TITLE: **Attrition Resistant Catalysts for Slurry-Phase Fischer-Tropsch Process**

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ABSTRACT

OBJECTIVE

Fischer-Tropsch (FT) synthesis to convert syngas ($CO + H_2$) derived from natural gas or coal to liquid fuels and wax is a well-established technology. For low H_2 to CO ratio syngas produced from CO_2 reforming of natural gas or from gasification of coal, the use of Fe catalysts is attractive because of their high water gas shift activity in addition to their high FT activity. Fe catalysts are also attractive due to their low cost and low methane selectivity. Because of the highly exothermic nature of the FT reaction, there has been a recent move away from fixed-bed reactors toward the development of slurry bubble column reactors (SBCRs) that employ 30- to 90-μm catalyst particles suspended in a waxy liquid for efficient heat removal. However, the use of Fe FT catalysts in an SBCR has been problematic due to severe catalyst attrition resulting in fines that plug the filter employed to separate the catalyst from the waxy product. Fe catalysts can undergo attrition in SBCRs not only due to vigorous movement and collisions but also due to phase changes that occur during activation and reaction.

The objectives of this research are to develop a better understanding of the parameters affecting attrition of Fe F-T catalysts suitable for use in SBCRs and to incorporate this understanding into the design of novel Fe catalysts having superior attrition resistance.

WORK DONE AND CONCLUSIONS

The effect of kaolin-clay-phosphate addition as a binder to a doubly promoted Fischer-Tropsch synthesis iron catalyst (100 Fe/5 Cu/4.2K/ 10 SiO_2) was studied. The catalysts were prepared by coprecipitation, followed by clay-phosphate binder addition and spray drying. Clay addition upto to a level of 8-24 wt % was studied. Addition of clay binder beyond 16 wt %, however, was found to be detrimental to attrition resistance and resulted in decreased CO conversion. An attrition resistant, active and selective catalyst was prepared that gave 90 % CO

conversion through 75 hours of testing in a fixed-bed at 250°C, 1.48 MPa and 2.0 NL/g.cat-h with C_5^+ selectivity of 64% and CH_4 selectivity of less than 10%.

ARTICLES AND PRESENTATIONS

K. Jothimurugesan, J.J. Spivey, S.K. Gangwal and J.G. Goodwin, Jr., "Development of Fe Fischer-Tropsch Catalysts with High Attrition Resistance, Activity and Selectivity", Spring AIChE National Meeting, Houston, TX, March 14-18, 1999.

K. Jothimurugesan, J.J. Spivey, S.K. Gangwal and J.G. Goodwin, Jr., "Development of Fe Fischer-Tropsch Catalysts for Slurry Bubble Column Reactors", 217 th Amercian Chemical Society National Meeting, Anaheim, CA, March 21-25, 1999.

K. Jothimurugesan, J.J. Spivey, S.K. Gangwal and J.G. Goodwin, Jr., "Development of Fe Fischer-Tropsch Catalysts for Slurry Bubble Column Reactors", ACS Preprints, Volume 44, No.1, 111-114, 1999.