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Lignocellulosic hydrogel from the deconstruction of sisal fibers by bis(ethylenediamine)copper(II) hydroxide

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Bis(ethylenediamine)copper(II) hydroxide solution (CUEN) was used to deconstruct sisal fibers and create hydrogels from their macromolecular components. The deconstruction of sisal fiber in CUEN 1M was done by mixing 1 or 2 g of ground sisal fiber in 25 mL of distilled water and then adding 25 mL of CUEN. The solvent could dissolve cellulose and hemicelluloses, while lignin remained suspended in the medium. The viscous solutions were added to cylindrical templates immersed in a distilled water bath until the complete hydrogel formation by phase inversion. The hydrogels were named Sisal_{1hydro} or Sisal_{2hydro} according to the initial biomass amount. The hydrogels were characterized by scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR), compressive properties, and swellability. FTIR analysis confirmed the presence of functional groups typical of cellulose, hemicelluloses, and lignin in both hydrogels. SEM images show that the lower biomass amount (Sisal_{1hydro}) generates smaller pores and higher porosity in the hydrogels. Young's modulus of the hydrogels was 30 KPa and 62 KPa for Sisal_{1hydro} and Sisal_{2hydro}, respectively, indicating the direct effect of the hydrogel density in the compression properties. Sisal_{2hydro}'s superior performance can be attributed to its higher amount of lignin acting as a reinforcement than Sisal_{1hydro}. The water sorption content was 5076 % and 2686 % for Sisal_{1hydro} and Sisal_{2hydro}, respectively, indicating that the presence of a greater amount of the hydrophobic lignin in Sisal_{2hydro} negatively impacted this property. The hydrogels derived from the disintegration of lignocellulosic sisal fibers exhibited high water absorption and showed great potential as sustainable alternatives to petroleum-based hydrogels in various applications. They can offer a promising solution for the development of materials that are both cost-effective and performance-efficient.

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