Preparation and electrocatalytic dechlorination performance of Pd/Ti electrode

Jingli Zhang\textsuperscript{a,}\textsuperscript{*}, Zhanping Cao\textsuperscript{b}, Yongzhi Chi\textsuperscript{a}, Liping Xie\textsuperscript{b}, Ligang Lin\textsuperscript{b}

\textsuperscript{a}School of Environmental and Municipal Engineering, Tianjin Chenjian University, Tianjin 300384, China, Tel. +86 22 23085117; email: jinglizhang2014@tcu.edu.cn
\textsuperscript{b}School of Environmental and Chemical Engineering, Tianjin Polytechnic University, Tianjin 300387, China

Received 26 August 2013; Accepted 5 March 2014

ABSTRACT

The Pd/Ti working electrode was prepared by the electrochemical deposition on the Ti plate and its structure and morphology were analyzed by an X-ray diffraction (XRD) and a transmission electron microscopy. The results showed that Palladium (Pd) crystals were coated uniformly on Titanium (Ti) base material with the average size of 8.69 nm. The cyclic voltammetry was employed to study the electrochemical reduction characteristics of 2,4,5-tripolychlorinated biphenyl (PCB29) in an electrocatalytic system. The results showed that the PCB29 dechlorination was a two-electron transfer reduction controlled by adsorption and conformed to the characteristics of the first-order reaction. The efficiencies of PCB29 degradation in the electrocatalytic system were more than 95% after 5 h at its concentration (mg/L) of 60, 80, and 100. The dechlorinations of PCB29 obeyed the pseudo-first-order reaction kinetic behavior. The reaction rate constant was approximately 0.011 min\textsuperscript{-1}. The reaction rate increased slightly as the temperature rose. The 2,5-PCB was first mainly generated by PCB29 para-position dechlorination, 2-PCB by meta-position dechlorination, and then diphenyl by the subsequent ortho-position dechlorination. Diphenyl could be further hydrogenated to Phenyl cyclohexane. The chlorine substitution position on PCB29 mainly affected the order of PCB29 electrocatalytic dechlorination.

Keywords: Pd/Ti electrode preparation; 2,4,5-tripolychlorinated biphenyl (PCB29); Electrocat-
alytic dechlorination; Degradation mechanism

\textsuperscript{*}Corresponding author.

1944-3994/1944-3986 © 2014 Balaban Desalination Publications. All rights reserved.