Desalination and Water Treatment
www.deswater.com
doi: 10.5004/dwt.2020.25631

189 (2020) 329–337
June

Removal of copper and cadmium from simulated wastewater using coupled internal electrolysis with flocculation: a comparison of effects and investigation of mechanisms

Luting Pan, Runqiu Tu, Ajun Wan*, Yunpeng Wu, Xinjue Xie

Modern Agricultural Science and Engineering Institute, Tongji University, Shanghai 200092, China, Tel. +86-181-0190-6160/ +86-138-1668-8116; email: wanajun@tongji.edu.cn (A. Wan), Tel. +86-133-2186-0376; email: lutingpan@163.com (L. Pan), Tel. +86-151-8431-2129; email: 1733004@tongji.edu.cn (R. Tu), Tel. +86-186-1681-6056; email: dxwyp@tongji.edu.cn (Y. Wu), Tel. +86-181-0190-6160; email: jane_xiexinjue@163.com (X. Xie)

Received 29 May 2019; Accepted 3 February 2020

ABSTRACT

A single factor experiment was conducted to analyze the impacts of initial pH (1.0–8.0), reaction time (10–120 min), aeration quantity (0–12 L/h), and flocculation pH (6.0–12.0) on the removal of Cu^{2+} and Cd^{2+} from simulated wastewater via coupled iron-carbon internal electrolysis with flocculation. The results showed that in the internal electrolysis reaction stage, the removal rate of Cu^{2+} remained steady at first and then slowly decreased with increasing initial pH, whereas the removal rate of Cd^{2+} continued to slowly increase. As the reaction time increased, the removal rate of Cu^{2+} increased steadily, and the removal rate of Cd^{2+} showed the same trend. With the growth of aeration intensity, the removal rate of Cu^{2+} increased rapidly and then decreased slowly, whereas the removal rate of Cd^{2+} continued to slowly increase. The removal rate of Cd^{2+} under different reaction conditions was lower than that of Cu^{2+}. In the flocculation reaction stage, as the flocculation pH increased, the removal rate of Cu^{2+} gradually increased at first and then stabilized, while the removal rate of Cd^{2+} rapidly increased at first and then stabilized. The Cd^{2+} removal rate could be increased to more than 90% by adjusting the pH to a suitable value. The internal electrolysis reaction followed the first-order kinetic model. Solution components after the reaction were determined by X-ray diffraction. It could be inferred that the underlying mechanism of coupled iron-carbon internal electrolysis with flocculation for the removal of Cu^{2+} was oxidation and reduction, while the mechanisms for the removal of Cd^{2+} were chemical precipitation and flocculation-adsorption.

Keywords: Iron-carbon internal electrolysis; Heavy metal wastewater; Flocculation; Reaction mechanism

* Corresponding author.