Incorporation of the GRG-optimization method in the design and simulation of solar falling-film slurry photocatalytic reactors operated under turbulent regime

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Photocatalytic reactor modeling has always been a complex duty involving several phenomena that must be described with powerful and accurate mathematical tools. Most efforts have been focused on simulating systems under controlled conditions and simplifying some models to obtain practical but reliable solutions. In this study, a falling-film solar pilot-scale photoreactor operated in turbulent regime is modeled for phenol degradation using the Generalized Reduced Gradient (GRG) method embedded in the MS Excel® environment. A Visual Basic code was developed to integrate this function with the equations corresponding to the transport phenomena, photons' emission and absorption models, mass balance, and kinetic expressions. The simulations were carried out considering different catalyst loads and radiation intensities, obtaining results with satisfactory agreement with experimental data of a TiO2-based slurry falling-film photoreactor operating with solar radiation and under a turbulent regime (R2=0.84 – 0.99). The model fitting improved with the empirical adjustment of the LVRPA exponent, exhibiting the strong dependence of this parameter on the radiation intensity. These results demonstrated that reliable simulations can be carried out by adapting different tools of low-cost software like MS Excel® for potential full-scale applications of a falling-film solar photoreactor.