Strength properties of clay bricks made with marine algae

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Introduction

Previous Studies and Results

- Made different types of clay bricks with algae and noted that strength properties increased depending on composition, but overall strength was lower[2]
- Added algae to cement at different percentages and found that the compressive strength decreased but the load capacity increased[4]
- Found that marine brown algae extract increased the cement mixture's viscosity; tests found it increased yield strength and air space[3]
- Made cob, an earth-based material, made with algae instead of flax, and it had better thermal insulating properties[1]

Current Applications

- Prometheus Materials, a company in Colorado, develops and produces microalgae-based concrete bricks for construction
- Unfired clay brick with *Sargassum muticum* is used by Sargablock, a company in Mexico, to build structures

Hypothesis

- We hypothesize the bricks with algae will have lower compressive and flexural strength than those without algae
- To measure this, we created bricks with and without algae

References

1: Affan, H., Touati, K., Benzaama, M.-H., Chateigner, D., & El Mendili, Y. (2023). Earth-Based Building Incorporating Sargassum muticum Seaweed: Mechanical and Hygrothermal Performances. *Buildings (Basel)*, *13*(4), 932-. https://doi.org/10.3390/buildings13040932
2: Dove, C. A., Bradley, F. F., & Patwardhan, S. V. (2016). Seaweed biopolymers as additives for unfired clay bricks. *Materials and Structures*, *49*(11), 4463–4482. https://doi.org/10.1617/s11527-016-0801-0
3: León-Martínez, F., Cano-Barrita, P. de J., Lagunez-Rivera, L., & Medina-Torres, L. (2014). Study of nopal mucilage and marine brown algae extract as viscosity-enhancing admixtures for cement based materials. *Construction & Building Materials*, *53*, 190–202. https://doi.org/10.1016/j.conbuildmat.2013.11.068
4: Ramasubramani, R., Praveen, R., & Sathyanarayanan, K. S. (2016). Study on the strength properties of marine algae concrete. Rasayan Journal of Chemistry, 9(4), 706-715.

Methods

- The algae was washed, dried, and then ground into a powder
- Molds were made according to industry/testing standards for clay bricks
- Clay is mixed with water and sand to create the base for the bricks
- Algae is added at 0%, 5%, or 8% of the brick's total volume to the clay and mixed in
- The clay was added to the mold, shaped, and then removed
- The samples were left to harden for 3 or 6 days in the sun, and then in a kiln for 24 hours
- The samples are labeled with algae type, percent algae, and curing time
- The bricks are placed into the equipment to test its flexural and compressive strength

Sargassum filipendula

Agardheilla subulata

Dried algae samples

Gulf Specimen Marine Lab

Data/Results

- There are no results or data to report at this time
- We expect the data to show that the algae bricks will have lower strength compared to the bricks without algae

Table of Specimens

Sample	Algae Type	Algae %	Curation Time	Quantity
1	*S. filipendula*	8	3	3
2	*S. filipendula*	8	6	3
3	*S. filipendula*	5	3	3
4	*S. filipendula*	5	6	3
5	*A. subulata*	8	3	3
6	*A. subulata*	8	6	3
7	*A. subulata*	5	3	3
8	*A. subulata*	5	6	3
9	*S. filipendula*	8	3	3
10	*S. filipendula*	8	6	3
11	*S. filipendula*	5	3	3
12	*S. filipendula*	5	6	3
13	*A. subulata*	8	3	3
14	*A. subulata*	8	6	3
15	*A. subulata*	5	3	3
16	*A. subulata*	5	6	3
Total				48

Table 1: sample 1-8 compression testing, sample 9-16 flexural testing, curation time in days

Conclusion

- We expect the algae bricks to have lower strength compared to the bricks with no algae
  - Previous studies showed that certain properties in algae bricks may increase but overall strength decreases[2]
  - The algae interacting with the clay and sand can make it more brittle
  - The algae can increase the air space inside the mixture[3], which could lower the strength
  - Algae added to cement caused the compressive strength of the sample to lower[4]
- Algae bricks could be a more environmentally sustainable substitute for traditional bricks in low-stress scenarios
  - For example, algae concrete companies aim to use their products in walkways, parking lots, and building construction
- Potential limitations or errors: brick-making process, type of clay and algae used, errors in the testing process
- Future studies: examining the thermal and insulating properties of the bricks to improve the energy efficiency of structures
  - In a previous experiment, the structure made from algae cob required less energy to heat and cool than the structure made from flax cob[1]