the ENERGY lab

PROJECT FACTS

Gasification Technologies

Advanced Acid Gas Separation Technology for the Utilization of Low Rank Coals

Background

Coal gasification is a promising alternative to traditional coal-fired combustion. Gasification can be adapted to carbon dioxide (CO_2) capture while supplying synthesis gas (syngas) to produce power, hydrogen (H_2), chemical products or combinations thereof. Cost-efficiency is the key to successfully gasifying coal. Downstream processing of syngas for CO_2 capture requires separation of the crude stream into the desired products of H_2 and carbon monoxide (CO), and also into a sulfur stream (primarily hydrogen sulfide [H_2S]) and sequestration-ready CO_2. Acid gas removal (AGR) via absorption in a physical solvent such as Rectisol® or Selexol™ are the conventional processes for processing syngas.

Air Products and Chemicals, Inc. (Air Products) has developed a proprietary alternative that consists of three process steps: Sour Pressure Swing Adsorption (Sour PSA) to separate the desired products from CO_2 and H_2S; sulfur disposition that can be accomplished in several different modes; and a CO_2 polishing and compression step that produces sequestration-ready CO_2. Sour PSA is the key enabler of the technology, but only limited testing of this adsorbent technology has been performed on syngas streams derived from higher-rank coals and petcoke. Results to date have been extremely encouraging, but more testing, especially of lower-rank coals, is important since the resultant syngas streams contain tars, ash, and a variety of impurities that could reduce adsorbent lifetime.

The Department of Energy (DOE) National Energy Technology Laboratory (NETL) has partnered with Air Products to test the advanced acid gas separation technology for the utilization of low-rank coals.

Project Description

Air Products will conduct extensive testing using a mobile, two-bed, Sour PSA unit fed with North Dakota lignite coal-based syngas streams. This testing will be conducted in collaboration with the Energy and Environmental Research Center (EERC) at the University of North Dakota, utilizing the EERC location and fluidized bed gasifier. Measurements of adsorbent and PSA unit performance over time will be taken and analyzed. The adsorbent system will be operated in thermal swing adsorption (TSA) mode as well as pressure swing adsorption (PSA) mode to determine the capability for TSA to operate when exposed to syngas derived from lower-rank coal.

CONTACTS

Jenny Tennant
Technology Manager
National Energy Technology Laboratory
3610 Collins Ferry Road
P.O. Box 880,
Morgantown, WV 26507-0880
304-285-4830
jenny.tennant@netl.doe.gov

Meghan Napoli
Project Manager
National Energy Technology Laboratory
3610 Collins Ferry Road
P.O. Box 880 PO3B
Morgantown, WV 26507-0880
304-285-5255
meghan.napoli@netl.doe.gov

Jeffrey Kloosterman
Principal Investigator
Air Products and Chemicals, Inc.
7201 Hamilton Boulevard
Allentown, PA 18195-1501
610-481-8093
kloostjw@airproducts.com

PARTNERS

University of North Dakota Energy and Environmental Research Center

PROJECT DURATION

Start Date
10/1/2011

End Date
12/31/2012

COST

Total Project Value
$999,930

DOE/Non-DOE Share
$799,944 / $199,986

NATIONAL ENERGY TECHNOLOGY LABORATORY

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

Website: www.netl.doe.gov

Customer Service: 1-800-553-7681

U.S. DEPARTMENT OF ENERGY

Goals and Objectives

The objective of this project is to test the performance of the Air Products Sour PSA process on a gaseous mixture generated from the gasification of lower-rank lignite coal and perform a techno-economic analysis to predict the change in cost of electricity (COE) from incorporation of Sour PSA into a base 90 percent CO_2 capture integrated gasification combined cycle (IGCC) power plant design utilizing low-rank coal. The target of this case study is a cost reduction of greater than 10 percent in capital scope at 90 percent CO_2 capture and greater than 95 percent CO_2 purity. The experimental portion of the work will test the performance and capability of the adsorbents in handling tar and other impurities resulting from gasification of lignite coal.

Benefits

The results of PSA and TSA testing will help determine if PSA alone, or a combination of TSA followed by PSA, will provide for more robust operation. Test results will be used to generate a high-level pilot process design and prepare a techno-economic assessment to evaluate the applicability of the technology to plants utilizing these low-rank coals. The adsorbent technology testing that has been performed to date utilized syngas streams derived from higher rank coals and petcoke. Using data from the experiments based on petcoke-derived syngas, replacing the physical solvent process with Air Products' downstream processes is initially estimated to reduce the cost of capital for CO_2 capture by 20 percent, increase CO_2 capture efficiency from 90 percent to greater than 95 percent, and provide other benefits in integration options.

Shown in the foreground is a refinery off-gas PSA at Air Products' facility in Baytown, TX