INJECTED NANOCOMPOSITES OF THERMOPLASTIC STARCH AND POLY (BUTYLENE SUCCINATE) BLENDS WITH CELLULOSE NANOCRYSTALS

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Abstract: Thermoplastic starch (TPS) is one of the most attractive biodegradable materials, which cheapen blends with others biodegradable polymers like poly(butylene succinate) (PBS). However, TPS decreases the final properties of blends. One way to overcome this drawback is reinforced TPS phase with cellulose nanofibers. Therefore, this work aims to investigate the potential of using cellulose nanocrystals (CNCs) in TPS/PBS 50/50 w/w blends. The following injected formulations were prepared by twin-screw extrusion: neat PBS; PBS/TPS 0 wt%; 2 wt%; 4 wt% and 6 wt% CNCs added in TPS phase. The addition of CNCs increased the impact resistance by almost three times (reaching 100 J / m) and the elongation at break by 7% (reaching 28%). The storage modulus (E') and the Youngs modulus decreases with addition of more than 4 wt% CNCs, indicating a possible interaction of CNCs to TPS molecules. DSC curves showed that CNCs in TPS phase increased the crystallinity index of PBS, indicating a possible CNCs migration to PBS / TPS interface, acting on crystallization kinetics of PBS. DMTA diagrams indicate an approximation of glass transition temperatures (Tgs) of PBS and TPS, creating the hypothesis of CNCs migration to PBS / TPS interface promoted a certain degree of interaction between TPS and PBS molecules. PBS / TPS without CNCs presented PBS and TPS continuous phases microstructures, while PBS / TPS with CNCs showed PBS and TPS phases in droplet format, as observed by SEM micrographs. The thermal degradation temperature of PBS/TPS blends decreased with addition of CNCs due to the lower thermal degradation of CNCs reported in the literature. This study concluded that CNCs in TPS phase act on final properties of PBS / TPS blends due to hypothetical CNCs migration to PBS / TPS interface, CNCs interaction to TPS molecules and the thermal properties of CNCs.

Keywords: Thermoplastic starch, poly(butylene succinate), cellulose nanocrystals, injected blends.