

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 cementitious materials. Our capabilities enable evaluation, specification, 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 and material improvement are being driven by environmental concerns, as production of cement is one of the largest industrial sources of CO₂ emissions.

RTI provides a suite of capabilities to address these unmet needs in the infrastructure field, developing cementitious materials for improved performance, better durability, and reduced environmental impact. With active research programs in both commercial and government sectors, we are enhancing concrete and cement engineering materials and practices, including in demanding underground environments and in the areas of the reduction of energy consumption and CO₂ emissions of cement production.

Areas of Expertise

RTI engineers and scientists have established expertise in basic and applied research in materials science relevant to cementitious materials. Working closely with clients, we offer expertise in synthesis, characterization, and modeling to design new materials or improve the performance of existing materials, which has enabled major R&D programs for commercial and government clients. The RTI team has more than 40 years of specific experience in cement and concrete R&D, including 30 years of 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 that focuses on key research areas relevant to cement and concrete technology, including

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

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

Research areas of interest include

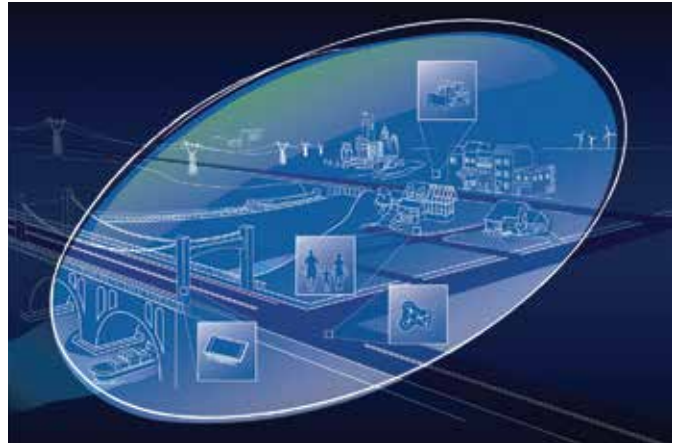
- Supplementary cementitious materials
- Cement chemistry
- Control of setting behavior
- Novel cements for demanding environments
- Ultra-high-strength concrete
- Long-term performance and sustainability
- Embedded sensors for plastic and hardened properties of concrete
- Energy harvesting for sensors

Project Highlights

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

Utilization of an industrial by-product as partial cement replacement material in concrete—RTI is working with a leading global manufacturer to evaluate the technical and market feasibility of using an industrial by-product that is currently landfilled as a cement replacement material in concrete. The project involves evaluating technical performance of the material in concrete, conducting a detailed techno-economic analysis for preprocessing of the material, evaluating environmental health and risk assessment from use of the material in concrete, evaluating different pathways for introducing the material in the concrete value chain, and developing a go-to-market strategy.

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 evaluating the business and market assessment as well as reviewing the technical evaluation and optimization



Next-generation infrastructure

of natural pozzolans in concrete using locally available raw materials and local concrete curing practices.

Sensor technologies—RTI has world-class expertise fabricating MEMS devices, which can be used as embedded sensors to monitor the properties of cement and concrete. RTI also has developed a novel in-ground thermal electric device that capitalizes on differences in temperature to generate power. This device is well suited for energy harvesting, capable of wirelessly powering unattended sensors in concrete.

Novel oil well cementing—RTI has been involved in a multiyear, multimillion 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 to meet the client's objectives.

More Information

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