World Academy of Science, Engineering and Technology
International Journal of Chemical and Materials Engineering
Vol:18, No:02, 2024

Cellulose Nanocrystals from Melon Plant Residues: A Sustainable and Renewable Source

Authors : Asiya Rezzouq, Mehdi El Bouchti, Omar Cherkaoui, Sanaa Majid, Souad Zyade

Abstract : In recent years, there has been a steady increase in the exploration of new renewable and non-conventional sources for the production of biodegradable nanomaterials. Nature harbours valuable cellulose-rich materials that have so far been under-exploited and can be used to create cellulose derivatives such as cellulose microfibres (CMFs) and cellulose nanocrystals (CNCs). These unconventional sources have considerable potential as alternatives to conventional sources such as wood and cotton. By using agricultural waste to produce these cellulose derivatives, we are responding to the global call for sustainable solutions to environmental and economic challenges. Responsible management of agricultural waste is increasingly crucial to reducing the environmental consequences of its disposal, including soil and water pollution, while making efficient use of these untapped resources. In this study, the main objective was to extract cellulose nanocrystals (CNC) from melon plant residues using methods that are both efficient and sustainable. To achieve this high-quality extraction, we followed a well-defined protocol involving several key steps: pre-treatment of the residues by grinding, filtration and chemical purification to obtain high-quality (CMF) with a yield of 52% relative to the initial mass of the melon plant residue. Acid hydrolysis was then carried out using phosphoric acid and sulphuric acid to convert (CMF) into cellulose nanocrystals. The extracted cellulose nanocrystals were subjected to in-depth characterization using advanced techniques such as transmission electron microscopy (TEM), thermogravimetric analysis (TGA), Fourier transform infrared spectroscopy (FTIR) and X-ray diffraction. The resulting cellulose nanocrystals have exceptional properties, including a large specific surface area, high thermal stability and high mechanical strength, making them suitable for a variety of applications, including as reinforcements for composite materials. In summary, the study highlights the potential for recovering agricultural melon waste to produce high-quality cellulose nanocrystals with promising applications in industry, nanotechnology, and biotechnology, thereby contributing to environmental and economic sustainability.

Keywords : cellulose, melon plant residues, cellulose nanocrystals, properties, applications, composite materials
Conference Title : ICP 2024 : International Conference on Polymer
Conference Location : Paris, France
Conference Dates : February 19-20, 2024