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An international team of researchers including UCI Earth system scientist Steven Davis has found that over time, cement reabsorbs a significant portion of the CO₂ emitted when the material was manufactured. Steven Davis / UCI

Concrete jungle functions as carbon sink, UCI and other researchers find

Cement-based materials eventually reabsorb much of the CO₂ released during creation

ON NOVEMBER 21, 2016

Irvine, Calif., Nov. 21, 2016 – Cement manufacturing is among the most carbon-intensive industrial processes, but an international team of researchers has found that over time, the widely used building material reabsorbs much of the CO₂ emitted when it was made.

“It sounds counterintuitive, but it’s true,” said Steven Davis, associate professor of Earth system science at the University of California, Irvine. “The cement poured around the world since 1930 has taken up a substantial portion of the CO₂ released when it was initially produced.”

For a study published today in *Nature Geoscience*, Davis and colleagues from China, Europe and other U.S. institutions tallied the emissions from cement manufacturing and compared them to the amount of CO₂ reabsorbed by the material over its complete life cycle, which includes normal use, disposal and recycling. They found that “cement is a large, overlooked and growing net sink” around the world – “sink” meaning a feature such as a forest or ocean that takes carbon dioxide out of the atmosphere and permanently tucks it away so that it can no longer contribute to climate change.

Cement manufacturing is considered doubly carbon-intensive because emissions come from two sources. CO₂ molecules are released into the air when limestone (calcium carbonate) is converted to lime (calcium oxide), the key ingredient in cement. And to generate the heat necessary to break up limestone, factories also burn large quantities of natural gas, coal and other fossil fuels.

Davis and his fellow researchers looked at the problem from a different angle. They investigated how much of the gas is removed from the environment over time by buildings, roads and other kinds of infrastructure. Through a process called carbonation, CO₂ is drawn into the pores of cement-based materials, such as concrete and mortar. This starts at the surface and moves progressively inward, pulling in more and more carbon dioxide as years pass.

More than 76 billion tons of cement was produced around the world between 1930 and 2013, according to the study; 4 billion tons were manufactured in 2013 alone, mostly in China. It’s estimated that, as a result, a total of 38.2 gigatons of CO₂ was released over that period. The scientists concluded, however, that 4.5 gigatons – or 43 percent of emissions from limestone conversion – were gradually reabsorbed during that time frame.

“Cement has gotten a lot of attention for its sizable contribution to global climate change, but this research reinforces that the leading culprit continues to be fossil fuel burning,” Davis said.

About the University of California, Irvine: Founded in 1965, UCI is the youngest member of the prestigious Association of American Universities. The campus has produced three Nobel laureates and is known for its academic achievement, premier research, innovation and anteater mascot. Led by Chancellor Howard Gillman, UCI has more than 30,000 students and offers 192 degree programs. It’s located in one of the world’s safest and most economically vibrant communities and is Orange County’s second-largest employer, contributing \$5 billion annually to the local economy. For more on UCI, visit www.uci.edu.

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