Impact of combined exposure of cadmium and TiO2 nanoparticles in sediment to the nematode *Caenorhabditis elegans*

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Introduction: The environmental fate of nanomaterials in sediment systems is the focus of a number of studies. Related to the rising number of nanoparticles in consumer products and different industrial sectors, the concentration of nanoparticles in water and soil systems is rising. Concentrations of nano-TiO_2 are predicted for the Rhine River to be in the ng/L range for water and mg/kg for sediments [1]. Due to sedimentation of nanoparticles in industrially impacted rivers the environmental risk from sediments is likely to increase. Here, co-contamination with other environmental pollutants and altered physic-chemical conditions could influence the toxicity of and accumulation of nano-TiO_2. It has been shown, that nano-TiO_2 enhances the toxicity of heavy metals significantly [2]. A strong increase in the toxic effects of nano-TiO_2 on nematodes has been shown when exposed to solar radiation [3]. Thus the toxicity of nano-TiO_2 in the complex sediment matrix (both artificial and natural), is the focus of this study.

Methods: Eco-toxicological methods based on the standardized nematode toxicity assay were used to assess the impact of nano-TiO_2. Based on the standardized bioassay ISO 10872 the nematode *Caenorhabditis elegans* „Maupus, N2 var. Bristol“ from the Caenorhabditis Genetics Center was used as a model organism. Nano-TiO_2 particles P 25 Aeroxide from Degussa AG with a primary size of 21 nm and a ratio of 4:1 Anatase:Rutile and cadmium nitrate tetrahydrate were chosen as test substances to investigate uptake and impact of co-contamination. Fluorescent polystyrene particles from Kisker Biotech with a size of 0.84 µm were applied to indicate defecation process changes caused by the test-materials.

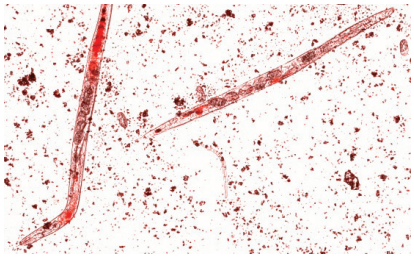

Fig. 1: Fluoresent polystyrene particles taken up by *Caenorhabditis elegans* in toxicity tests

Results: Previous studies using the nematode test, have shown a decrease in growth and survival rate and fertility due to nano-TiO_2 In addition strong agglomeration in the intestinal tract of *Caenorhabditis elegans* was observed in the absence of *E. coli* [3]. Uptake into the cells was not indicated. So the question arises as to the mode of action of nano-TiO_2 on organisms. Our hypothesis is that it interacts with the internal membranes of the intestine. In this case, it may also influence uptake and thus toxicity of cadmium, for which it may also serve as vehicle.
This study aims to identify the potential and so far overlooked effects of mixture toxicity – involving TiO_2 - in sediments and investigates the modes of action.
The project commenced in October 2014 and the project outline will be discussed and first results will be presented.

References: [1] Praetorius et al. (2012) *Environmental Science & Technology* **46**:6705-6713; [2] Zhang et al. (2007) Chemosphere **67**:160-166; [3] Angelstorf et al. (2014) Environmental Toxicology and Chemistry **33**: 2288–2296;