PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Vision 21

02/2003

NETL

NOVEL PROCESS FOR UPGRADING COAL SYNGAS

Description

Efficient removal of carbon dioxide from coal syngas is a key technical challenge for next-generation power plants. Nexant, Inc. and Los Alamos National Laboratory (LANL) are developing a low temperature process owned by SIMTECHE, which captures carbon dioxide by formation of gas hydrates. The process has potential for being both less energy-intensive and less capital-intensive than the conventional technologies currently used for capture of carbon dioxide from shifted synthesis streams.

Conventional technology makes use of solvents to absorb carbon dioxide from the syngas, with subsequent recovery using heat and lowered pressures. The high-pressure SIMTECHE process forms gas hydrates, which are ice-like water cages enclosing carbon dioxide molecules. These cage structures can be decomposed with minor temperature increases enabling the recovery of the carbon dioxide at high pressures. Carbon dioxide capture and regeneration at system pressures would greatly decrease the compression costs associated with providing gas at sequestration pressures.

In this process, coal syngas is cooled and fed to a reactor with water to form the hydrates. Heat evolved from hydrate formation is removed with ammonia refrigerant. The solid hydrate crystals and liquid water slurry is then separated from the syngas, which is then suitable for final cleanup prior to being fed to a gas turbine. The water/hydrate slurry is decomposed, generating high-pressure CO_2 for sequestration. Process water is resaturated and recycled to the hydrate formation reactor.

Goals

The project has four phases. Phase 1 is devoted to experimental validation of the SIMTECHE concept, generating basic phase equilibria and flow system data on the formation of hydrates and refined engineering analyses based on the new laboratory data. Phase 2 is devoted to further experimental work and optimization of processing conditions, which will in turn be used for the design and construction of a modular pilot plant. Phase 3 will consist of pilot plant operation at LANL and further process development/analysis. In phase 4, the pilot plant will be installed at an operating gasifier site to demonstrate the commercial feasibility of the process.

PRIMARY PARTNERS

Nexant, Inc
San Francisco, CA

Los Alamos National Laboratory
Los Alamos, NM

PARTICIPANTS

SIMTECHE
Redding, CA

TOTAL ESTIMATED COST

$9,076,621

CONTACTS

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DEPARTMENT OF ENERGY • UNITED STATES OF AMERICA

PROJECT MILESTONES

This is a 83-month project executed in four sequential phases:

Initiate Project:	Oct 1999
Begin Phase 2:	Feb 2002
Begin Phase 3:	June 2004
Begin Phase 4:	Sept 2005

PERFORMANCE TARGETS

CO_2 Capture Efficiency : 75%

Cost of Carbon Control:
\$10 per ton of CO_2

Parasitic Power Loss:
7.5% of power generated

CUSTOMER SERVICE

800-553-7681

WEBSITE

www.netl.doe.gov

NOVEL PROCESS FOR UPGRADING COAL SYNGAS

Benefits

The efficiency targets for conversion of coal to electricity, as well as the near-zero emissions targets, require improvement in the current state of emissions control technology. Conventional CO_2 scrubbing methods are well known but unlikely to be more than marginally improved in efficiency or cost. Since the process doesn't require large absorbers or reboiled regenerators, the SIMTECHE hydrate process offers promise as a substantial improvement for CO_2 removal from coal syngas and delivery of the CO_2 to sequestration, both in reduced capital cost and reduced parasitic power losses.

Next-generation power plants based on IGCC designs are targeting high-pressure (1000+ psig) syngas generation. This enables high CO_2 removal depth using hydrate formation, since the theoretical removal percentage depends on the difference between the feed partial pressure of the CO_2 and the minimum hydrate formation pressure. The development program is dedicated to maximizing the removal percentage from dirty shifted synthesis gas, developing experimental data enabling design of key pieces of equipment, and running a pilot unit that demonstrates the actual performance of the process.