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CALGARY | New

University of Calgary researchers creating better concrete

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CALGARY -- It's long been known that nanoparticles added to cement improve its strength, but doing it economically has been challenge.

A big part of the problem has been that nanoparticles need to be evenly dispersed through the cement, but when they're added to the cement slurry they tend to clump together.

Now, a University of Calgary professor and a doctoral student may have solved the problem.

"They ended up with nanoparticle clumping together at a certain spot within the structure, and that led to actually a defective structure," said Maen Husein a professor of chemical Engineering in Calgary's Schulich School of Engineering.

"In our case, we haven't seen that," he added. "And we have seen actually the cement under the microscope 100,000 times magnification, we have seen particles that are well dispersed."

Husein, and doctoral student Ahmed Mahairi, have discovered a chemical reaction that can be cheaply and easily created as the cement is being mixed.

"The reactions that we were doing - it's typical reactions that (have been) known for ages.(in chemical engineering)." said Mahairi. "It's just that nobody have ever thought of doing them within cement"

The reaction both creates and then evenly disperses the nanoparticles throughout the cement slurry. It's that dispersion of the nanoparticles that creates a stronger cement.

Nanoparticles are microscopic pieces of matter, under 100 nanometers (billionth of a metre) in size. Because of their size, nanoparticles have more surface area per gram than other solids. That aids in binding the cement to make it more durable under stress. The stronger cement means less of it is required for projects.

”Instead of using one tonne of your concrete, you may need to use 70 per cent of that, or even 50 per cent of that, and still achieve the very same properties that you're looking to achieve.” said Husein.

”Imagine how much saving that will happen in terms of energy consumption and material use if you're using nanoparticle cement. You can use half as much and get the same load bearing capacity.”

Oilfield uses

While most people likely picture sidewalks and bridge decks when thinking of concrete, Husein and Mahairi see the first use of their enhanced cement in the oilfields, where cement is used in well casing, and to cap off retired wells.

An additional property of the nanoparticle-laden cement is it that it is less porous when set, meaning it prevents both water seeping in and gasses seeping out of abandoned and disused wells.

“The procedure is to shut off the well by cementing is the practice that we have seen in many of the wells in Alberta, and elsewhere as well," said Husein.

"There is always CH4 (methane gas) that seeps from the wells, that first of all is the greenhouse gas, which is very potent - 20 to 21 times more potent than co2.”

Added Husein: “If it seeps then it kind of impacts the environment. If you can have a cement that does not allow for CH4 permeation, or reduces the permeation of CH4, then this would be a more much more reliable procedure to shut off wells."

The pair are still testing their cement creations at a southeast lab owned by Trican Well Services, which is funding their research. The chemical process the team have discovered will be patented before being scaled up to industrial use. Trican will own the patent.

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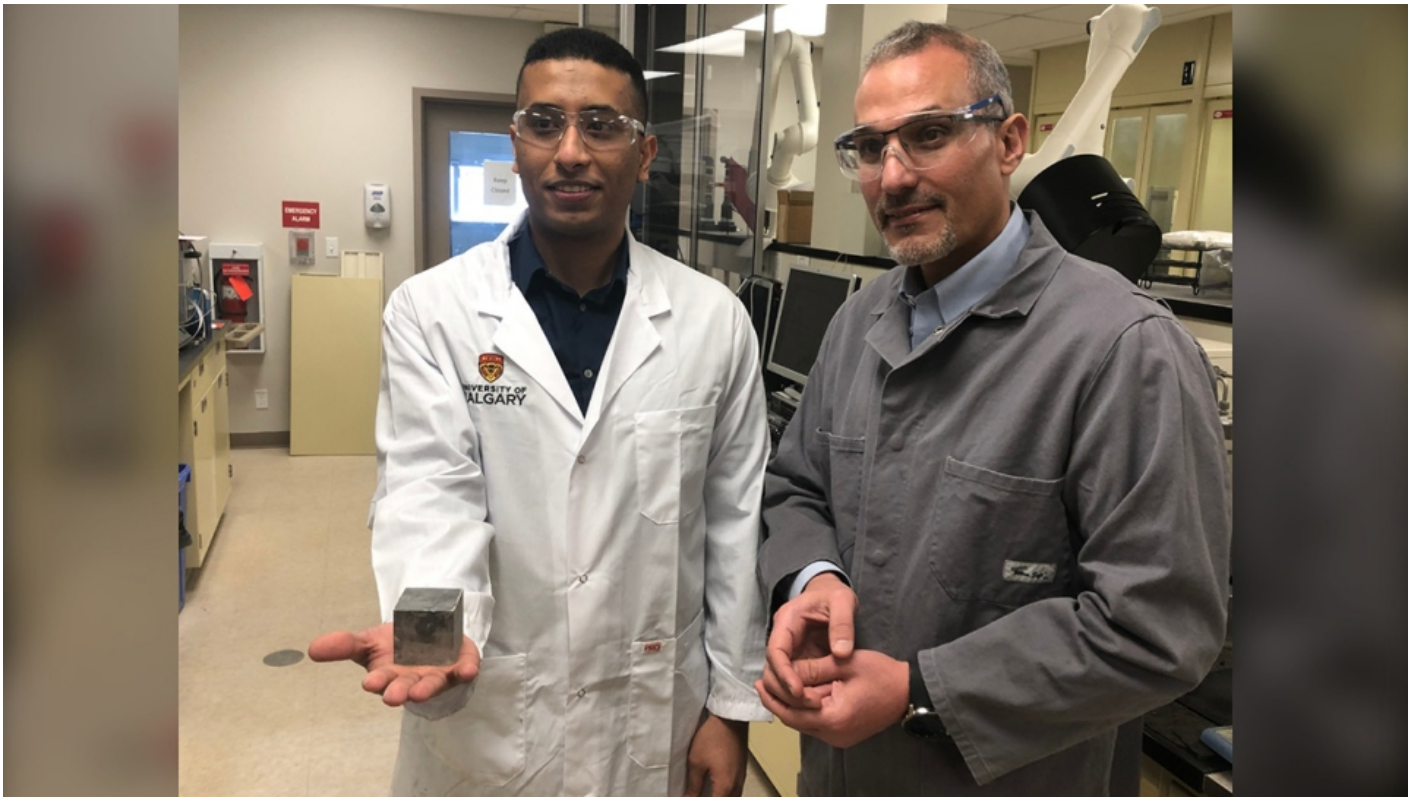

Doctoral student Ahmed Mahairi and U of C professor Maen Husein are creating better concrete by adding microscopic nanoparticles to the mix

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