Artificial neural network modelling of photodegradation in suspension of manganese doped zinc oxide nanoparticles under visible-light irradiation

ABSTRACT

The artificial neural network (ANN) modeling of m-cresol photodegradation was carried out for determination of the optimum and importance values of the effective variables to achieve the maximum efficiency. The photodegradation was carried out in the suspension of synthesized manganese doped ZnO nanoparticles under visible-light irradiation. The input considered effective variables of the photodegradation were irradiation time, pH, photocatalyst amount, and concentration of m-cresol while the efficiency was the only response as output. The performed experiments were designed into three data sets such as training, testing, and validation that were randomly splitted by the software's option. To obtain the optimum topologies, ANN was trained by quick propagation (QP), Incremental Back Propagation (IBP), Batch Back Propagation (BBP), and Levenberg-Marquardt (LM) algorithms for testing data set. The topologies were determined by the indicator of minimized root mean squared error (RMSE) for each algorithm. According to the indicator, the QP-4-8-1, IBP-4-15-1, BBP-4-6-1, and LM-4-10-1 were selected as the optimized topologies. Among the topologies, QP-4-8-1 has presented the minimum RMSE and absolute average deviation as well as maximum R-squared. Therefore, QP-4-8-1 was selected as final model for validation test and navigation of the process. The model was used for determination of the optimum values of the effective variables by a few three-dimensional plots. The optimum points of the variables were confirmed by further validated experiments. Moreover, the model predicted the relative importance of the variables which showed none of them was neglectable in this work.

Keyword: Artificial neural network (ANN); Photodegradation; m-cresol; Visible-light irradiation