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Respirometric Evaluation of Biodegradability of PLA/Micronized Cellulose Composite Pellets

Abstract: Polylactic acid (PLA) is a biodegradable thermoplastic biopolymer of natural origin, widely used due to its origin from renewable sources, such as corn starch or sugar cane. The incorporation of micronized cellulose (MC) in PLA enhances its mechanical properties in addition to improving the thermal characteristics and microbiological degradation of the composite. The respirometric assessment of the biodegradability of the PLA and MC composite is a crucial study to understand the environmental potential of these materials. The PLA/MC pellets were characterized in terms of heavy metal contamination by Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-OES), Total Organic Carbon (TOC) according to ISO 10694, and Fourier Transform Infrared Spectroscopy Attenuated Total Reflectence (FTIR-ATR). The material under study was buried in soil for 120 days to evaluate its biodegradability using a respirometric method according to ISO 14855-1, which consists of measuring the production of carbon dioxide (CO2) during the aerobic microbiological degradation of the composite in controlled temperature, pH and humidity conditions. The control reference used was microcrystalline cellulose (MCC) with a particle size of 20 µm. The heavy metals quantification indicates that they are under the limits imposed by the European Union (EU), acording to standards EN 13432, EN 14995 and ISO 18602. The respirometry test was considered valid because both checking points were positive, 70% of the MCC reference biodegradability was achieved after 45 days of testing and on this date the sample already showed 30% biodegradability. This study is a step forward in the developement of sustainable materials, contributing to reduce the environmental impact caused by conventional plastics and promoting a circular economy approach.

Keywords: Biodegradability, Cellulose, Composite, PLA, Respirometry, Sustainability

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