

Pollution 'bull's-eye'

Cement makers seen as a key global-warming culprit

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A radial arm, left, blends and stacks the raw material that will become Portland cement at the Lehigh Southwest Cement Co. plant in Redding. The limestone is crushed and cooked in a super-heated kiln, releasing carbon dioxide in a chemical reaction that forms the main ingredient in cement: clinker. Sacramento Bee/Andy Alfaro

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REDDING -- At the Lehigh Southwest Cement Co. factory off Interstate 5, all the pollutants are funneled through a single chimney stack stretching 270 feet into the sky. It's a point of pride for plant manager Jim Ellison that nothing visible is coming out. "From the highway, you can't tell if we're running or not," Ellison said.

In making cement, an inherently dusty process that burns tons of coal by the hour, Lehigh produces its share of pollution. But it does a noteworthy job curtailing releases of the standard bad actors -- oxides of nitrogen, sulfur dioxide and particulate matter.

"They have a good program for controlling their emissions," said Ross Bell, air quality district manager for Shasta County.

In a world increasingly anxious over the risks of climate change, however, controlling standard pollutants is not enough.

Like most heavy industries, cement manufacturing is a significant source of carbon dioxide. Technically, carbon dioxide is not classified as a pollutant in the United States, but this invisible gas, once considered benign, is increasingly seen as an environmental threat because it traps heat in the atmosphere.

Most heavy industries produce carbon dioxide by burning fossil fuels. Cement manufacturing is different. While the process does consume plenty of fossil fuels, its chief source of carbon emissions is a chemical reaction that forms the main ingredient in cement -- a substance derived chiefly from limestone called clinker.

"By design, we're producing CO₂," Ellison said, underscoring how difficult it would be to separate cement-making from that byproduct.

Because of this characteristic, cement manufacturing, responsible for about 5 percent of the world's industrial climate-changing emissions, is a singular challenge in the global quest to ratchet down greenhouse gases.

It also symbolizes how profoundly modern society relies on processes that create carbon dioxide. As the glue that holds concrete together, cement literally is the foundation of civilization.

"It's so mundane that no one ever thinks about it, yet you use it every day," said Joel Levin, vice president of business development with the California Climate Action Registry. "Our civilization is based upon cement. We couldn't function

without it."

Nowhere in the United States is that truer than in California, which is both the nation's biggest producer and consumer of cement. With 11 manufacturing plants, the state puts out 12 million metric tons of cement a year, according to the Portland Cement Association, an industry trade group in Washington, D.C.

California also is among leading states trying to cap output of carbon dioxide and other atmosphere-warming gases. A recent proposal by Gov. Arnold Schwarzenegger's Climate Action Team would require cement makers, along with the oil industry, electric utilities and landfill operators, to report and limit their greenhouse gases.

So far, cement manufacturers have resisted involvement in a state climate program. The California Climate Action Registry, a 4-year-old voluntary program in which businesses, agencies and organizations calculate and report their global-warming emissions, has members from the petroleum, power and landfill industries -- but not cement.

The industry opposes state-by-state efforts to regulate greenhouse gases but acknowledges a need to address climate change.

"This is an issue viewed as significant by the industry," said Andy O'Hare, president of the Portland Cement Association. "The cement industry is a multinational industry, so (we have) sensitivity to these kinds of issues. We're a bull's-eye."

And a growing one. Tracking with economic growth, demand for cement is on the rise nationally and globally. According to the U.S. Geological Survey, the world produced 2.2 billion metric tons of cement in 2005.

China is the largest maker and consumer of cement globally.

The development of modern cement dates to 1824, when a British stonemason named Joseph Aspdin patented a concoction he cooked in his kitchen. He named his product Portland cement, because he thought it resembled a stone mined on the Isle of Portland in the English Channel.

Not to be confused with concrete, cement is a component of concrete. Combined with water, it holds together concrete's other components -- sand, air and crushed stone or gravel.

The limestone from which most cement is made is one of the most abundant rocks in the earth, a relic of ocean life.

"It's basically the solidified remains of discrete shells, reef material or compacted silts and muds from the destruction of those structures," said Hendrik van Oss, an economic geologist at the U.S. Geological Survey.

In that sense, limestone is a kind of fossil fuel, locking in the earth carbon once found in the skeletons of marine organisms. Making cement unlocks that carbon. Understanding how that happens requires a quick look at the composition of cement. It is made principally of four elements: calcium, silica, iron and aluminum. Limestone, chemically calcium carbonate (CaCO₃), supplies the calcium.

Carbon dioxide is released when ground limestone is cooked in a long, cylindrical rotating kiln that reaches a ferocious 2,700 degrees Fahrenheit.

For every ton of cement made, nearly one ton of carbon dioxide goes into the atmosphere -- a little more than half from the heating of limestone, the rest from the burning of fuel to heat the kiln. When factories worldwide made 2.2 billion metric tons of cement last year, they put about 1.8 billion metric tons of carbon dioxide into the air.

Lehigh's Redding plant is one of three cement manufacturers in Northern California. Plant sites generally are determined by proximity to limestone. In Redding, Lehigh quarries the chalky rock from Gray Rocks Mountain.

Lehigh is part of the German-owned Heidelberg Cement Group. As a business in a country participating in the Kyoto Protocol, an international agreement to curtail greenhouse gases, Heidelberg is obliged to cut its carbon emissions. In the United States, which has not ratified the Kyoto Protocol, factories are taking part in a voluntary industry program that aims to reduce carbon dioxide emissions per ton of cement produced but does not address an overall limit.

In Redding, Lehigh has cut some of its carbon dioxide output by burning waste tires as a supplement to coal to heat the kiln. Although burning tires releases CO₂, greenhouse-gas accounting conventions consider used tires a "carbon neutral" source because the carbon is out of the ground and destined for the atmosphere.

Another way to reduce carbon output is by reducing the clinker in cement. O'Hare said cement sold in the United States is 90 percent clinker, whereas European buyers accept cement with as little as 60 percent clinker.

As a plant manager and someone who has worked in cement for 23 years, Ellison said his main concern is not greenhouse gas emissions but remaining competitive in a global market.

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Morgan Johnson stands near where the clinker is tested for its chemical compounds in the lab at the Lehigh plant. Sacramento Bee/Andy Alfaro

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