

Assessment of arsenic toxicity using bioassays. Application in contaminated soils

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In last decades, arsenic has become a serious environmental problem due to the extensive use and to its potential high toxicity [1]. Arsenic trends to accumulate in soils because its low mobility in this media, although water-soluble fractions are highly bioavailable [2]. Soil toxicity bioassays are based on the evaluation of the toxic effect of the solid phase or the soil solution over a living organism [3].

Potential As toxicity from bioassays with *Vibrio fischeri* and *Lactuca sativa* germination test was estimated. These assays were done in artificially contaminated solutions (ranging from 0.1 to 100 ppm As), and in water extracts from soils spiked with 100 ppm As. Both bioassays had a different response in the artificially contaminated solutions. According to the EC50 values (Table 1), the *Lactuca sativa* test showed higher sensitivity to the toxicity than *Vibrio fischeri* bioassay.

	EC50 (mg/kg)	
	Value	95% CI
<i>Lactuca sativa</i>	2.46	1.36 - 4.48
<i>Vibrio fischeri</i>	12.33	7.83 - 19.42

Table 1: EC50 values in the contaminated solutions. CI: Confidence interval at 95%.

Four soils with different properties were contaminated with 100 mg As kg⁻¹ soil. Soil organic matter ranged from 1.2 to 6.8%, calcium carbonate from 0 to 39%, and clay content from 9 to 33%. In all cases the As concentration in soil solutions was below 0.03 mg kg⁻¹. The results of toxicity bioassay with the solutions coming from the contaminated soils indicated no toxic response in the case of lettuce germination test or *Vibrio fischeri* bioassay. Further studies are needed to check the main parameters controlling the reduction of toxicity in relation to soil properties.

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[1] Adriano (1986) Springer-Valag. 533 p. [2] Beesley *et al.* (2010) *Env. Poll.* **158**, 2282–2287. [3] Martín *et al.* (2010) *Int. J. Chem. Eng. Art* ID 101390.

Imaging the removal of radionuclides from solution by NZVI using HRTEM

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Nano zero valent iron (NZVI) has been promoted as a remedial strategy for a range of contaminants present in the environment. Its applications range from the remediation of chlorinated compounds in sediments to arsenic in groundwater and aquifer material. Its properties such as size, mobility through porous media and reactivity offer advantages for remediation of contaminants under a variety of remedial strategies: used as complement material on iron barriers, direct injection to aquifers and targeted emplacement in subsurface zones.

We explore here the use of NZVI as an external barrier to radionuclide deep nuclear repository waste containment. Rates of removal of U (VI) removal in suspensions of NZVI (nanoFer 25 and 25S) were performed in batch systems in presence of ordinary portland cement (OPC) at pH 9 and 12. All experiments were conducted in an anoxic glovebox free of CO₂. Samples were taken for the quantification of U (VI), Ca and total Fe by ICP-MS. Samples were also analysed using a HRTEM JEOL 2200FSC. The HRTEM provides a maximum 0.05 nm spatial resolution, this allowed the imaging of the reaction products at atomic scale.

The results showed that NZVI can effectively remove uranium (VI) from solution under a range of conditions. The presence of high Ca concentrations reduce the efficiency of NZVI to remove U (VI) when compared to systems without Ca. However, the overall efficiency of the NZVI-cement system was little compromised since U (VI) was effectively removed from solution under all studied conditions.

The HRTEM results indicated mainly a coprecipitation mechanism for the removal of U (VI) from solution at highly alkaline pH. Therefore the potential to use NZVI technology to increase the efficiency of barriers around a deep nuclear waste repository is very promising. Additionally, HRTEM has proven to be a very valuable tool on the investigation of nanoparticle interactions with porous media.