Nanocomposites and nanomaterials

Efficiency and energy consumption of sonocatalytic degradation of reactive red 198 by nano-sized ZnO/SiO_2 composite

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In this study the possibility of synthesized nano-sized ZnO/SiO_2 composite was evaluated for degradation of reactive red 198 (RR198) under ultrasonic irradiation. Nano-sized ZnO/SiO_2 powder without high-temperature activation was synthesized and was introduced to act as the sono-catalyst. Some different characterization analysis were applied to demonstrate and to confirm the structure of synthesized particles. Effects of six operational parameters including initial solution pH (pH_0), initial concentration of RR198 (C_0), addition dose of nano-sized ZnO/SiO_2 powder (D_{SC}), ultrasound irradiation frequency (Fr_{SC}), ultrasound irradiation power (P_{SC}) and treatment time (t_{SC}) were examined on the sono-catalysis color removal efficiency (CR%) and energy consumption per removal mass (EPM). Sonication was achieved at frequency of 37 and 80 kHz with an ultrasonic generator with a piezoelectric transducer fixed at the bottom of the vessel. Multiple linear regression (MLR) and artificial neural network (ANN) were used for data modeling. The ANN models obviously outperformed MLR models. Therefore, Multi-objective optimization of CR% and EnC was carried out using genetic algorithm (GA) over the outperformed ANN models. The optimization procedure causes non-dominated optimal points which give an insight of the optimal operating conditions. The measured CR% ranging from 0.5 to 100 and EnC (wh) from 0.22 to 12.8 gained under given conditions. The optimization procedure causes non-dominated optimal points which gave an insight of the optimal operating conditions.

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