Desalination and Water Treatment
www.deswater.com

doi:10.5004/dwt.2021.27129

224 (2021) 187–196
June

Removal of naphthalene from aqueous solutions by phosphorus doped-titanium dioxide coated on silica phosphoric acid under visible light

Bahman Banaei[a], Amir Hessam Hassani[a,*], Farhang Tirgir[b,*], Abdolmajid Fadaei[c], Seyed Mehdi Borghaei[d]

[a]*Department of Environmental Engineering, Faculty of Natural Resources and Environment, Science and Research Branch, Islamic Azad University, Tehran, Iran, emails: ahhassani@srbiau.ac.ir (A.H. Hassani), Bahman_14929@yahoo.com (B. Banaei)*
[b]*Department of Chemistry, Faculty of Sciences, Shahrekord Branch, Islamic Azad University, Shahrekord, Iran, email: Tirgir588@gmail.com*
[c]*Department of Environmental Health Engineering, School of Health, Shahrekord University of Medical Sciences, Shahrekord, Iran, email: ali2fadae@yahoo.com*
[d]*Department of Chemistry and Environment, Faculty of Chemistry and Oil Industry, Sharif University of Technology, Tehran, Iran, email:mborghei@sharif.edu*

Received 29 June 2020; Accepted 12 February 2021

ABSTRACT

In this research, titanium dioxide-phosphorus (TiO_2-P) immobilized on silica phosphoric acid (SPA) was prepared by a simple modified sol–gel method with SPA as a precursor instead of phosphoric acid. TiO_2-P thin film photocatalyst immobilized on SPA as a novel high-efficiency photocatalyst was investigated to remove naphthalene as a toxic compound from wastewater. The novel resulting photocatalyst were characterized by energy-dispersive X-ray (EDX) and X-ray diffraction pattern revealed nano-photocatalyst TiO_2-P with the average size of 15–20 nm. EDX analysis showed the presence of phosphorus elements in the crystalline structure of TiO_2 and diffuse reflectance spectroscopy showed the energy bandgap narrowing and transfer of photocatalytic activity of TiO_2-P to the visible region. The excellent photocatalytic activity of TiO_2-P/SPA compared with TiO_2-N,S as thin films coated on glass microspheres. The results showed that the optimal pH, time, concentration, and efficiency removal of naphthalene for TiO_2-P were 5, 50 min, 25 mg/L, and 92.12% and TiO_2-N,S catalyst were 5, 60 min, 25 mg/L, and 88.47%, respectively ($P < 0.05$). The removal of chemical oxygen demand in pH 5 for TiO_2-N,S was obtained 79.26% and for TiO_2-P was obtained 81.64%. In this research, the ability to use immobilized TiO_2-P in SPA can be used as a new, effective and practical method in the treatment of water and industrial wastewater containing naphthalene in the presence of visible light.

Keywords: Naphthalene; Titanium dioxide-phosphorus; Silica phosphoric acid; Visible light; Titanium dioxide

* Corresponding author.