Monuron photodegradation using peroxymonosulfate activated by non-metal-doped TiO_2 under visible LED and the modeling via a parallel-serial kinetic approach

Amal Abdelhaleem, Wei Chu

PII: S1385-8947(18)30034-2
DOI: https://doi.org/10.1016/j.cej.2018.01.036
Reference: CEJ 18356

To appear in: *Chemical Engineering Journal*

Received Date: 16 October 2017
Revised Date: 5 January 2018
Accepted Date: 6 January 2018

Please cite this article as: A. Abdelhaleem, W. Chu, Monuron photodegradation using peroxymonosulfate activated by non-metal-doped TiO_2 under visible LED and the modeling via a parallel-serial kinetic approach, *Chemical Engineering Journal* (2018), doi: https://doi.org/10.1016/j.cej.2018.01.036

Monuron photodegradation using peroxymonosulfate activated by non-metal-doped TiO_2 under visible LED and the modeling via a parallel-serial kinetic approach

Amal Abdelhaleem, Wei Chu*

Department of Civil and Environmental Engineering, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong

* Corresponding author. E-mail address: wei.chu@polyu.edu.hk

ABSTRACT: N-doped TiO_2 (NT) was proven to be efficient for monuron decay via peroxymonosulfate (PMS) activation under visible LED (Vis LED). The activation mechanism revealed that $^{\bullet}OH$ and $SO_4^{-\bullet}$ have a critical role in the monuron decay with a ratio of about 3 to 1, respectively; and the holes at the catalyst surface are the main precursors in forming $SO_4^{-\bullet}$. The NT/PMS/Vis LED hybrid process was found to be an effective approach under a wide solution pH range of 2.5-9.2 (> 80% decay). Interestingly, the highest efficiency was observed at pH 9.2 due to the contribution of PMS/Vis LED process by generating both $^{\bullet}OH$ and $SO_4^{-\bullet}$ at alkaline pH. However, the decay rate of monuron was inhibited at pH 11.6 due to the dissociation of $^{\bullet}OH$ into $O^{-\bullet}$ and the electrostatic repulsion among reagents. The process was also suitable for ion-rich wastewater since no significant reduction in the performance was induced in the presence of high concentrations of inorganic anions. Furthermore, the process was proven to be a promising approach for mineralization of monuron and its intermediates. Twenty reaction intermediates were detected and five of them are newly reported. A novel mathematical model was established based on reaction intermediates using a parallel-serial-irreversible reaction approach, which is helpful in predicting the detoxification extent of hazardous intermediates.

Keywords: Photodegradation; Herbicides; PMS activation; Mathematical model; visible LED