Environmental Engineering and Management Journal xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
http://www.eemj.icpm.tuiasi.ro/; http://www.eemj.eu

"Gheorghe Asachi" Technical University of Iasi, Romania

ACTIVATED CARBON REGENERATION BY PEROXIDASE ENZYME IN THE TREATMENT OF PHENOLIC COMPOUNDS

Özgür Aktaş*, Işık Çoban

Department of Bioengineering, Istanbul Medeniyet University, 34700, Istanbul, Turkey

Abstract

The occurrence of bioregeneration in biological systems combined with activated carbon increases the service life of activated carbon in biological systems and thereby decreases the costs related with activated carbon addition or regeneration. Regeneration occurring due to extracellular enzymes is a possible mechanism in these systems. In this study, enzymatic degradation of phenolic compounds and enzymatic regeneration of thermally (PKDA) and chemically activated (Cgran) carbons loaded with these compounds were investigated using horseradish peroxidase (HRP) enzyme. It was aimed to show the occurrence of enzymatic regeneration of activated carbons loaded with biologically resistant compounds by using an extracellular enzyme. For this purpose, phenol, 2-nitrophenol, and bisphenol-A were tested as the target compounds. Initial enzymatic degradation studies showed that peroxidase (5 U/mL) degraded phenol and 2-nitrophenol (each 200 mg/L) by 83 % and 51% efficiencies, respectively. Peroxidase (5 U/mL) degraded bisphenol-A (100 mg/L) with 55-70% efficiency. In subsequent regeneration experiments, peroxidase (5 U/mL) regenerated PKDA (1 g/L) by 44 % and 93%, and Cgran (1 g/L) by 59 % and 76% efficiencies when they were loaded with phenol and 2-nitrophenol, respectively. PKDA loaded with bisphenol-A was regenerated by peroxidase (1-10 U/mL) by 30-50 % whereas Cgran was regenerated by 90-98 % efficiencies. Enzymatic regeneration efficiencies were higher than maximum achievable abiotic desorption efficiencies of all three phenolic compounds, showing that regeneration occurred primarily due to the presence of extracellular peroxidase enzyme. The study indicated that engineered use of enzymes can significantly increase regeneration of activated carbons depending on their activation type.

Key words: activated carbon, bioregeneration, bisphenol-A, 2-nitrophenol, peroxidase

Received: April, 2024; Revised final: February, 2025; Accepted: March, 2025

* Author to whom all correspondence should be addressed: e-mail: aktasozg@gmail.com; Phone: +90.216.2803210