



WATER REUSE QUALITY OBTAINED FROM SUGARCANE VINASSE CLARIFICATION USING NATURAL AND CHEMICAL COAGULANTS

Nathaskia Silva Pereira Nunes¹; Emerson Machado de Carvalho²; Gustavo Graciano Fonseca^{3*}

¹ Federal University of Grande Dourados, Faculty of Biological and Environmental Sciences, Dourados, MS, Brazil

² Federal University of Southern Bahia, Training Center in Techno-Science and Innovation, Ilhéus, BA, Brazil

³ University of Akureyri, Faculty of Natural Resource Sciences, Akureyri, Iceland

E-mail: gustavo@unak.is

This study investigated the effectiveness of different coagulation and flocculation strategies to clarify sugarcane vinasse, aiming to produce a water source suitable for reuse, specifically for microalgae cultivation. Vinasse is a high-strength liquid waste characterized by an intense dark brown color and high organic load, which typically limits light penetration and inhibits biological processes. The clarification process compared the performance of a chemical coagulant, aluminum sulfate ($\text{Al}_2(\text{SO}_4)_3$), against a natural, sustainable alternative, *Moringa oleifera* seed flour. The quality of the treated water was assessed through the reduction of turbidity and the removal of total phenolic compounds. Results indicated that the chemical coagulant $\text{Al}_2(\text{SO}_4)_3$ was highly effective, achieving a turbidity removal of 98.4% and a 68% reduction in phenolic compounds at a concentration of 10 g L⁻¹ and pH 7.0. In comparison, the natural coagulant *M. oleifera* achieved its best performance at a concentration of 2.0 g L⁻¹ and pH 9.0, resulting in 91.3% turbidity removal and 52% phenolic compound reduction. Despite the high efficiency of the chemical treatment, the water clarified with *M. oleifera* demonstrated superior biological quality for subsequent reuse. Microalgae (*Chlorella vulgaris*) cultivation in the vinasse clarified with the natural coagulant showed a significantly higher growth rate (0.370 day⁻¹) and biomass productivity (0.116 g L⁻¹ day⁻¹) compared to the chemically treated vinasse. These findings suggest that while chemical coagulants provide higher mechanical clarification, natural coagulants like *M. oleifera* produce treated water with lower toxicity and better nutrient availability, making it a more viable and sustainable strategy for water reuse in integrated bio-refinery systems.



Keywords: *Water reuse; Sugarcane vinasse; Moringa oleifera; Coagulation-flocculation; Turbidity removal*