Toxicity evaluation of phenol by-products resulted from degradation of phenol by Fe (III)-doped TiO₂/UV process

Saeedeh Hemmati Borji¹,², Simin Nasseri¹,²,⁴, Ramin Nabizadeh³,⁵, Amir Hossein Mahvi²,⁶, Mohammad Reza Zare⁷

¹Department of Environmental Health Engineering, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran, Tel. +98 21 88978396, email: saeedeh.hemmati@yahoo.com (S.H. Borji), Tel. +98 21 88978396, email: naserise@tums.ac.ir (S. Nasseri), Tel. +98 21 88954914, email: nnabizadeh@tums.ac.ir (R. Nabizadeh), Tel. +98 21 88951400, e-mail: ahmahvi@yahoo.com (A.H. Mahvi)
²Center for Water Quality Research (CWQR), Institute for Environmental Research (IER), Tehran University of Medical Sciences, Tehran, Iran
³Center for Air Pollution Research (CAPR), Institute for Environmental Research (IER), Tehran University of Medical Sciences, Tehran, Iran
⁴Center for Solid Waste Research (CSWR), Institute for Environmental Research (IER), Tehran University of Medical Sciences, Tehran, Iran
⁵Department of Environmental Health Engineering, Eraz School of Public Health, Larestan School of Medical Sciences, Larestan, Iran, Tel. +98 917 108 2125, email: zaremohammad1363@yahoo.com (M.R. Zare)

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ABSTRACT

The objective of this study was the evaluation of phenol toxicity and by-products resulted from its degradation by Fe (III)-doped TiO₂/UV process. 10 mg/L of phenol solution was manipulated for degradation by Fe (III)-doped TiO₂ (synthesized by sol-gel method) under UV ray. By-products detected using GC-MS. In order to toxicity assessment of phenol by-products, the effluent was used in bioassay tests performed using Daphnia magna at 24, 48, 72, and 96 h exposure and 50% lethal concentration (LC₅₀) was determined using probit analysis in SPSS ver. 16.0 software. Results indicated that after 210 min, phenol concentration was decreased to 1.022 mg/L. Detected by-products consisted of catechol, resorcinol, hydroquinone, glycerol, glutaric acid, oxalic acid, 1,2,3–benzenetriol, phenol, acetic acid, and E–2–butenedioic acid. According to the obtained values of LC₅₀s, the effluent toxicity was 6–9-fold higher than that of initial phenol solution at all of the exposure times. Results of the present study confirmed that the by-products of phenol oxidation by Fe(III)-doped TiO₂/UV may introduce more toxic effects on Daphnia magna and this phenomenon should be considered in the future applications.

Keywords: Phenol; By-product toxicity; Fe (III)-doped TiO₂; Daphnia magna; LC50

*Corresponding author.