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Compressive Strength for Geopolymer Mortar

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INTRODUCTION

- ❖ Concrete is known to be the second most used material on the planet, second only to water
- ❖ "Approximately 5 % of global CO2 emission originate from the manufacturing of cement" (Huntzinger & Eatmon).
- ❖ Sustainable building material is important to reduce the amount of carbon dioxide production in the atmosphere.
- ❖ Geopolymers produce less carbon dioxide during production and have been proposed as a possible building material.
- ❖ Project Scope: To determine the compressive strength of a geopolymer mortar using a geopolymer cement mixed with fine aggregates.

BACKGROUND

- ❖ ASTM C 109: Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2-in or [50mm] Cube Specimens) was used as the testing guide when performing the experiment.
- ❖ Slight Modifications have been made to account for the different chemical composition of geopolymers.
- ❖ Geopolymer cement is created by combining a binder with a reagent. No water is needed compared to Portland cement.

METHODS

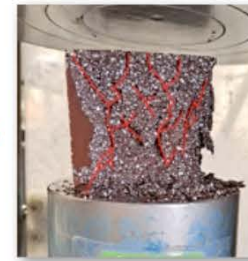
- ❖ 12 Geopolymer mortar samples were created and a few for Portland cement mortar for future comparison between the 28-day values.
- ❖ Geopolymer samples were tested for compressive strength on days 3, 7, 15, and 28 while Portland was only tested on 28-days of curing .
 - ❖ Fracture line formation was evaluated to determine the materials behavior
 - ❖ Comparisons were made between the geopolymer and Portland cement mortar samples.



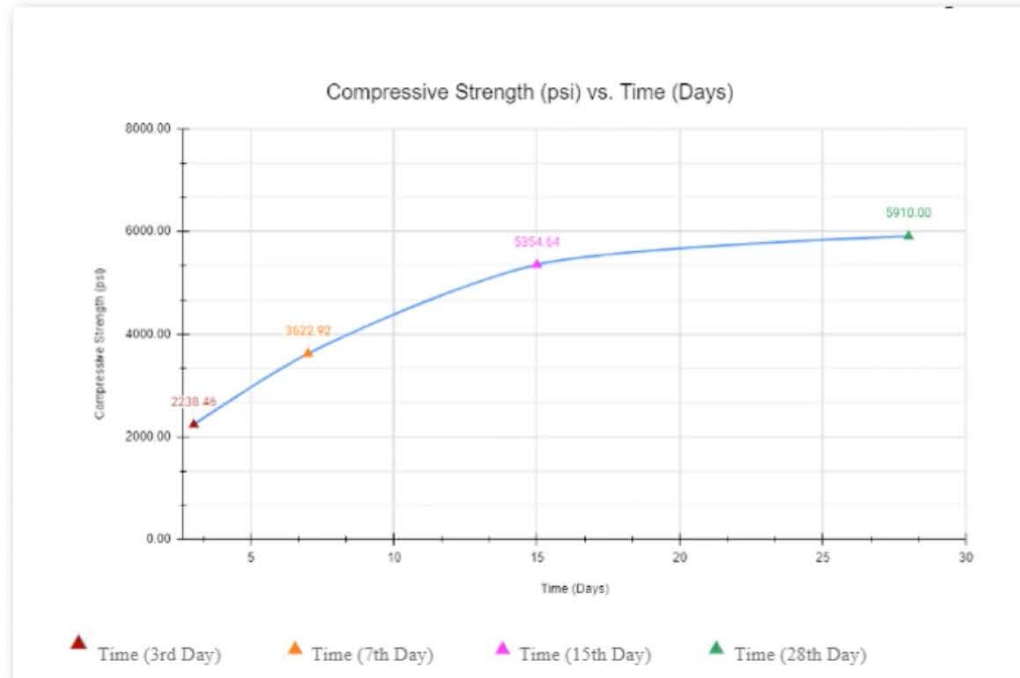
Sample Preparation



Compressive Test



Fracture Line Formation



RESULTS

- ❖ High workability
- ❖ Fast hardening after pouring
- ❖ Early strength development within first 15 days of curing
- ❖ Similar behavior compared Portland cement mortar
- ❖ Maximum compressive strength of 5910 psi for this batch
- ❖ Even fracture line development
- ❖ Fracture line formation increases with age
- ❖ Possibly more brittle
- ❖ Portland Cement 18% higher compared to geopolymer ratio used

Discussion

- ❖ The composition of this geopolymer mortar almost meet maximum strength of the Portland cement sample
- ❖ More research should be conducted to investigate different batch compositions and its ability to reach higher strengths
- ❖ Other types of Geopolymers also exist which could provide different results
- ❖ Geopolymers have the potential to be a strong and reliable building material after more information about its behavior have been observed

References

- Huntzinger, D. N., & Eatmon, T.D. (2009). A life-cycle assessment of Portland cement manufacturing: comparing the traditional process with alternative technologies. *Journal of cleaner Production*, 17(7), 668-675.
<https://doi.org/10.1016/j.jclepro.2008.04.007>