Carbothermal synthesis of activated carbon-supported nano zero valent iron: effects of temperature, characterization, and reactivity

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ABSTRACT

Activated carbon-supported nano zero valent iron was synthesized through a carbothermal reduction process. Specifically, iron-impregnated activated carbon was thermally treated under N\textsubscript{2} atmosphere at temperatures ranging from 350 to 1,150\textdegree C. Major properties of the synthesized materials were obtained through analysis of iron content, BET surface area, and pore size distribution. TEM images, X-ray diffraction (XRD), and Fourier transform infrared patterns were also obtained for characterization. Results show that zero valent iron was reduced from iron oxide and those nanoparticles were highly dispersed based on TEM images while XRD patterns indicate a progressive reduction of iron oxide to form elemental iron. Treatment temperature greatly impacted the characteristics of the carbothermal products. The size of the particles, content of elemental iron, surface functional groups, and pore structure all changed with the change in treatment temperature. Synthesized materials were tested for their reactivities on chromate. Reduction of Cr(VI) by carbothermal products occurred based on analysis of Cr speciation. In addition, reduction ability differed with various carbothermal temperatures. Overall, materials synthesized at 550–750\textdegree C appears to stand out when chromate removal capability and removal rate are concerned.

Keywords: Carbothermal synthesis; Elemental iron; Activated carbon; Characterization; Chromate