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THE EFFECT OF Si CONTENT ON FERRIHYDRITE SORPTION CAPACITY FOR Pb(II), Cu(II), Cr(VI), AND P(V)

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Abstract

In this study, the impact of silicate admixture in 2-line ferrihydrite on its sorption properties is presented. Synthetic ferrihydrites with broad Si content in the range of 0 to 1.5 Si/Fe molar ratios were prepared and characterized using X-ray diffractometry (XRD), Fourier-transform infrared spectroscopy (FTIR), and scanning electron microscopy (SEM-EDS). With an increase in the Si/Fe ratio, a typical XRD peak at 2.5Å broadens and shifts toward 3 Å; the position of Si-O stretching band in FTIR spectrum shifts from 930 to 1003 cm^{-1}; the pH_{pzc} value strongly decreases from 8.41 to 1.99. The surface area, equal to 280 m^2/g for pure ferrihydrite, increases to 332 m^2/g for the lowest Si/Fe molar ratio but decreases to 245 m^2/g for the highest Si/Fe molar ratio. Si-bearing ferrihydrites exhibit higher cation sorption capacities and lower anion sorption capacities compared to Si-free oxyhydroxide. Regarding sorption behavior, Si-ferrihydrites were divided into two groups: low-Si ferrihydrites (LSFs) with Si/Fe molar ratios up to 0.2 and high-Si ferrihydrites (HSFs) with Si/Fe molar ratios above 0.2. These two groups reveal completely different surface chemistry. Langmuir isotherms fit better to the experimental results of anion adsorption onto pure ferrihydrite and LSFs, while the anion adsorption on HSFs fits the Freundlich isotherm in a better manner. The opposite results from cation adsorption experiments: data fit the Freundlich isotherm better for LSFs but the Langmuir model is usually preferred for cation sorption on HSFs. Si-ferrihydrite appears to be an effective adsorbent, for instance in water treatment, thanks to the enhanced cation sorption efficiency and higher stability compared to those of pure ferrihydrite.

Key words: adsorption, iron oxyhydroxides, silicate, surface chemistry

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