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Experts getting a handle on concrete

Studies under way on how it can help rather than hurt environment

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As the planet becomes increasingly covered with concrete, Tarun Naik says at least some of it could be used to help the environment rather than hurt it.

Some of the negative consequences are worrisome. The production of one ton of cement, the paste used to make concrete, creates almost an equal amount of greenhouse gases. That's more than 1.2 billion tons of carbon dioxide a year, says Naik, a University of Wisconsin-Milwaukee engineering professor.

Concrete roads and buildings have been linked to "hot city syndrome," a condition in which temperatures keep rising in urban areas. There's a direct link between concrete and global warming, according to Naik, who has spent decades studying greener alternatives to conventional cement and concrete.

What's more, entire geographical regions of the world are running out of limestone to make cement, Naik says.

"As limestone becomes a limited resource, employment and construction associated with the concrete industry will decline," he wrote in a recent study about the sustainability of the cement and concrete industries.

Naik and his colleagues are seeking ways to make the use of concrete more sustainable and environmentally friendly. It's a huge task since concrete is second only to water when it comes to the consumption of materials worldwide.

"It's a global issue. China alone plans to double or triple its cement capacity in the near future," said Rudolph Kraus, assistant director of the UWM Center for By-Products Utilization, which is doing research on cement and concrete.

Researchers are studying things such as porous pavement that allows the earth to breathe and take in water. Stone and soil underneath porous pavement acts as a reservoir and cleans runoff water like the filter on a fish tank.

"It's a sore point with me that we spend millions of dollars a year flushing storm water into Lake Michigan," Naik said.

Porous concrete study

Highway barriers made from porous concrete could absorb sound and act as sponges that soak up greenhouse gases, according to Naik.

Currently, he and other UWM researchers are trying to quantify how well porous concrete absorbs carbon dioxide. They're exposing crushed concrete to carbon dioxide in the atmosphere, triggering a chemical reaction that sequesters the gas and keeps it from leaching out.

Through the reaction, which converts calcium hydroxide to limestone, porous concrete gets stronger. But eventually the material becomes saturated with carbon dioxide and stops absorbing it.

Researchers don't know how long it takes to reach the saturation point, though it might be years. When a porous highway barrier stopped absorbing gas, it could be torn down and recycled to make new concrete.

"Even if it only sequestered a small amount of carbon dioxide, it would be a step in the right direction," Naik said.

Buildings made from porous concrete could help cleanse indoor air. Ordinary concrete walls absorb some carbon dioxide, but not much of it because the surface isn't very porous.

Porous concrete could help filter storm water in parking lots. Studies have shown that most pollutants would be trapped in the material rather than passed through to the aquifer.

Crushed concrete could be used to cleanse waste gases from power plants. And fly ash, a waste product from coal-burning power plants, has been used as a substitute for cement in making concrete.

"By using fly ash in place of cement, we cut the corresponding amount of CO2 emissions," Naik said. "It has been a holy grail to use 100 percent fly ash. We have had successes with this idea in lab-produced concrete. However, it has not yet been implemented in real-world practice."

The building materials industry recognizes it has environmental issues, but not everyone agrees that porous concrete provides many solutions.

The material isn't necessarily compatible with climates that have frequent freeze-and-thaw cycles, said David Schulz, an engineering professor at Northwestern University and former Milwaukee County executive.

"Road builders spend a lot of time and money trying to keep water out of concrete," Schulz said. "In the winter it freezes and expands with incredible pressure. That's what causes the breakup of a lot of concrete."

But in tests done in Wisconsin, porous concrete has held up well to freezing and thawing, Naik said.

One of the tests, in Port Washington, involved the use of porous concrete on a road. After 10 years of exposure to year-round weather, the road was undamaged.

Another test, in Green Bay, is under way to evaluate porous concrete in a parking lot and truck loading area. So far, after four years, there's not been any damage from freeze and thaw cycles, Naik said.

The U.S. Department of Energy concluded that porous concrete would not suffer winter damage, assuming the proper mix of materials is used and water is not allowed to saturate the porous material.

As long as water drains through it and into the ground below, there should not be a problem, according to Naik.

The Portland Cement Association, which represents U.S. cement companies, is at the center of the environmental debate. Cement companies have improved their environmental performance and are constantly evaluating new materials and ideas, said David Shepherd, the association's director of sustainable development

Industrial waste that used to clog landfills is now added to concrete mixes to reduce the reliance on raw materials.

When it's constantly recycled, concrete produces very little waste, Shepherd said.

"You certainly would not make concrete as a remedial solution for carbon dioxide, but I think the industry will be spending money trying to figure out what our overall impact is" on greenhouse gases, Shepherd said.

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