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PII: S1385-8947(15)01000-1
DOI: http://dx.doi.org/10.1016/j.cej.2015.07.034
Reference: CEJ 13932

To appear in: *Chemical Engineering Journal*

Received Date: 10 April 2015
Revised Date: 5 July 2015
Accepted Date: 11 July 2015

Please cite this article as: F. Zhou, C. Lu, Y. Yao, L. Sun, F. Gong, D. Li, K. Pei, W. Lu, W. Chen, Activated carbon fibers as an effective metal-free catalyst for peracetic acid activation: Implications for the removal of organic pollutants, *Chemical Engineering Journal* (2015), doi: http://dx.doi.org/10.1016/j.cej.2015.07.034

Activated carbon fibers as an effective metal-free catalyst for peracetic acid activation: Implications for the removal of organic pollutants

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Abstract:

The development of an efficient and green catalytic system for recalcitrant pollutant removal is an attractive yet challenging research topic in the field of environmental catalysis. In the present work, the use of activated carbon fibers (ACFs) as a novel and excellent metal-free catalyst is proposed for peracetic acid (PAA) activation, constructing a pro-environmental and efficient catalytic system for the removal of organic pollutants. In this system, ACFs could effectively activate PAA to remove the dye Reactive Brilliant Red X-3B (RR X-3B) over a wide pH range (3−11), exhibiting a remarkable pH-tolerant performance. Moreover, the ACFs also displayed excellent sustained catalytic ability and regeneration capability, avoiding secondary contamination. A hybrid method that combines various radical scavengers with electron paramagnetic resonance (EPR) technology has been used to confirm that both hydroxyl radicals (HO•) and alkoxyl radicals ($CH_3C(O)O$•) were generated in the ACFs/PAA catalytic system. Furthermore, a combination of EPR with density functional theory calculations has been employed to evaluate the role of ACFs in the ACFs/PAA system. The results suggested that the introduction of ACFs facilitated homolytic cleavage of the O–OH bond, resulting in the generation of HO• and $CH_3C(O)O$• for the effective removal of organic dyes. Based on these results and analyses, a possible mechanism is

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