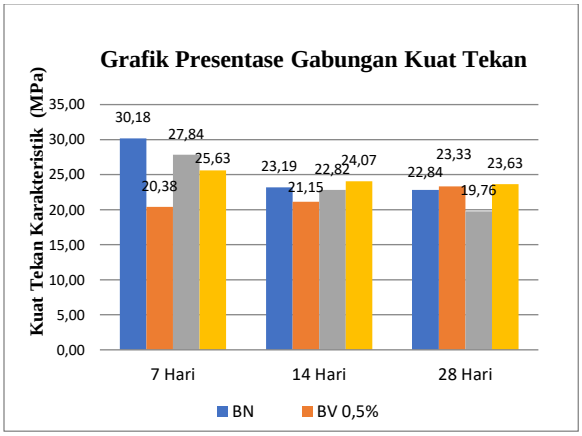

Figure 2. Compressive Force Combined Percentage Chart

From the comparison graph, it can be seen that the relationship between the compressive strength of normal concrete and concrete using iron sand with a cement water factor (FAS) of 0.49 shows a graph model where there is a variation in the compressive strength of concrete.

Concrete using iron sand has a percentage of 0.5% of the compressive strength value has decreased, while at the percentage of 5% the compressive strength value is in the middle. However, there was an increase at the age of 28 days for a percentage of 5% and a decrease in the percentage of 20%.

Concrete using iron sand with a percentage of 0.5% of the compressive strength value is brought, while at the percentage of adding bamboo of 5%, the compressive strength value is at the minimum condition. However, at a percentage of 5%, there was an increase at the age of 14 days and at the age of 28 days.

When comparing the compressive strength of normal concrete with concrete that uses iron sand, it can be seen that concrete that uses iron sand by 0.5%, 5% and 20% has increased and some have decreased.

From the results above, we can see that normal concrete with concrete using iron sand, has more increased compressive strength in normal concrete. However, in the compressive strength of concrete using iron sand with variations of 0.5%, 5% and 20%, some have increased and some have decreased, such as in the presentation of 5% and 20%, the compressive strength value of concrete has decreased at the age of 14 days and 28 days

4. CONCLUSION

The study concluded that incorporating iron sand into concrete affects its compressive strength, with varying results based on the percentage used. Normal concrete with a cement-water factor (FAS) of 0.49 showed better compressive strength overall compared to iron sand mixtures. Specifically, as the percentage of iron sand increased, the compressive strength generally decreased. Thus, normal concrete proved to be more effective than concrete containing iron sand at the tested FAS of 0.49.

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