Photocatalytic oxidation of volatile organic compounds for indoor environment applications: Three different scaled setups

Zahra Shayegan, Fariborz Haghighat, Chang-Seo Lee

PII: S1385-8947(18)31885-0
DOI: https://doi.org/10.1016/j.cej.2018.09.167
Reference: CEJ 20006

To appear in: *Chemical Engineering Journal*

Received Date: 16 July 2018
Revised Date: 10 September 2018
Accepted Date: 21 September 2018

Please cite this article as: Z. Shayegan, F. Haghighat, C-S. Lee, Photocatalytic oxidation of volatile organic compounds for indoor environment applications: Three different scaled setups, *Chemical Engineering Journal* (2018), doi: https://doi.org/10.1016/j.cej.2018.09.167

Photocatalytic oxidation of volatile organic compounds for indoor environment applications: Three different scaled setups

Zahra Shayegan, Fariborz Haghighat*, Chang-Seo Lee

[1]Department of Building, Civil and Environmental Engineering, Concordia University, Montreal, Quebec, Canada

*Corresponding email: Fariborz.Haghighat@Concordia.ca

Abstract

Ultraviolet photocatalytic oxidation process (UV-PCO) is a promising approach for removing indoor volatile organic compound (VOC). Although the adequate efficiency of PCO in laboratory conditions has been proven, the application of PCO in VOCs degradation has been greatly hindered in large-scale applications. The effect of scaling up and real conditions cause some limitations for large-scale systems. Based on our knowledge, despite extensive published research on PCO of TiO_2-based photocatalysts in bench-scale setups, there is a lack of studies regarding the effects of scaling up and by-product generation in pilot and full-scale setups. The main objective of this study is to investigate the scaling effect on toluene and isobutanol removal efficiency and by-product generation in conditions close to the real application. For this purpose, three test setups i.e., full, pilot, and bench-scale, were employed to investigate the PCO removal of VOC pollutants in the gas phase. Also, the effect of light type on the performance of PCO was examined in the pilot, and full-scale. A brief description of three setups is presented, followed by experimental results and discussions about the difference between each setup. The PCO efficiency and by-product generation rate are evaluated in conditions close to the real application, considering low-level contaminant concentration, small residence time, and high flow rate. The relative humidity for all experiments is kept in the comfort zone (RH~50±5%). The performance of vacuum UV (VUV) photolysis and VUV-PCO in pilot and full-scales, and UVC-PCO in all three scales, are compared and discussed.

Keywords: Photocatalytic oxidation (PCO); Volatile Organic Compound (VOC); Titanium dioxide (TiO_2); Scale-up; By-product; Indoor air quality.