Water treatment plants would be ready for the removal of nanoplastics

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Topics: Drinking Water | Pollutants

The biologically active, slow-flow sand filters of lake water treatment would remove nanoplastics from the raw water very efficiently. This was shown both in the laboratory and in larger, realistic tests and modelling.

It's a hot topic, at least on social media: tiny plastic particles allegedly end up not only in oceans and lakes, but also in drinking water – and, yes, even in bottled mineral water. Eawag and the Zurich Water Works launched a joint project in 2019 to find out whether the tiniest of particles, measuring less than a thousandth of a millimetre across, actually find their way from lake water into drinking water pipes and therefore into homes, hospitals and restaurants.

Retained at 99.9%

The results are now in, and they include some reassuring findings. In a report published today in the *Journal of Hazardous Materials*, the researchers show that even if untreated water contained considerable quantities of nanoplastics, these particles were retained in sand filters very efficiently during water treatment. Both in laboratory tests and in a larger test facility located directly on the premises of the Zurich Water Works, the biologically active slow sand filter was the most effective at retaining nanoparticles – achieving an efficacy level in the region of 99.9%.

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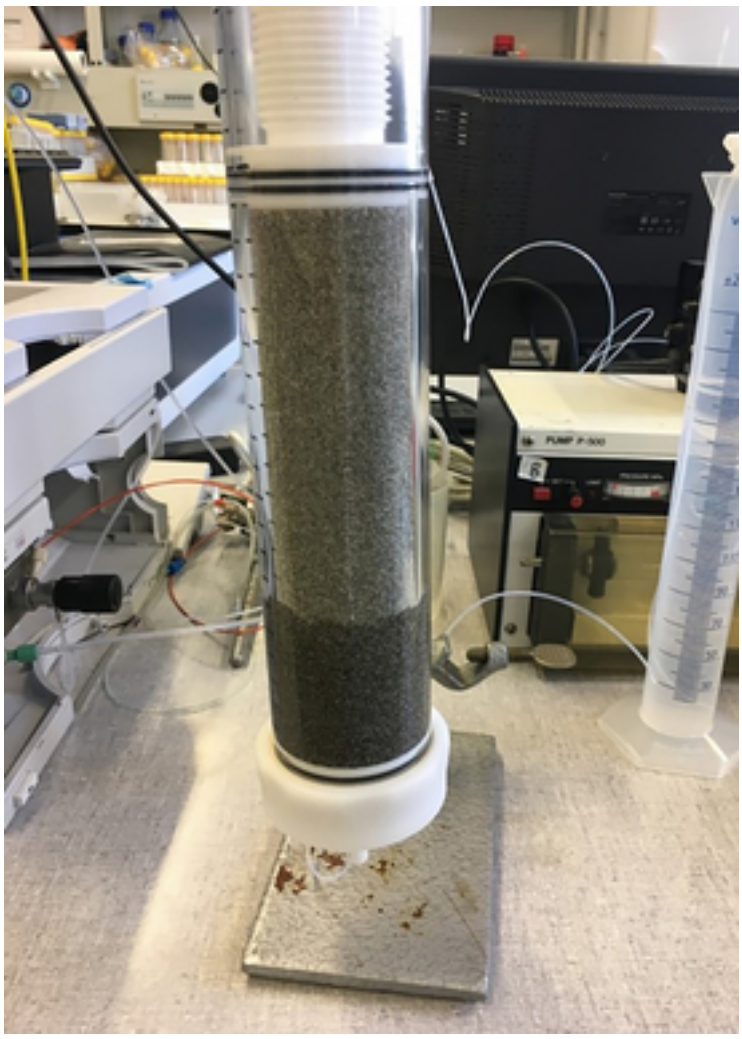

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Filtration column at the Eawag laboratory (left) and on the pilot scale at the lake water facility of the Zurich Water Works (WVZ) (right). (Photos: Eawag)

So far, there has only been limited research into how exactly nanoplastics are formed. “But it would appear that the degradation of larger plastic particles in the environment eventually results in nanoplastics,” says Ralf Kägi, Head of Eawag's Particle Laboratory. However, even the process of identifying nanoplastic particles is anything but easy. For this, the team of researchers from Eawag, ETH Zurich, EPFL and the Politecnico di Torino used labelled nanoplastic particles, whose route through – or final location in – the water treatment process could be tracked using a mass spectrometer. This process is similar to that used in medicine, where cancer cells are specifically labelled in order to monitor their potential distribution in the human body.

