New bendable cement-free concrete can potentially make safer, long-lasting and greener infrastructure

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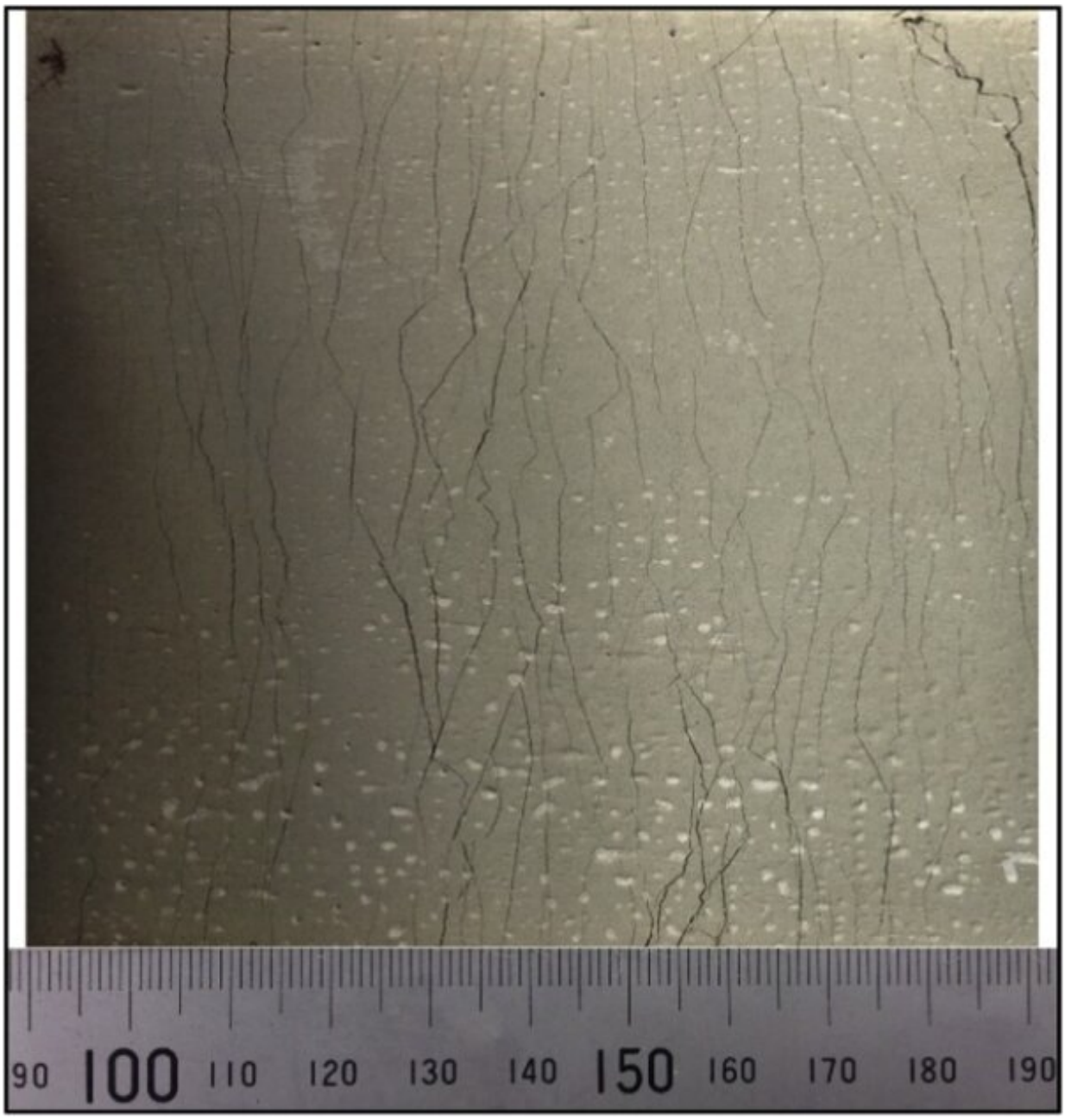

Fig. 1. Typical multiple hair-size cracks of our bendable cement-free concrete when put under tension load (i.e. being stretched). Credit: Swinburne University of Technology

A new type of concrete that is made out of waste materials and can bend

under load has been developed by researchers from Swinburne University of Technology in Melbourne, Australia.

