GKD
WORLD WIDE WEAVE

Tracking down microplastics

TU Berlin: Developing avoidance strategies with innovative superfine mesh and sampling baskets

Microplastics are a global environmental problem. The tiny plastic particles find their way into rivers and oceans via drains, sewer systems, and also sewage plants. In 2016, some 335 million tonnes of plastic were produced worldwide. Based on estimates of the International Union for Conservation of Nature (IUCN), around 9.5 million tonnes – or three percent – of this makes its way into the oceans each year. When discussing microplastics, i.e. plastic particles less than five millimeters in size, we differentiate between those of primary and secondary origin. Primary microplastics for example include abrasives used in body care and cleaning products, while secondary microplastics are classed as all particles produced by degradation and abrasion of plastic, such as synthetic fibers released when washing textiles or tire abrasion caused by road use. According to the German Federal Environmental Agency, up to 500 tonnes from cosmetic and body care products, up to 400 tonnes of chemical fibers from synthetic textiles, and 111,000 tonnes of tire abrasion materials are produced each year in Germany alone. Daniel Venghaus is engaged in research at the TU Berlin in the field of urban water management, where he works on avoidance strategies to prevent microplastics from entering aquatic systems. In a discussion, he explains the objectives and details some initial successes.

What is the significance of microplastics in the field of urban water management?

Daniel Venghaus: According to a recent literature study, as much as 2.5 million tonnes of microplastics could find their way into aquatic systems per year. Some 25% of these microplastics enter circulation via the outlet of sewage plants, while 66 percent take the form of street runoff water.

Why is this the case?

Daniel Venghaus: Processes used to date are not specifically designed to filter microplastics at the outlet of sewage plants or street runoff water. The various volumes of microplastics in municipal waste water have scarcely been researched to date.

Among others, the TU Berlin is addressing this topic intensively in two projects sponsored by the Federal Ministry of Education and Research. These projects are referred to as OEMP and RAU. What are the objectives of these projects?

Daniel Venghaus: The goal with *OEMP* is to develop innovative materials and processes to improve the retention of microplastic particles of various size, shape, or material characteristics during municipal waste water treatment. The collaborative research project entitled Tire abrasion in the environment (*RAU*) examines the emergence, composition, and retention of tire abrasion throughout the entire useful life of a tire. The goal here is to balance its quantities, as well as to both identify and quantify the influential factors and paths leading to its occurrence as a way of highlighting options for its reduction.

The technical weavers GKD – Gebr. Kufferath AG were a project partner in both projects. How did the partnership come about and what were GKD's main duties in this regard?

Daniel Venghaus: When we started taking initial samples in 2013, the key was to find a filter material that could deliver the strict separation limit of 10 micrometers, while also securing the requisite flow rate. It also needed to be rugged, since acids, alkalis, and enzymes may need to be blasted against the filter cake on the mesh to ensure that the particulate material is removed along with the microplastics. With its optimized dutch weaves (ODW), GKD already offered one such filter material. The company further refined this mesh in the course of the *OEMP* project, so that ODW is now also available with separating limits of 8 and 6 micrometers. Assuming a good flow rate, the volume of retained particles at the sewage plant outlet is approximately double with ODW 6 in comparison with ODW 20. This is just one of several reasons why this high performance mesh is also being used in the *RAU* project. The most important point, however, is that not only the product but also the partner company is highly innovative. In our experience, GKD is committed to developing mesh for a very wide range of applications and is not afraid of adopting a different perspective to develop new fields of application. This is a real help, particularly in cases such as these where it is important for the partner to understand the objective and provide the right tools for the job. During the *RAU* project, the company was therefore tasked with developing a sampling basket with defined fractionation for sampling an entire rainfall event. This has already delivered excellent results.

OK, let's return to the OEMP and the optimized dutch weaves. What makes the product stand out?

