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# AI-DRIVEN OPTIMIZATION OF OXYGEN TRANSFER EFFICIENCY IN SOLID JET AERATION SYSTEMS FOR ENHANCED WASTEWATER TREATMENT

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## Abstract

The present study presents an AI-driven approach to optimize and predict efficiency of transfer of Oxygen (OTE) in solid jet aeration systems with circular apertures, which is crucial for improving the efficiency of treatment processes of wastewater and water. The research examines the influence of key operational parameters, encompassing the numerical count of water jets in single, dual, quadruple, and octuple configurations, varied jet span lengths (170-470 mm), systematically varied discharge levels (1.05-3.04 l/s), and opening areas (49.24-124.03 mm²), based on 320 experimental runs. Advanced soft computing techniques, including Artificial Neural Networks (ANN), Group Method of Data Handling (GMDH), Support Vector Machines Regression (SVMR), and Gaussian Process Regression (GPR), were employed to model and forecast OTE. Among these, the Radial Basis Function model utilizing Gaussian Process Regression (GPR_RBF) proved most effective, achieving a Nash-Sutcliffe Efficiency (NSE) of 0.9987, a Mean Absolute Error (MAE) of 0.1242, a Root Mean Square Error (RMSE) of 0.2305, a Scattering Index (SI) of 0.0390, and a coefficient of correlation (CC) of 0.9994. Sensitivity analysis identified rate of flow discharge (Q) as the most critical factor, with its exclusion resulting in a significant increase in MAE and RMSE to 5.025 and 6.8018, and a drastic reduction in CC to 0.0683. The findings highlight the potential of integrating AI-based models like GPR_RBF into real-time monitoring and control systems, providing a robust framework for optimization of aeration processes in both municipal and industrial wastewater treatment, thereby contributing to sustainable water management.

*Key words:* artificial neural networks, gaussian process regression, oxygen transfer efficiency, soft computing techniques, solid jet aerators

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