BIOBASED WET CELL

Water Resistance and Mechanical Properties of Crosslinked Na-Alginate Geopolymer

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About this Project...

The Wet Cell project aims to develop water-resistant paneling solutions for wet areas such as bathrooms and showers by using sustainable, biobased materials. This initiative addresses the environmental impact of concrete, which has had a major ecological footprint, by exploring sustainable alternatives such as geopolymers made from industrial waste like blast furnace slag.

Basic Terms :

1. **Geopolymers** are inorganic materials formed by reacting aluminosilicate powders with alkaline activators a cement-like binder.

2. **Sodium Alginate (SA)** is a natural polymer extracted from brown seaweed. It thickens water and can from gels with specific ions.

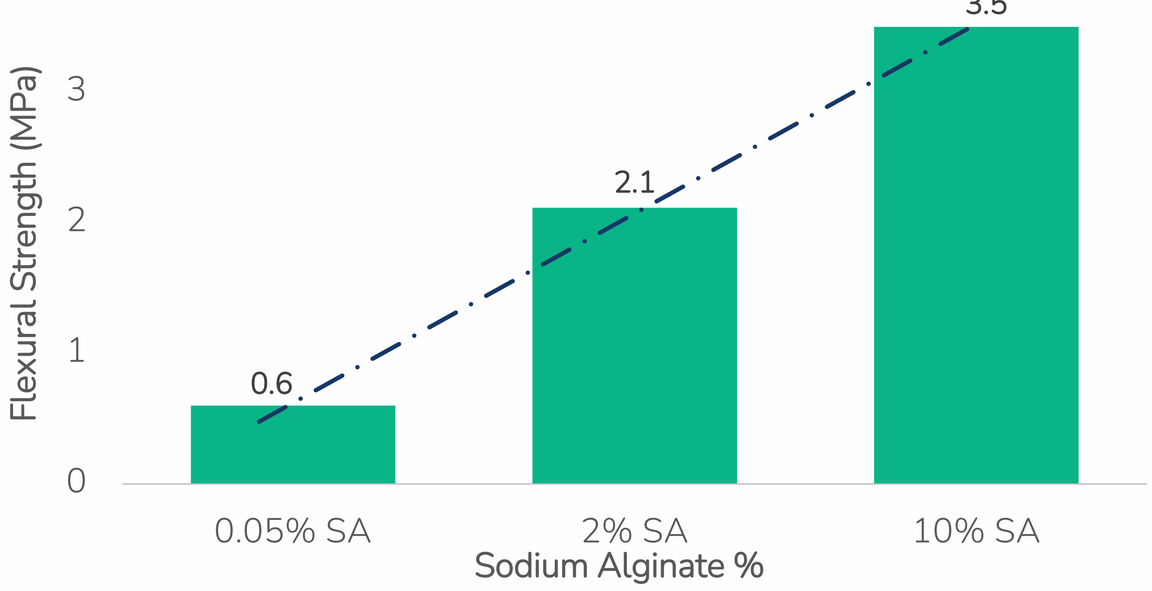
Why Add Alginate?

Geopolymers are *notoriously difficult* to produce well, consistently. Specifically sensitive to the water present both inside the mixture and outside as moisture in the air.

- Once vibrated, internal water separates from denser geopolymer particles, causing diluted areas and thus disrupting curing.
- Adding SA therefore increases water viscosity, preventing separation, and promotes more even curing

This **has been confirmed** in previous **WET CELL** findings

Flexural Strength Per SA Content



Illustrated results indicating that the addition of more SA is positively correlated to an increase in the geopolymer flexural strength from previous thesis study by K. Hulsinga.

Unfortunately, as SA is **highly** water-soluble, the more you add, the higher the water absorption is:

