GREEN CEMENT: Making a Sustainable and More Durable Cement

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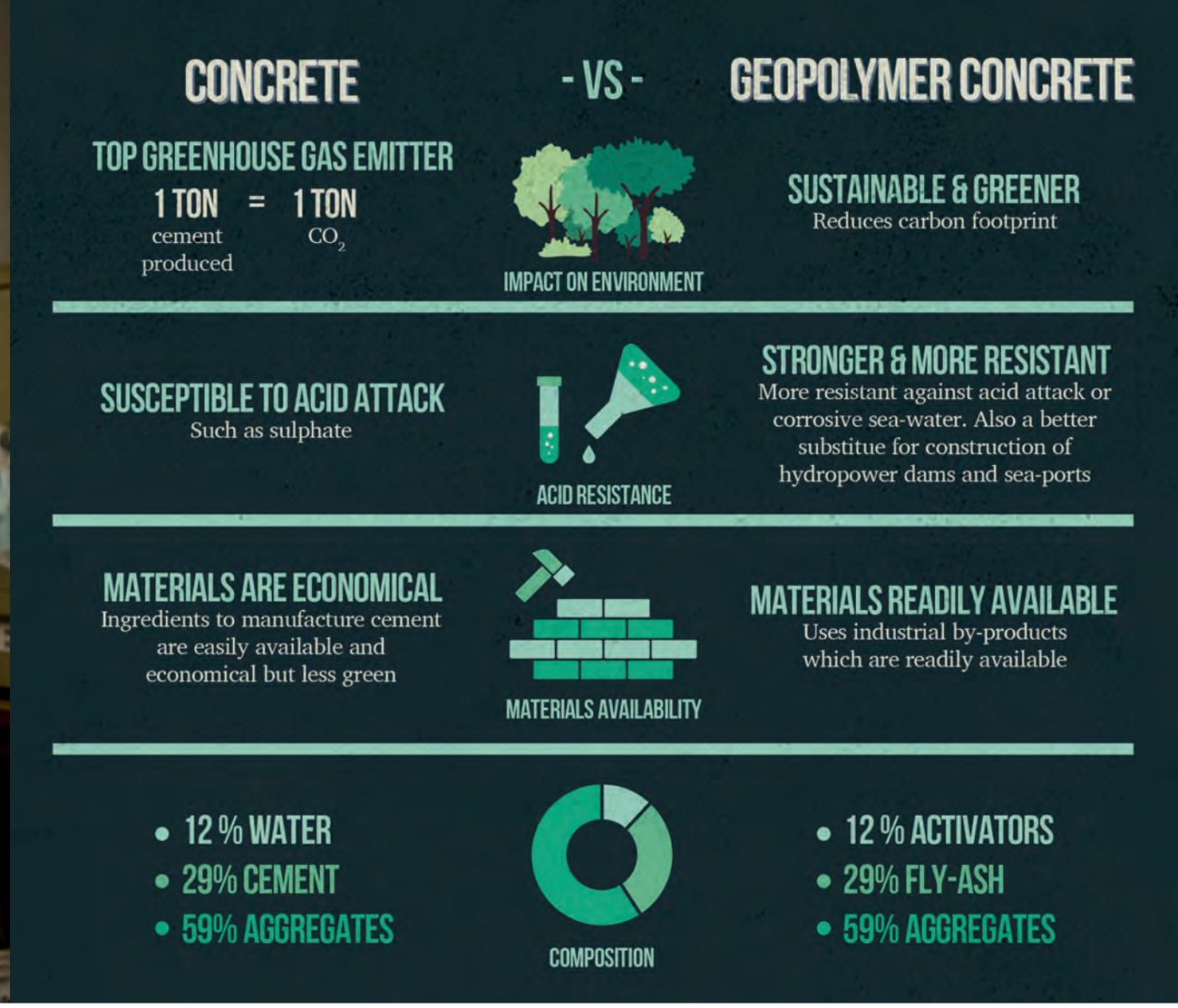

- One ton of carbon dioxide is emitted when one ton of cement is produced.
- Geopolymer has the potential to be an alternative and sustainable construction material to ordinary cement.
- Tweaking the alkali activators in geopolymer could further enhance its strength capabilities.

In an urban landscape cement is simply everywhere but sadly the cement industry is one of the top five emitters of greenhouse gases worldwide. Here at Swinburne Sarawak Research Centre for Sustainable Technologies we have come up with a stronger and greener variety of cement in which industrial by-products partly or totally substitute cement.

As Sarawak is fast gaining ferroalloy production plants and power stations to supply electricity to them, a lot of reusable industrial by-products are generated like fly-ash from combusting coal and manganese and iron slag from smelting these metals. All these by-products can be used to form a mix called geopolymer, which is greener than the ordinary Portland cement. We have made fly-ash geopolymer which is a total replacement of cement. The chemical composition of fly-ash is similar to cement but they react very differently to water. For fly-ash to have a cement-like consistency it needs an alkaline environment, so we've added chemicals such as sodium hydroxide and sodium silicate. This fly-ash geopolymer is stronger and more resistant against acid attack or corrosive sea-water than ordinary cement, which possibly makes it a better alternative to cement for the construction of hydropower dams and sea-ports.

> *Construction companies in Malaysia have been adding fly-ash to their cement mix for the last 20 years, but it could never wholly substitute cement as it needs to be reactive to achieve a cement-like texture.*

We need to look into how we can produce this geopolymer on an industrial scale, and it is a good basis for further research into its mechanical properties. We want to explore the ratio of alkali activators in the fly-ash to enhance its strength and to ease the process of mixing fly-ash at construction sites. After fly-ash, we want to look at other by-products like manganese and iron slag, also readily available in Sarawak to make another kind of geopolymer.

Geopolymer is the future of green construction and it makes perfect sense to reuse the fly-ash and slag.