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Modeling of cavitation as an advanced wastewater treatment

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ABSTRACT

This paper presents a theoretical study of cavitation as an advanced oxidation process. A mathematical algorithm, which couples single bubble dynamics and chemical reactions for a cavitating bubble, is proposed and compared with experimental and theoretical works reported in the literature. The main output variable, used for comparison, is the hydroxyl radical production. A wide range of parameter values is evaluated for the analysis of hydrodynamic cavitation in an orifice. Thanks to the large number of simulation, it was possible to find a very good agreement with a design correlation proposed in the literature. Additionally, a novel approach has been proposed, which consists of integrating the estimated radical production over a typical bubble size distribution in order to predict a global oxidant production. Moreover, by fixing the values of flowrate, pressure, and geometric parameters, a real experimental condition of hydrodynamic cavitation in a Venturi device has been simulated. This allowed the comparison of simulation results with the experimental ones reported in the literature. A good agreement has been found in terms of cavitational yield, an estimation of the process efficiency from an energetic perspective.

Keywords: Advanced oxidation processes; Hydrodynamic cavitation; Theoretical modeling; Hydroxyl radicals

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