

Fish Scales as Fine Aggregate in Cement Floor Tiles



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Introduction

The main objective of this research is to assess and utilize fish scales as fine aggregate replacement in making cement floor tiles. Some specific objectives would be to analyze the physical properties of the fish scales-partially replaced cement tiles made and to determine the optimum proportion of replacement of sand with fish scales.

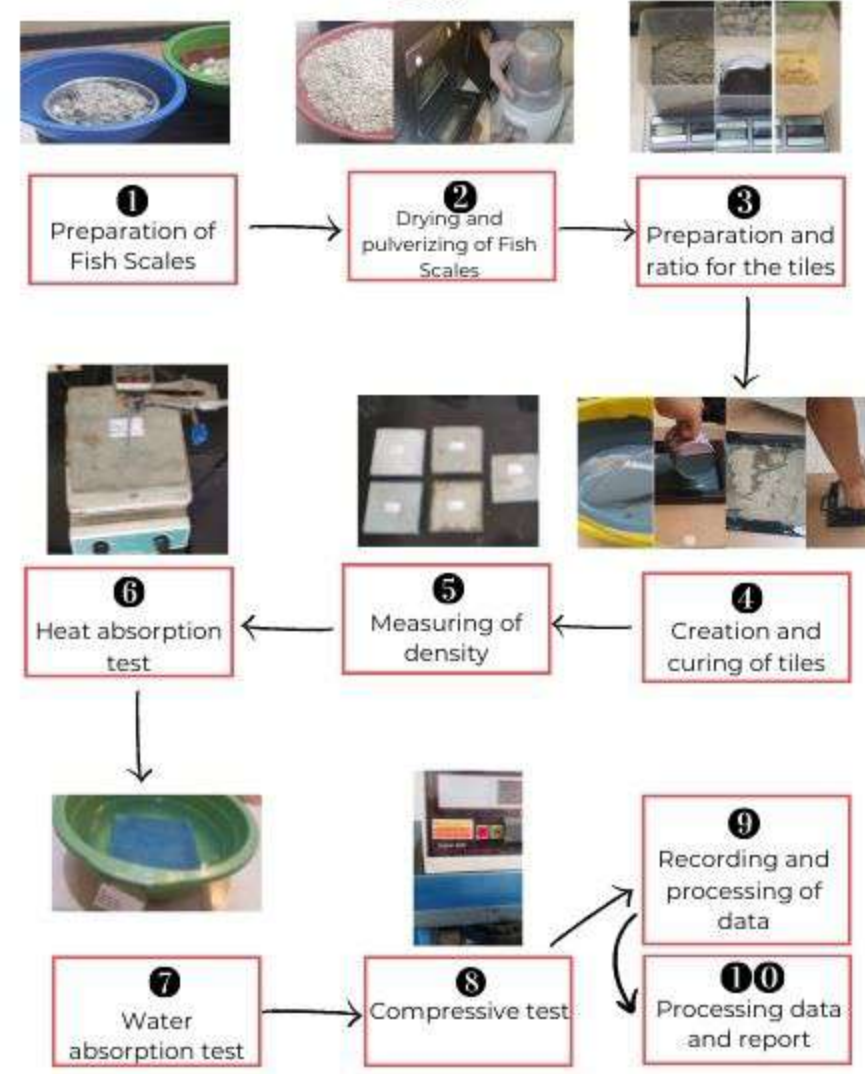
Research Questions

- 1 To what extent, if there is, can the fish scales be used as a fine aggregate in cement tiles?
- 2 How does the ratio of pulverised fish scales to sand affect the physical properties of the cement tiles made?

Hypotheses

- 1 Fish scales contain calcium. Any calcium-containing material can be a fluxing additive in the production of ceramic or concrete. With that, it is hypothesized that the pulverized fish scales can be used as a fine aggregate when mixed in a certain proportion with sand and cement.
- 2 The usual composition of a cement tile is sand as the aggregate, cement, water, and color pigment. Replacing the sand with pulverized fish scales will affect the physical properties of the cement tiles but the difference will not be significant.

Methodology



Treatment	Composition (g)			Ratio (C:S:FS)
	Cement	Sand	Fish Scales	
Control	150.00	150.00	0.00	1 : 1 : 0
FS1	150.00	112.50	37.50	1 : 0.75 : 0.25
FS2	150.00	75.00	75.00	1 : 0.50 : 0.50
FS3	150.00	37.50	112.50	1 : 0.25 : 0.75
FS4	150.00	0.00	150.00	1 : 0 : 1

Table 1.1 Compositions and treatments for the tiles.

