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Thermoplastic starch reinforced with short sisal fibers

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Thermoplastic starch (TPS) is a renewable and biodegradable material that aligns with the current sustainable trend. However, it is crucial to enhance the mechanical properties of TPS-based materials to replace materials derived from fossil sources with TPS [1]. The present study aims to investigate the impact of reinforcing TPS (Mater-Bi EI51NO) using short sisal fibers (2mm) on its properties. To achieve this, TPS mixed with sisal fibers was processed using a Gelimat machine at 130-150°C temperature and then through an injector. The injector was operated at various temperatures (120, 125, 130, 135, and 145°C) with a flow of 8.0 cm3/s and a pressure range of 300-500 bars. Here, results of flexural properties are reported specifically. The study found that adding fibers to TPS increased its flexural strength. Specifically, the strength increased by approximately 63%, 83%, and 106% when 20wt%, 30wt%, and 40wt% of fibers were added, respectively. However, when 50wt% of fiber was used, the strength decreased compared to 40wt% fiber, from 106% to 71%. From 50% onwards, the dispersion of fibers within the material will probably become more difficult, favoring agglomerations, which can negatively impact flexural strength. Adding 20wt%, 30wt%, 40wt%, and 50wt% of fibers increased the flexural modulus; at 50wt%, there was no significant change compared to 40wt%. The deformation decreased as the fiber percentage increased, with a reduction of about 180% at 40wt% and 50wt%. The addition of fibers increased the material's stiffness, resulting in greater resistance to deformation. Highly renewable TPS matrix composites were successfully produced, exhibiting good flexural properties. This is an ongoing study. Following the flexural tests, impact and tensile strength tests will be carried out.

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[1] M. Dammak et al, Industrial Crops and Products vol. 144, page 112061 (2020)