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Abstract

Valorization of Medical Gauze Waste into Sustainable PLA/Cellulose Fiber Composites †

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The main objective of using natural fibers as a reinforcement phase in composites is to improve the mechanical properties and production of lightweight materials. Moreover, their biodegradability, renewability, nontoxicity, and abundance in nature make natural fibers ideal for use in composites. The valorization of biomass is one of the important ways we can control the consumption of non-renewable resources. Also, biocomposites have gained considerable academic and industrial attention due to their improved properties (thermal, mechanical and barrier, as well as fire resistance) compared to virgin polymer. The effects of properties as a result of the presence of fillers include an increase in Young's modulus and yield strength, a decrease in gas permeability, an increase in thermal resistance, and an increase in biodegradability rates. Integrating cellulose fibers into PLA enables the development of advanced composites that exhibit notable improvements in mechanical strength, thermal stability, barrier performance, and overall sustainability.

The present work consists of extracting cellulose fibers from gauze strips (F-BG) for the production of PLA/F-BG biocomposites. The improvement of the compatibility of PLA and cellulose fibers was achieved by adding a synthesized compatibilizer (PLA-g-MA). The fiber loading in PLA/F-BG composites varied between 1% and 3%. Rheological analysis indicated that the incorporation of F-BG fibers led to a reduction in the melt flow index, with a more pronounced decrease observed as the PLA-g-AM content increased. Moreover, mechanical characterization through impact and flexural tests showed that impact resistance decreased with higher F-BG content. However, the addition of F-BG significantly enhanced the flexural strength and elastic modulus of the composites.

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