CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

M-Al_2O_3, m-Al_2O_3, and AC impregnated with Cu^+ and Ni^{2+} was investigated to remove dibenzothiophene (DBT) in simulated diesel (80 wt% dodecane + 20 wt% toluene + 150 ppmw S). The adsorbents were prepared by incipient wetness method by using aqueous solution of $CuCl_2$ (very soluble in water) and $NiCl_2$, then followed by a reduction step of Cu^{2+} to Cu^+ by H_2.

For non-impregnated adsorbent, AC had a higher breakthrough capacity (to remove DBT at 0 ppm) than m- Al_2O_3 and M- Al_2O_3, respectively which corresponds to the higher surface area. The breakthrough capacity was greater with the lower feed flow rate (0.4 cm^3/min) to increase the contact time between DBT and the adsorbent, while the optimum temperature is room temperature (30°C). Quite all the breakthrough curves obtained for DBT showed a very broad shape, indicating that strong diffusion limitations seem to occur. An effort will therefore have to be done to optimize the experimental conditions, mainly by increasing the contact time and reducing the particle size of the adsorbent.

For both of Cu^+ and Ni^{2+}, on both alumina, the presence of metal seemed to reduce the breakthrough and adsorption capacity, probably by lowering the accessible porosity. The smaller size at diameter 300-500 μm crushed after impregnation of the 100% monolayer of Cu^+/m-Al_2O_3 showed the higher breakthrough than the normal size (extruded length 4 mm), and also higher than the same small size crushed before impregnation. For all among the adsorbents studied, the breakthrough capacity decreased in order of 43 wt% of Cu^+/AC > AC > 100% monolayer of Cu^+/m-Al_2O_3 (300-500 μm crushed after impregnation) > non-impregnated m-Al_2O_3 > 50% monolayer of Ni^{2+} /m-Al_2O_3. From these experiments, one can think that the amount of metal within the porosity of the solid is too high, therefore additional experiments with lower metal loadings will have to be carried out.

5.2 Recommendations

Several recommendations for future work can be offered. As the breakthrough capacity seems to be decreased when the amount of metal increased, it is possible that the theoretical monolayer coverage resulted in too much metal deposit, so it will be interesting to study the effect of a lower amount of metal loading than a 50% theoretical monolayer coverage to avoid pore blocking.

To avoid the diffusion limitation occurring in liquid phase, it will be necessary to increase the contact time by using static experiments, as well as gas phase adsorption experiments with smaller S-compound, like thiophene.

Further characterization by Thermogravimetric Analysis (TGA) experiments, to study desorption of S-compound by comparison with the raw non impregnated solids, as well as SEM, could be performed to lead to a better understanding of the phenomena.