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### Project Title

Geopolymer Concrete Investigation: The ABCs of GPC

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# Project Summary

Technology Transfer Outreach Publication

## Geopolymer Concrete Investigation: The ABCs of GPC

Currently, hydrated ordinary portland cement (OPC) is the most common binder used in concrete. The production of OPC requires large amounts of energy, and has a large carbon footprint, emitting approximately 5% of global CO<sub>2</sub> emissions annually. Geopolymer cement concrete (GPC) is a relatively new material, with the potential to be an alternative to OPC. GPC has a lower environmental impact, resulting in approximately 85% less CO<sub>2</sub> in production as compared to OPC. GPC is produced from fly ash (or other natural pozzolans), sodium hydroxide and sodium silicate.

One of the principal CO<sub>2</sub> sources and the primary energy consumption in the production of GPC results from the production of the sodium silicate “activator”. The current process for producing commercial sodium silicate utilizes pure glass cullet that is subjected to elevated pressures and temperatures. The process of making sodium silicate could be made more sustainable by using discarded packaging glass cullet as an alternative silicate source.

### Research Objectives

- To become familiar with current state of the art for geopolymer concrete technologies.
- Create a future research plan for extracting sodium silicate from municipal waste glass.

### Methodology

- A literature review on geopolymer cement concretes, sodium silicate manufacturing processes and municipal waste glass streams.
- Laboratory study: The research team will develop three mix designs and then mix three different geopolymer cement mortars. The compressive strength will then be measured at 3, 7, 14, 21 and 28 days.

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## University Facts (2008-2009)

Total Enrollment	7018
Graduate Enrollment	984
Number of Faculty	445
Placement Rate	96%

*Michigan Technological University is located in Houghton, Michigan on the south shore of Lake Superior. This rural area is known for natural beauty, pleasant summers, abundant snowfall, and numerous all-season outdoor activities. In addition, the University maintains its own downhill and cross-country ski facilities and golf course. There are numerous cultural activities and opportunities on campus and in the community. Michigan Tech has also been rated as one of the safest college campuses in the United States, and the local community provides excellent resources conducive to an outstanding quality of life.*

For more information, visit the University's website.

[www.mtu.edu](http://www.mtu.edu)

## Benefits

The research will provide a foundation for future explorations into GPC, and facilitate the implementation and wider use of this potential new building material. The current best-practice for GPC production involves the use of commercial sodium silicate solutions produced from pure glass cullet, an energy-intensive process. Alternatively, there is the potential to substitute glass from the municipal waste stream for pure glass cullet, which would represent an incremental reduction on the carbon footprint of GPC. And reduced waste glass for disposal in land fills.

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