NanoFATE Deliverable 2.7

Research report on ZnO and Ag ENP fate in STW: Measurement of nano ZnO and Ag partitioning and removal during primary and secondary sewage treatment stages.

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Research Report Summary

The environmental exposure of engineered nanoparticles that have their life cycle passing through the waste water cycle are to a large extend depending on the fate within the waste water treatment processes. It is now known that zinc regardless of being of ZnO nanoform, bulk particles or dissolved ionic form it is rapidly dissolved and transformed to identical phases of sulphides, phosphates and adsorbed species in the waste water treatment stage. However, for silver the extent of dissolution and sulfidization was less elucidated and this has been identified as an important information for fate and bioavailability. A novel method of FAST true realtime single particle ICPMS was developed in order to be able to probe smaller nanoparticles than had previously been possible in such complex samples of both other nanomaterials and with colloidal (adsorbed ionic forms) background of silver.

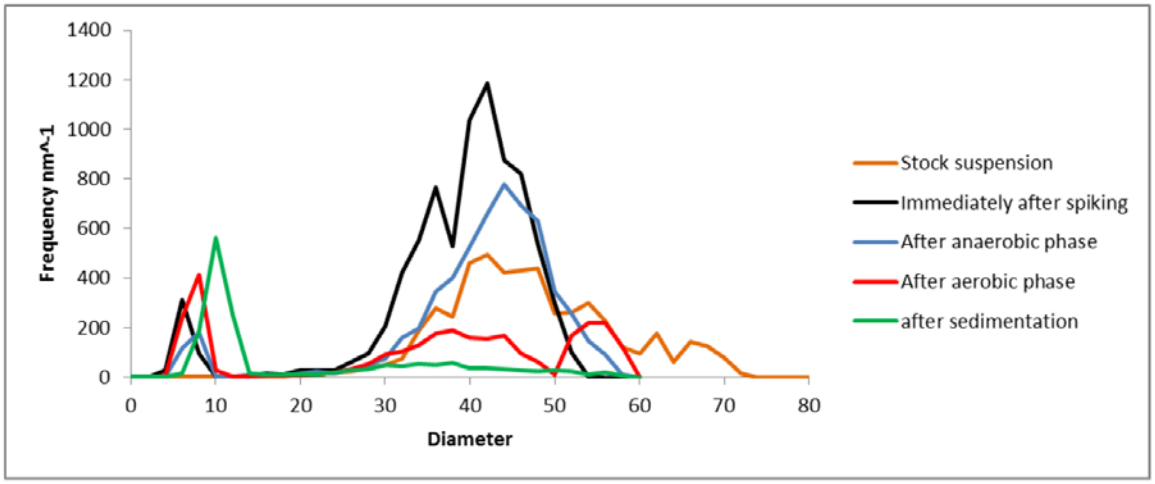

Figure 10. Particle size distribution at the beginning of the experiment of 15/10/2013 compared to PSDs at the end of each phase. Diameter scale refers to that of equivalent spheres of elemental silver.

A microcosm with real sewage, was setup to mimick as realistic as possible a modern real waste water treatment process with a anerobic, aerobic and settling treatment stages. Interestingly, a population of small silver containing nanoparticles (~5-10 nm), was immediately formed, and the extent of these small particles increased in size and concentration over the course of the treatment cycle while the original population was decreasing mainly in concentration but to a small extent also in size (see figure). Based on

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available literature and own electron microscopy analysis we hypothesize that the small particles are silver sulphides being formed as a result of dissolution reprecipitation reactions. The results confirmed other studies that silver nanoparticles are transformed within the relevant time scales of waste water treatment process cycles, but that the original suspensions seem to sustain to some extent as well (although likely with changed surface characteristics).

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