This material, which incorporates industrial waste products such as fly ash produced by coal-fired power stations, is especially suited for construction in earthquake zones—in which the brittle nature of conventional concrete often leads to disastrous building collapses.

"Concrete is the most widely used construction materials in the world," says researcher Dr. Behzad Nematollahi. "In fact, it is the second most consumed material by human beings after water, so its quality has a massive effect on the resilience of our infrastructure such as buildings, bridges and tunnels."

Traditional concrete is not only prone to shatter when being stretched or bent, but also has a huge carbon footprint due to calcination of limestone to produce its key ingredient, cement.

By using industrial waste products, Dr. Nematollahi and colleagues have done away with the need for concrete, making the product more sustainable.

"Production of this novel concrete requires about 36% less energy and emits up to 76% less carbon dioxide as compared to conventional bendable concrete made of cement," says Dr. Nematollahi.

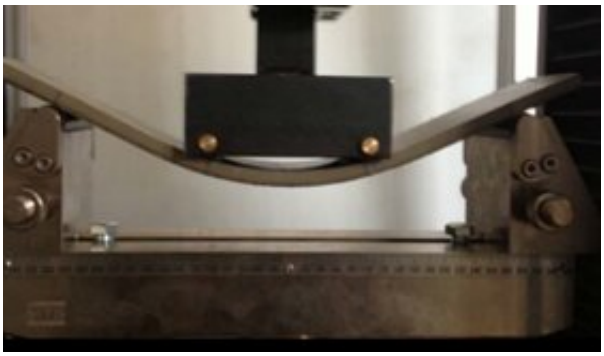

Fig. 2. Significant bending capacity of our bendable cement-free concrete. Credit: Swinburne University of Technology

