V. RECOMMENDATIONS FOR FURTHER STUDY

Several catalysts synthesized at TAMU during the current contract have met most of the DOE target performance criteria. Some of these catalysts are more active than any other known Fischer-Tropsch catalysts developed for production of high molecular weight hydrocarbons, and their deactivation with time is rather moderate. A research program to demonstrate repeatability of catalyst performance in a stirred tank slurry reactor, reproducibility of preparation procedures on a laboratory scale, followed up by catalyst production scale-up in collaboration with a catalyst manufacturer is recommended. A successful completion of this program would provide a state-of-the-art precipitated iron catalyst for future process evaluation studies in the DOE owned Alternative Fuel Development Unit (a bubble column reactor of 0.6 m in diameter, 6 m tall) located at LaPorte, Texas.

Further improvements in the catalyst performance (activity, selectivity, and/or stability) are needed to accelerate commercialization of Fischer-Tropsch technology based on coal derived synthesis gas. This may be achieved through further research on (a) the use of different pretreatment procedures; (b) the use of higher reaction pressure and gas space velocity to increase the reactor productivity; and (c) modifications in catalyst preparation steps.

As shown in this contract, and elsewhere, pretreatment conditions (nature of reductant, temperature, duration and gas flow rate during the pretreatment) can be used to alter catalyst activity, selectivity, and stability. The pretreatment conditions chosen in this study (with iron-silica catalysts) are not necessarily the optimal ones. A comprehensive catalyst characterization studies are needed to gain understanding of the underlying reasons for differences in catalyst performance following different pretreatments.

In several tests with different catalysts, we have shown that the reactor productivity (space-time-yield) can be improved by using higher reaction pressure and gas space velocities. A penalty seems to be in a higher rate of catalyst deactivation, but this needs to be examined over a long period of time.

Also, we recommend studies on the effects of basic oxides as promoters (e.g. MnO, MgO and/or CaO), sources of potassium, and calcination conditions on the catalyst performance.

Finally, the studies on the effect of reactor type: stirred tank slurry reactor (STSR) vs. bubble column slurry reactor (BCSR) are recommended. The space-time-yield and product distribution in a STSR may be significantly different than those in a laboratory BCSR operating under the same process conditions. At high syngas conversions (≥80%) a catalyst in the STSR is exposed to a hydrogen rich syngas, and methane selectivities are expected to be higher than in the BCSR.