THERMAL STABILIZATION, ENHANCED PROCESSABILITY AND PROPERTIES OF BIODEGRADABLE POLYMERS

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The use of biodegradable polymers, which are based on aliphatic polyesters, is limited due to its thermal degradation and low crystallization rate during melt processing and low toughness following solidification to room temperature. To remedy these shortcomings the effects of hyperbranched polyesters (HBP) and plasticizers were studies in the case of the biodegradable poly (hydroxyalkaonoates) (PHA). Experimental results have shown that a synergistic effect takes place when a liquid HBP has been combined with a plasticizer based on citrate oil (CO) having a combined content of only 5%. In the optimized case the molecular weight of the processed PHA containing the HBP and the CO increased by close to 20% compared to the processed neat PHA. This was attributed to the reduction in viscous heating of the composite phase separated melt. Furthermore, the crystallization rate constant increased by 200 fold while the total crystallinity was raised from 20% for the neat PHA to 40% of the composite PHA and the crystallization temperature increased from 65 to 90oC, respectively. This was attributed to heterogeneous nucleation of the HBP and CO phase. As for the mechanical properties the elongation to break was enhanced from the low level of 12% for the neat PHA to the level of 26% in the case of the composite PHA. This increase in toughness was accompanied with a moderate decrease of the modulus from 740MPa to 570MPa. The formation of a separated phase containing HBP and CO and its effect on the plasticization, nucleation and mechanical properties was studied and verified by scanning electron microscopy (SEM).