Nanomaterials poised for big impact in construction

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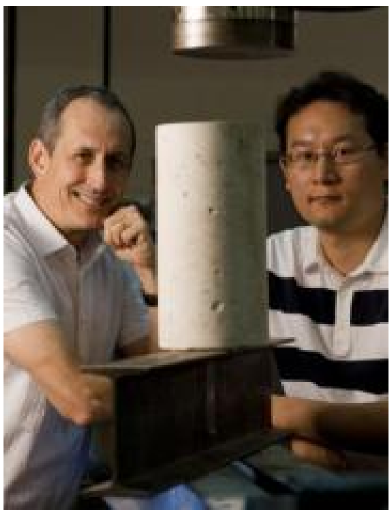

Rice University's Pedro Alvarez (left) and Jaesang Lee reviewed more than 140 scientific papers to investigate the potential uses of nanomaterials by the construction industry. Credit: Jeff Fitlow/Rice University

Nanomaterials are poised for widespread use in the construction industry, where they can offer significant advantages for a variety of applications ranging from making more durable concrete to self-cleaning windows. But widespread use in building materials comes with potential environmental and health risks when those materials are thrown away. Those are the conclusions of a new study published by Rice University engineering researchers this month in *ACS Nano*.

"The advantages of using nanomaterials in construction are enormous," said study co-author Pedro Alvarez, Rice's George R. Brown Professor and chair of the Department of Civil and Environmental Engineering. "When you consider that 41 percent of all energy use in the U.S. is consumed by commercial and residential buildings, the potential benefits of energy-saving materials alone are vast.

"But there are reasonable concerns about unintended consequences as well," Alvarez said. "The time for responsible lifecycle engineering of man-made nanomaterials in the construction industry is now, before they are introduced in environmentally relevant concentrations."

Alvarez and co-authors Jaesang Lee, a postdoctoral researcher at Rice, and Shaily Mahendra, now an assistant professor at the University of California, Los Angeles, note that nanomaterials will likely have a greater impact on the construction industry than any other sector of the economy, after biomedical and electronics applications. They cite dozens of potential applications. For example, nanomaterials can strengthen both steel and concrete, keep dirt from sticking to windows, kill bacteria on hospital walls, make materials fire-resistant, drastically improve the efficiency of solar panels, boost the efficiency of indoor lighting and even allow bridges and buildings to "feel" the cracks, corrosion and stress that will eventually cause structural failures.

In compiling the report, Lee, Mahendra and Alvarez analyzed more than 140 scientific papers on the benefits and risks of nanomaterials. In addition to the myriad benefits for the construction industry, they also identified potential adverse health and environmental effects. In some cases, the very properties that make the nanomaterials useful can cause potential problems if the material is not disposed of properly. For example, titanium dioxide particles exposed to ultraviolet light can generate molecules called "reactive oxygen species" that prevent bacterial films from forming on windows or solar panels. This same property could endanger beneficial bacteria in the environment.

"There are ways to engineer materials in advance to make them environmentally benign," Alvarez said. "There are also methods that allow us to consider the entire lifecycle of a product and to ensure that it can be recycled or reused rather than thrown away. The key is to understand the specific risks and implications of the product before it it is widely used."

More information: "Nanomaterials in the Construction Industry: A Review of Their Applications and Environmental Health and Safety Considerations", *ACS Nano*.

Provided by Rice University

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