Preliminary all-clear

What impact do nanomaterials have when they enter the environment via wastewater treatment plants? A team of scientists from the University of Siegen in collaboration with several European project partners got to the bottom of this issue in this interdisciplinary research project.

We deal with them on a daily basis without actually realizing it. So-called ‘nanomaterials’ are present in many common everyday products, such as sunscreen and tooth paste, but also wound dressings or even functional textiles. The most special feature of these materials is their small size: A nanoparticle is 1000-fold thinner than a human hair. In combination with unique chemical and physical properties, this renders them so interesting for many applications. But what happens when they reach the environment via wastewater treatment plants? Scientists from the University of Siegen and project partners from Germany, Austria and Portugal have investigated this process. The interdisciplinary research project ‘FENOMENO’ was funded by several national institutions (in Germany the Federal Ministry of Education and Research, BMBF), which participated in the ERA-NET program, with a total sum of EUR 1.1 million.

In the context of a recent project workshop at the University of Siegen, the researchers have now presented first results of this interdisciplinary project. ‘Based on results we have obtained thus far, we can give a preliminary all-clear’, says project leader Prof. Dr. Holger Schönherr, who heads the Physical Chemistry Group at the University of Siegen. Using silver and titanium dioxide nanomaterials as relevant examples, the project teams investigated the possible impact on aquatic environments, including algae and animals. ‘The final evaluation is still pending, but we could not find any effect on different tiers in the food chain up to now’, Schönherr explains.

The scientists analyzed samples from the Austrian Lake Mondsee to which a wastewater treatment plant is directly connected. Also, sewage treatment processes were simulated in model facilities at the Fraunhofer Institute IME in Schmallenberg, Germany. The influents were spiked with the nanomaterials to eventually investigate algae, daphnia (water fleas) and fish after exposure to the sewage effluents. ‘Scientists of different disciplines have closely collaborated on this project. We carefully examined all samples chemically, microscopically, biologically, molecularly and biochemically’, project leader Schönherr points out.

Schönherr and his Siegen colleague Prof. Dr. Carsten Engelhard investigated the samples with their teams using microscopy and advanced mass spectrometry. The composition and size of analysed nanoparticles could be determined via single particle mass spectrometry, a highly sensitive measurement technique that was refined in Siegen. The chemists also succeeded in elucidating the chemical transformation of those particles during the sewage treatment process in model plants. ‘Silver nanoparticles can be converted to silver sulfide in the sewage plant. They remain in the sewage sludge as sparingly soluble compounds and are hence less harmful to the environment’, Engelhard explains.

To further study the impact of nanoparticles from sewage plants on the ecosystem, biologists from the University of Siegen investigated water fleas that were exposed to effluents from the model wastewater treatment plants over a long period. The fleas feed on algae, to which the nanoparticles can attach. There was no visible effect on the fertility or mortality over six generations, as Prof. Dr. Klaudia Witte summarizes. 'There was also no change in their mobility pattern, when they were exposed to silver nanoparticles from the model wastewater treatment plant. However, it did change, when the solution contained pristine silver particles at identical nominal concentrations.’

Scientists from Austria looked in detail into fish samples from Lake Mondsee. Tissue samples are still currently biochemically analysed at the University of Aveiro in Portugal. ‘In laboratory tests we were able to find out under which conditions and at which concentrations those nanoparticles affect different tiers in the food chain’, Prof. Schönherr explains. These concentrations are mostly far above those found in field studies. From the scientists’ perspective there is no reason for concerns regarding toxic effects.

Background:

The project ‘FENOMENO’ comprises researchers from the University of Siegen, the Fraunhofer Institute IME in Schmallenberg, Germany, the Limnological Institute Mondsee of the University of Innsbruck, Austria, as well as the University of Aveiro in Portugal. The project is funded within the framework of the SIINN ERA-NET program with a total sum of EUR 1.1 million. For further information, please go to: www.fenomeno-nano.de