

Fly ash builds green cement mixture

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"We had two problems with the mixture, the reaction was really slow, and the hardening process was really slow which would be too expensive," Mr Kulasuriya says. Credit: Chris Northwood

An eco-friendly cement, known as Alkali Pozzolan Cement (APC), containing a mixture of fly ash, dry lime powder and sodium sulphate under specific scaffolding conditions has been developed by Curtin University research.

The study, involving Curtin postgraduate researcher and co-author

Chandana Kulasuriya, investigated an alternative for Ordinary Portland Cement (OPC); a conventional cement that was developed more than 100 years old and produces one ton of carbon dioxide for every ton of produced cement.

"We wanted to design a non-hazardous, non-wet, dry-form cement that can be stored in air-tight bags," Mr Kulasuriya says.

"The more fly ash you can use, the [less [carbon dioxide](#) emissions will occur] and that is the purpose of the research; how far we can go to replace the ordinary [cement](#)," co-author Dr Vimonsatit says.

APC, which is made by mixing the pozzolanic material (fly ash) with a commercially available basic material (dry lime power), provides about 75 per cent of the compressive strength of OPC, under ambient curing conditions.

Improved reaction time holds the key

The research team aimed to advance a well-known pozzolanic material method in which the pozzolanic materials can be activated by strong basic solutions.

The scientists encountered numerous issues surrounding the mixture's reaction time, resulting in lengthy reactions that would not meet industry standards.

"We had two problems with the mixture, the reaction was really slow, and the hardening process was really slow which would be too expensive," Mr Kulasuriya says.

"By putting sodium sulphate within the mixture, we reacted it with calcium hydroxide forming a little bit of sodium hydroxide inside the

mixture increasing the pH level of the mixture.

"Since the [sodium hydroxide](#) is produced inside the mixer, it does not behave as hazardously, so it breaks the glass phases of [fly ash](#) and provides an opportunity for calcium hydroxide to react with it and produce the cementing compound known as Calcium Silicate Hydrate (CSH)."

The researchers were also tasked with finding a mechanism to hold the mixture until it hardened.

After lengthy research into scaffolding they decided that a scaffolding material known as a Clinker, which reacts with water to produce Calcium Silicate Hydrate, would be the best option.

"We mixed some OPC with the mixer, and it blended together very well and as the properties were the same no cracks developed, but as mentioned before we have to research on many other aspects as well," Mr Kulasuriya says.

More information: Chandana Kulasuriya, Vanissorn Vimonsatit, WPS Dias, P. De Silva, "Design and development of Alkali Pozzolan Cement (APC)," *Construction and Building Materials*, Volume 68, 15 October 2014, Pages 426-433, ISSN 0950-0618, [dx.doi.org/10.1016/j.conbuildmat.2014.06.095](https://doi.org/10.1016/j.conbuildmat.2014.06.095).

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