Kinetic oxidation of antipyrine in heat-activated persulfate

Chaoqun Tan, Naiyun Gao, Yang Deng, Lei Li, Jing Deng, Shiqing Zhou

State Key Laboratory of Pollution Control and Resource Reuse, Tongji University, 1239 Siping Road, Shanghai 200092, China
Tel. +86 021 65982691; email: gaonaiyun1@126.com
Department of Earth and Environmental Studies, Montclair State University, Montclair 07043, NJ, USA

Received 5 April 2013; Accepted 15 September 2013

ABSTRACT

The kinetic oxidation of antipyrine by activated persulfate oxidation was investigated. The reaction kinetic rates under different temperature (T, 40–70°C), initial persulfate concentration ([PS]₀), and initial antipyrine concentration ([AP]₀) were examined in batch experiments. The results show that higher temperature, higher persulfate concentration, and lower initial antipyrine favored antipyrine degradation. A deep investigation into the reaction order obtained a more accurate kinetics rate equation (−d[AP]/dt = 0.34 [PS]₀ [AP]) with the limits of the experimental conditions applied here. The removal of antipyrine in 120 min was 54.3% at pH 4.5, and antipyrine degradation at different pH followed the order: pH 4.5 > pH 11.0 > pH 7.0 > pH 9.5. The persulfate disappearance fits pseudo-first-order kinetics well, the calculated disappearance rate of persulfate (k_{obs-PS}) was 2.33 ± 0.23 x 10^{-4} min^{-1} at 60°C. Although 71.4% of initial antipyrine was degraded at 60°C, only 12.5% of initial antipyrine was mineralized. At last, norantipyrine and 5-pyrazolidinone-3-methyl-1-phenyl were identified to be the degradation products of antipyrine in heat activated persulfate system for the first time, and the degradation pathway of antipyrine was also tentatively proposed.

Keywords: Antipyrine; Degradation products; Heat; Kinetics; Persulfate