Daniel Venghaus: The key advantage of this mesh over other filter media is its sharp separation limit. Within the scope of the *OEMP* project, we compared optimized weaves in a disc filter system with a cloth filter in a drum filter system. The drainage values were similar for both configurations. The aperture of the optimized dutch weaves is an absolute value, enabling the system operator to guarantee that no spherical particles larger than 6 micrometers could find their way into the water.

The same mesh is also used for the RAU project in a sampling basket. How does this sampling basket work?

Daniel Venghaus: An integrated filter cascade is used to catch the tire particles from the street runoff drains. The sampling basket separates all particulate material that is larger than 6 micrometers. While engaged in this research project, we are interested both in the entire mass of tire abrasion and the respective quantity of this in a fraction, so that we can estimate which contains the greatest volume of abrasion. Depending on the area, the sampling basket employs up to six filter elements, which can best be envisaged like sieve pans. To be able to use the basket in any street, we took the leaf grate used in many drains as our inspiration and GKD developed a basket with similar dimensions. This basket can be used in all locations and for the first time facilitates reliable sampling of all street runoff water. Until now, it had only been possible to sample partial flow. We can also use the basket to sample various rainfall events – from very heavy rain to very light rain. The latter was not possible at all in the past. Another advantage of the basket is the integrated online measurement functionality, which measures street runoff from the very first second without the warm-up time of conventional measuring technology. For the first time, this has also enabled us to automatically sample the so-called first flush – i.e. the rain that feeds the drains in the first few minutes and is the subject of much discussion in the field of research – and evaluate this based on the respective drainage basin. This performance spectrum makes the sampling basket a core element of the *RAU* project.

Where exactly is this basket used within the scope of the RAU project?

Daniel Venghaus: First of all, its functionality was verified in comprehensive laboratory testing. For the in-situ sampling now following, we chose the deployment locations on the basis of load scenarios: main streets and side streets, highway ramps, parking spaces, traffic lights, roundabouts, etc. as well as various road surfaces. We hope that this will provide us with valid findings as to how tire abrasion even occurs, the size of the particles, what they look like, and the density of the abrasion…

What is the significance of the sampling basket from the perspective of urban water management?

Daniel Venghaus: It is an important instrument that should help in developing ideas and approaches to the factors to be determined within the scope of the *RAU* project. With the sampling basket, we are capable of filtering out all particulate materials in street runoff down to a size of 6 micrometers for subsequent analysis. Going beyond sampling, we will also investigate the filter potential as a localized cleaning system for the basket. It is important to understand here that street runoff is often dewatered via waste water separation channels and can then make its way into rivers without first being treated. When using mixed sewage systems, on the other hand, it is forwarded to the sewage treatment plant. Thanks to the fractioned sampling, we can investigate individual rainfall events to describe and evaluate tire abrasion. The ultrafine separation limit of the optimized dutch weaves permits sampling down to the fine particulate size, which starts at 10 micrometers. With this sampling, we are keen to evaluate drainage basins, understand challenges, and derive solutions.

What was GKD's special contribution in the product developments you have mentioned?

Daniel Venghaus: The optimized dutch weave opens up a broad range of applications. For example, we have used it to filter various sewage plant outlets and mixed sewage during the *OEMP* project. In the *RAU* project, it has also been used to construct a sampling device. These are very different things, as the requirements of a sampling device are quite different than those of a filter system. The basket is a prime example of innovative implementation of an equally innovative mesh as a scientific response to a concrete application/issue. The scientist defines the requirements and the company provides the technical solution. This makes GKD an eye-level sparring partner.

What are the next planned steps?

Daniel Venghaus: Within the scope of *OEMP*, mixed sewage investigations are currently being performed, during which we apply this exacting waste water type to the systems. To this end, we connected filter systems to a mixed sewage basin operated by Berliner Wasserbetriebe. In the *RAU* project, the in-situ street runoff water sampling process is getting under way. Sixty such processes are planned over the course of the next two years.

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