

Photodegradation of 2-Chlorophenol over ZnO/KCC-1: Reaction Optimization by Response Surface Methodology

R.S.R. Mohd Zaki^a, X.R. Lim^a, H.D. Setiabudia^{b,*} and N.F. Jaafar^c

^aFaculty of Chemical and Process Engineering Technology, College of Engineering Technology, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300, Gambang, Kuantan, Pahang, Malaysia.

^bCentre for Research in Advanced Fluid and Processes, Universiti Malaysia Pahang, Lebuhraya Tun Razak, 26300 Gambang, Kuantan, Pahang, Malaysia.

^cSchool of Chemical Sciences, Universiti Sains Malaysia, 11800 USM Penang, Penang, Malaysia

*Corresponding author: herma@ump.edu.my

Abstract

Removing 2-chlorophenol (2CP) from water is an imperative task due to its toxicity. Various methods have been introduced for 2CP removal, and photocatalytic degradation is one of the best alternative solutions due to its effectiveness and simple process. This study focused on the potency of ZnO/KCC-1 as an effective photocatalyst for 2CP elimination from aqueous solutions. ZnO/KCC-1 was prepared by impregnation of commercial ZnO precursor into the synthesized KCC-1. The synthesized Zn/KCC-1 was characterized by using TEM, FESEM, XRD, FTIR, and PL. The characterization results revealed that the addition of ZnO did not cause the collapse of the dendrimeric structure of KCC-1. The analysis via response surface methodology (RSM) over independent variables of initial concentration (X_1), catalyst dosage (X_2), and pH (X_3) revealed that X_2 was the most essential variable, while X_1 was the least significant variable. The ideal parameter for 2CP degradation was achieved at $X_1 = 10$ mg/L, $X_2 = 2$ g/L, and $X_3 = 10$ with photodegradation efficiency (Y) of 90.62% (predicted) and 88.93% (experimental). This research revealed that ZnO/KCC-1 had a good potential for photocatalytic degradation of 2CP from an aqueous solution.

Keywords: 2-chlorophenol; Photocatalyst; ZnO/KCC-1; Photodegradation; Response surface methodology.