Desalination and Water Treatment
www.deswater.com
doi: 10.5004/dwt.2021.27691

236 (2021) 123–143
October

A comprehensive insight into the application of machine learning approaches in predicting the separation efficiency of hydrocyclones

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Received 1 April 2021; Accepted 4 August 2021

ABSTRACT

The applications of hydrocyclones have been reputed due to their versatile performance, robustness, and easiness in design. In this study, the separation efficiency of hydrocyclones is intended to be determined by means of machine learning approaches, namely radial basis function, least-squares support-vector machine, multi-layer perceptron, and adaptive network-based fuzzy inference system. A data set entailing diverse features of either geometrical features of hydrocyclones and operating conditions are taken as inputs, and the separation efficiency is considered as the target element. Sensitivity analysis is also carried out to eliminate less effective inputs before applying the algorithms to the collected data set to improve the accuracy of algorithms and avoid inevitable noises and unnecessary extra measurements. Since the performance of utilized artificial neural networks is considerably dependent on the optimal network configurations, an optimization scheme using particle swarm optimization is used to meet the objective. The results authenticated the applicability of the respective algorithms in predicting the separation efficiency of hydrocyclone as a function of 14 different features. Good agreements between experimental data and applied models have been ascertained. Lastly, in-depth analyses into the behavioral performance of employed algorithms and their potential effects on the prediction capability have also been presented.

Keywords: Hydrocyclones; Sensitivity analysis; Artificial neural networks; Machine learning algorithms; Data science

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