

A Novel Electrochemical Remediation Process for Degradation of Chlorophenol Presented in Soil

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Chlorophenols, priorities pollutants listed by the U. S. EPA, are typical contaminants at many sites including soil and groundwater. Due to their toxicity, bioaccumulation and carcinogenic potential, the treatment of these compounds is of significant environmental concern.

Recently, advanced oxidation processes (AOPs) have attracted a great deal of attention to treat wastewater containing biorefractory compounds for its amenability to automation, high efficiency and environmental compatibility^{1,2}. And some works on chlorophenol anodic oxidation on different anodes have brought about satisfactory results^{3,4}, however, because of the chloride that released from the compounds may participate in the anodic oxidation, there exists the potential problems of chlorination. On the other hand, the electrochemical reductive approach has been suggested as a promising method for detoxification of chlorine-containing compounds, which ensures the selective removal of chlorine atoms from various chloroaromatics under mild experimental conditions without using the highly reactive reducing agents⁵. However, it could not reach the mineralization of compounds, thus it does not meet with the requirement for soil remediation.

In this work, a novel electrochemical reactor was adopted where the simulated wastewater containing chlorophenol was pumped into cathodic cell to reach the dechlorination of the compound, then passed through the soil cell, and finally entered the anodic cell where the dechlorinated compounds were further oxidized till mineralization. The aim of this work is to explore the feasibility of this method for contaminated soil remediation.

The operating parameters including flow rate, initial pH, current density and initial chlorophenol (CP) concentration were found to affect the remediation. An increase of liquid flow rate and current density could significantly improve the CP removal. Higher CP removal rate was observed at low initial CP

concentration while the absolute CP removal was relatively lower.

A comparison of CP removal by anodic oxidation or cathodic reduction was carried out, and it found that CP was dechlorinated more quickly and easily in the cathode, indicating necessary to treat CP by reduction firstly.

The main degradation intermediates in the cathodic cell was phenol, and in the anodic cell were principally hydroquinone, benzoquinone, fumaric acid, and oxalic acid, based on which the degradation mechanism for CP was proposed.

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