



Optimization and mechanism pathways of *p*-cresol decomposition over Cu-Fe/NaP1 catalyst by Fenton-like process

Kitirote Wantala^{a,b,c,d,*}, Wasipim Chansiriwat^{a,b}, Rattabal Khunphonoi^{b,d,e},
Chatkamol Kaewbuddee^{a,b}, Totsaporn Suwannaruang^{a,b}, Narong Chanlek^f,
Nurak Grisdanurak^g

^aDepartment of Chemical Engineering, Faculty of Engineering, KhonKaen University, KhonKaen 40002, Thailand, Tel. +668 1499 5370, email: kitirote@kku.ac.th (K. Wantala), oirnas@hotmail.com (W. Chansiriwat), k_chatkamol@kkumail.com (C. Kaewbuddee), totsaporn.s@kkumail.com (T. Suwannaruang)

^bChemical Kinetics and Applied Catalysis Laboratory (CKCL), Faculty of Engineering, KhonKaen University, KhonKaen 40002, Thailand, email: rattakh@kku.ac.th (R. Khunphonoi)

^cResearch Center for Environmental and Hazardous Substance Management (EHSM), Faculty of Engineering, KhonKaen University, KhonKaen 40002, Thailand

^dResearch Program on Development of Appropriate Technologies for Coloring Agent Removal from Textile Dyeing, Pulp & Paper, Sugar Industries for Sustainable Management, Center of Excellence on Hazardous Substance Management (HSM), Chulalongkorn University, Bangkok 10330, Thailand

^eDepartment of Environmental Engineering, Faculty of Engineering, KhonKaen University, KhonKaen 40002, Thailand,

^fSynchrotron Light Research Institute (Public Organization), Nakhon Ratchasima 30000, Thailand, email: narong@slri.or.th (N. Chanlek)

^gDepartment of Chemical Engineering, Faculty of Engineering, Thammasat University, Pathumthani 12121, Thailand, email: gnurak@engr.tu.ac.th (N. Grisdanurak)

Received 10 February 2019; Accepted 29 June 2019

ABSTRACT

The degradation of *para*-cresol (*p*-cresol, 100 ppm) was assisted by Cu-Fe/NaP1 catalyst heterogeneous Fenton-like process. The characterizations of Cu-Fe/NaP1 catalyst were done for surface morphology, specific surface area and oxidation state of the elements by using scanning electron microscope (SEM), N₂ adsorption-desorption apparatus and X-ray photoelectron spectroscopy (XPS), respectively. The amount of Cu-Fe mass ratio, initial pH of the solution and initial hydrogen peroxide concentration was studied as the design variable. The degradation of *p*-cresol was found that over Cu-Fe/NaP1 catalyst gave a higher performance than Cu or Fe alone. Additionally, the alloy structure between Cu and Fe was observed in CuFeO₂, which exhibited synergistic effects to enhance the *p*-cresol degradation efficiency. According to the design of experiment, the maximum *p*-cresol removal and initial reaction rate were computed and found at the optimum condition following, 58% Cu mass ratio, initial solution pH 4 and 120 mM of initial H₂O₂ concentration. The 4-methylcatechol, 4-hydroxybenzoic acid, 4-hydroxybenzyl alcohol and 4-hydroxybenzaldehyde intermediates were observed during the degradation reaction and demonstrated as less toxic intermediates comparing with the original substance. The degradation of *p*-cresol was achieved by the heterogeneous Fenton-like process over the Cu-Fe/NaP1 catalyst.

Keywords: Cu-Fe; NaP1; Pathway; Advanced oxidation processes; Catalytic wet peroxidation

*Corresponding author.