8.0 CONCLUSIONS

8.1 WAX CHARACTERIZATION

Significant advances were made in characterizing Fischer-Tropsch waxes using gel permeation chromatography, liquid-solid chromatography, enhanced MS techniques and other supplemental analytical procedures. The lower carbon number "soluble" fraction was characterized completely. Carbon number distributions and hydrocarbon types were determined for the acetone soluble fractions of three waxes. These waxes were produced using different Fischer-Tropsch synthesis schemes. Detailed characterization of the heavier "insoluble" fractions was difficult due to their extreme insolubility in solvent and poor vaporization. Also, attempts to use the FAB technique for the acetone insoluble fraction were unsuccessful. The total wax molecular structure was defined using MS analyses and IR spectroscopy.

Characterization was done on a commercial Fischer-Tropsch derived wax (Arge) as well as three experimentally produced samples (Union Carbide, Air Products and Mobil). The Arge wax was shown to be highly paraffinic with few branched molecules. Union Carbide and Air Products waxes are also paraffinic, but with significantly more branched molecules. The Mobil wax is the least paraffinic of the samples. The mono-olefin and oxygenate content of the Mobil material are significantly higher than the other three samples.

8.2 WAX HYDROCRACKING

Catalytic hydrocracking was successfully used for converting Fischer-Tropsch wax to transportation fuels. A high yield of specification grade diesel fuel was produced with satisfactory catalyst performance at relatively mild operating conditions.

Pilot plant runs were conducted with Arge and Mobil waxes. Both waxes were good feedstocks, but the Mobil wax produced more light ends and consumed more hydrogen, probably because the Mobil wax has more branched paraffins.

8.3 BLENDING STUDIES

Blending equations based on literature blending correlations were developed to predict key properties of Fischer-Tropsch derived diesel fuel. The literature correlations were fine-tuned so that they matched actual laboratory blends of Fischer-Tropsch derived distillate.

Diesel fuel produced in a Fischer-Tropsch upgrading complex was shown to have excellent properties. The high cetane and smoke point (low aromatic content) properties of the diesel fuel make it possible to blend lower value material, such as light cycle oil (low cetane, high aromatics), into the diesel pool. Diesel blends with up to 60 wt-% LCO still met diesel specifications.

8.4 ECONOMIC EVALUATION

The economics of wax hydrocracking were examined by comparing Internal Rate of Return (IRR) for two upgrading complex flow schemes. The difference between the complex flow schemes is the absence of a hydrocracker in the alternate case.

The returns for the base case (with hydrocracker) are considerably higher. This demonstrates that hydrocracking Fischer-Tropsch wax provides higher returns than blending the wax into a fuel oil stream.

When the value added to an external LCO stream is considered, hydrocracking becomes even more attractive. This blending situation is made possible because of the excellent quality diesel fuel made from Fischer-Tropsch derived hydrocarbons.

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