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# Macaúba Biochar as a Sustainable Adsorbent for Reducing Chemical Oxygen Demand in Brewery Wastewater

**Aline M. Valendorff (PG)[1*], Júlia M. H. Rodrigues (PG)[1], Chalder N. Nunes (PQ)[1], Liliane S. de Lima[2], Maria L. Felsner[1], Sueli P. Quinaia (PQ)[1].**

**Valendorffa16@gmail.com**

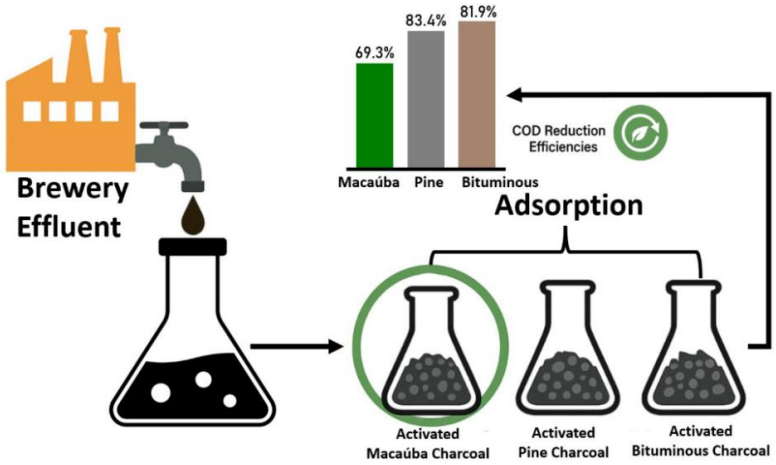
[1]*Departamento de Química, UNICENTRO*
[2]*Alpha Carbo Industrial Ltda., Guarapuava, PR, Brasil*

Palavras Chave: *Macaúba; activated carbon; adsorption; wastewater treatment; sustainability.*

## Highlights

- Brewery effluents have high organic load and COD, requiring efficient and sustainable treatment.
- Activated carbons from macaúba endocarp, pine, and bituminous coal were evaluated as adsorbents.
- A fractional factorial design ($2^{5-2}$) optimized the adsorption parameters.
- Adsorbent mass was identified as the most significant variable affecting COD removal.
- Macaúba charcoal showed consistent results and great potential as a sustainable, low-cost adsorbent.

## Abstract




Beer production generates effluents with high organic load and Chemical Oxygen Demand (COD), requiring efficient treatment before disposal (RICE et al., 2017; Zhang et al., 2013). This study evaluated the adsorption efficiency of activated carbons from macaúba (*Acrocomia aculeata*) endocarp, pine, and bituminous coal in reducing the COD of brewery wastewater collected in Guarapuava, Paraná. The initial COD was 7860 mg $O_2$ $L^{-1}$. A fractional factorial design ($2^{5-2}$) was employed to evaluate the effects of adsorbent mass, pH, contact time, agitation, and temperature. Adsorbent mass was the main factor influencing COD removal. Under optimized conditions, COD reductions reached 83.8% (pine), 81.9% (bituminous), and 69.3% (macaúba). Although slightly less efficient, macaúba charcoal demonstrated excellent reproducibility (CV = 2.38%) and low cost, confirming its potential as a sustainable and promising adsorbent for brewery effluent treatment within circular economy principles.

[1] RICE, E. W. *et al. Standard Methods for the Examination of Water and Wastewater*. 23rd ed. Washington, DC: American Public Health Association, 2017.

[2] ZHANG, Y. *et al.* Removal of dyes from aqueous solutions by adsorption onto activated carbon: A review. *Chemical Engineering Journal*, **228**, 1038–1054, 2013.

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