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DEVELOPMENT OF A SELECTIVE RUTHENIUM FISCHER-TROPSCH CATALYST. FINAL REPORT, OCTOBER 1, 1984--FEBRUARY 28, 1989

UOP, INC., DES PLAINES, IL. TECHNICAL CENTER

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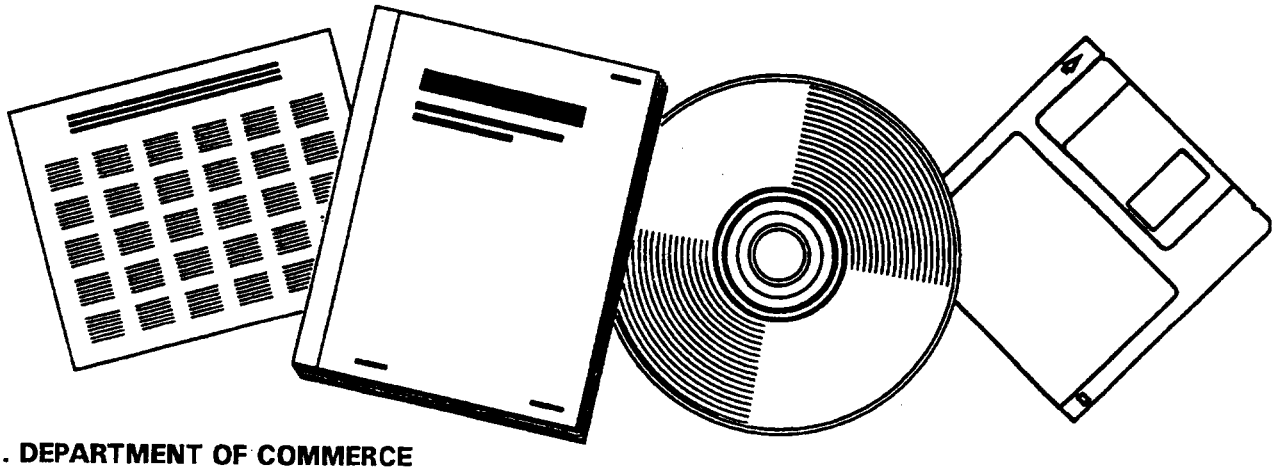

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THE DEVELOPMENT OF A SELECTIVE RUTHENIUM FISCHER–TROPSCH CATALYST

Final Report for the Period October 1, 1984–February 28, 1989

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For
U.S. Department of Energy
Pittsburgh Energy Technology Center
Pittsburgh, Pennsylvania

By
UOP Des Plaines Technical Center
Illinois

THE DEVELOPMENT OF A SELECTIVE RUTHENIUM FISCHER-TROPSCH CATALYST

ABSTRACT

A new stable Fischer-Tropsch catalyst with very high selectivity to distillate fuels and with low light ends production was developed. This catalyst, which was made by a reverse micelle technique, contains 2.8% (by weight) ruthenium in the form of 4-6 nm particles on alumina and a proprietary modifier.

The new modified ruthenium catalyst did not noticeably deactivate during 814 hours at about 80% CO conversion, $2H_2$:1 CO feed ratio, 208°C at inlet, 62 atm and 150 gas hourly space velocity. In order to determine the catalyst's tolerance, the operational severity was increased between 814 hours and 1700 hours by increasing the temperature and space velocity to 225°C at inlet and to 205 hr^{-1}, respectively. A deactivation rate of about 0.016%/hour was measured under these more severe conditions at about 70% conversion level.

Deactivation of the new modified ruthenium catalyst seems to have occurred by migration of ruthenium to the exterior of alumina particles, followed by agglomeration. The causes for the migration of ruthenium particles are not known but appear to be related to filling of the alumina pores with Fischer-Tropsch products. On the other hand, unmodified ruthenium catalysts deactivated by coking, and not by agglomeration.

A total of 787 g hydrocarbons + oxygenates were made with 0.15 g ruthenium in this catalyst during this 1700-hour-demonstration run. Approximately 55% of the products were in the distillate range (C_5-C_{22}) for both test periods. The light ends (C_1-C_4) amounted to 9.5% of the total products made during first 814 hours. Since the light ends selectivities gradually decreased during the first 500 hours on stream the lined-out light ends production is much lower than the average value reported here. The light ends selectivity was higher (13%) during the second test period because of the higher temperature and lower conversion level. The other product was wax which could be efficiently hydrocracked to make more distillates.

These results with the new modified ruthenium catalyst compare favorably with those reported for the two commercial Sasol processes. The Arge process makes approximately 38% distillate fuel with 14-18% light ends, while the Synthol process makes about 48% distillate with 38% light ends.

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