Área: ANA

Post-Treatment of Anaerobic Reactor Effluent Using Vertical Flow Wetlands and Slow Filtration for reuse

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Highlights

Vertical flow wetlands at 200 mm·d^{-1} removed up to 97% of BOD, COD, and turbidity, however, dual filtration achieved 99% removal regardless of the applied rate.

Abstract

Population growth, diffuse pollution, and climate change intensify pressure on water resources, making reuse increasingly necessary. In this context, nature-based solutions, such as constructed wetlands (CW), stand out by combining efficiency in wastewater treatment with environmental sustainability[1]. Therefore, the objective of this study was to evaluate the influence of increasing the Hydraulic Loading Rate (HLR) in Vertical Flow Constructed Wetlands (VFCW) associated with double slow filtration in the post-treatment of effluents from Upflow Anaerobic Sludge Blanket (UASB) reactors at the Gertrudes Wastewater Treatment Plant (WWTP) in Ponta Grossa (PR), aiming at their reuse. Two VFCWs were built, filled with layers of gravel and sand and planted with *Juncus* spp., fed with UASB effluent under different hydraulic loading rates (200, 400, and 600 mm·d^{-1}). Influent and effluent samples were collected from the VFCWs and after double filtration (sand, activated carbon, and clinoptilolite). The characterization of raw and treated effluents involved determining physicochemical and microbiological parameters, including biochemical oxygen demand (BOD), chemical oxygen demand (COD), turbidity, total suspended solids (TSS), nitrogen species, total phosphorus, phenols, and thermotolerant coliforms (*Escherichia coli*). The VFCWs showed higher efficiency at an HLR of 200 mm·d^{-1}, with removals of up to 97% BOD, 93% COD, 92% turbidity, 70% TSS, and 62% *E. coli*. A reduction of 36% in total nitrogen and 36% in ammonia was also observed, with an increase in nitrate and nitrite due to nitrification, while total phosphorus was reduced by 14%. At HLRs of 400 and 600 mm·d^{-1}, efficiency decreased, with lower removals of COD, BOD, and turbidity, in addition to increases in nitrate, nitrite, phosphorus, and phenols. Subsequent double filtration enhanced the removal of all parameters regardless of HLR, achieving up to 99.9% removal of total nitrogen, nitrate, nitrite, phosphorus, phenols, and 10^5 CFU 100 mL^{-1} of *Escherichia coli*. This performance is associated with the properties of activated carbon and clinoptilolite, which exhibit high adsorption capacity, large surface area, and microporosity, enabling the retention of organic and inorganic pollutants. It is concluded that the combination of VFCWs and double filtration significantly improved effluent quality, allowing its reuse in non-potable urban, agricultural, forestry, environmental, and industrial applications, in accordance with Paraná State Resolution CERH nº 122/2023, and meets all reuse possibilities except potable use under international legislation EPA/600/R 12/618.

[1] DE CAMPOS, Sandro Xavier; SOTO, Manuel. The Use of Constructed Wetlands to Treat Effluents for Water Reuse. Environments, v. 11, n. 2, p. 35, 2024. Disponível em: https://www.mdpi.com/2076-3298/11/2/35.

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