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Applying iron coating on the Saudi Arabia volcanic tuff for enhancing mercury adsorption from synthetic wastewater

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ABSTRACT

The collected volcanic tuff was modified and characterized using X-ray diffraction, scanning electron microscopy (SEM), and cation exchange capacity (CEC). The sorption behavior of two samples of volcanic tuff was determined by a set of parametric batch experiments that were conducted as a function of pH, ionic strength (*I*), and the concentration of selected metals. The particle characterization revealed that iron oxide coating was successfully applied onto the surface of volcanic tuff and showed high CEC (1.02 mol/kg for the natural Kingdom of Saudi Arabia (KSA) volcanic tuff and 0.81 mol/kg for the modified volcanic tuff), specific surface area, and uniform distribution of iron. The SEM illustrated that the concentration of iron varied between the different spectra. The CEC of the modified volcanic tuff decreased relative to their nature and was proportional to the concentration of iron used in the modification process. Applying iron-coating increased the mercury removal capacity of the KSA volcanic tuff up to 100%, specifically at the higher initial concentration (IC) of Hg (8.76 mg/L) and low *I* (0.01 M $NaNO_3$). In contrast, for low IC of Hg (0.0876 mg/L) and high *I* (1 M $NaNO_3$), the experiments did not indicate an increase in the sorption process efficiency. More experiments with a wider range of pH values, silicate, sulfate, carbonate, and ionic strength are needed to fully quantify the dependence of maximum sorption on such factors.

Keywords: Adsorption; Ion exchange; Mercury (Hg); Volcanic tuff; Sorption; Wastewater

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