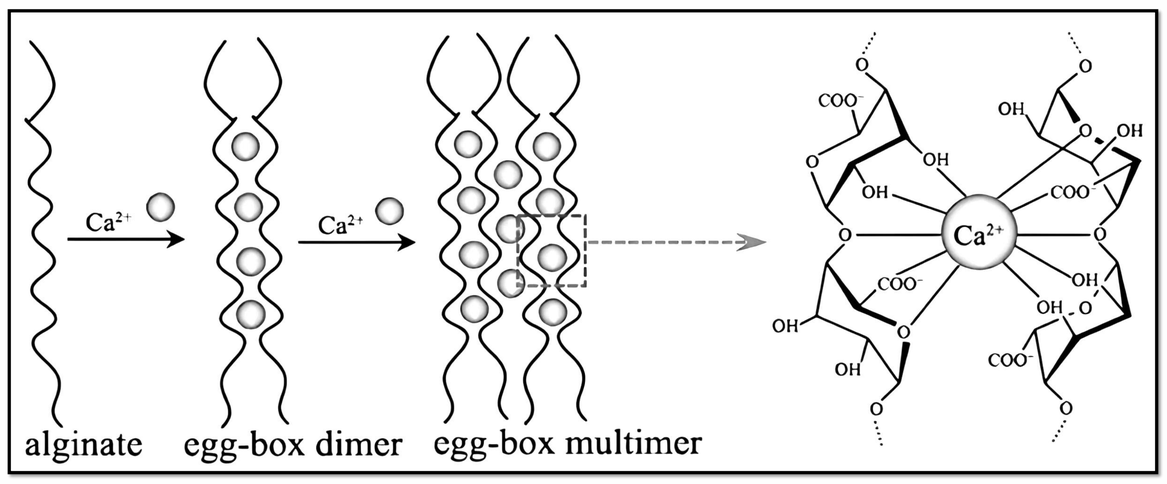
24-hour Water Abortion of SA Geopolymer

SA Amount (%)	0.05%	2%	10%
Absorption (%)	15%	53%	87%

Table with results indicating that the addition of more SA is positively correlated to an increase in the geopolymer's absorption rate

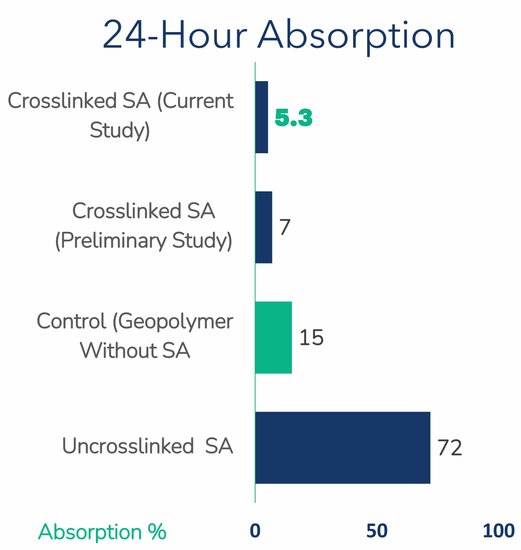
Ionic Crosslinking

To rectify this water-soluble nature of the SA, it could be crosslinked with $CaCl_2$ to form an insoluble **Calcium Alginate** salt instead.

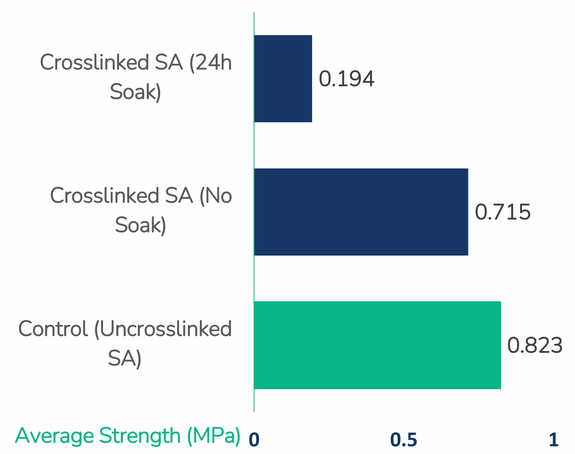


Ionic crosslinking of SA in the presence of Ca ions inside the Guluronic acid unit

Crosslinking Effect on Absorption



Crosslinking Effect on Flexural Strength



The geopolymer samples were put through a 24-hour absorption test :

In both groups, the crosslinked SA samples absorbed **significantly less** water than the uncrosslinked samples, even outperforming the control mixture without any alginate.

The geopolymer samples were put through a bending test :

The crosslinking process doesn't appear to reduce the geopolymer's flexural strength. However, the strength of the samples exposed to water was highly reduced.

References

[1] Hulsinga, K. (2024). *Research and development of geopolymer tiles made with alginates*.

[2] Zhang, Xiaolin et al. (2022). Fabrication, Property and Application of Calcium Alginate Fiber: A Review. Polymers. 14. 3227. 10.3390/polym14153227.