Faculty of Science

Department of Chemistry

Development of carbon modified polymer adsorbents for water treatment applications

A thesis submitted in partial fulfillment of the requirements for the Doctor of Philosophy degree in Science.

In

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Presented by

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Dandelion-like Cu-Ni LDH-decorated biochar/aminated chitosan composite for boosting Fenton-like degradation of doxycycline: Insights into performance and mechanism

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Abstract

This study fabricated a novel biochar/amine chitosan composite (BC/AmCS) decorated with dandelion-like Copper-Nickel layered double hydroxide (Cu-Ni LDH) for Fenton-like degradation of doxycycline (DOX). The Fenton-like degradation of DOX proceeded at varied experimental conditions, implying the superior degradation efficacy of Cu-Ni LDH/BC/AmCS composite at pH = 8, H_2O_2 = 400 mg/L, and composite dosage = 0.03 g/L. Interestingly, results showed that the Fenton-like degradation % of DOX reached 86.9 % after 1 h at a high concentration of DOX (500 mg/L). Furthermore, it was recorded a synergistic effect between adsorption, and Fenton-like processes during

the degradation of DOX, where the adsorption % attained 46.9 %. Moreover, kinetic modeling clarified the fitting of a pseudo-first-order kinetic model to model the degradation of DOX by Cu-Ni LDH/BC/AmCS/H_2O_2 system. Based on the X-ray photoelectron spectroscopy (XPS), and quenching test, the Fenton-like degradation mechanism of DOX followed a radical pathway forming a continuous redox cycle in Cu-Ni LDH/BC/AmCS. In addition, the degradation pathway was presumed via gas chromatography–mass spectrometry (GC–MS) measurements. The developmental toxicity of the produced intermediates was assessed using quantitative structure–activity relationship (QSAR) prediction. The durability of Cu-Ni LDH/BC/AmCS catalyst was scrutinized by performing a cycling test for 5 runs, and measuring the metal leaching. The H_2O_2 decomposition was determined via the potassium titanium (IV) oxalate spectrophotometric technique. Eventually, Cu-Ni LDH/BC/AmCS composite could be recommended as a promising catalyst for the efficient degradation of organic pollutants from wastewater.