1.0 INTRODUCTION

Coal liquefaction will be an important source of transportation fuels in the future, and can be accomplished by either a direct route (hydrogenation of coal in a donor solvent) or an indirect route (gasification of coal followed by the Fischer-Tropsch reaction).

The product selectivity of the Fischer-Tropsch reaction has been the focus of extensive research for many years, yet still remains a prime target for technical innovation. Fischer-Tropsch technology, as it is currently practiced commercially for liquid fuels production, provides a broad range of hydrocarbon products which require costly downstream refining.

Selectivity can be influenced by variations in the catalyst composition and process conditions. Yet, in spite of the extensive effort devoted to this problem, a suitable catalyst has not yet been developed for producing a narrow boiling range hydrocarbon product, such as gasoline or diesel fuel, without the coproduction of undesirable lighter and heavier products.

The Fischer-Tropsch reaction is exothermic, and improved heat transfer would also be expected to have a major beneficial effect on product selectivity. Slurry phase reactor operation improves heat transfer and temperature control and results in greater selectivity to liquid products, usually through lower methane production. However, considerable differences have been reported in the space-time yield, catalyst life and ease of operation of slurry phase reactors.

In addition to improved product selectivity, slurry phase operation offers the advantage of ease of scale-up and the ability to directly utilize the carbon monoxide-rich synthesis gas produced by modern coal gasifiers. The full potential of the slurry phase Fischer-Tropsch process has not yet been realized, and its further development is an important part of our country's program to establish viable technology for converting coal to hydrocarbon fuels.

Air Products, under contract to the DOE, has undertaken a program in catalyst and reactor development for a slurry phase Fischer-Tropsch process. A major requirement of this program was the development of a preliminary design for a bench scale slurry phase reactor. In keeping with the scale of the research and development on this contract, a preliminary design and cost estimate was developed for a 4" to 5" internal diameter, bench-scale, three-phase bubble column reactor. This size is intermediate between the 1-liter, laboratory-scale stirred reactor operated in Task 2 of this contract and the LaPorte, Texas process development unit operated by Air Products under DOE contract DE-AC22-87PC90005 for Liquid Phase Methanol (LPMEOH*) research. The reactor is sized to operate in the same hydrodynamic flow regime as a commercial reactor.

This report describes the bench-scale liquid phase Fischer-Tropsch reactor design developed in Task 4 of DOE Contract Number DE-AC22-80PC30021.

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