

INTERIM FINAL TECHNICAL REPORT  
September 1, 2002, through August 31, 2003

Project Title: **ZERO EMISSION COAL GASIFICATION PROCESS FOR  
ILLINOIS COAL – MINI-BENCH SCALE TEST**

ICCI Project Number: 02-1/2.3A-2  
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ABSTRACT

The objective of this project is to determine the gas cleaning requirements of the raw gas produced via the hydrogasification of an Illinois coal, within the context of the Zero Emission Coal (ZEC) process. GTI has demonstrated the feasibility of the ZEC concept for Illinois coal in last year's project (ICCI Project No. 01-1/2.3C-2). In this project, we have conducted a combination of theoretical and experimental studies for the high sulfur Illinois coal on the desulfurization, carbonation, and calcination steps of the ZEC process. Both dolomite and limestone were selected as the sorbent materials for this study as they show both desulfurization and carbonation capabilities.

Thermodynamic simulation shows that the H<sub>2</sub>S content of the syngas is about 0.4% after the hydrogasification. If calcium oxide is used as a desulfurization sorbent, the H<sub>2</sub>S level can be reduced to about 200 ppm at 1500°F and 900 psig. This trace of H<sub>2</sub>S would enter into the downstream reformer/carbonator and potentially compete with CO<sub>2</sub> for the carbonation sorbent, which is also a calcium oxide.

The experiments were carried out in a High Pressure Thermogravimetric Analyzer (HPTGA) unit. Single components of H<sub>2</sub>S or CO<sub>2</sub> (in helium) were first measured on dolomite and limestone at various partial pressures and temperatures, up to 900 psig and 1800°F. Both sorption capacity and kinetics increased with increasing partial pressure. The presence of helium with CO<sub>2</sub> reduced the carbonation kinetics, indicating either film diffusion control or macropore diffusion control. The effect of steam on the sulfidation reaction was also studied. Steam did not appear to affect the sulfidation rate, but reduced the equilibrium capacity slightly.

When both H<sub>2</sub>S and CO<sub>2</sub> were reacted with the sorbent simultaneously at 1500°F and 900 psig, H<sub>2</sub>S appeared to be preferentially reacted with the sorbent over CO<sub>2</sub>. Chemical analysis of the reacted sorbents also showed very little CO<sub>2</sub>. This could imply that traces of H<sub>2</sub>S could impede the carbonation reaction. More confirming testing will be conducted.

A "no-cost time extension" has been approved by ICCI for this project. The final report will be completed by November 30, 2003.