the ENERGY lab

PROJECT FACTS

Carbon Capture

Sorbent Based Post-Combustion CO_2 Slipstream Testing

Background

The mission of the U.S. Department of Energy/National Energy Technology Laboratory (DOE/NETL) Carbon Capture Research & Development (R&D) Program is to develop innovative carbon dioxide (CO_2) emissions control technologies for fossil fuel-based power plants. The Carbon Capture R&D Program portfolio of pre- and post-combustion CO_2 emissions control technologies and related CO_2 compression is focused on advancing technological options for new and existing power plants to enable cost-effective CO_2 capture for beneficial use or storage of CO_2 and ensure that the United States will continue to have access to safe, reliable, and affordable energy from fossil fuels. The DOE/NETL goal is to demonstrate second-generation technologies that can capture 90 percent of the CO_2 at less than $40 per metric ton (tonne) in the 2020–2025 timeframe. DOE is also committed to extend R&D support to even more advanced transformational carbon capture technologies that will increase the competitiveness of fossil-based energy systems beyond 2035.

Post-combustion CO_2 capture technologies are applicable to conventional pulverized coal (PC)-fired power plants, where the fuel is burned with air in a boiler to produce steam that drives a turbine generator system to produce electricity. The CO_2 is exhausted in the flue gas at atmospheric pressure and a concentration of 10–15 percent by volume. Post-combustion separation and capture of CO_2 is a challenging application due to the low driving force resulting from low pressure and dilute concentration of CO_2 in the waste stream, trace impurities in the flue gas that affect removal processes, and the parasitic energy cost associated with the capture and compression of CO_2. Carbon capture technologies developed by the DOE program may also be applied to natural gas power plants after addressing the R&D challenges associated with the relatively low concentration of CO_2 (typically 3–4 percent) in the flue gas of natural gas plants. A new, low-cost solid sorbent-based carbon capture process has shown the potential to capture 90 percent of the CO_2 emissions from existing PC-fired power plants.

TDA's solid alkalized alumina sorbent.

CONTACTS

Michael Matuszewski
Carbon Capture Technology Manager
National Energy Technology Laboratory
626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0940
412-386-5830
michael.matuszewski@netl.doe.gov

Andrew O'Palko
Project Manager
National Energy Technology Laboratory
3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507-0880
304-285-4715
andrew.opalko@netl.doe.gov

Jeannine Elliott
Principal Investigator
TDA Research, Inc.
12345 West 52nd Avenue
Wheat Ridge, CO 80033
303-261-1142
jelliott@tda.com

PARTNERS

University of California at Irvine
Clariant
Babcock and Wilcox

PROJECT DURATION

Start Date	End Date
02/03/2014	12/31/2017

COST

Total Project Value
$5,880,378

DOE/Non-DOE Share
$4,704,509 / $1,175,869

PROJECT NUMBER

DE-FE0012870

NATIONAL ENERGY TECHNOLOGY LABORATORY

Albany, OR • Anchorage, AK • Morgantown, WV • Pittsburgh, PA • Sugar Land, TX

Website: www.netl.doe.gov

Customer Service: 1-800-553-7681

U.S. DEPARTMENT OF ENERGY

Project Description

TDA Research, Inc. (TDA), along with their partners, will further evaluate their solid sorbent-based post-combustion CO_2 capture system at pilot scale to show its technical and economic viability. TDA's process is based on an alkalized alumina adsorbent that can remove CO_2 from coal-fired power plant flue gas. Under a previous DOE-funded project (DE-NT0005497), TDA established the effectiveness of their process through laboratory, bench-scale, and field testing. This testing showed that TDA's sorbent achieved greater than 90 percent CO_2 capture with stable CO_2 loading, and recent work has further improved the sorbent, significantly reducing the capital and operating costs of the technology. Further testing and analysis is needed to enable a practical path to development of this technology at larger scales and, ultimately, commercialization of the capture process.

In this project a pilot-scale plant will be designed, fabricated, and installed at the National Carbon Capture Center (NCCC) to test TDA's sorbent-based process using a 0.5 megawatt electrical (MWe) slipstream of flue gas. TDA will test their most advanced sorbent formulations and conduct parametric and steady-state testing to measure the performance of the sorbent and the plant. Results of the slipstream testing will be used to evaluate the effectiveness and economics of the carbon capture technology.

Primary Project Goal

The overall project goal is to evaluate TDA's alkalized alumina sorbent under realistic conditions during continuous long-term operation at the 0.5 MWe scale, collecting the data necessary for further process scale-up, and showing the technology can meet or exceed the DOE goal of demonstrating second-generation technologies that can capture 90 percent of the CO_2 at less than $40 per tonne in the 2020–2025 timeframe.

Objectives

The project objectives are to design a 0.5 MWe pilot-scale test unit to capture 10 tons of CO_2 per day; scale-up production of the sorbent material; fabricate, shake down, and operate the pilot plant; conduct parametric and long term continuous steady-state testing; and analyze the pilot plant data to make recommendations for scaling up the technology to the next level and eventual full-scale deployment.

Planned Activities

- Prepare a preliminary techno-economic analysis and environmental, health, and safety (EH&S) assessment
- Conduct process optimization testing in an existing bench scale laboratory unit
- Develop a basic process design for the pilot plant using previous data and optimization test results
- Complete the detailed engineering design of the pilot plant and coordinate with the NCCC for slipstream testing
- Scale up production of the advanced sorbent material required for the pilot-scale test unit
- Fabricate components and assemble the pilot plant at the NCCC
- Conduct 1.5 months of parametric testing and a minimum of 2 months of continuous steady-state testing
- Decommission the pilot-scale test unit
- Complete post-testing sorbent analysis
- Complete slipstream testing data analysis
- Update the techno-economic analysis and EH&S assessments

Accomplishments

- Project awarded in February 2014.
- Kick-off meeting held in May 2014.

Benefits

Successful completion of this project will establish the scalability and technical and economic feasibility needed to progress TDA's sorbent-based CO_2 capture system to a large-scale pilot unit at the 10-50 MWe level. This progression is necessary to enable a practical technology path to development at larger scales and, ultimately, commercialization of the capture process. This sorbent-based technology is expected to advance the DOE goal to demonstrate second-generation technologies that can capture 90 percent of the CO_2 at less than $40 per tonne in the 2020–2025 timeframe.