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Prediction of effluent concentration in a wastewater treatment plant using machine learning models

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ABSTRACT

Of growing amount of food waste, the integrated food waste and waste water treatment was regarded as one of the efficient modeling method. However, the load of food waste to the conventional waste treatment process might lead to the high concentration of total nitrogen (T-N) impact on the effluent water quality. The objective of this study is to establish two machine learning models—artificial neural networks (ANNs) and support vector machines (SVMs), in order to predict 1-day interval T-N concentration of effluent from a wastewater treatment plant in Ulsan, Korea. Daily water quality data and meteorological data were used and the performance of both models was evaluated in terms of the coefficient of determination (R^2), Nash–Sutcliff efficiency (NSE), relative efficiency criteria (d_{rel}). Additionally, Latin-Hypercube one-factor-at-a-time (LH-OAT) and a pattern search algorithm were applied to sensitivity analysis and model parameter optimization, respectively. Results showed that both models could be effectively applied to the 1-day interval prediction of T-N concentration of effluent. SVM model showed a higher prediction accuracy in the training stage and similar result in the validation stage. However, the sensitivity analysis demonstrated that the ANN model was a superior model for 1-day interval T-N concentration prediction in terms of the cause-and-effect relationship between T-N concentration and modeling input values to integrated food waste and waste water treatment. This study suggested the efficient and robust nonlinear time-series modeling method for an early prediction of the water quality of integrated food waste and waste water treatment process.

Introduction

Following the restrictive landfill legislation passed by the European Union (EU) in 1999, many developed countries have implemented various policies and technical developments for reducing the quantity of biodegradable waste landfill (Burnley et al., 2011; García et al., 2005). The South Korean government also prohibited the landfill of municipal solid sludge (MSS) and food waste (FW) in the early 21st century (S. Cheon et al., 2013). However, this strict regulation causes the dumping of both the sludge and FW water (*i.e.*, leachate) at sea, consequently leading to the prohibition of its disposal in the ocean

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