

Advanced Energy Systems - Gasification Systems

Water-Gas Shift (WGS) Tests to Reduce Steam Use

Performer: Southern Company Services, Inc.

Project No: NT0000749

Project Description

The National Carbon Capture Center is testing commercial water-gas shift (WGS) catalysts from multiple vendors in support of developing WGS reactor systems which will reduce the cost of carbon dioxide (CO₂) capture from the production of syngas using coal. These tests have revealed that steam-to-carbon monoxide (CO) ratios can be reduced, resulting in a substantial increase in the net power output and significantly reducing the cost of electricity from an integrated gasification combined cycle (IGCC) plant with CO₂ capture. Several commercially available WGS catalysts have been tested, and the results are being provided to the manufacturers to aid them in specifying future WGS systems for IGCC plants incorporating CO₂ capture.

- [Project Fact Sheet](#)



Water-Gas Shift Reactors

Project Background and Project Benefits

Gasification is used to convert a solid feedstock, such as coal, petcoke, or biomass, into a gaseous form, referred to as synthesis gas or syngas, which is primarily hydrogen and carbon monoxide. With gasification-based technologies, pollutants can be captured and disposed of or converted to useful products. Gasification can generate clean power by adding steam to the syngas in a water-gas-shift reactor to convert the carbon monoxide to carbon dioxide (CO₂) and to produce additional hydrogen. The hydrogen and CO₂ are separated—the hydrogen is used to make power and the CO₂ is sent to storage, converted to useful products or used for EOR. In addition to efficiently producing electric power, a wide range of transportation fuels and chemicals can be produced from the cleaned syngas, thereby providing the flexibility needed to capitalize on the changing economic market. As a result, gasification provides a flexible technology option for using domestically available resources while meeting future environmental emission standards. Polygeneration plants that produce multiple products are uniquely possible with gasification technologies. The Gasification Systems program is developing technologies in three key areas to reduce the cost and increase the efficiency of producing syngas: (1) Feed Systems, (2) Gasifier Optimization and Plant Supporting Systems, and (3) Syngas Processing Systems.

Syngas processing research and development underway emphasizes technologies that can be efficiently integrated into the plant, optimized with the temperature and pressure requirements of other systems, and meet product delivery specifications. A major cost element in gasification plants is converting raw syngas into a pure and specific gas used to create the plant's target product suite. High-hydrogen, low-methane, ultraclean syngas is versatile and can be used for power production with CO₂ capture, fuels or chemicals production, and for many polygeneration applications. The technologies being developed are focused on high-efficiency processes that operate at moderate to high temperatures and clean syngas of all contaminants to the extremely low levels needed for chemical production—often significantly lower than the U.S. Environmental Protection Agency (EPA) required levels for power plants.

The National Carbon Capture Center (NCCC) is testing commercial water-gas shift (WGS) catalysts from multiple vendors to reduce the cost of carbon dioxide capture for IGCC plants. In the DOE vision for clean power using gasification, additional hydrogen is produced by adding steam to the syngas in a water-gas-shift reactor to convert carbon monoxide to CO₂ and hydrogen. After separation the hydrogen rich syngas is used to make power and the CO₂ is captured. Improved WGS catalysts that support reduction of steam-to-carbon monoxide ratios reduce the steam requirement for IGCC cycles, which in turn will reduce the cost of electricity with CO₂ capture.

Performer website: [National Carbon Capture Center](#)