Advanced Cement and Concrete Technologies

RTI International provides technologies and solutions to advance practices in cement and concrete applications. Ongoing collaborative programs with both commercial and government partners focus on all aspects of cement and concrete engineering and management, including long-term performance, performance evaluation and prediction, life-cycle cost analysis, and the environmental and sustainability aspects and implications of concrete and cement materials. We also offer material testing, evaluation, specification and mixture design, and optimization for both traditional and innovative materials.

Overview

Portland cement-based concrete is the most commonly used building material; however, its use as a high-performance material in reinforced structures such as bridges and in demanding underground environments requires sophisticated engineering. The complex chemistry of modern Portland cement is incompletely understood, which can limit the utility and predictability of the material in critical applications, but offers opportunities for formulation to add control. Additional opportunities for process improvement are being driven by environmental concerns, as production of cement is one of the largest industrial sources of CO_2 emissions.

To address these issues, RTI has initiated a strategic research thrust to develop cementitious materials for improved performance, better durability, and reduced environmental impact. With active research programs in both commercial and government sectors, we are improving cements used in demanding underground environments and on reducing the energy consumption and CO_2 emissions of cement production.

Areas of Expertise

RTI engineers and scientists conduct basic and applied research in materials science. Working closely with clients, we offer expertise in synthesis, characterization, and modeling to design new materials or improve the performance of existing materials. RTI's materials science researchers have more than 40 years of cumulative experience in cement and concrete R&D, including 30 years from commercial product development in cement additives and concrete admixtures.

RTI's laboratories offer state-of-the-art capabilities for cement, concrete, and materials analysis on its main campus, including a cement laboratory dedicated solely to the formulation and screening of unique cementitious materials. Additionally, RTI has a wide range of instrumentation available that focuses on key research areas relevant to cement and concrete technology:

- Materials characterization
- Advanced electron and optical microscopy
- Formulation chemistry

- Rheology of cementitious materials
- Testing of oil well slurries in high-temperature/high pressure conditions
- Calorimetry and inductively coupled plasma mass spectrometry

Research areas of interest include the following:

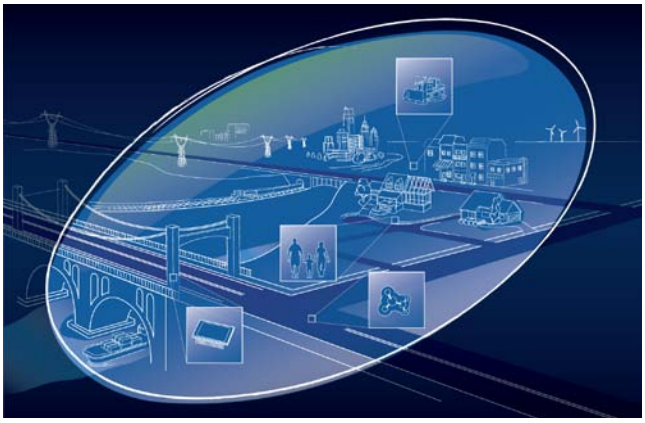
- Supplementary cementitious materials
- Cement chemistry
- Embedded sensors for plastic and hardened properties of concrete
- Energy harvesting for sensors
- Control of setting behavior
- Oil well cements
- Ultra-high-strength concrete

Project Highlights

The following selected project summaries highlight RTI's solution-oriented research services.

Utilization of class C fly ash in concrete—RTI is working with a large commercial partner to develop novel fly ash beneficiation technologies for increased utilization of class C fly ash in concrete. The technology is aimed at increasing the use of the under-utilized class C fly ash in concrete from current levels of 20% to 50% on an industrial scale. The project involves characterization of class C fly ash, technology development at the laboratory scale, technology evaluation in field trials at ready-mix concrete plants, monitoring and evaluation of the long-term durability of concrete made using high-replacement levels of cement, and eventually commercialization.

Evaluation of natural pozzolans in concrete—RTI is working with a client to explore the use of locally available natural pozzolans as partial replacement for cement in concrete. The work involves both the business and market assessment as well as the technical evaluation and optimization of natural pozzolans in concrete using locally available raw materials and local concrete curing practices.



Next-generation infrastructure

Energy harvesting for sensors—RTI has expertise in fabricating MEMS-based sensors, which can be embedded to monitor the plastic and hardened properties of concrete. Related expertise includes the development of thermoelectric devices. These devices can use low-temperature differences to generate power and are well suited for energy harvesting and powering unattended sensors in concrete. RTI has developed an in-ground thermoelectric device that functions simply as a stake in the ground to derive energy, using the small temperature differential between the ground surface and subsurface. This device can generate the required current to sustain MEMS-based sensors.

Novel oil well cementing—RTI has been involved in a multi-year, multi-million dollar project targeted at developing novel oil well cementing formulations for a client in the energy sector. RTI manages a strong research team composed of RTI researchers, personnel from the client R&D organization, staff from academic research laboratories, and external consultants.

More Information

Michele Ostraat, PhD
Senior Director, Center for Aerosol and Nanomaterials Engineering
919.541.5830
mostraat@rti.org

RTI International
3040 East Cornwallis Road, PO Box 12194
Research Triangle Park, NC 27709-2194 USA

RTI 7868 12-11