Project Summary/Abstract

Applicant: Air Products and Chemicals, Inc.

Principal Investigator: Dr. Fabrice Amy

Project Title: Advanced Acid Gas Separation Technology for Clean Power and Syngas Applications

Project Objectives and Description of the Project:

Gasification is a promising alternative to traditional coal-fired combustion that can be adapted to carbon dioxide (CO_2) capture while supplying synthesis gas (syngas) for hydrogen, power, or chemical products. A key challenge for coal gasification is to reduce its cost. Downstream processing of syngas for CO_2 capture requires separation of the crude stream into the desired products (H_2/CO), a sulfur stream (primarily H_2S), and sequestration-ready CO_2. The process most commonly employed for this is acid gas removal (AGR) based on absorption in a physical solvent. Air Products has developed a proprietary alternative that consists of two process blocks: Sour Pressure Swing Adsorption (PSA) that separates CO_2 and H_2S from the desired products, and a tailgas disposition block which separates the sulfur-containing compounds and purifies the CO_2 to a sequestration-grade product. Sour PSA is the key enabler of the technology, but only limited testing of the adsorbent technology has been performed on high-hydrogen syngas streams. Through PSA testing and techno-economic assessment (TEA), Air Products has already successfully demonstrated a 4% reduction in COE from a low-rank coal-based, integrated gasification and combined cycle (IGCC) plant with CO_2 capture.

This project will be conducted in cooperation with the National Carbon Capture Center, where Air Products proposes to operate a two-bed PSA unit. The testing will utilize a slipstream of authentic, high-hydrogen syngas based on low-rank coal. Testing will provide data on far longer adsorbent exposure than has been demonstrated to date. By utilizing high-hydrogen syngas, it will also provide information necessary to understand the utility of the system for methanol production.

In addition, Air Products will also operate a multi-bed PSA process development unit (PDU), located at its Trexlertown, PA headquarters, to evaluate the system incorporating pressure equalization cycles. This will refine the reliability of predictions of PSA performance at commercial scale.

Finally, the information obtained from the two-bed mobile PSA unit and the PDU will be combined to build a techno-economic assessment (TEA) of PSA utilization for methanol production, as well as to update the TEA already completed for IGCC.

It is anticipated that replacing the AGR process with Air Products' downstream processes will reduce the cost of capital for CO_2 capture in a high-hydrogen-containing syngas by approximately 15%, while maintaining >90% CO_2 capture efficiency. The project will also provide critical information necessary to advance the technology toward commercialization.