

FINAL TECHNICAL REPORT
September 1, 2005, through October 31, 2006

Project Title: **OXIDATIVE HYDROTHERMAL DISSOLUTION OF ILLINOIS
COAL**

ICCI Project Number: 05-1/5.1A-1
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ABSTRACT

The primary objective of this project was to determine the feasibility of oxidative dissolution of Illinois coal under hydrothermal (superheated liquid water) conditions using only molecular oxygen (O₂) as the oxidant. A micro-scale, semi-continuous, short contact time hydrothermal reactor system has been constructed to investigate this novel coal processing concept. This system performs at or exceeds all original design specifications. Oxidative dissolution of Illinois coal by O₂ under hydrothermal conditions with resultant liberation of soluble low molecular weight products has been demonstrated. Characterization of oxidation products demonstrate that dissolution of the coal occurs by surface reaction at the surface of the coal with rapid dissolution and removal of the resulting solublized products. The rate and extent of reaction are directly proportional to oxidant loading.

EXECUTIVE SUMMARY

The overarching objective of this project was testing of the feasibility of a novel coal processing concept known as oxidative hydrothermal dissolution (OHD). At a molecular level, coal is comprised of complex, interconnected macromolecular network. Coal is an insoluble solid largely because of the extent of cross-linking present between different parts of this network. In principle, disruption of these cross-linking structures should release low molecular weight products, potentially valuable as chemical feed-stocks. OHD attempts to accomplish this disruption of cross-linking structures by selective oxidation of the coal by reaction with molecular oxygen (O_2) in high temperature liquid water.

The specific objectives of this project were:

- Construction of a micro scale, semi-continuous, short contact time hydrothermal reactor system.
- Investigation of oxidative hydrothermal dissolution of Illinois coal under a variety of reaction conditions.

The key objectives of the project have been accomplished. A flexible experimental micro-reactor system for investigation of ODH of Illinois coals has been designed, constructed and commissioned. This tool performs at or exceeds all original specifications.

OHD of Illinois coal has been demonstrated successfully. The macromolecular network of coal can be disrupted by controlled oxidation using molecular oxygen under hydrothermal conditions, resulting in the release of lower molecular weight products that are readily soluble in a variety of media. Analysis of data from OHD experiments indicates that the reaction is rapid and effective under the conditions tested.

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