the ENERGY lab

PROJECT FACTS

Carbon Sequestration

Research and Education of CO_2 Separation from Coal Combustion Flue Gases with Regenerable Magnesium Solutions

Background

Increased attention is being placed on research into technologies that capture and store carbon dioxide (CO_2). Carbon capture and storage (CCS) technologies offer great potential for reducing CO_2 emissions and, in turn, mitigating global climate change without adversely influencing energy use or hindering economic growth.

Deploying these technologies in commercial-scale applications requires a significantly expanded workforce trained in various CCS specialties that are currently under-represented in the United States. Education and training activities are needed to develop a future generation of geologists, scientists, and engineers who possess the skills required for implementing and deploying CCS technologies.

The U.S. Department of Energy's (DOE) National Energy Technology Laboratory (NETL) has selected 43 projects to receive more than $12.7 million in funding, the majority of which is provided by the American Recovery and Reinvestment Act (ARRA) of 2009, to conduct geologic sequestration training and support fundamental research projects for graduate and undergraduate students throughout the United States. These projects will include such critical topics as simulation and risk assessment; monitoring, verification, and accounting (MVA); geological related analytical tools; methods to interpret geophysical models; well completion and integrity for long-term CO_2 storage; and CO_2 capture.

Project Description

DOE is partnering with the University of Cincinnati to conduct research and training on separating CO_2 from coal combustion flue gases using regenerable magnesium hydroxide ($Mg(OH)_2$) slurry, followed by a regeneration step (separating CO_2 from solvent). $Mg(OH)_2$ is readily available commercially and/or may be easily and economically reclaimed from power plants using lime-based flue gas desulfurization systems (FGD). The proposed research is to effectively and reliably separate CO_2 from flue gases for potential sequestration purposes by means of CO_2 absorption at 52 °C using a magnesium hydroxide ($Mg(OH)_2$) slurry, followed by a regeneration step conducted at 65 °C in order to achieve 95% CO_2 purity.

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PARTNERS

University of Cincinnati Utility Plant
EnerChem Inc.
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PROJECT DURATION

Start Date
12/01/2009

End Date
11/30/2012

COST

Total Project Value
$299,851

DOE/Non-DOE Share
$299,851 / $0

Government funding for this project is provided in whole or in part through the American Recovery and Reinvestment Act.

The project will include engineering education in the field of carbon capture and sequestration for chemical and environmental engineering graduate students. The project will include laboratory research to obtain fundamental experimental data for the determination of the optimal liquid-to-gas ratio for fluid flow rates; phase equilibrium data for the CO_2 stripper; heat of absorption; impact of acid gases entering the absorber; optimum $Mg(OH)_2$ composition; and the kinetics of magnesium carbonate ($MgCO_3$) formation. Based on the research, a pilot-scale unit will be designed, constructed, and tested to determine CO_2 removal performance at a utility plant located at the University of Cincinnati. Furthermore, this research will support graduate students in an effort to provide a trained workforce necessary for implementing and deploying CCS technologies on a commercial scale.

Goals/Objectives

The goal of this project is to integrate ongoing research on CO_2 separation from flue gasses using regenerable magnesium solutions with engineering education in the field of CSS (Figure 1). The research objective is to determine the proof-of-concept of the proposed technology by conducting additional investigations with the assistance of graduate chemical and environmental engineering students.

Benefits

This project will support two graduate students over the entire project period in an effort to provide a trained CCS workforce. Overall the project will make a vital contribution to the scientific, technical, and institutional knowledge necessary to establish frameworks for the development of commercial-scale CCS.

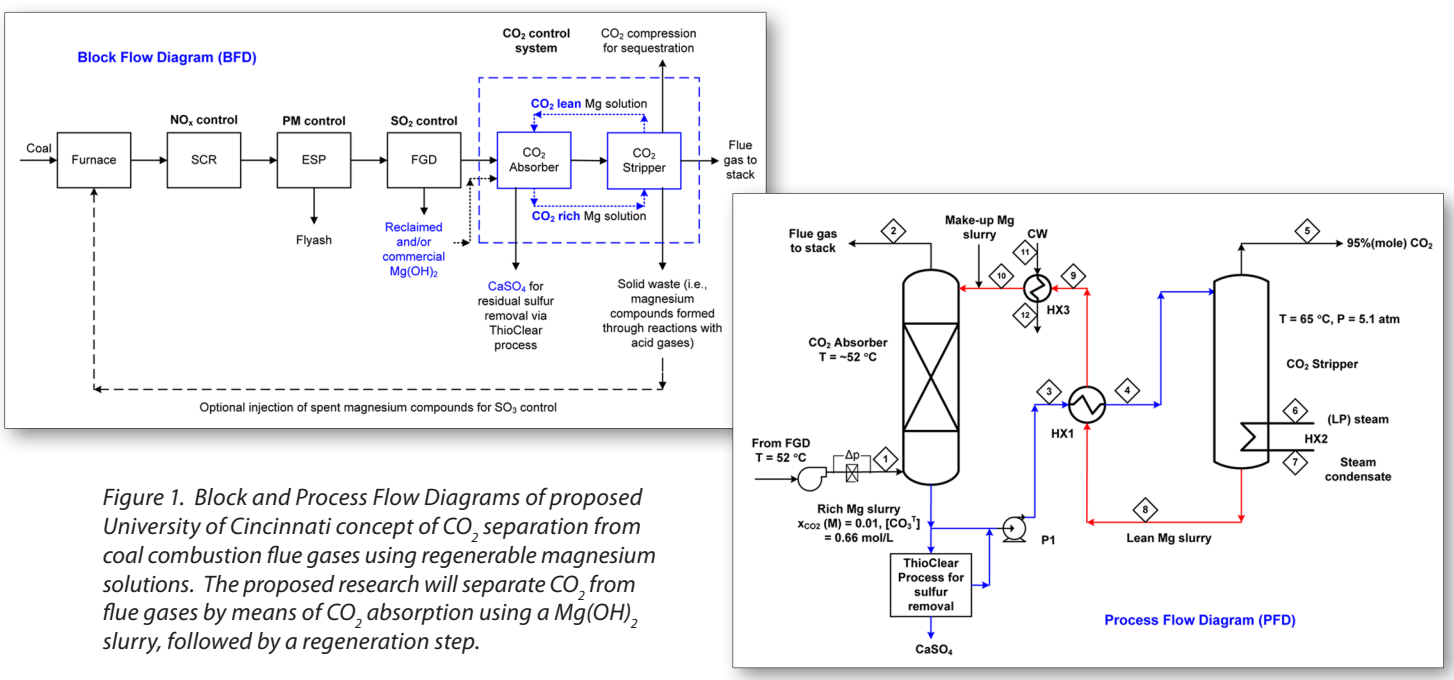

Figure 1. Block and Process Flow Diagrams of proposed University of Cincinnati concept of CO_2 separation from coal combustion flue gases using regenerable magnesium solutions. The proposed research will separate CO_2 from flue gases by means of CO_2 absorption using a $Mg(OH)_2$ slurry, followed by a regeneration step.