New type of cement could offer environmental protection, lower cost

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If widely adopted, a new approach to making cement could significantly reduce greenhouse gas emissions, water consumption, help address global warming, produce a more durable concrete, and save industry time and significant costs.

The findings of a recent study show great potential for a type of cement that gains strength through carbonation, rather than the use of water. Concrete made with this cement also appears to better resist some of the most common de-icing salts that can lead to failure and dramatically reduce the lifespan of roads.

The research was published in Construction and Building Materials, by engineers from Oregon State University, Purdue University and Solidia Technologies. This work was supported in part by Solidia Technologies, which licensed core technology from Rutgers, The State University of New Jersey.

"Instead of water reacting with cement, this carbonated cement reacts with carbon dioxide and calcium silicate," said Jason Weiss, the Miles Lowell and Margaret Watt Edwards Distinguished Chair in the OSU College of Engineering.

"This new product at first blush looks like conventional concrete, but it has properties that should make it last longer in some applications," Weiss said. "In addition, use of it could reduce carbon dioxide emissions , which is an important goal of the cement industry."

Crude cement was used by the Egyptians to build the pyramids, improved during the time of the Roman Empire, and reached its modern form around 180 years ago. When used to make concrete – a combination of cement, sand and crushed rock - it's one of the most proven building materials in human history.

This is actually part of the problem – concrete works so well, for so many uses, that 2-4 tons per year are produced for every person on Earth. It's popular, plentiful, cost effective, and research is continuing to reduce its environmental impact. Production of the cement used in concrete is believed to be responsible for 5-8 percent of the global emissions of carbon dioxide, largely just because so much concrete is used.

The cement industry has committed itself to the goal of cutting those emissions in half, and this new approach might help. Beyond that, the new research shows the ability of this "carbonated calcium silicate-based cement," or CCSC, to be far more resistant to degradation from deicing salts such as sodium chloride and magnesium chloride.

"In places where deicing salts are routinely used, they can cause damage to roadways that cost about $1 million a mile to fix, and can reduce a 40-year lifespan of a surface to as little as 8-10 years," Weiss said. "By using a type of cement that requires carbon dioxide to make, and in turn greatly extend the lifespan of some roads, the environmental benefits could be enormous."

These products are just now being developed and tested, Weiss said, and some obstacles exist to their widespread, global use. New construction codes and standards would need to be developed. However, the new approach has already been adapted to existing raw materials, formulas and equipment.

Some of the first uses of these products, Weiss said, will be in pre-cast concrete products that can be created in a factory and transported to where they are needed. More ambitious and widespread use of the new approach may take longer. Other technologies, such as topical treatments to resist deicing salts, or the use of waste products to produce supplemental cements, may gain earlier use to address some of these issues.

In the latest research, the new CCSC concrete was shown not to react with deicing chemicals in the way that conventional concrete does. Such chemicals can cause a serious and premature deterioration in concrete pavements, even if the concrete does not experience freezing and thawing.

Provided by Oregon State University