CHAPTER FIVE

Conclusion

5.1 CONCLUSION

Complexes of chromium(III) acetate, iron(III) acetate, chromium(III)-iron(III) acetate and chromium(III) benzoate were successfully synthesized. The highest yield was obtained from the combination of metal salt and carboxylic acid at molar ratio 1:7. The colour of the Cr-only and Cr-Fe complexes ranged from green to red; **CI[1]** and **CI[5]** were green, **CI[2]** was dark purple, **CI[3]** was reddish purple and **CI[4]** was red. All complexes were found to dissolve in methanol, ethanol and water, but not in toluene and chloroform. The complexes have the formula $[M_3O(RCOO)_6.3H_2O]^+$. From UV-spectrometric and X-ray crystallographic analyses, the complexes were found to form a distorted octahedral geometry.

CI[1], **CI[2]**, **CI[3]**, **CI[4]** and **CI[5]** complexes were used as catalysts in combination with co-catalysts, $AlEt_2Cl$, for the polymerization of ethylene. The optimum Al/Cr molar ratio that gave the highest catalytic activity at 30^{o}C for each complex was **CI[1]** = 26.2, **CI[2]** = 23, **CI[3]** = 28.5 and **CI[5]** = 36.4. The kinetic curve for the polymerization of ethylene was the decaying type and was found to be a first order reaction. The sequence of catalytic activity arranged from the highest to the lowest are **CI[5]** > **CI[1]** > **CI[2]** > **CI[3]**. **CI[4]** does not show any catalytic activity in the polymerization of ethylene. The PE produced from the polymerization was a high-density polyethylene (HDPE). Based on DSC analysis, ΔH_m, ΔH_c and the percentage of crystallinity for PE were found to increase as the Al/Cr molar ratio increased. Meanwhile, ΔH_m and ΔH_c and the percentage of crystallinity for PE was decreased from

PE-**CI[5]** > PE-**CI[1]** > PE-**CI[2]** > PE-**CI[3]** as the amount of Cr metal in complexes were decreased.

The polymerization of ethylene-SMRCV showed the same kinetic properties as the polymerization of ethylene i.e. the decaying type. The maximum initial catalytic activity of polymerization was decreased as amount of SMRCV increased. The polymers were thermally stable up to ~180^{o}C but the decomposition range was increased as the amount of SMRCV increased. However, the percentages of crystallinity of polymers were decreased as the higher amount of SMRCV were added.

5.2 SUGGESTIONS FOR FUTURE STUDY

The study was successfully achieved nevertheless some interesting parts can be further investigated to intensify the topic. The catalytic activity of the complex may be expanded by preparing a complex containing more Cr(III) metals such as four or five, instead of three Cr(III) metals in a complex. This study has shown that more Cr-content in the catalyst can lead to increase in the catalytic activity. The mixed-metal complex can be prepared by combining with other transition metals such as cobalt, manganese, vanadium, molybdenum and many more to study their catalytic activity. Moreover, the introduction of the electron withdrawing group to the ligand can improve the catalyst activities.

The polymerization of ethylene may be performed by using support such as $MgCl_2$, silica or alumina to improve the catalytic activity. Graft copolymer also can be applied to modify the properties of PE by using some monomers such as MMA or styrene. Furthermore, the characterization of polymer can be enhanced by analysing the polymer using high temperature GPC for molecular weight determination and SEM for the surface morphology of polymer. Moreover, NMR-spectroscopy can be used to analyse the PE by dissolving in dichlorobenzene at 120^{o}C temperature.