Tests

- Density: Record and calculate each tile's volume and mass.
- Water absorption: Place the tiles in a container filled with water, measure the mass before and after the tile is soaked underwater in the span of 20 minutes.
- Heat absorption: Tiles will be placed on a heater and temperature will be measured every 5 minutes in the span of 20 minutes.
- Strength: A compressive strength test is conducted to all the tiles at ITATS, Surabaya.

Results and Analysis

Density

It can be seen from the table that the control group is the most dense of all the tiles made, followed by FS1 and with FS4 as the least dense. The table also shows a downward trend. As fish scales proportion is increased, density decreases.

Treatments	Average	
	Mass (g)	Density (g/cm ³)
Control	852	1.820
FS1	848	1.812
FS2	838	1.577
FS3	820	1.532
FS4	802	1.326

Table 1.2 Percentage temperature difference

Heat Absorption

Table 1.4 shows the average initial, final, and the temperature percentage difference of each tile during the experiment. In terms of heat absorption, the control absorbs the most heat, while the one with the most fish scales absorbs the least.

Treatment	Initial Temp (°C)	Final Temp (°C)	Percentage Diff.(%)
Control	27.50	31.30	13.82
FS1	27.60	29.00	5.07
FS2	27.50	28.70	4.36
FS3	27.60	28.20	2.17
FS4	27.70	28.10	1.44

Table 1.3 Percentage temperature difference

ANOVA and Tukey HSD Test

Property	Xs	df	F	p	Tukey HSD*
Density	1.61	4 10	15651.5 9	0.0000 0	C ^a , FS1 ^a , FS2 ^b , FS3 ^b , FS4 ^b
Heat Absorption	28.87	4 10	18.22	0.0001 4	C ^a , FS1 ^{ab} , FS2 ^{ab} , FS3 ^{bc} , FS4 ^d
Water Absorption	66.27	4 10	38.80	0.0000 0	C ^a , FS1 ^{bc} , FS2 ^{bc} , FS3 ^{bc} , FS4 ^{bc}
Compressive Strength	1404	4 10	83.31	0.0000 0	C ^a , FS1 ^{ab} , FS2 ^{bc} , FS3 ^{bd} , FS4 ^{de}

Table 1.5. ANOVA and Tukey HSD test results

Water Absorbance

Figure 1.2 shows the results of the water absorption test conducted. It can be gleaned from the table that the control group has the highest average absorption while FS4 has the lowest.

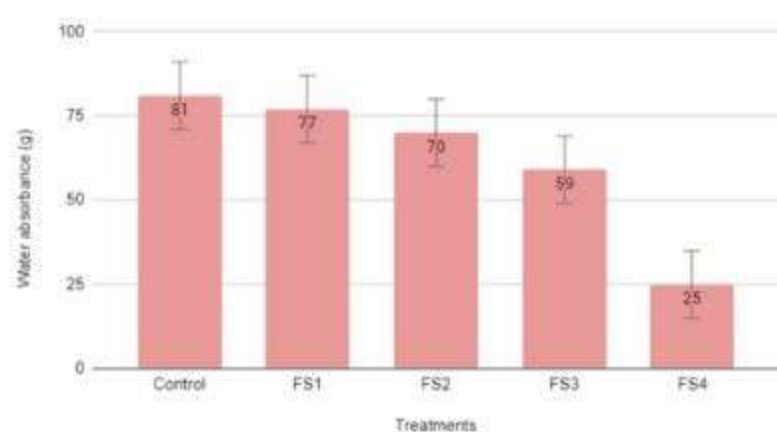


Figure 1.2 Water absorbance test result

Compressive Strength

Figure 1.3 shows the average compressive strength of each of the treatments. The figure reveals that the control group has the highest compressive strength. Also, as the amount of fish scales is increased in the tile, its compressive strength decreases.



Figure 1.3 Compressive test result

Conclusion

- 1 Based on the ANOVA and Tukey HSD test result, the pulverized fish scales, to a maximum of 25% (FS1), was chosen to be the best in most of the physical property test.
- 2 There is a change in physical property when sand is replaced with fish scales. As the amount of pulverized fish scales aggregate increases, density decreases, less water is absorbed, temperature change decreases, and compressive strength decreases.

Recommendations

To further improve this research, more comprehensive tests could be subjected to the floor tiles, such as slip resistance, to further determine the quality and the physical properties of the floor tiles.

The use of hydraulic presses in the making of the tiles may also help in reducing random errors.

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