CHAPTER VI
CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

Na-bentonite was treated with quaternary alkyl ammonium cation, Stepantex^{TM} SP-90, which is surfactant by ion exchange reaction; and 3-aminopropyltrimethoxysilane was also added to act as surface treatment. This organomodified bentonite was characterized using XRD and FT-IR. The d-spacing of organomodified bentonite increases when the surfactant was added and the C=O bond and $-CH_2$ of surfactant occurred at 1740 and 2921 cm^{-1}. From these result, they are indicated that the surfactant can be incorporated in the bentonite to ensuring that organomodified bentonite is obtained.

When the organomodified bentonite was incorporated with polypropylene to fabricate the active packaging film by varying the content of organomodified bentonite in the film. Increasing the percent of organoclay content can improve the degradation temperature, melting temperature and percent crystallization. Moreover, the addition of organomodified bentonite into PP can improve the Young's modulus of the films when increasing the organomodified bentonite content, however, stress at break and elongation at break decrease. When increases the organomodified bentonite content in the packaging film system, the agglomeration occurred as shown in the SEM images. These agglomeration is the main factor to reduce the tensile properties of the films. The oxygen permeability also reduces when increasing the organomodified bentonite content.

In addition, aluminum hydroxide and calcium hydroxide can enhance ethylene and carbon dioxide removal capacity, respectively, organobentonite and aluminum hydroxide/calcium hydroxide were incorporated into polypropylene with a compatibilizer (Surlyn® ionomer) in a twin screw extruder and fabricated into films by the blow film extrusion process to obtain ethylene/carbon dioxide scavenger active packaging films. The addition of aluminum or calcium hydroxide into PP increased % crystallinity, melting temperature and crystallization temperature of PP. These are the result from the organomodified bentonite that act as nucleating agent for crystallization of PP matrix. However, the crystal structure of PP was not affected by the existence of organomodified bentonite. For mechanical properties of the filme, Young's modulus was increased when add organoclay, but stress at break and elongation at break of the active packaging films were reduced when compare with traditional PP. These due to the agglomeration of organomodified bentonite inside PP matrix. The oxygen permeability decreases when increasing the content of organoclay and gas scavenger compounds. These results indicated that PP/ organomodified bentonite nanocomposite film can be used as ethylene/carbondioxide scavenger active packaging film to extend the self life of fresh fruits and vegetables.

6.2 Recommendations

Base on what have been discovered in this study, the following recommendations are suggested.

(1) Na-bentonite should be purified before organomodification to remove some impurity.

(2) The other surfactants which are used with clay should be concerned.

(3) Further studies on the processing conditions such as speed of twin screw extruder should be studied to investigate the affect on dispersion and appearance of organomodified bentonite on PP.

(4) The other factors should be studied to improve the quality of packaging such as humidity, anount of oxygen, temperature, etc.

(5) The various types of fresh fruits and vegetables should be focus for further study.

(6) The other ethylene scavenger compounds should be studied to enhance ethylene scavenger capacity of PP/organomodified bentonite active packaging film.