

Development of biosorbent derived from the endocarp waste of gayo coffee for lead removal in liquid wastewater—effects of chemical activators

ABSTRACT

This study reports the development of bio-based adsorbent by utilizing coffee endocarp (CE) waste as a raw material for lead (Pb) removal from liquid wastewater. The effect of NaOH and HCl as activation precursors on the characteristics and performance of the resulting adsorbents was investigated. The prepared adsorbents were characterized using scanning electron microscopy (SEM), Fourier transform infrared spectroscopy (FTIR), X-ray diffraction (XRD), X-ray fluorescence (XRF) and Surface Area Analyzer (SAA). The characterization results confirm the positive role of the activation by either NaOH or HCl in enhancing the surface properties of the resulting adsorbents. The chemical activations removed most of impurities leading to smoother surface, pore size enlargement and enhanced surface area to pore volume ratio, which result in an enhanced adsorption capacity and Pb removal efficiency. The raw adsorbent shows 57.7% of Pb removal efficiency and sorption capacity of 174.4 mg/g. On the other hand, after the chemical treatment using HCl and NaOH, the Pb removal efficiencies increased up to 63.9% and 89.86%, with adsorption capacity of 193 and 271.58 mg/g, respectively. Though both activated sorbents demonstrate better adsorption performance compared to the non-activated CE, overall results reveal that the NaOH-activated sorbent offers better characteristic and performance than the HCl-activated sorbent.