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TECHNOLOGY DEVELOPMENT FOR COBALT F-T CATALYSTS

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EXECUTIVE SUMMARY

A number of important technical accomplishments and conclusions have been reached during this reporting period.

Following the catalyst pretreatment effects reported in the previous quarterly report, it appears that the higher activity obtained for the catalysts prepared using an organic solution and reduced directly without prior calcination was the result of higher dispersions obtained under such pretreatment.

A Ru-promoted Co catalyst on alumina with 30% Co loading exhibited a four-fold increase in dispersion and a two-fold increase in activity in the fixed-bed reactor from that obtained with the non-promoted catalyst, reported in the previous report. Compared with the results obtained with the Ru-promoted 20 wt% Co catalyst, the increase in activity due to higher Co loadings is not as significant as that reported for the non-promoted catalysts. This would confirm the suggestion that a greater percent of the additional Co is reducible to the metal without the presence of a reduction promoter such as Ru.

Several slurry bubble column reactor runs during this reporting period have again focused on pushing conversion to higher levels. Larger charges of catalysts than in previous runs, in addition to raising the temperature and varying the reactants flow rates, were used in order to achieve higher conversions. The maximum conversion obtained has been 49.7% with 26g catalyst at 260°C and 403 SL/h (25% N_2 in a H_2 + CO mixture). The higher catalyst charge resulted in higher conversions at the standard reaction conditions. However, as in the previous runs at high conversions, low flow rates and higher temperatures resulted in greater heat being released. This resulted in difficulties in temperature control and faster loss of activity especially at the high

temperatures. When a low activity catalyst was used, relatively high conversions could be achieved at temperatures as high as 280°C without excessive deactivation.

Further investigations of the effect of reaction temperature on the performance of Co catalysts during F-T synthesis were started using a low activity catalyst and one of the most active catalysts. The catalysts were tested in the fixed-bed reactor at various temperatures while monitoring their deactivation. The preliminary results obtained during this quarter confirm that Co catalysts are very sensitive to temperature. They deactivate very fast at temperatures above 240°C. Further tests will be carried out in the following quarter in order to determine the nature of this deactivation process and possible means to prevent it.

The three 1 kg catalyst batches prepared by Calsicat for the reproducibility and aging studies were tested in both the fixed-bed and slurry bubble column reactors under the standard reaction conditions. Their performances for F-T synthesis were similar, and they were also similar to the performances obtained with two catalysts previously prepared by Calsicat in smaller batches and with the reference catalyst prepared in-house. The 1000 hour aging test was started with one of these catalysts prepared by Calsicat.

The effects of adding various promoters to some cobalt catalysts have also been addressed. Based on the SBCR results, La and Zr promotion of Co/Al_2O_3 appear to have little or no effect on catalyst activity. However, these activities were also among the highest already obtained in SBCR. On the other hand, Re and La addition to Co/SiO_2 did not improve the activity over that obtained with the low activity unpromoted Co/SiO_2 catalyst.

Finally, a special test run was made to determine whether slugging or plugging occurred in the reactor system at higher solids loading. A charge of 50 wt% inactive catalyst in synfluid was tested at 240°C, 450 psi. Nitrogen gas feed rate was varied between 900 SL/h and 1300 SL/h with no solids carryover. In addition, synfluid was fed at 30 ml/hr and no overhead slugging and no plugging occurred in the internal heavy product filter. This test suggests that the reactor system can handle high catalyst loading. However, the reactor cannot handle high heat generation because there is no capability for removing the heat of reaction.

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ACKNOWLEDGEMENT

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