

CHAPTER V

CONCLUSIONS AND RECOMMENDATION

The non-isothermal melt and cold crystallization kinetics of PHB and its blends for eight different cooling rates were investigated. It can be seen that the temperature at 1% relative crystallinity, the temperature at the maximum crystallization rate and the temperature at 99% relative crystallinity were all shifted to lower temperatures for melt crystallization and shifted to higher temperatures for cold-crystallization by increasing the cooling rates for all compositions.

On the other hand, for both melt and cold crystallization, the apparent incubation period, the crystallization time at different relative crystallinity values and the apparent total crystallization period showed a linear relationship with the cooling rate in log-log plots, with all the plots show a similar trend and slope.

The Avrami and Tobin models could describe the crystallization of PHB and its blends well, with the Avrami model showed a better trend. Both the Avrami and Tobin crystallization rate constants increased by increasing the cooling rate.

The Ozawa model also could predict the crystallization data of PHB and its blends fairly well. For non-isothermal melt-crystallization, the Ozawa exponent showed a little increase while the Ozawa crystallization rate constant showed a decreasing function with temperature. For non-isothermal cold-crystallization, the Ozawa crystallization rate constant was an increasing function of temperature.

Lastly, the effective energy barrier of non-isothermal melt-crystallization, increased by increasing the relative crystallinity values while for non-isothermal cold-crystallization, it showed a decreasing function.

In the isothermal part, crystallization behaviors and morphologies of PHB and its blends have been investigated. From DSC measurement, PHB/PLA blends are miscible in amorphous state for composition range studied based on single T_g of these blends.

The subsequent melting exotherms for all the blends exhibited double exothermic melting phenomena. The occurrence of the first peaks was a result of the melting of the primary crystallites and the second ones were the result of the melting

of the recrystallized crystallites of different stabilities. By increasing T_c , there is a really small shift of the peak to a higher temperature for all blends. The position of the melting peaks for all the compositions are in higher temperatures in comparison to neat PHB. However, the compositions of the blends do not have obvious affect on the peaks at the same range of crystallization temperatures.

All of the overall crystallization rate parameters for all models which were studied, were found not to have significant change in the crystallization temperature, although there were a little increases with decreasing the crystallization temperatures (or with increasing degree of undercooling). It can be said that all blends crystallized at low temperature faster than that at high temperatures. Considering at the same T_c , all the values decrease by increasing the content of PLA and the amount for PHB97.5/PLA2.5 which were the highest. So, PHB97.5/PLA2.5 crystallized the fastest followed PHB, PHB95/PLA5, PHB92.5/PLA7.5 and PHB90/PLA10.

From PLM measurement, linear growth rate of PHB and its blends were measured in the temperature range studied. The spherulite growth rate decreased with increasing the crystallization temperature T_c for all compositions. At the same T_c , the trend is similar to analyzing the overall kinetics parameters.

The kinetics parameters showed regime II for all compounds for crystallization range studied.

The recommendations for this work is studying about different system of blends and study about the range that this system is not miscible