Geophysical Research Abstracts,
Vol. 10, EGU2008-A-00443, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-00443
EGU General Assembly 2008

Deciphering Zn speciation in pig slurry by using X-Ray Spectroscopy

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Introduction

Zinc occurs in pig slurry as a result of its use as biocides in animal feeds (250 mg/kg dm). Increased concentrations of Zinc (Zn) have been measured in the surface horizon of soils on which pig slurry was applied (L'Herroux *et al*, 1997). Due to this accumulation, phytotoxicity (Coppenet *et al*, 1993) and potential groundwater contamination (Lake *et al*, 1984) can be feared. Therefore a better prediction of the mobility and bioavailability of Zn after pig slurry spreading on soils is required and the determination of the speciation of this element has to be done. The Zn speciation within pig slurry was ascertained by EXAFS (Extended X-ray Absorption Fine-Structure spectroscopy).

Material and methods

Pig slurry (containing ca. 5000 mg/kg of Zn) is a complex matrix so a size fractionation was performed in triplicate using the following sieve sizes: 1000 μm, 630 μm, 355 μm, 200 μm, 50 μm, 20 μm, and 0.45μm. Zn concentration and EXAFS spectra of each fraction (e.g. PS 0.45-20 corresponding to the particle size between 0.45μm and 20 μm of pig slurry) were undertaken. EXAFS data reduction was accomplished

according to a procedure previously described (Doelsch *et al*, 2006).

Results and discussion

The majority of the Zn was detected in the PS 0.45-20 fraction, with 3120 mg/kg (75 %) of Zn. EXAFS study of each samples, by Fourier transformation of the oscillatory fine structure, yields a radial function distribution (RDF) in real space with peaks revealing the local environment of Zn. Fitting results show a double contribution in the first shell: Zn-O contribution with a peak at 1.9 Å and Zn-S contribution with a second peak at 2.3 Å. Moreover, our results revealed that 56 % of Zn was bound to O and 44% to S.

This sulfur-linked form of Zn was unexpected and is described for the first time. The origin of Zn-S speciation within pig slurry could be explained by a bacterial form of this metal. Indeed, Guiné *et al* (2006) suggests the presence of mixed environments in the bacterial cell walls, with Zn bound to sulfhydryl (Zn-S contribution) and carboxyl and/or amine ligands (Zn-O contribution).

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