

# UFS green concrete project aims to help fight global warming

Led by Dr Abdolhossein Naghizadeh, lecturer and project leader in the Department of Engineering Sciences at the University of the Free State (UFS), the green concrete project is research aimed at producing environmentally friendly concrete based on industrial waste materials while also addressing global warming.



Dr Abdolhossein Naghizadeh, lecturer and green concrete project leader in the Department of Engineering Sciences at the University of the Free State

According to Naghizadeh, the chemical reactions that take place in the production of conventional cement release significant amounts of CO<sub>2</sub> into the atmosphere, which has a huge environmental impact. “Meanwhile, its production requires a considerable amount of energy, which in turn has promoted the global warming issue. These points show the significance of obtaining an alternative concrete with a lower environmental impact than the conventional one,” says Naghizadeh.

## How does green concrete work?

Naghizadeh explains that in green concrete mixtures, geopolymer is used as the binder. Geopolymer binders consist of two components comprising raw material (solid) and alkali activator (liquid). Once the raw material is mixed with an alkali activator, the hardening process starts. In order to obtain high strengths, the mixture is exposed to elevated temperatures of between 40°C and 80°C for a few hours (up to 24 hours).

Though geopolymer concrete technology has been employed in limited projects in different countries such as China, Australia, France, and the USA, there are some issues regarding the complexity of this technology that need to be solved before its extensive application in the industry. It may take some time before this ‘new’ concrete will be used more regularly in the construction industry.



Image: Supplied

## Green concrete the future of the construction industry

According to the Paris agreement of 2015, different strategies must be implemented by governments to decrease carbon emissions in order to moderate the global warming phenomenon. One of these strategies is to limit conventional cement production worldwide to control the carbon emission caused by this industry. Since there is a remarkable demand for concrete, finding an alternative cement, such as geopolymer binder, is essential to respond to the demand from the construction industry.

“Although the main objective of green concrete technology is to minimise the environmental impact caused by normal cement, consuming green concrete based on a geopolymer binder system can also provide economic benefits by utilising waste materials as well as minimising energy consumption. Meanwhile, the reuse of industrial waste materials such as fly ash would help tremendously with waste management in power stations,” according to Naghizadeh.

He says the technology of geopolymer binder as an alternative cement was introduced to the academic world a few years ago. However, there are some issues that greatly hinder its application in the industry, such as conventional cement. Some of these issues are related to the mixing design complexity, aggressiveness of the activators used, diversities of raw materials found in different countries, and special curing procedures required for this type of concrete.

The UFS’ green concrete project aims to produce user-friendly geopolymer concrete by eliminating aggressive alkali activator additives from the mixtures. The potential product will be formulated by optimising mixture parameters and

ingredients based on the South African industrial by-products.



Image: Supplied

## How did this research/project come about?

These days, topics related to alternative cements and geopolymers are considered as advanced and up-to-date research areas in the fields of civil engineering and construction materials. This research area connects the most consumed human-made material (concrete) with the biggest environmental challenge (global warming).

Based on the significance of the research topic, as well as the existing research capacity in the Department of Engineering Sciences at the UFS, the research committee decided to play a role and contribute to the ongoing development of the new technology, known as geopolymer concrete or green concrete.

“I was already the head of the project when I joined the UFS last year. The Department of Engineering Sciences at the UFS has decided to establish a supporting laboratory to enable the UFS to fill a current laboratory void for the project.”

“The particular project aims of this laboratory are to create formulations of green concrete based on user-friendly materials and the simplification of the preparation and mixing process. This could introduce a more eco-friendly, desirable product that can be easily employed extensively in the construction industry,” explains Naghizadeh.



### Green cement a step closer to being a game-changer for construction emissions

Yixia (Sarah) Zhang, Khin Soe, and Yingying Guo 20 Nov 2019



## How important is this project for the environment?

Portland cement production has a huge impact on carbon emission and global warming. This matter has convinced governments to reduce the conventional cement production rates in order to control their impact on the environment. However, the demand for concrete is increasing year by year, and this strategy would not be feasible without finding a suitable alternative to the existing cement technology. From this point of view, green concrete technology is essential to mitigate the environmental impact caused by Portland cement production.

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