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Adsorption–dechlorination of 2,4-dichlorophenol using two specified MWCNTs-stabilized Pd/Fe nanocomposites

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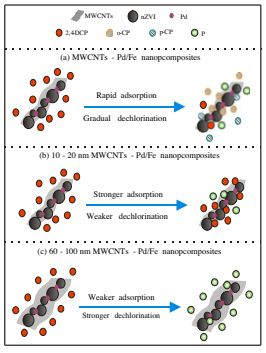
HIGHLIGHTS

- Two MWCNTs-Pd/Fe nanocomposites were synthesized to inhibit iron aggregation.
- Two MWCNTs-Pd/Fe nanocomposites used remove 2.4-DCP was investigated.
- MWCNTs had a selective adsorption capacity as follows: 2,4-DCP > p-CP, o-CP > P.
- Stronger dechlorination and weaker adsorption was found by 60–100 nm MWCNTs-Pd/Fe.

GRAPHICAL ABSTRACT



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ABSTRACT

In this study a systematic investigation of two specified MWCNTs-Pd/Fe nanocomposites to remove 2,4-dichlorophenol (2,4-DCP) is presented. Two specified Multi-Walled Carbon Nanotubes (MWCNTs), i.e., 60–100 nm and 10–20 nm were introduced in nZVI synthesis in order to improve its adsorption–dechlorination efficiency. Both MWCNTs-Pd/Fe nanocomposites showed excellent adsorption efficiencies for phenols and followed the sequential order; 2,4-DCP > p-CP > o-CP > P. Batch sorption experiments including kinetics and isotherm were also intensively investigated. Significantly high 2,4-DCP removal was observed after 1 min when it reached to 49.7% and 53.2%, then continuously increased up to 95.2% and 77.7% after 5 h at 0.20 wt.% Pd loading by 60–100 nm and 10–20 nm MWCNTs-Pd/Fe nanocomposites, respectively. However, stronger dechlorination and weaker adsorption was found in 60–100 nm MWCNTs-Pd/Fe nanocomposites. Moreover, an integrated approach of physical adsorption by 60–100 nm MWCNTs and chemical reduction by Pd/Fe nanoparticles to remove 2,4-DCP was successfully achieved. The property of quick adsorption of targeted pollutants and steady release of dechlorination products enhance the applicability of this process for an in situ pollution remediation measures.

1. Introduction

Chlorinated phenols are commonly applied in agricultural and industrial sectors and result of growing ecological and environmental concerns [1], although their use have been strictly restrained in recent years due to carcinogenic properties. In general, Chlorinated phenols concentrations in contaminated soils range 0.1–10 mg kg^{-1}, but in highly contaminated areas, like

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