NORTHWESTERN UNIVERSITY

ACTIVITY AND SELECTIVITY STUDIES ON SILICA SUPPORTED FISCHER TROPSCH CATALYST

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ABSTRACT

Activity and Selectivity Studies

Silica Supported Fischer Tropsch Catalysts

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Fischer-Tropsch reaction studies are conducted over well characterized silica supported Fe, Co, and FeCo alloy catalyst at 250°C and total pressures of 1 to 14 atm. Low CO conversions (< 5%) are employed in order to minimize the complications of integral reaction systems. The reactant streams include 1/1 and 1/3 CO/H_2 mixtures in addition to a 1/3 CO/H_2 feed containing either 5.4 mole % C_2H_4 or 0.5 mole % 1-pentene. Specific CO activities are generally found to decrease with increasing CO conversion. No irreversible loss in activity is observed at the pressure and feed conditions employed. The Co catalyst possesses the highest specific CO activity at 1 atm; however the activity decreases by 50% as the pressure increases to 14 atm. For both iron containing catalysts the CO activity increases with increasing pressure such that the Fe catalyst possesses the highest activity while the FeCo catalyst yields activity comparable to that of pure Co.

The alloy catalyst yields the smallest product fraction of long chain (Cn > 4) hydrocarbons while the Co catalyst produces the largest fraction. Methanol becomes a dominant product at elevated pressures for the iron containing catalyst while long chain hydrocarbon products are produced with the Co catalyst. The Schulz-Flory chain growth probability increases for both the pure component catalysts and decreases for the FeCo catalyst with increasing pressure.

The presence of ethylene in the feed stream increases the product yields of the Cn > 2 hydrocarbon products but does not affect the growth probability. The fraction of feed ethylene incorporated into longer product chains is typically 0.02 while the fraction hydrogenated is greater than 0.2. The presence of 1-pentene in the feed stream marginally enhances the Cn $\geq$ 6 yields while not affecting the growth probability. Transient reaction studies imposed by a step change in the space velocity indicate that steady state hydrocarbon production occurs sequentially with increasing carbon chain length.

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DEDICATION

This work is dedicated to my parents, Andrew and Kathleen, and Christine M. Cates, who provided love and support throughout the most difficult times encountered in the progress of my graduate studies.

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