



Michael Kanellos June 15, 2009

Can Buildings Last 16,000 Years? New Concrete Will Help

When nano-scale particles in concrete rearrange themselves, the life of a building can be shortened. Luckily, researchers have figured out how to make buildings stronger. It's one more element in the changing world of concrete.

MIT researchers have pieced together one of the oldest mysteries in construction – why concrete breaks down. The answer could help buildings, bridges and other structures last far longer than they do today.

Longer-lasting structures, of course, would directly help reduce the carbon dioxide generated in manufacturing concrete – 5 percent to 8 percent of the total manmade CO₂ comes from making concrete – and eliminate tons of waste by curbing building demolition.

In a paper published in the Proceedings of the National Academy of Sciences (PNAS) online Early Edition the week of June 15, Professor Franz-Josef Ulm explains that creep is caused by a rearrangement of calcium-silicate-hydrates (CSH) in concrete at the nano scale.

CSH particles typically assemble in two distinct phases when mixed with water. In the first phase, the concrete exhibits a density close to around 64 percent. In the second phase it increases to about 74 percent. The shift in density causes creep.

So how can you stop creep? By adding silica fumes, a waste product of producing aluminum, the density phases can be accelerated and the overall density increased to 87 percent. This third phase, discovered by Ulm, can in turn lead, ideally, to longer lasting or even lighter structures.

The paper also explains, experimentally, that the rate of creep is logarithmic, which means slowing creep increases durability exponentially. Slowing creep with the process outlined in the paper could extend the life of a nuclear waste container built to last 100 years to 16,000 years.

Twenty billion tons of concrete are produced a year, and the total increases 5 percent annually.

Various green building startups are already working on ways to modernize concrete. [Hycrete](#) has developed chemicals that can waterproof concrete, which eliminates the

need for plastic, protective membranes and early failures. Its technology is already being used in large construction projects. It also costs less.

"We can cut 30 to 60 percent of the cost [of waterproofing] on just materials alone," said Aaron Ayer, who runs Hycrete's marketing, in a recent interview.

Also look out for iCrete, founded by Global Crossing founder Gary Winnick, and Zeobond, CalStar Products and Calera in the related cement markets.