

Carbon Capture R&D

RTI International is actively developing technology solutions for capturing CO₂ from fossil fuel-based combustion and gasification power plants. These include two novel processes for post-combustion capture, the first of which is a sorbent-based technology—named the Dry Carbonate CO₂ Removal Process—that has been developed for CO₂ removal from power plant flue gases. This technology has been demonstrated in a field test and will move into the next phase of demonstration in 2009. The second process, which focuses on CO₂ separation based on a novel membrane technology, is in early-stage development and shows promise as a cost-effective, energy-efficient CO₂ separation solution. In addition, RTI is developing a pre-combustion CO₂ removal technology for the next generation of gasification-based power plants.

Carbon Capture Research

Fossil fuels used for power generation, for transportation, and by industry are the primary sources of anthropogenic CO₂ emissions to the atmosphere. Although there are many approaches to limiting these emissions, it is increasingly clear that CO₂ capture and sequestration technologies will play an important role in reducing worldwide CO₂ emissions. Because large, stationary CO₂ point sources in the power and industrial sectors contribute to about half of the current CO₂ emissions, RTI has made these sectors primary targets for their CO₂ capture research. As RTI develops solutions for the power industry, we will leverage the expertise gained to offer CO₂ capture solutions for other industries such as cement manufacturing, petroleum refining, and natural gas processing.

RTI Develops Novel Processes for Post-Combustion CO₂ Capture

RTI's Sorbent-Based Dry Carbonate CO₂ Removal Process

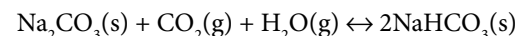
RTI, in collaboration with several industrial partners, has developed the Dry Carbonate CO₂ Removal Process—a sorbent-based technology for removing CO₂ from power plant flue gases. This process will offer utility companies an energy-efficient and economically attractive means for removing CO₂ from their power plant flue gases.

The Dry Carbonate CO₂ Removal Process is based on a sodium carbonate (Na₂CO₃) sorbent that removes CO₂ from flue gas by reacting with carbon dioxide and water

The Dry Carbonate CO₂ Removal Process has several key features and advantages:

- Uses a low-cost, non-toxic solid carbonate sorbent
- Sorbent is thermally regenerable at modest operating temperatures
- Applicable to fossil fuel-fired power plants
- Suitable for retrofit in existing power plants
- Less expensive and less energy-intensive than currently available technologies

to form sodium bicarbonate (NaHCO₃). Upon heating (ideally with low-grade heat from the power plant), the bicarbonate decomposes and releases a CO₂/steam mixture that can be converted into a “sequestration-ready” CO₂ gas stream through steam condensation. The reversible carbonation reaction inherent to this process is



Extensive thermodynamic analysis and laboratory research was carried out to prove the feasibility of the technology and to support the design, construction, and demonstration of a bench-scale research unit. In 2007, the bench-scale Dry Carbonate CO₂ Removal Process was relocated to a combustion facility and tested with a slipstream of actual coal-fired flue gas. RTI's technology consistently demonstrated greater than 90% CO₂ removal during hundreds of hours of field testing. Extensive data were collected relating to process operating conditions, sorbent attrition, and contaminant interaction.



Additional bench-scale R&D is being funded by the Department of Energy to resolve any remaining process challenges of the Dry Carbonate CO₂ Removal Process. RTI has improved upon reactor designs and the CO₂ capture capacity of its sorbents. RTI is using the data collected during bench-scale testing to build and evaluate a pilot-scale prototype capable of capturing 1 ton of CO₂ per day at a coal combustion facility. Upon successful completion of this pilot phase, RTI will move to a demonstration phase that will involve the construction and extended operation of a 5MW_e equivalent (100 tons CO₂ per day) system at an actual power plant site.

Preliminary economic and thermal analyses indicate that RTI's Dry Carbonate CO₂ Removal Process is potentially less expensive and more efficient than commercial amine-based CO₂ capture systems.

Membrane-Based CO₂ Separation

Membrane processes are attractive because they are generally energy-efficient (i.e., no phase changes occur), require minimal operator attention and maintenance, and are modular and scalable. Membrane-based CO₂ separation systems have the potential to greatly expand the options of utility companies producing electrical power in a carbon-constrained world.

RTI and a team of industrial partners are working together to develop and demonstrate novel fluorinated polymer membranes for separating CO₂ from post-combustion flue gas with a focus on total process design and process integration. RTI's research is focused on three areas: new high-performance membrane materials, improved hollow-fiber membrane module design, and cost- and energy-efficient integration into existing coal-fired power plants. RTI will evaluate new materials and process designs in the laboratory, followed by bench-scale evaluation at a coal combustion facility.

Pre-Combustion CO₂ Separation Targets Next Generation of Gasification Plants

Modern gasification technology provides an efficient means of producing power from carbonaceous fuels. CO₂ capture in gasification-based systems can be conducted before complete



RTI's bench-scale Dry Carbonate CO₂ Removal Process

combustion (i.e., at elevated process temperatures and pressures). This can significantly reduce the parasitic power load necessary for CO₂ compression before sequestration. RTI is currently developing a pre-combustion CO₂ removal technology for the next generation of gasification-based power plants.

RTI researchers have made considerable progress in developing a high-temperature, regenerable, mixed oxide-based sorbent technology that can be integrated into advanced gasification systems. We anticipate that this technology will avoid the significant thermal penalty associated with existing CO₂ removal technologies. Our researchers are actively involved in the synthesis, development, scale-up, and testing of both fixed- and fluidized-bed high-temperature CO₂ sorbents. RTI is also investigating the use of these sorbents with water-gas shift catalysts to achieve in situ water-gas shift and CO₂ removal, thereby increasing the effectiveness of CO₂ capture and the generation of a hydrogen-rich product gas.

More Information

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