CHAPTER VI
CONCLUSIONS

6.1 Effects of Different Nucleating Agents on Crystallization and Melting Behavior and Mechanical Properties of Nucleated sPP

The effects of various inorganic and organic nucleating agents [e.g. 1,3:2,4-dibenzylidene sorbitol (DBS), 1,3:2,4-di-*p*-methyldibenzilidene sorbitol (MDBS), 1,3:2,4-di-*m*,*p*-methylbenzylidene sorbitol (DMDBS), kaolin, talcum, marl, titanium dioxide (TiO_2), and silica (SiO_2)] on non-isothermal melt-crystallization and subsequent melting behavior and mechanical properties of nucleated syndiotactic polypropylene (sPP) in comparison with those of the neat sample were investigated and reported for the first time. Based on the values of the temperature at 1% relative crystallinity, the ability for these fillers in nucleating sPP could be ranked from the best to the worst as follows: DBS > talcum > MDBS > kaolin > SiO_2 > DMDBS > marl > TiO_2. Qualitatively, DBS was able to shift the onset of the crystallization process of sPP by ca. 18°C, while TiO_2 was able to do so by only ca. 6°C. Most of the sPP compounds exhibited double melting peaks, while only sPP filled with marl exhibited triple melting peaks. Based on the values of the low-temperature melting endotherm, the stability of the primary crystals for all of the sample types investigated can be ranked from the best to the worst in the following order: DBS-filled > talcum-filled > MDBS-filled ~ DMDBS-filled ~ kaolin-filled > SiO_2-filled > marl-filled > TiO_2-filled > neat sPP samples. Wide-angle X-ray diffraction analysis revealed that addition of these fillers did not affect the modification of the sPP crystals. Mechanical property measurements revealed that both of the tensile strength and the percentage of elongation at yield for sPP compounds investigated were not much different from those of the neat sPP. After natural weathering for 1 month, the tensile strength at yield for sPP compounds investigated increased, at the expense of the percentage of elongation at yield, but, after natural weather for 3 months, both of the tensile strength and the percentage of elongation at yield were found to decrease.

6.2 Non-isothermal Melt-Crystallization Kinetics of sPP Filled with Various Nucleating Agents

The kinetics of non-isothermal melt-crystallization of syndiotactic polypropylene (sPP) compounded with 5 percent by weight (wt.%) of some inorganic fillers [i.e. kaolin, talcum, marl, titanium dioxide (TiO_2), and silicon dioxide (SiO_2)] and 1 wt.% of some organic fillers, which are some sorbital derivatives (i.e. DBS, MDBS, and DMDBS) was investigated and reported for the first time. The non-isothermal melt-crystallization trace for each sample type became wider and shifted towards lower temperatures with increasing cooling rate used. Comparison among the non-isothermal melt-crystallization traces for all of the sample types investigated at a fixed cooling rate of 10°C/min revealed that DBS was the best, while TiO_2 was the worst, nucleating agent for sPP. Careful analysis of the onset temperature shift (i.e. $\Delta T_{0.01}$) suggested the ability for these fillers to nucleate sPP in the following order: DBS > talcum > MDBS > SiO_2 ~ kaolin ~ DMDBS > marl > TiO_2, with DBS being able to shift the crystallization exotherm by ca. 18°C on average, while TiO_2 being able to shift the crystallization exotherm by only ca. 6°C on average, from that of neat sPP. The Avrami analysis revealed the Avrami exponent for sPP compounds being in the range of 2.9 to 4.3, with the values for neat sPP being in the range of 3.1 to 6.8. Lastly, the Ziabicki's crystallizability of sPP compounds was found to range between 0.93 and 1.00 which was greater than that of neat sPP, suggesting the enhancement in the crystallization ability of sPP with addition of these fillers.