ABSTRACT

The objective of this research is to study the decomposition behaviors of gaseous phases by using UV/TiO2 photocatalytic systems within a continuous-type photoreactors to investigate the reaction efficiency of the photooxidation of gas-phase volatile organic compounds (IPA and Formaldehyde). The experiments were carried out under various UV light intensities, flow rates, humidities, reaction times, initial concentrations of reactants and photocatalytic areas in a disk-type and an annulus-type photoreactor to investigate the removal efficiencies of pollutants and organic intermediates, CO2 in order to determine the completeness of decomposition. The Fluent 6.2 software was used to simulate the flow field of air streams with the photoreactor to validate whether the flow is laminar flow. Based on the simulated results, it's confirmed that there's no radial convection effect in the photoreactor, the reaction determining step to the whole reaction would be the effect of wall shearing stress and the effect of detention time. In the 400W UV photocatalytic systems for degrading the IPA and formaldehyde, only the effect of axial detention time was to be the main limitation to the removal of VOCs. That is why the reaction rate decreased with increasing flow rate and initial concentration of IPA. The decomposition of formaldehyde is limited to the superficial active site of the catalyst, the degrading rates decreased with increasing flow rate and initial concentration of formaldehyde. In the 8W UV photocatalytic systems for degrading the IPA, the two effects of shearing stress and detention time need to be combined for discussing the reaction behaviors. In the 8W UV/TiO2 system, the decomposition rates of IPA and formaldehyde increased with decreasing flow rates, but there existed an optimum flow rate. Almost of VOCs can be totally degraded. When flow rate is at 600 ml/min, the best removal was about 50%. The initial concentration of 20 ppmv to 200 ppmv (IPA) and 3 ppmv to 30 ppmv (formaldehyde), the removal of the two VOCs were from 40% down to 20% (IPA) and from 100% down to 20% (formaldehyde). The mineralization conversion of VOCs by TiO2 process ranged from 20% to 90%. Compared to the decomposition results of the 8W and 400W systems, the better removal of IPA can be reached by the 400W system rather than 8W system. However, the difference of mineralization conversion of VOCs by the 8W and 400W systems was found to be trivial. The mineralization rates of VOCs increased with decreasing initial concentration of VOCs and flow rates. Key word: Oxidation advanced, photocatalyst, IPA, formaldehyde, conversion.

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