Session: The environment as a reactor determining fate and toxicity of nanomaterials (P)
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Ecotoxicity and fate of Ag and CeO_2 nanomaterials in outdoor lysimeter experiments

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Nanomaterials (NM) will enter the environment via diverse pathways. Sewage sludge for example is repeatedly applied as fertilizer on farmland due to its high nutrient content. This may lead to a significant increase of NMs in soil over years. However, there are other scenarios like the exposure of the terrestrial environment via runoff. Therefore, our aim was to investigate the ecotoxicity and fate of CeO_2-NM and Ag-NM under environmentally relevant conditions in outdoor lysimeters over around 2 years (CeO_2-NM) and 3 years (Ag-NMs).

Nanomaterials of the OECD Sponsorship Programme, namely NM-212 (Ce_2) and NM-300K (Ag), were used for the experiments. Two concentrations for each CeO_2-NM and Ag-NM were applied via sewage sludge into the top 20 cm of lysimeter soil. In addition, CeO_2-NM were applied via simulated rainfall over four weeks on the surface of the lysimeter soil and afterwards mixed into the top 20 cm to simulate ploughing. Subsamples of the soil were incubated under laboratory conditions for 180 days to study the comparability of outdoor and laboratory results regarding ecotoxicity.

The results from our long-term lysimeter experiments showed no detectable horizontal displacement in combination with very low remobilization for both tested NM over 2 to 3 years. Thus, indicate that the sludge applied NM and the NM applied via simulated rainfall remained nearly immobile in the pathway between soils and leachate. However, Ag uptake in the roots of wheat, canola and barley indicates that the chemical conditions in the rhizosphere induce Ag-NM remobilization from the incorporated sewage sludge even after three harvesting cycles. The CeO_2-NM did not induce any adverse effect on the investigated soil microorganisms and the plant growth. At the higher Ag-NM concentration, a constant inhibition of the soil microflora (ammonium oxidizing bacteria and substrate-induced respiration) was observed over about 3 years in the lysimeter study, while there was no effect at the lower Ag-NM concentration. The ecotoxicological results of the laboratory experiment over 180 days reflect the findings of the lysimeter study. For Ag-NM and CeO_2-NM the results indicate that a hazard assessment based on data from laboratory tests is acceptable.