Nano-Ecotoxicology – Assessment of Potential Effects of Engineered Nanomaterials in the Environment

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Ecotoxicology is defined as the study of the effects of toxic chemicals on biological organisms (and populations, communities, ecosystems). Ecotoxicology is a multidisciplinary field, which integrates toxicology and ecology. The goal of this approach is to be able to predict the effects towards organisms, so that the most efficient and effective action to prevent or remediate any detrimental effect can be identified. For the testing of chemicals, numerous standard tests exist, however, there are still many examples of adverse effects on environmental organisms, because the predictive power of such is limited and results can hardly be extrapolated across species (e.g. decline of vulture population in India and Nepal due to Diclophenac).

With the advent of nanotechnology, the need to assess the effects of nanomaterials on environmental organisms arose and led to the emergence of nano-ecotoxicology as a branch of ecotoxicology specifically dedicated to engineered nanomaterials. The assessment of environmental hazard of nanomaterials is needed, because exposure is likely to occur during the life-cycle of a nanoproduct. Risk assessment is also an important step toward a sustainable development of nanotechnology and broad acceptance in the society.

The applicability of standard test methods to identify adverse effects of nanomaterials is still under discussion. Interference of the nanoparticles with the test design or components of the test have been described. Further, knowledge on modes of action is needed, which means to develop an understanding how nanomaterials interact with an organism on molecular or cellular basis.

Up to now, several types of nanomaterials (e.g. TiO_2, fullerens, nanosilver, ZnO, CNT) have been tested in several environmental organisms or *in vitro* systems. The results show, that basically soluble nanoparticles have the potential to be toxic for organisms; here the effect is not due to the nano size, but to the (toxic) ions released (e.g. cobalt, silver).

Also, environmental behaviour of particles has to be considered and is under investigation. This includes studies on the sorption of chemicals or nutrients by nanoparticles, the sorption to soils or organic matter, and general the fate and deposition in the environment. This has important implications on the test design for ecotoxicological tests, as only relevant particle stages (e.g. agglomerates) and test conditions lead to meaningful results.

This talk will introduce into the general approach how to test nanomaterials and summarise the mayor results in the field so far. Also light will be shed on the pitfalls and methodological difficulties of nanoecotoxicology.

References:

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