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AVAILABILITY OF HEAVY METALS IN A FORMER SETTLING POND OF IRON INDUSTRY

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Iron industry generated numerous by-products that are now found in brownfields after activity suspension. Among them, sludge resulting from scrubber wet cleaning of blast furnace fumes was not often recycled because of its composition in Zn, Pb, Cd and alkali metals but dumped into settling ponds. In the Lorraine region (North-East of France) the quantity of iron industry sludge in ponds is estimated at 210⁶ tons. After dumping suspension, some ponds have been colonized by vegetation despite the potentially polluting compounds, *e.g.* heavy metals or cyanides, they contain [1]. This development of vegetation may suggest a rather low bioavailability and mobility of metals in the soil. With the aim of confirming and explaining this hypothesis, a former settling pond was investigated by characterizing the properties of materials and the dynamic of metals in the soil.

This pond (Frouard, Lorraine) mainly received blast furnace sludge until the mid-20th century and is nowadays covered by a diversified forest. The soil is composed of contrasted layers and a 20 cm organic layer has developed at its surface [2]. To monitor metal fluxes through the soil, two lysimeters (2 m deep – 1 m² in area) were sampled in the pond and installed in the GISFI experimental station under real climatic conditions (<http://www.gisfi.fr>, Homécourt, Lorraine). The percolates were quantified and analysed. To characterize the materials, twelve samples were collected in different layers along the profile resulting from the extraction of one lysimeter. Chemical and mineralogical characterizations were carried out to determine metal speciation. Physical and hydraulic parameters, *e.g.* specific surface area, porosity and water retention were measured to characterize solute transport.

Elemental composition was dominated by Fe, Mn, Ca and Si with very high contents of heavy metals, up to 10 wt% and 8 wt% for Pb and Zn respectively. The soil was slightly alkaline (5-30 wt% carbonate). Cation exchange capacity was quite high (24-83 cmol⁺ kg⁻¹). Mineralogy was characterized by poorly crystalline and reactive phases, mainly aluminosilicates, Fe and Mn (hydr)oxides and carbonates. Main bearing phases of Pb and Zn were poorly crystalline Mn oxides and aluminosilicates. Physical and hydraulic properties were characterized by a low bulk density (0.2-0.7 g cm⁻³), a high total porosity (75-92 % (v/v)) dominated by micropores, a strong water retention capacity and a high specific surface area (50-300 m² g⁻¹). The presence of reactive mineral phases, known to bear metals, the alkaline conditions and the microporous structure of the materials favoured a low availability and mobility of metals. This was confirmed by the low metal contents in the percolates. However the question of the

potential mobilization of metals in the future, in particular, under the influence of the vegetal cover arises. Is vegetalization a sustainable solution to manage such sites?

[1] Mansfeldt, T. and Dohrmann, R., 2004. *Environ.Sci.Technol.*, 38, 5977-5984.

[2] Schwartz, C. *et al.*, 2001. *Etude et Gestion des Sols*, 8, 135-148