Task 4.7 - Diesel Fuel Desulfurization

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TASK 4.7 – DIESEL FUEL DESULFURIZATION

1.0 INTRODUCTION

Reductions in the maximum permissible sulfur content of diesel fuel to less than 0.05 wt% will require deep desulfurization technologies to meet these standards. In some refineries, a new hydrogenation catalyst may be required for diesel fuel production.

2.0 OBJECTIVES

Some of the major components of diesel fuel are dibenzothiophenes and its alkyl derivatives. These components are desulfurized by the *Rhodococcus rhodocrous IGTS8* enzymes. But when they are highly diluted with other hydrocarbons in the diesel fuel, will there be enough specificity for their absorption and degradation by the enzyme systems? The extent to which a diesel fuel or middle distillate feed can be desulfurized by desulfurization enzymes will be determined. In addition, the effectiveness of molybdenum sulfide catalysts in removing sulfur from the middle distillate cut will be determined. The catalyst preparation involves creation of the molybdenum sulfide in a highly dispersed form essentially between the layers of a hydrotalcite material, which is then dissolved away to expose the active sites.

3.0 WORK PERFORMED

In the previous period, molybdenum sulfide dispersed on a layered hydrotalcite support was prepared and then used for hydrotreatment of a dibenzothiophene solution in 1-methylnaphthalene as a surrogate for diesel fuel. This preparation gave high conversions of dibenzothiophene to hydrocarbon products. In this period, further investigation of the dispersed molybdenum sulfide was carried out by dissolving the hydrotalcite matrix to form the dispersed molybdenum sulfide.

4.0 RESULTS/CONCLUSIONS

The molybdenum sulfide catalyst was prepared by ion exchange of thiomolybdate anions into the interlayer of the terephthalate form of aluminum–magnesium hydrotalcite, exchanging for some of the terephthalate ions. Heating this material decomposed the thiomolybdate to a molybdenum sulfide and also decomposed the remaining terephthalate to form a carbonaceous deposit in the interlayer. The aluminum–magnesium mixed oxide matrix dissolved in acetic acid. This formed a very fine dispersion of molybdenum sulfide on the carbonaceous material. Use of this material as a catalyst for hydrodesulfurization gave a high conversion of dibenzothiophene to hydrocarbon products (mainly biphenyl and phenylcyclohexane). A similar reaction with molybdenum sulfide prepared by heating ammonium thiomolybdate gave a slightly higher conversion.

5.0 FUTURE WORK

Further work on the nature and the stability of the fine carbon-supported molybdenum sulfide dispersions will be carried out.

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