

UNIVERSITI TEKNOLOGI MARA

**BIOSORPTION OF Pb(II) AND
METHYLENE BLUE ONTO
CHEMICALLY MODIFIED SPENT
GRATED COCONUT (*Cocos nucifera*)**

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ABSTRACT

Wastewater contaminated by lead (Pb(II)) heavy metal and methylene blue (MB) dye, and improper solid waste disposal of agro-based industries has been a major concern among the researchers. In addition, the uncertainty regarding the mechanism and process of biosorption involving the chemically modified biomaterials are also crucial that need to be investigated. This research investigated the application of three types of biosorbents derived from spent grated coconut (SGC) powder: hexane-washed (HSGC), sulphuric acid treated (SSGC) and xanthated spent grated coconut (XSGC) to adsorb two types of adsorbate cations namely Pb(II) and methylene blue (MB) dye from aqueous solutions. The biosorbents were characterised by spectroscopic and quantitative analyses. Different chemical treatments had successfully changed the physicochemical characteristics of all biosorbents such as the surface area, pore diameter, CHNOS content, $\text{pH}_{\text{slurry}}$ and pH_{PZC} , light metal ions content and ash content. The morphology of the SSGC had become spongy-like whereas XSGC had formed a flake-like structure. The pore size of HSGC and XSGC are in the range of nonpores whereas the SSGC is mesopores as confirmed by Brunauer, Emmett and Teller (BET) analysis. Elucidation of chemical characteristics of biosorbents surface by Fourier transform infrared (FTIR) spectroscopy revealed different types of functional groups. The performance of all biosorbents were affected by pH, biosorbent dosage, stirring speed, ionic strength, and initial concentration of adsorbate cations (Pb(II) and MB). The rate of Pb(II) uptake was rapid compared to MB. The biosorption of Pb(II) and MB on all biosorbents were best fitted to pseudo-second order kinetic models ($R^2 > 0.95$) and Langmuir isotherm model ($R^2 > 0.99$). The Langmuir maximum biosorption capacities (q_{max}) for Pb(II) by HSGC, SSGC and XSGC were 37.88, 172.41 and 53.76 mg/g respectively. For MB biosorption, the recorded q_{max} were as 52.77, 363.64 and 64.52 mg/g, respectively. The thermodynamic study revealed that all adsorbents showed spontaneous and feasible nature of biosorption process as the ΔG^0 values were negative for both cations. The Pb(II) biosorption was endothermic for HSGC and SSGC while the XSGC was exothermic. The Pb(II) and MB ions were strongly bound to all biosorbents with recovery efficiencies of less than 50% by 0.10 M HCl, HNO_3 and disodium-EDTA or NaOH solutions. Complexation was the dominant mechanism involved in the Pb(II) biosorption. MB interaction with all biosorbents was suggested to be of H-bonding, Yoshida H-bonding, $\pi \rightarrow \pi$ and $n \rightarrow \pi$ bonding while electrostatic attraction could not be ruled out. Good precision study was recorded with RSD values $< 2.1\%$ ($N = 12$).

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