

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The hydrodesulfurization reaction of thiophene over molybdenum on titania supported catalysts was studied using a differential flow reactor. Activity, selectivity, sulfidation level and surface species were observed. The catalysts were prepared by an impregnation technique and an equilibrium adsorption technique and the molybdenum loadings were 5% and 2.5% respectively. The results indicate that the low loading equilibrium adsorption catalysts have higher activity and selectivity compared to that of impregnation catalysts.

The activity and selectivity of the sulfided catalysts are related to the form of molybdenum oxide on the surface. The low loading equilibrium adsorption catalyst contained both the polymeric molybdate and bulk-like MoO_3 , whereas high loading impregnation catalyst has only bulk-like MoO_3 . It was shown that the sulfided polymeric molybdate converted to the more active surface species compared to the bulk-like MoO_3 . The sulfur to molybdenum atomic ratio of both catalysts was shown to be unity, which confirmed that the activity is dependent on the type of molybdenum oxide species initially on the catalyst.

Increasing thiophene concentrations in the feed decreased the activities and increased the selectivities but did not depend significantly on the sulfidation level. The activities were also affected by the pretreatment conditions. The pre-reduction of catalysts with H₂ gave high activities while selectivities were the same, indicating the same surface sites for both HDS and hydrogenation reactions.

5.2 Recommendations

Sulfidation levels of the catalysts could not be clearly detected in this work due to the limitations of the equipment. However, structures of the surface sulfur are still of interest. Temperature-Programmed Reduction (TPR) and Temperature-Programmed Oxidation (TPO) are recommended for further study. Comparison of presulfidation with hydrogensulfide and direct sulfidation with thiophene would explain more about the formation and stability of the molybdenum-sulfur active sites. Further investigations of active sites for hydrodesulfurization and hydrogenation reactions would also be of interest.