DEVELOPMENT AND PROCESS EVALUATION OF IMPROVED FISCHER-TROPSCH SLURRY CATALYSTS. FINAL REPORT

AIR PRODUCTS AND CHEMICALS, INC.
ALLENTOWN, PA

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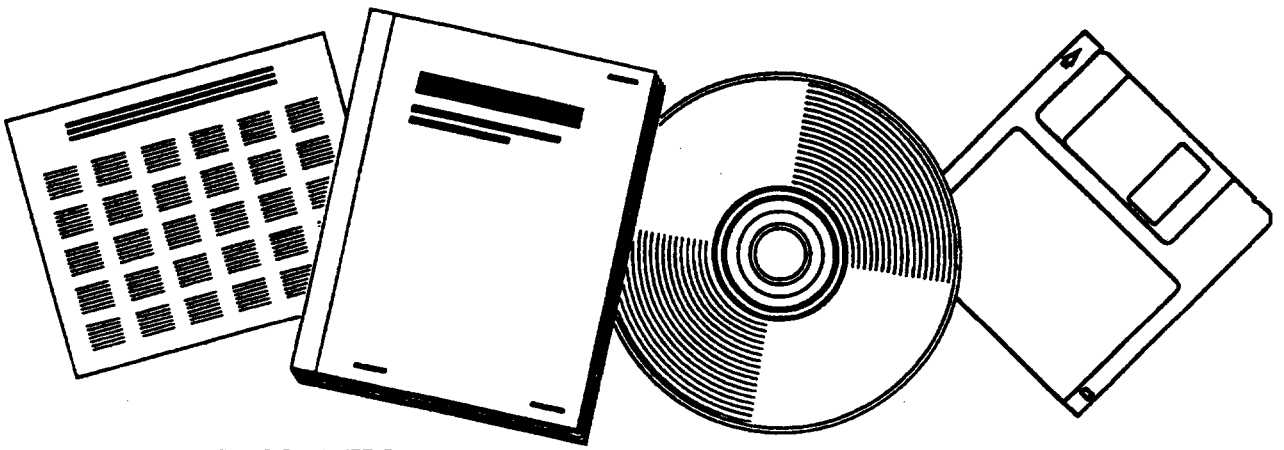

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DEVELOPMENT AND PROCESS EVALUATION OF IMPROVED FISCHER-TROPSCH SLURRY CATALYSTS

Final Report

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Report Prepared By

Dragomir B. Bukur
Doble Mukesh
Snehal A. Patel
Michael P. Rosynek*
William H. Zimmerman

Contributors

William P. Addiego*
Xiaosu Lang
Chiuping Li*
Joseph A. Rossin
E. Benjamin Yeh*

Department of Chemical Engineering
Department of Chemistry*
Texas A&M University
College Station, Texas 77843

Economic Evaluation Prepared By

Lyndon J. Kellogg

Air Products and Chemicals, Inc.
7201 Hamilton Boulevard
Allentown, Pennsylvania 18195-1501

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ABSTRACT

This report describes results of a study aimed at developing and evaluating improved catalysts for a slurry Fischer-Tropsch (FT) process for converting synthesis gas to high quality transportation fuels (gasoline and distillate). The improvements in catalyst performance were sought by studying effects of pretreatment conditions, promoters and binders/supports. A total of 20 different, iron based, catalysts were evaluated in 58 fixed bed reactor tests and 10 slurry reactor tests. The major accomplishments and conclusions are summarized below.

The pretreatment conditions (temperature, duration and the nature of reducing gas) have significant effect on catalyst performance (activity, selectivity and stability) during Fischer-Tropsch synthesis. One of precipitated unsupported catalysts had hydrocarbon selectivity similar to Mobil's I-B catalyst in high wax mode operation, and had not experienced any loss in activity during 460 hours of testing under variable process conditions in a slurry reactor.

The effect of promoters (copper and potassium) on catalyst performance during FT synthesis has been studied in a systematic way. It was found that potassium promotion increases activities of the FT and water-gas-shift (WGS) reactions, the average molecular weight of hydrocarbon products, and suppresses the olefin hydrogenation and isomerization reactions.

The addition of binders/supports (silica or alumina) to precipitated Fe/Cu/K catalysts, decreased their activity but improved their stability and hydrocarbon selectivity. The performance of catalysts of this type was very promising and additional studies are recommended to evaluate their potential for use in commercial slurry reactors.

Kinetic parameters for the FT and WGS reactions were determined from slurry reactor tests with four catalysts in which the catalyst activity was fairly stable with time on stream.

The catalytic studies were complemented with characterization studies which provided valuable information on the effects of copper and potassium promoters, and of silica and alumina supports on reduction behaviors (temperature programmed and isothermal reduction) and surface properties (X-ray photoelectron spectroscopy).