KINETIC STUDY OF THE CRYSTALLIZATION OF LLDPE AND WAX IN LLDPE/WAX PHASE-CHANGE BLENDS USED FOR THERMAL ENERGY STORAGE

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ABSTRACT

The purpose of this research is to study self-nucleation (SN), SSA thermal fractionation, isothermal crystallization kinetics and the morphology of each of the constituents of LLDPE/wax blends as a function of composition. Wax is a phase change material (PCM) which stores and releases energy through melting and solidification. SN was performed in order to determine the ideal self-nucleation temperature ($T_{s(ideal)}$) for thermal fractionation, which is the temperature that causes maximum SN without any annealing. It was performed on pure LLDPE, since this is the blend component that melts at a higher temperature (T_m = 124 °C). For this particular LLDPE $T_{s(ideal)}$ was 123 °C. Thermal fractionation was performed using successive self-nucleation and annealing (SSA) in order to observe whether there is possible co-crystallization or phase segregation between the components in the blend. SSA is very sensitive to branches or any other defect that interrupts the methylene linear sequence which crystallizes. The alpha olefin in LLDPE is a defect since it introduces a branch point, and we observed several melting peaks after thermal fractionation. Soft paraffin wax is made of a polydisperse collection of linear chains. It is not sensitive to fractionation, since the technique and especially the fractionation conditions are rather insensitive to molecular weight differences. This is an indication that soft paraffin wax is essentially linear and is not susceptible to thermal fractionation. The results obtained by SSA indicate that the wax acts as a solvent for LLDPE inducing a 'dilution effect' without co-crystallization. This presentation will further report on the results of the isothermal crystallization kinetics and morphology studies of this system.