Effect of organic matter on size and structural strain of nano-ZnS formed in organic waste

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Anaerobic digestion (AD) is an interesting opportunity for organic wastes (OW) treatment because of biogas production and agricultural valorisation of digestate as fertiliser. OW often contain large amounts of zinc (Zn), potentially toxic for soil living organisms on the long term. Therefore, it is crucial to understand the effect of AD on Zn speciation in OW to determine the risk of digestate recycling. ZnS have already been evidenced in digestates in varying proportions according to past studies [1-2]. Besides, the dissolution in soil is faster for ZnS that precipitated in OW than for ZnS from other origins [3-4].

In order to better understand process influence on Zn speciation, a systematic study was needed. We have sampled OW in nine AD and composting plants that cover most of the current practices. Zn k-edge ExtendedX-ray Absorption Fine Structure (EXAFS) was used to determine Zn speciation. We showed that nano-ZnS is a major phase in all digestates. The high reactivity of those nano-ZnS is reflected by the drastic change of Zn speciation along the OW treatment chain.

The OW is a too complex matrix to investigate these processes. Therefore to go further into the mechanisms that drive ZnS reactivity, we used laboratory batch experiments. Nano-ZnS of different sizes have been synthetized in presence of organic molecules in the laboratory and characterized by X-ray Diffraction (XRD) and Wide Angle X-ray Scattering (WAXS). Pair Distribution Function (PDF) analysis was perfomed on WAXS signals to obtain real-scale interatomic distances distribution. It has shown structural size-dependent properties and has underligned the influence of OM on both size and strain.

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[3] Formentini et al. (2017) *Env. Pol., 222*, 495-503.
[4] Voegelin et al. (2011) *ES&T*, *45*, (1), 255-261.