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Rapid removal of boron from environmental water samples using magnetic graphene oxide: optimized by central composite design

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ABSTRACT

In the present study, magnetic graphene oxide nanocomposite (GO/Fe_3O_4) was synthesized and used as an efficient adsorbent for the removal of boron from water samples. The removal efficiency was checked using inductively coupled plasma optical emission spectrometry (ICP-OES). The adsorbent was characterized by field emission scanning electron microscopy (FESEM), X-ray diffraction (XRD), Fourier transform infrared (FTIR) spectroscopy, and vibrating sample magnetometry (VSM). The effective parameters of adsorption process including pH, adsorbent dosage, and contact time were optimized using a central composite design (CCD). Under the optimal conditions (pH 9.2, adsorbent dose of 82 mg, and contact time of 14.8 min), the relative standard deviation was 1.87% (C=100 mg L^{-1}, n=9) with the determination coefficient (R^2) of 0.9980. The maximum adsorption capacity of GO/Fe_3O_4 was 35.7 mg g^{-1}. The adsorption isotherm was well fitted with the Langmuir model. Finally, the method was applied to remove boron in tap, mineral and groundwater samples and satisfactory removal efficiencies (95–97%) were obtained.

Keywords: Boron; Magnetic graphene oxide; Inductively coupled plasma optical emission spectroscopy; Central composite design; Adsorption isotherm models

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