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Study of the incorporation and behavior of regenerated cellulose in various formulations involving thermoplastic starch for the production of composites

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Keywords: *Cellulose, Starch, Composites.*

Highlights

Developed composites using thermoplastic starch (TPS) and regenerated cellulose.

Explored multilayer composites with improved mechanical properties.

Investigated extrusion and thermo-compression methods for composite production.

Enhanced tensile strength and elastic modulus in multilayer composites.

Analyzed morphological, thermal, and mechanical properties of composites.

Suggested future research for renewable material development.

Resumo/Abstract

This study focuses on the development of composites based on thermoplastic starch (TPS) and regenerated cellulose, exploring their integration in various formulations. The research was divided into three main stages. In Stage I, regenerated cellulose spheres were produced, immersed in a glycerol solution for plasticization, forming a homogeneous structure with a diameter variation of 0.2 mm after glycerol addition. In Stage II, composites were developed using an extrusion process with a TPS matrix and regenerated cellulose reinforcements. Optical microscopy revealed that although the cellulose spheres adhered to the TPS, there was no homogeneous mixing of the materials. In Stage III, multilayer composites were fabricated by thermo-compression, combining TPS films intercalated with layers of plasticized regenerated cellulose. This approach resulted in significant improvements in mechanical properties, such as an increase in tensile strength from 1.7 to 4.6 MPa and an increase in elastic modulus from 3.5 to 19.7 MPa, although there was a reduction in elongation at break from 92% to 51.5%. The characterization of the composites was carried out using various techniques, such as morphological and thermogravimetric analyses and tensile tests, which highlighted improvements, especially in the multilayer composites. These composites exhibited better adhesion through physical interactions between the layers and superior mechanical properties. The study suggests that enhancing production methodologies and incorporating additional characterization techniques, such as contact angle and moisture absorption analysis, could strengthen observations and guide future research toward the development of materials based on renewable sources, such as TPS and regenerated cellulose.

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