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Rapid removal of phosphates, nitrates, lead, and cadmium from wastewater using fast pyrolysis biochar

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Magnetic biochar was prepared by magnetite (Fe_3O_4) precipitation onto the biochar's surface from an aqueous Fe^{3+}/Fe^{2+} solution upon NaOH treatment. The resulting magnetic and raw biochar was used to remove phosphates, nitrates, lead, and cadmium from water. The surface chemistry and composition of the biochars were examined by TEM, SEM, SEM-EDX, XPS, XRD, PZC, elemental analysis, and surface area measurements. Batch sorption studies were carried out from pH 2 to 10 using different adsorbate concentrations at 25, 35 and 45°C. Magnetic biochar was suspensions in the contaminated solutions were vortexed for two min and then magnetically removed. Remediated solutions were then analyzed using UV-Visible spectroscopy and AAS. Sorption studies were carried out at 25, 35 and 45°C was evaluated using the Langmuir, Freundlich, Sips, Redlich–Peterson, and Toth adsorption isotherm models. The fast adsorption kinetics and high adsorption capacities of biochar could be advantageously employed in filtration devices, columns, or as shown here, in batch operations with stirring to speed adsorption, followed by magnetic separation of the adsorbent for regeneration.

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