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The removal of boron from aqueous solutions using natural and chemically modified sorbents

Mohsen Jalali, Fahimeh Rajabi, Faranak Ranjbar*

Department of Soil Science, College of Agriculture, Bu-Ali Sina University, Hamedan, Iran, emails: jalali@basu.ac.ir (M. Jalali), rajabi_fahimeh@yahoo.com (F. Rajabi), Tel. +98 81 34425292; Fax: +98 81 34424012; email: f_ranjbar1980@yahoo.com (F. Ranjbar)

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ABSTRACT

The presence of excessive amounts of boron (B) in water resources can endanger the health of organisms in an ecosystem. In this study, B removal from aqueous solutions was investigated using natural easily available materials including bentonite, kaolinite, zeolite, waste calcite, and residues of wheat, rice, and green shell of walnut as native and chemically modified with $FeCl_3$. The optimum values of pH and contact time for the B sorption were determined before isotherm experiments. The maximum sorption of B by mineral sorbents was observed at pH 9, while it was obtained at pH 7 for walnut shell and rice residues and at pH 8 for wheat residues. The optimum time obtained for mineral sorbents and organic sorbents was 24 and 48 h, respectively. The values of pHzpc measured for chemical sorbents were higher than those for organics. The sorption isotherms were performed using optimum parameters at three $CaCl_2$ concentrations as background electrolytes. Increasing $CaCl_2$ concentration caused to increase in B sorption. The chemical modification of sorbents by $FeCl_3$ had a positive significant effect on B sorption. The fit of Freundlich and Langmuir models to the experimental data was very well. The largest B sorption capacity among the mineral and organic sorbents was, respectively, observed in the waste calcite and rice residues. However, the extent of the B sorption by organics was much higher than by minerals. Therefore, the use of organic materials to remove excess amounts of B from water resources can be considered as an available, cost-effective, and environmentally friendly strategy.

Keywords: Boron removal; Natural sorbents; Sorption; Organic residues; Waste calcite

*Corresponding author.