Effect of nano zero-valent iron on the behaviour of metals in soil and rhizosphere

M. VÍTKOVÁ[1*], E. DRAGOUNOVÁ[1], P. FEJFAROVÁ[1], V. TEJNECKÝ[2] AND M. KOMÁREK[1]

[1]Department of Environmental Geosciences, Faculty of Environmental Sciences, Czech University of Life Sciences Prague, Kamýcká 129, 165 21 Prague 6 – Suchdol, Czech Republic (*correspondence: vitkovam@fzp.czu.cz, +420 22438 3864)

[2]Department of Soil Science and Soil Protection, Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences Prague, Kamýcká 129, 165 21 Prague 6 – Suchdol, Czech Republic

The application of nanoscale zero-valent iron (nZVI) is a fast developing alternative for environmental remediation [1]. However, detailed research on the behaviour of nZVI particles in soils is necessary for evaluating their efficiency and stability, especially in multi-element contaminated areas. Moreover, chemical stabilisation lower the risk of the metal(loid) uptake by plants. In this context, the processes at the soil-root interface (i.e., in the rhizosphere) significantly affect the behaviour of both the amendment and potential contaminants through the interaction with organic acids [2].

The study is focused on the investigation of nZVI effects on the mobility of metals when used in a contaminated soil and on the basic characteristics of the soil. The objective was to assess the stabilisation of metals particularly under simulated rhizosphere conditions by using various experimental/extraction methods.

Particles of nZVI were mixed with the soil (1 wt.%) and left to equilibrate for 1 month at about 70% water holding capacity. A set of extraction methods was applied, including 0.43 M HNO_3, Milli-Q H_2O, $CaCl_2$, $NaNO_3$ and "RHIZO" solution (a mix of acetic, lactic, citric, malic and formic acids simulating root exudates; [3]).

The addition of nZVI increased the soil pH. A significant decrease in Zn concentration was observed upon the H_2O extraction, while higher leachability of Pb was determined compared to non-amended soil. Upon contact with "RHIZO" solution the presence of nZVI significantly decreased the Zn and Pb concentrations. Positive effect of nZVI on the metal stabilisation is expected in the presence of root exudates.

[1] Tosco *et al*. (2014) *J. Clean. Prod*. **77**, 10-21. [2] Vítková *et al*. (2015) *J. Hazard. Mater*. **293**, 7-14. [3] Feng *et al*. (2005) *Chemosphere* **59**, 939-949.