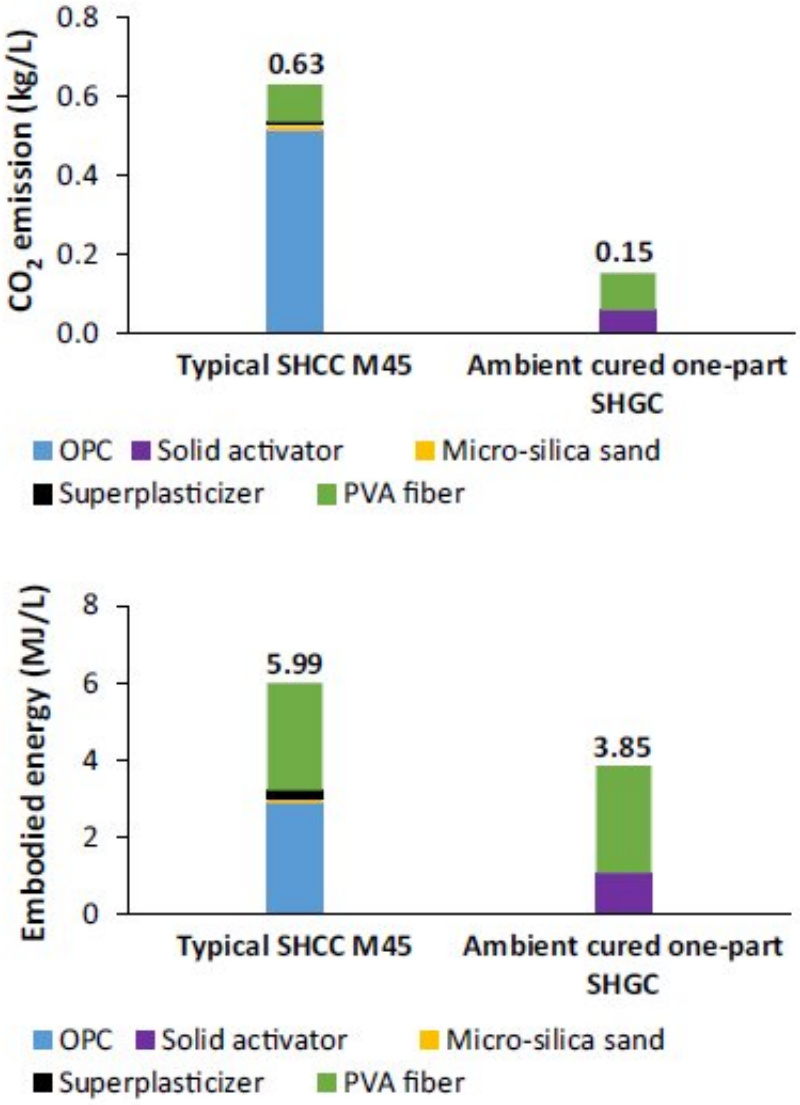

Fig. 3. Materials sustainability performance of our bendable cement-free concrete in comparison to conventional bendable concrete made of cement. Note: "Typical SHCC M45" represents conventional bendable concrete made of cement. "Ambient cured one-part SHGC" represents our bendable cement-free concrete. Credit: Swinburne University of Technology

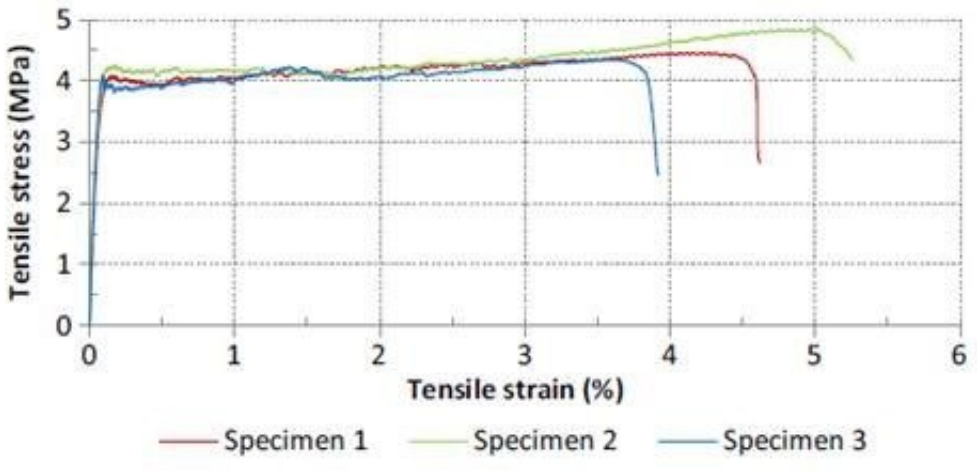

Fig.4. Stress-strain response of our bendable cement-free concrete when put under tension load. Credit: Swinburne University of Technology

Furthermore, the inclusion of short polymeric fibres in this novel concrete allows it to sustain multiple hair-size cracks when put under tension or bending and not break into pieces. In effect, it is able to bend when force is applied to it—meaning that buildings made from it will be much more likely to remain intact during earthquakes, hurricanes, projectile impacts, and blasts.

"Building in areas vulnerable to that sort of natural disaster is one of the main uses to which we see this material being put," he adds. "Our laboratory test results showed that this novel concrete is about 400-times more bendable than normal concrete, yet has similar strength."

More information: Behzad Nematollahi et al. Tensile Strain Hardening Behavior of PVA Fiber-Reinforced Engineered Geopolymer Composite, *Journal of Materials in Civil Engineering* (2015). DOI: 10.1061/%28ASCE%29MT.1943-5533.0001242