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Numerical prediction of the reaction rate constant of chlorine disinfection process at a waste-water treatment plant: Experimental model validation and simulation studies

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Chlorine disinfection of waste-water was investigated to estimate the reaction rate constant of the disinfection process at a wastewater treatment plant. The kinetic studies of free chlorine with ammonia show the experimental conditions for the determination of the reaction rate constant. Chlorine reactions with waste-water occurred in the contact basin, and they could be characterized by partial differential equations. In addition to the difficulties of the solution of these partial differential equations, the determination of the reaction rate constant of chlorine disinfection is also difficult because of complex reactions with ammonia and the dynamic behavior of waste-water. These vary, depending on the influent ammonia concentration, chlorine dosage, and waste-water content and flow rate. A method of characteristics and an odometric transformation technique were applied to these equations to more easily obtain a solution. The method of characteristics is a mathematical-solution technique that transforms a partial differential equation into an ordinary differential equation. Because the disinfection reaction also has a large and variable time delay, the odometric transformation technique was introduced to eliminate this obstacle. The application of these mathematical solution and transformation techniques converted the dynamics of the system into a constant time-delay model and a set of ordinary differential equations that were feasible for the numerical integration. To validate the model and determine the reaction rate constant by simulation, the resulting equations were coded in Matlab and solved numerically. The validation was performed by the comparison of the simulated response of the developed model with the experimental data using Matlab software packages. The validation criterion was the obtainment of the highest fit (%) for the simulated result. The simulation results revealed that the fit (%) was the highest when the reaction rate constant was 0.0074 h^{-1}.

Biography

Feridun Demir obtained his PhD degree from the Department of Chemical Engineering at the University of Florida. He is currently a Professor of Chemical Engineering at Osmaniye Korkut Ata University in Osmaniye, Turkey.

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