ORIGINAL

REPORT SUMMARY

SUBJECTS: Coal-derived liquids / Gasification power plants

TOPICS: Methanol; Synthetic fuels; Cogeneration; Gasification—combined cycles

AUDIENCE: Fuels and generation planners

EPRI-AP--4430

DE86 006782

Liquid-Phase Methanol (LPMeOH™) Process Development Unit (PDU)—40-Day Run at LaPorte, Texas (1984)

Sustained catalyst life is a key to improved methanol synthesis from coal gasification products. A demonstration of scaled-up PDU operation—first using a large-particle catalyst and then a liquid-entrained slurry in a single run—produced a significant amount of crude methanol.

BACKGROUND

Methanol synthesis in a gasification-combined-cycle (GCC) power plant offers utilities greater flexibility in handling variable load requirements. Approximately 10 years of research jointly supported by EPRI and DOE culminated in a methanol synthesis proof run at the LaPorte pilot plant. In previous plant demonstrations and laboratory research, investigators did not fully understand the conditions for maintaining catalyst life.

OBJECTIVES

- To test short-term catalyst activity with carbon monoxide-rich synthesis gas at a 5-t/d scale.
- To demonstrate methanol production in an ebullated-bed reactor containing catalyst particles fluidized by gas and liquid flow.

APPROACH

A previous bench-scale PDU, autoclave tests, and model predictions indicated that liquid-phase methanol was in an excellent position for scale-up. The LaPorte methanol synthesis run was scaled up by a factor of 100. Investigators expected to demonstrate unit performance and catalyst stability using a large-particle catalyst. However, they performed most of the run in a slurry mode because of the rapid attrition rates with the large-particle catalyst. They analyzed catalyst activity with both conventional (balanced) and once-through synthesis (unbalanced) gas flows.

RESULTS

Scale-up of methanol synthesis and PDU performance proved successful. The project team reported the following findings:

- Initial catalyst performance in the fluidized mode equaled that of corresponding smaller-scale tests and predictions, but catalyst activity declined more rapidly than predicted. The attrition rates showed that the catalyst was not suitable for this mode.

- Use of an attrited catalyst in the slurry mode worked reliably, even though the catalyst was intended for the fluidized mode.
- Smooth transition from fluidized to slurry modes of operation allowed a comparison of the catalyst with both modes. The project investigators also recommended future tests to demonstrate the adequacy of catalyst activity for commercial applications.

EPRI PERSPECTIVE

Successful operation of the 5-t/d LaPorte PDU was a major milestone toward development of methanol-from-coal-gas technology. This project involved scale-up of earlier work described in EPRI report AP-1291. In another report (AP-3749), researchers assessed the economic feasibility for coproduction of electricity and methanol in an integrated coal GCC power plant. Successful development of the LPMeOH process would enhance the economic incentive for methanol synthesis in GCC plants.

PROJECT

RP317-3
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Contractor: Air Products and Chemicals, Inc.

For further information on EPRI research programs, call EPRI Technical Information Specialists (415) 855-2411.

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AP-4430
Research Project 317-3
DOE Contract DE-AC22-81PC30019

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ABSTRACT

Air Products and Chemicals, Inc. and Chem Systems Inc. have completed a 40-day run in the LaPorte LPMEOH™ PDU with R71/OF12-26 catalyst. The primary purpose of this test was to demonstrate short-term activity maintenance with CO-rich synthesis gas at the five metric ton per day scale of operation.

The catalyst was reduced and then brought on stream in the liquid-fluidized mode with balanced synthesis gas on April 11, 1984. Within 30 hours the liquid-fluidized catalyst had attrited to form the expected 29 weight percent slurry. The first 102.5 hours of operation were dedicated to process variable scans with space velocities ranging from 2,400 to 14,400 liters per hour per kilogram of catalyst.

For the remaining 862 hours on stream, the following relatively constant conditions were maintained with CO-rich synthesis gas:

Reactor temperature, °C	250
Reactor pressure, kPa	5,400
Catalyst concentration, weight percent	27.5-23.3
Space velocity, liters/hr-kg catalyst	10,000-12,500

During this period, CO conversion declined slowly from about 10 to 4.8 percent and methanol productivity decreased slowly from about 23 to 14.3 g mol/hr-kg catalyst. Trace poisons were at least partly responsible for this activity decline.

The run was voluntarily terminated on May 21, 1984 after accumulating 964.5 hours on synthesis gas. A major achievement of this test was the demonstration of sustained PDU operation in the liquid-entrained mode with relatively high slurry concentrations. The run produced 151 metric tons of crude methanol.