Study on the Photocatalytic Reactor Design for the Treatment of Isopropanol Wastewaters by a Laminar-FallingFilm-Slurry(

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ABSTRACT

The purpose of this study is to develop the design equation of a laminar-falling-film-slurry-type (LFFS) photoreactor for the treatment of isopropanol (IPA) wastewaters by UV/TiO2 and UV/TiO2/H2O2 processes. The photoreactor design equations were established by combining with the chemical kinetics of the photocatalytic system, gas-phase light emission model, and gas-liquid-phase light absorption model within the photocatalytic reactor, and then were validated by the experimental results of the decomposition of IPA in aqueous solution within the photoreactors of different geometries at various operating conditions (solution pH values, UV light intensities, reactor diameters, flow rates) to verify its rationality and feasibility. By the treatment of the LFFS-UV/TiO2 and LFFS-UV/TiO2/H2O2 process, it was found that the decomposition rates of IPA in aqueous solutions increase with increasing the dosage of TiO2, UV light intensity, effective UV light length, the diameter of outer tube of the photoreactor, and dosage of H2O2 (for UV/TiO2/H2O2 process). The optimum solution pH values for the decomposition rates of IPA by the LFFS-UV/TiO2 process was found at 7. It was determined a best possible flow rate for the decomposition rates of IPA by the LFFS-UV/TiO2 and LFFS-UV/TiO2/H2O2 processes possibly due to the competition between the effects of effective retention time and reaction zone within the liquid films. Experimentally observed removal of the IPA by the LFFS-UV/TiO2 and LFFS-UV/TiO2/H2O2 processes agreed well with the theoretical solutions modeled by the developed photoreactor design equation. The results of this work can be as useful bases of the future application of the heterogeneous UV-based advanced oxidation processes.

Keywords : Isopropanol(IPA) ; laminar-falling-film-slurry-type (LFFS) reactor ; photocatalysis ; UV/TiO2 process ; UV/TiO2/H2O2 process

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