the ENERGY lab

PROJECT FACTS

Gasification Technologies

Integrated Warm Gas Multicontaminant Cleanup Technologies for Coal-Derived Syngas

Description

Integrated Gasification Combined Cycle (IGCC) technology offers a means to utilize coal—the most abundant fuel in the United States—to produce a host of products, ranging from electricity to value-added chemicals like transportation fuels and hydrogen, in an efficient, environmentally friendly manner. However, the overall cost (capital, operating, and maintenance) of IGCC technology remains higher than that of pulverized-coal and natural gas-fired power plants, which has impeded the commercialization of the technology. A number of factors contribute to the overall cost; for example, the cost of cleaning the syngas to near-zero contaminant levels is a major component that accounts for up to 18 percent of the overall capital cost. Conventional syngas cleanup technologies use low-temperature or refrigerated solvent-based scrubbing systems, such as methyl-diethanol amine (MDEA) or physical solvents (i.e., Rectisol, Selexol, Sulfinol)—processes that require temperature reductions to below 100 °F and then reheating to downstream process temperature requirements, resulting in efficiency losses and increased costs. Therefore, in order to improve the economics of the syngas cleaning system, cost-effective, multi-contaminant cleanup systems must be developed that align with the elevated temperature and pressure conditions of gasification processes. This is expected to result in reduced capital and operating costs.

This Research Triangle Institute (RTI) project, which builds upon the results of DE-AC26-99FT40675 (Novel Technologies for Gaseous Contaminants Control), will develop warm syngas cleanup through pilot-scale testing. While DE-AC26-99FT40675 examined sulfur cleanup, this project will focus on trace contaminant removal and the optimization of the whole contaminant removal section of a gasification plant.

Primary Project Goal

The project goal is to support the development of a warm, multi-contaminant syngas cleaning system for operation over 400 °F and 600 pounds per square inch (psi) that will clean coal-derived syngas to at least the following levels:

- Ammonia (NH_3) to 10 parts per million (ppm)
- Arsenic (As) to 5 parts per billion (ppb)
- Cadmium (Cd) to 30 ppb
- Chlorine (Cl) to 10 ppb

CONTACTS

Gary J. Stiegel
Gasification Technology Manager
National Energy Technology Laboratory
626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236
412-386-4499
gary.stiegel@netl.doe.gov

Jenny Tennant
Project 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

Brian S. Turk
Principal Investigator
Research Triangle Institute
3040 Cornwallis Road
P.O. Box 12194
Research Triangle Park, NC 27709
919-541-8024
bst@rti.org

PARTNERS

Research Triangle Institute
Nexant, Inc.

COST

Total Project Value
$7,154,057

DOE/Non-DOE Share
$5,724,245 / $1,429,812

NATIONAL ENERGY TECHNOLOGY LABORATORY

Albany, OR • Morgantown, WV • Pittsburgh, PA

Website: www.netl.doe.gov

Customer Service: 1-800-553-7681

U.S. DEPARTMENT OF ENERGY

- Mercury (Hg) to 5 parts per billion weight (ppbw)
- Phosphorus (P) < 20 ppbw
- Selenium (Se) to 0.2 ppm
- Sulfur (S) to 50 ppbw

