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Unveiling AI-Optimized Ofloxacin Removal from Aqueous Solutions through a Redox Process and •OH Radical Incorporating Using ANN, SVR, and GA

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ABSTRACT

Introduction: Advanced reduction/oxidation processes using UV/ZnO/KI have attracted significant attention due to their effectiveness in eliminating various pollutants. This study focuses on modeling and optimizing the degradation of Ofloxacin antibiotic in these processes, using a combination of Artificial Neural Networks (ANN), Support Vector Regression (SVR), and Genetic Algorithm (GA).

Methods and Materials: We investigated various parameters such as Ofloxacin concentration, ZnO and KI quantities, pH levels, and reaction durations in our experimental setup, which provided data for training Artificial Intelligence (AI) models.

Results: The results show that AI-driven optimization accurately predicts and improves Ofloxacin elimination, offering a sustainable water treatment approach. When comparing the models, SVR outperforms ANN in testing, demonstrating significantly reduced errors (MAE: 0.4978, RMSE: 0.6868, MSE: 0.4717) and a higher R^2 score (0.9969), indicating superior predictive accuracy and reliability. On the other hand, during training, ANN exhibits lower errors (MAE: 1.0047, RMSE: 1.2958) and a higher R^2 score (0.9983), suggesting a closer fit to the training dataset but potential overfitting, while SVR shows consistent and generalized performance across test data. The maximum Ofloxacin degradation (99.26% based on Genetic Algorithm (GA)) occurred under conditions of pH 11.68; initial Ofloxacin concentration of 1 mg L-1; reaction time of 29.96 min, and reductant/oxidant ratio of 2.72 (predicted optimal conditions).

Conclusion and Discussion: This underscores the importance of integrating AI and advanced reduction processes for sustainable environmental management.

Keywords: Artificial intelligence, Environment, Ofloxacin,

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