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Gamma Irradiation as a Compatibilization Tool for PLA/PBAT Blends Reinforced with Nanocellulose

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Resumo:
PLA/PBAT (polylactic acid/polybutylene adipate-co-terephthalate) blends are promising bioplastics to replace petroleum-based polymers. Despite PLA's strength, its brittleness limits its applications. On the other hand, PBAT offers ductility and impact resistance. However, poor interfacial adhesion makes PLA/PBAT blends immiscible. This study investigates the effect of gamma irradiation on the physicochemical and performance properties of PLA/PBAT blends reinforced with nanocellulose (NC). PLA samples were previously irradiated with gamma radiation doses of 0, 80, 100, 120, and 150 kGy. PLA/PBAT (50/50) blends were prepared by extrusion and injection, in which NC was incorporated into the blends at different concentrations (0, 1, and 3%). The properties evaluated include: crystallinity, morphology, thermal properties, mechanical properties, and biodegradability. Gamma irradiation slightly increased the crystallinity of PLA and blends, according to DSC and XRD analyzes. TGA analyzes showed that as the absorbed dose of gamma radiation increases, the thermal stability of the material decreases. SEM analysis revealed

that PLA irradiation promoted more homogeneous PLA/PBAT blends, indicating higher compatibility for blends subjected to absorbed doses above 100 kGy. And with the addition of 1 and 3% of NC, there was no change in the interface by SEM, remaining more homogeneous as the irradiation dose was increased. Gamma irradiation reduced the tensile strength of the irradiated blends by an average of 33% due to PLA scission, however, a recovery of this loss was evidenced for irradiation doses above 100 kGy. The addition of NC improved the mechanical properties of the blends, in which with only 1% of NC added, the irradiated samples reduced only 29% on average of the tensile strength. PLA/PBAT blends are biodegradable and compostable, which means they can be decomposed by microorganisms in natural environments, reducing environmental impact. Gamma irradiation and NC can be used to improve the properties of PLA/PBAT blends. NC acts as a reinforcing agent, while gamma irradiation, despite promoting a reduction in tensile strength, presents itself as a promising tool to compatibilize PLA/PBAT blends, improving homogeneity and interfacial adhesion between polymers.