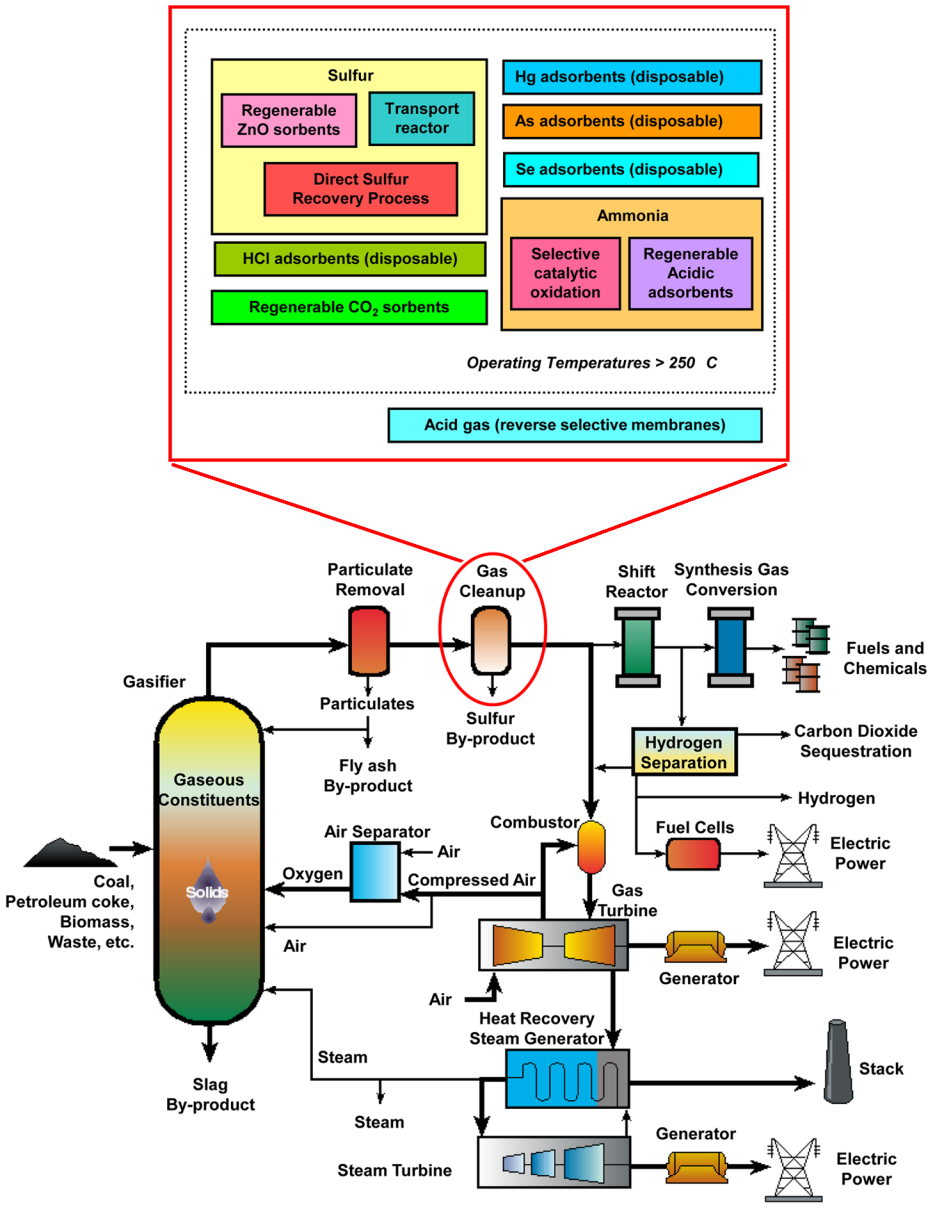
Accomplishments

A system analysis of the RTI warm syngas cleaning technology platform, which included S, Hg, and hydrogen chloride (HCl) removal at 392 °F was completed and demonstrated the potential for significant improvements in overall thermal efficiency and the cost of electricity.

- Developed and validated lab-scale testing systems to test sorbent exposure using simulated syngas containing S, Hg, arsine (AsH_3), hydrogen selenide (H_2Se), and NH_3 at temperatures >392 °F.
- Performed analysis for trace metals present in sorbent materials generated during exposure to real coal-derived syngas generated at Eastman Chemicals in Kingsport, Tennessee, under DE-AC26-99FT40675.
  - Demonstrated As removal in fixed-bed As sorbent with over 1 wt% loading at reactor inlet.
  - Demonstrated near complete Hg removal in the first sorbent bed.

Benefits

A National Energy Technology Laboratory economic analysis, based on the RTI sulfur removal process, shows warm gas cleanup technologies can improve the overall efficiency of an IGCC power plant by about 2.3 percentage points and reduce the cost of electricity by 4 percent.



RTI's Warm Syngas Cleaning Technology Platform