Speciation of Cr and V within leached BOF steel slag

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Reuse of waste materials has become very important within the past decade because of the reinforcement of environmental legislations that force minimizing waste disposal. Basic Oxygen Furnace (BOF) steel slag is a residue from the basic oxygen converter in steel-making operations, which is partially reused as an aggregate for road constuctions. Even if BOF slag is an attractive material, its long-term behaviour (and the associated environmental and human health risks) must be taken into account. BOF slag is composed essentially of calcium, silicon and iron but also contents potential toxic elements present as traces, like chromium (2600 ppm) and vanadium (690 ppm), which can be released. The present research focus on the evolution during leaching (i) of the mineral phases composing BOF slag and (ii) of the speciation of Cr and V within the carrier phase because the mobility and the toxicity of these elements strongly depend on their oxidation states.

Multiple scale structural studies (XRD, SEM-EDX, XAS) are necessary to characterize heterogenous material as BOF slag. Synchrotron-based technique of X-ray absorption near-edge structure (XANES) spectroscopy is the most well-known method permitting direct determination of the speciation of elements present in solid sample at such low concentrations.

The linked results of chemical analysis, XRD and SEM-EDX enable to identify the main mineral phases composing BOF slag : dicalciumsilicate, dicalicumferrite, solid solutions rich in iron or calcium oxides, hydroxide and carbonate of calcium and iron metal. Then, EDX micro-analyses indicate that V and Cr are associated to dicalciumferrite. The abiotic leaching of BOF slag at a laboratory scale shows that Cr is little release (less than 0.1 % of Cr total content) while V is significantly released (3 % of V total content). Finally, XANES investigations show that chromium is present at octaedral coordination in the trivalent form, the less mobile and less toxic one, and that its speciation does not evolve during leaching. XANES spectra also indicate that V is predominantly present in the +4 oxidation state and seems to become oxidized to the pentavalent form (the most toxic form) during leaching.

Adsorption of lead on single and mixed mineral assemblages

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Thermodynamic surface complexation models (SCMs) have been successfully used to quantify metal adsorption on a wide variety of pure solids as a function of solution pH, ionic strength and metal concentration (Dzombak and Morel, 1990). However, relatively few studies have applied SCMs to complex mineral assemblages. Existing studies propose either a "component additivity" or "generalized composite" approach for modeling metal adsorption on solid assemblages (Davis et al., 1998). In this study, Pb adsorption on single and binary solid systems comprised of mixtures of HFO and silica was measured and the results compared to predictions based on the component additivity model.

Measurements of Pb adsorption as a function of pH were completed using batch reactors with total Pb concentrations of 10^{-4}, 10^{-5} and 10^{-6}M in solutions of .001, .01 and .1M $NaNO_3$; samples were equilibrated for 24hrs in a rotating shaker and supernatant Pb concentrations analyzed using ICP-MS. In all experiments, adsorption of Pb increases with increasing pH; adsorption edges are much sharper for systems containing HFO in comparison to the pure silica system. Pb adsorption is independent of ionic strength in systems containing HFO, but increases slightly with increasing ionic strength for the pure silica system.

Experimental data from the binary mineral systems is in good agreement with double layer SCM model predictions made using the equilibrium speciation code JCHESS based on the component additivity approach and data collected for the single mineral systems. Ongoing experiments will be used to assess mineral-mineral interactions in other binary and ternary systems.

References
Dzombak, D.A., and Morel, F.M., (1990) Surface complexation modeling, Hydrous Iron Oxide, Wiley.
Davis, J.A., Coston, J.A., Kent, D.B., and Fuller C.C., (1998) *Environ. Sci. Technol.* **32**, **2820-2828**.