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BIOSORPTION OF HEAVY METALS BY BIOSORBENT MIXTURE OF MANGROVE BARK AND OIL PALM MESOCARP FIBER: KINETICS AND ISOTHERM STUDIES

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ABSTRACT

The existence of toxic metals in water supply has become a severe issue and created awareness amongst researchers in order to find the significant methods for the removal of toxic metals. This is due to the characteristics of heavy metals that can accumulate in living tissues and cannot be degradable. Currently, people are using traditional method in removing heavy metals; however, this method has the disadvantages in term of cost and not eco-friendliness compared to biomass. In this study, oil palm mesocarp fibre (OPMF) (*Elaeis guineensis sp.)* and mangrove bark (MB) (*Rhizophora apiculate sp.)* were used as biosorbent. Both MB and OPMF were chemically treated using 37% Formaldehyde and NaOH, and HNO_3 to ensure the better biosorption efficiency. These biomasess were mixed to form the biosorbent mixture (BM) to enhance the biosorption performance towards Ni (II), Pb (II), Cr (III) and Cu (II) metal ions. Four parameters were applied to investigate the biosorption performance and analysed using the Flame Atomic Absorption Spectroscopy (FAAS), i.e. reaction time, ratio/dosage, initial concentration and initial pH values. Physical and chemical characterisation of biosorbents were analysed using Fourier Transform Infrared (FTIR) and Scanning Electron Microscopy-Energy Dispersive X-ray (SEM-EDX). From the FAAS results, it was shown that, except Ni (II) (87%), the biosorption efficiency of other metals is more than 90%. This was very much higher than efficiency shwn by single biosorbents (OPMF and MB), which recorded an efficiency of less than 83% for all metals. The FTIR results for both biosorbents showed several important functional groups namely hydroxyl, carbonyl, alkyl, phenolic, aromatic and carboxylic groups. In addition, SEM image of MB and OPMF showed unoccupied pores that act as active sites before the biosorption process but fully occupied after the biosorption process. Besides, EDX analysis also proved that both biosorbent have successfully adsorbed the intended heavy metals. The study found that the biosorption performance of BM is higher than single biosorbent. Five kinetic models were used to investigate the kinetic mechanisms namely pseudo-first-order and second-order, Bangham's theory, intra-particle diffusion and Elovich equation. The isotherm models viz. Langmuir, Freundlich, Dubinin-Radushkevich (D-R) and Temkin Isotherm exercised to analyse the equilibrium biosorption data. Overall, pseudo-second-order discovered to act as biosorption kinetics for all types of heavy metals. Whereas the equilibrium biosorption data of Pb (II) and Cr (III) was followed Temkin isotherm, and Ni (II) and Cu (II) supported by Freundlich isotherm.

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"I can do all things through Christ who strength me" Philippians 4:13

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