
**Área: ANA**

# Biochar: Transforming Tannery Waste into a Sustainable Product

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## Highlights

Pyrolysis of tannery sludge yields biochar with promising carbon purity for electrocatalysis and sustainable hydrogen peroxide production.

## Resumo/Abstract

The continuous increase in industrial waste generation, particularly tannery sludge, demands innovative strategies to mitigate environmental burdens while advancing circular economic practices. In this study, tannery sludge was investigated as a precursor to produce high-value carbon-based materials through pyrolysis at 800 °C under $N_2$ atmosphere. Four distinct biochar samples, derived from different stages of the tanning disposal process, were synthesized and characterized by Fourier Transform Infrared Spectroscopy (FT-IR), Scanning Electron Microscopy (SEM), and Thermogravimetric Analysis (TGA). The main objective was to assess the feasibility of extracting high-purity carbon suitable for advanced technological applications, particularly in electrocatalysis. SEM analysis revealed sheet-like lamellar morphologies, composed of irregular micrometric aggregates with interparticle porosity and non-uniform cracks, indicative of a turbostratic carbon arrangement. FT-IR confirmed the hybrid nature of the samples, identifying condensed aromatic carbon backbones (~1600 $cm^{-1}$), oxygenated functional groups, and a substantial inorganic fraction (intense bands below 1200 $cm^{-1}$) [1]. TGA under oxidizing conditions proved crucial for evaluating oxidative stability and ash content. Biochar 1, 2, and 3 exhibited high thermal stability but retained elevated residual mass (~80–85%), consistent with significant inorganic ash content (Ca, Na) [2,3]. In contrast, Biochar 4 displayed lower oxidative stability but yielded the smallest residual mass (~42%), reflecting a reduced load of inorganic impurities. The diminished intensity of mineral-related FT-IR bands further supports Biochar 4 as the most promising precursor for purification. Based on these findings, the next step involves optimizing an acid leaching protocol focused on Biochar 4 to efficiently remove residual inorganic contaminants (Ca, Cr). The production of purified high-value carbon will enable subsequent electrochemical investigations. Future work will explore its performance as a support material for electrocatalysts in the oxygen reduction reaction (ORR), aiming at sustainable hydrogen peroxide generation [4].

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