Nanoparticles pretreatment as a tool to enhance magnetic soil washing

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Soil washing and nanoparticles

Soil washing is an ex-situ decontamination process based on concentrating pollutants into a smaller fraction of soil, leaving the matrix with a lower content of pollutants [1, 2]. Nanoscale zero-valent iron (nZVI), is a nanomaterial able to immobilize, sorb and capture trace elements [3]. Moreover, magnetic separation is a physical separation technique that applies magnetic fields to separate substances on the basis of their magnetic properties [3, 4]. Within this context, we tested soil polluted with potentially toxic elements. The fractions were pretreated with nZVI and then subjected to Wet-High Intensity Magnetic Separation (WHIMS). The results obtained were compared with those obtained without any pretreatment.

Results and discussion

Remarkable recoveries were obtained for most trace elements, namely: Cu, Pb and Sb, which concentrated together with the nZVI in the magnetic fraction. In contrast, Hg, reported to the non-magnetic fraction, meanwhile As recovery did not suffer any sort of improvement. Moreover, we observed that pH greatly influenced their recovery. As a consequence, we hypothesized that nanoparticles adsorption efficiency increased with the rising pH for Cu, Pb and Sb because these elements are prone to be in cationic form at soil pH and that nZVI was oxidized as magnetite. In accordance, we suggest that As was mostly as oxyanions, and Hg as cinnabar, thus hindering nanoparticle-pollutant interaction [3]. All things considered, we conclude that nZVI pretreatment seems to strongly enhance soil washing efficiency.

[1] Dermont et al. (2008) *J. Hazard Mater.,* **152**, 1-31. [2] Sierra *et al.* (2014) *Chemosphere*, **107**, 290-296. [3] Boente *et al.* (2018) *J. Hazard Mater.*, **350**, 55-65. [4] Boente *et al.* (2016). *J. Clean. Prod.,* **142**, 2693-2699.