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Concrete Sustainability Hub at Massachusetts Institute of Technology (MIT)

Research work is progressing quickly at the Concrete Sustainability Hub (CSH) at MIT. The CSH was established in late 2009 to better understand the sustainable attributes of concrete and the areas where they can be improved, and develop scientific breakthroughs at the atomistic level to make cement and concrete even more sustainable into the future.

MIT has assembled a “dream team” of researchers to work through the CSH, including those from a variety of disciplines such as engineering, architecture, life-cycle assessment, economics, physics, nuclear science, computational modeling and others. There are three major platforms to the CSH – Building Technology, Concrete Science, and Econometrics. The two initial work plans, “The Edge of Concrete: A Life-Cycle Investigation of Concrete and Concrete Structures” and “From Liquid to Stone: The Genesis of Concrete”, are well underway and researchers are identifying areas where concrete excels and where its intrinsic sustainable benefits can be maximized. They are also moving ahead on a “bottom up” approach to understanding the DNA of concrete at the atomistic level so that, for example, performance requirements can be met using less material and we can truly understand the chemical reactions that take place so that they can be manipulated for maximum environmental benefit.

The two initial work plans under the Building Technology and Concrete Science platforms are very synergistic, and the Econometrics platform overlays the two. The industry is extremely fortunate and excited to be working with MIT researchers under the leadership of Dr. Hamlin Jennings, CSH Executive Director, and the two principal investigators Drs. Franz-Josef Ulm and John Ochsendorf. Tremendous progress has already been made in a very short time, and although the research body will in many ways build on itself over the next few years, MIT expects to officially release some of its early findings later this fall.

The Concrete Sustainability Hub is a research center at the Massachusetts Institute of Technology that is being co-funded by the Portland Cement Association (PCA) and RMC Research & Education Foundation (RMCREF). Each organization is committing \$1 million a year for the next five years, for a total of \$10 million, with the goal of accelerating emerging breakthroughs in concrete science and engineering and transferring that science into practice. As the call for an increased emphasis on environmental issues grows louder, this is a chance for the concrete and cement industries to be proactive in establishing a CSH that will focus on quantifying and enhancing the sustainable nature of concrete.



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Resources List

Many resources are already available as a product of the research taking place at the MIT Concrete Sustainability Hub. The first two projects, "The Edge of Concrete: A Life Cycle Investigation of Concrete and Concrete Structures" and "From Liquid to Stone: The Genesis of Concrete" are both well underway. Information on how to access early findings is as follows:

Life Cycle Assessment Reports and Briefs

Interim reports and periodic briefs on the Life Cycle Assessment Platform are published regularly and include:

Homes: A Match for Concrete Innovation – February 2012

Smoothness Matters, But... – January 2012

Methods, Impacts, and Opportunities in the Concrete Pavement Life Cycle – August 2011

Methods, Impacts, and Opportunities in the Concrete Building Life Cycle – August 2011

The Effects of Inflation and Its Volatility on the Choice of Construction Alternatives – August 2011

Accounting for Inflation in LCCA – July 2011

When the Rubber Hits the Road – June 2011

Adopting a Life Cycle Perspective – April 2011

Designing for Sustainable Pavements – March 2011

Life Cycle Assessment of Buildings – December 2010

Life Cycle Assessment of Pavements – December 2010

Concrete Science One-Page Briefs

Work is progressing quickly on the Concrete Science platform, as evidenced by one-page briefs that are published monthly on a variety of topics, including:

Locking radionuclides in Cement – January 2012

Holding it Together: C-S-H Cohesion – December 2011

Predicting Setting Times Bottom-Up – November 2011

Why Wet C-S-H is Weak – October 2011

When Concrete Takes (part of) the Heat – September 2011

ReaxFF Hydration of Clinker Surfaces – July 2011

Setting From Statistical Principles – June 2011

Clinker Grinding at Breaking Point – May 2011

What's in Your Concrete? (Part 2) – April 2011

Clinker: When Impurities Matter – March 2011

What's in Your Concrete? (Part 1) – February 2011

Toughness Simply by Scratching – January 2011

C-S-H: Water, Water Everywhere – December 2010

The Hidden Forces of Setting – November 2010

Quantum Clinker Engineering – October 2010

Locking Mercury into Concrete – October 2010

Fly Ash is Critical for C-A-S-H – September 2010

Each of the reports and briefs noted above is available from the Foundation's homepage at www.rmc-foundation.org and the MIT CSH website at <http://web.mit.edu/cshub/news/news.html>. Look for new briefs and reports regularly.

The Concrete Sustainability Hub was established in 2009 by the RMC Research & Education Foundation and the Portland Cement Association to accelerate emerging breakthroughs in concrete science and engineering and to transfer that science into practice. The research taking place at MIT CSH will focus on quantifying and enhancing the sustainable nature of concrete.