

# Wastewater Treatment Plant Operation Optimization Towards Energy Efficiency and Reduced Effluent Loading Based on Artificial Neural Network Models

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## ABSTRACT

Traditional wastewater treatment plant operations often face challenges in balancing treatment performance with energy consumption, particularly under dynamic influent conditions. This study presents a novel approach to model wastewater treatment plants by leveraging statistical, data-driven and optimization methods to enhance both classical and recent approaches. Historical operational and influent data from a full-scale plant was used to accurately predicted effluent key performance indicators, such as total suspended solids, total nitrogen, and orthophosphate concentrations with model performance indicators of up to  $R^2=0.99$  and mean absolute percentage error  $<1\%$ . The best performing model was utilized to identify potential operation strategies towards improved energy efficiency and reduced effluent loading. The potential of intelligent modelling tools to facilitate sustainable and effective wastewater treatment plant operation is highlighted by this study.

## KEYWORDS

WWTP, data-driven modelling, ANN, WWTP energy efficiency, reduced effluent loading.

## ACKNOWLEDGMENT

This work was supported by a grant of the Ministry of Research, Innovation and Digitization, CNCS - UEFISCDI, project number PN-IV-P2-2.1-TE-2023-0666, within PNCDI IV.

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