AGING OF DENSE NZVI SUSPENSION - IMPACT ON SURFACE MORPHOLOGY, PHASE COMPOSITION AND REACTIVITY

SLOVÁK Petr, SOUKUPOVÁ Jana, KAŠLÍK Josef, NOVÁK Petr, FILIP Jan, ZBOŘIL Radek, ČERNÍK Miroslav

Palacky University in Olomouc, Olomouc, Czech Republic, EU
Technical University of Liberec, Liberec, Czech Republic, EU

Abstract

Aging of surface-modified nanoscale zero-valent iron (nZVI) particles represents one of the key limiting factors in their usage for remediation of polluted sites. We investigated a short-term aging process of nZVI particles stabilized with 4 nm thin iron oxide shell (Nanofer STAR from NANO IRON, s.r.o.). Dense suspension (20 wt.%) of Nanofer STAR was prepared using homogenization of powdered particles in either water or sodium carboxymethyl cellulose (CMC) solution and stored at either room temperature or at approx. 6°C. Morphological changes (TEM), surface area (BET), phase transformations (XRD, Mössbauer spectroscopy) and impact on Cu2+ removal were monitored after 8, 24 and 48 hours of aging. The results showed partial degradation of the protective shell after 48 hours of aging in both aqueous and CMC-containing suspension at room temperature. It was accompanied with the increase of surface area of vacuum dried samples (from 10 - 15 to 30 m2•g1). However, these effects were fairly suppressed at lower temperature in both media. Phase composition changes caused by aging were under limit of detection. Six times higher removal of Cu2+ was achieved with 48 hours-aged Nanofer STAR (water, room temperature) than with the freshly homogenized suspension. Such dramatic increase in the removal efficiency was observed also with CMC modified Nanofer STAR suspension aged for 24 hours at room temperature. As Nanofer STAR is being used for the site remediation in pilot scale at various localities worldwide, these observations should be taken into account in order to achieve highest possible removal efficiency.

Keywords: nZVI, Nanofer STAR, aging, shell degradation, Cu2+ removal

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