# CHAPTER V
# CONCLUSIONS AND RECOMMENDATIONS

## 5.1 Conclusions

Pillared hydrotalcite-typed clays were studied here as catalysts for selective catalytic reduction of NO by ammonia in excess oxygen. They showed only moderate activities of around 70% NO conversion at 350°C. Mo-V-clay had the highest NO conversion of 75%, however it gave only 9% $N_2$ selectivity. When iron was loaded on the catalysts by either ion exchange or impregnation methods, NO reduction decreased significantly possibly dues to the double calcination of catalysts or pore blocking by Fe. However, in contrast, 100% $N_2$ selectivity was achieved using Fe-loaded catalysts. Additionally, loading Fe by ion exchange method is better than that by impregnation method in terms of NO conversion. It was evident that iron loaded on pillared hydrotalcite-typed clay played an important role in high selectivity to produce large amount of $N_2$ The product selectivity towards $N_2$ of the Fe-loaded catalysts at 350 °C was also higher than that for the $V_2O_5/WO_3$ commercial catalyst when tested at same conditions. For $Fe^{3+}$ ion-exchanged catalysts, they have higher NO conversion than Fe-impregnated catalysts. Because iron could exchange with cations in hydrotalcite-typed clay mainly $H^+$, and also $Al^{3+}$ and $Mg^{2+}$ in clay sheets. For Fe-impregnated catalysts, iron could block some of the pores in the catalysts, resulting in lower surface area of the catalysts. That may be the reason that $Fe^{3+}$ ion-exchanged catalysts showed higher NO activities than Fe-impregnated catalysts.

## 5.2 Recommendations

From XRD results, the structure of all pillared hydrotalcite-typed clays was collapsed after calcined at temperatures higher than 350°C. The collapse led to the decrease of their surface areas, which played an important role in selective catalytic reduction reaction. It is necessary to maintain the clay structure when running reaction. Thus, for future work, intercalating of an inorganic compound such as $TiO_2$

in order to sustain the clay sheets would improve the NO reduction activities of all clays. $TiO_2$ itself has been widely used as a pillaring agent, and do not interfere the activity on selective catalytic reduction. Moreover, for experimental parameters, it is recommended that the effect of water vapor and $SO_2$ should be examined, because most NO effluent streams normally have these two components. Another recommendation is that it is interesting to apply the TA-clay catalysts to $NO_x$ storage catalytic reduction because they had high NO adsorption capacity. Therefore, if their structures could be sustained and improved, they might promote significant higher NO conversion and $N_2$ selectivity.