Bavarian Environment Agency

SCIENTIFIC STAKEHOLDER MEETING ON NANOMATERIALS IN THE ENVIRONMENT

Detection of nanoparticles in rivers and industrial wastewaters

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Very little data is available on the occurrence of engineered nanoparticles in the environment. Therefore, it is difficult to assess whether these particles pose a risk to the environment. To get an overview on the occurrence of nanoparticles in the aquatic environment, Bavarian rivers were analysed for metal nanoparticles. To retrace the contribution of industrial activities to the occurrence of nanoparticles in the environment, industrial wastewaters from different branches were analysed.

Methods

Nanoparticles were analysed by single particle-ICP-MS (Agilent, 7700x) resp. asymmetric flow-field-flow-fractionation (AF4 2000, MALS, UV, Postnova) combined with ICP-MS.

Results

Nanoparticles in rivers

River samples were taken at 25 Bavarian river surveillance monitoring stations.

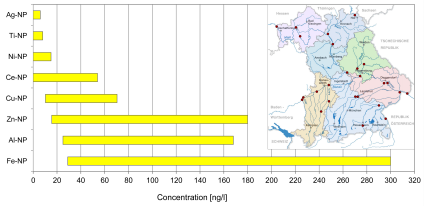

Fig. 1: Nanoparticles in rivers

The highest values were measured for nano-iron, with the contents of nano-zinc and nano-aluminium being half as high. Nano forms of silver, titanium and nickel were found in concentrations < 20 ng/l. It has to be assumed that nanoparticles in watercourses are mainly of natural origins.

In order to assess the environmental risk of the measured concentrations, the values were compared to aquatic PNEC (*Predicted No Effect Concentrations*) for nanoparticles. PNEC-values published by the Danish Environmental Protection Agency were used as a reference.

Nanoparticles in rivers: Comparison to PNEC-values

Nanoparticles	max. Concentration [µg/l]	PNEC [µg/l]	
		[A*]	[B*]
Nano-Ag	0,006	0,012	0,001 – 1
Nano-ZnO	0,161	2,5	0,042 – 2194
Nano-CuO	0,020	0,34	0,48
Nano-TiO_2	0,008	18	1 – 61
Nano CeO_2	0,014	5,2	2 – 108

*[A]: PNECs, as suggested by the Danish EPA [1]
*[B]: Range of PNECs – according to literature [1]

There is no evidence for risk in the aquatic environment. However, due to uncertainties for available PNEC-values for nanomaterials, this risk assessment has to be considered as preliminary.

Nanoparticles in industrial wastewater

Industrial wastewater of 27 companies was analysed for metal nanoparticles. All these companies discharge their effluents directly into river whereby they must comply with official regulations. Nano forms of silver, zinc, copper, aluminium and iron were widely spread while the nano forms of titanium, nickel and cerium were found only in a few cases.

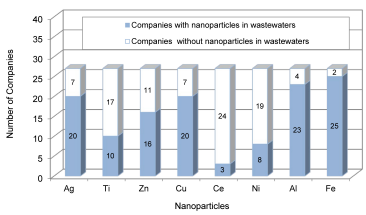

Fig. 2: Occurrence of nanoparticles in industrial wastewaters

The highest loads of silver, titanium, nickel, copper, zinc and iron are to be found in wastewaters from chemical industry. High loads of nano-cerium are characteristic for mechanical engineering, whereas for nano-aluminium paper industry is a relevant source.

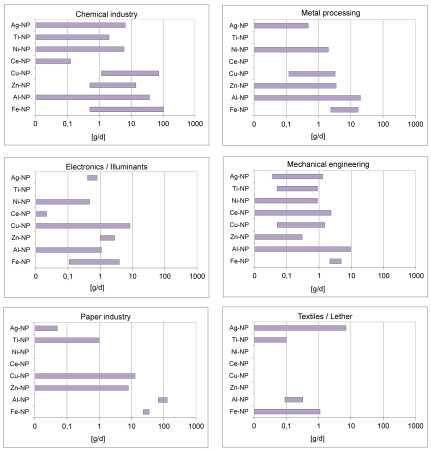

Fig. 3: Nanoparticle-loads in industrial wastewater

Conclusions

For the first time data was made available on the occurrence of eight metal nanoparticles in Bavarian rivers. There is no evidence for risk in the aquatic environment. Nanoparticle contents of industrial wastewaters showed characteristic differences.

[1] Danish Environmental Protection Agency (2015): Environmental effects of engineered nanomaterials. Estimation of Predicted No-Effect Concentrations (PNECs)

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