Modelling enables forecasts

The researchers took the experimental findings from small laboratory setups at Eawag and larger test facilities at the Zurich Water Works and combined them with complex theoretical model calculations. This allowed them to make predictions regarding the behaviour of nanoplastics in drinking water treatment facilities. One interesting finding for water companies is that the models indicate a very high level of nanoplastic elimination even over long periods

of time, such as when filters have a long operating life or long backwashing intervals.

Original study

Pulido-Reyes, G.; Magherini, L.; Bianco, C.; Sethi, R.; von Gunten, U.; Kaegi, R.; Mitrano, D. M. (2022) Nanoplastics removal during drinking water treatment: laboratory- and pilot-scale experiments and modeling, *Journal of Hazardous Materials*, 436, 129011 (13 pp.), doi:10.1016/j.jhazmat.2022.129011, Institutional Repository

Three questions to Ralf Kägi and Urs von Gunten

At first glance, it seems clear that plastic waste and larger plastic particles will eventually turn into nanoplastics in the environment. Is it that simple?

Ralf Kägi: Plastic was developed not to decompose. It's no great surprise, therefore, that we're now seeing plastic particles in the environment. More research is needed into how much and how quickly conventional types of plastic are broken down into smaller particles in the environment.

Third-party analyses failed to detect microplastics at the depths at which the lake water was collected (around 30 m), so we assume that almost no nanoplastics will exist there either. For our experiments, we had to add labelled nanoplastics to untreated water from Lake Zurich.

In Switzerland, lake water facilities are equipped with multi-stage treatment systems. However, there are some water companies that feed completely untreated groundwater into the network. Should consumers in those areas expect their drinking water to contain nanoplastics?
Urs von Gunten: When rain percolates into the subsoil, the water first passes through a layer of humus that contains biofilms, such as those in slow sand filtration. These biofilms have proven to be very effective at adsorbing nanoparticles in technical systems. When the water reaches the saturated region, it is also purified by huge sand and gravel filters. The concentration of nanoparticles in the pumped groundwater is therefore likely to be very low. The situation may be different with spring water, as this experiences a much weaker filtration effect than the pumped groundwater. However, given that the springs are largely located in areas with less anthropogenic influences (forests, mountainous areas), this water is only expected to exhibit low concentrations of nanoparticles. Moreover, it is common practice not to use spring water following intensive rainfall, as the turbidity increases rapidly. This measure also serves as a very effective barrier against undesired nanoparticles. Studies into microplastics and nanoplastics are currently underway for both groundwater and spring water.

Your study has produced some very optimistic findings. Do you think the headlines about nanoplastics in drinking water will disappear as a result?
Ralf Kägi: I suspect not. On the one hand, good news is always harder to communicate than bad news. On the other hand, drinking water – as a foodstuff – remains a sensitive area, and one that is full of scientifically unfounded or unprovable theories.

Cover picture: If lake water is filtered through sand filters, microplastics present in it would be efficiently retained. Lake Zurich. (Photo: Andri Bryner, Eawag)

Related Links

Topic page on microplastics

Ecotox Centre fact sheet: Mikroplastik in der Umwelt (Microplastics in the environment):

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Blick, 7 September 2017: Trinkwasser-Studie zu Mikroplastik «nicht glaubwürdig» (Drinking water study on microplastics “not credible”)

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https://www.eawag.ch/en/info/portal/news/news-archive/archive-detail/water-treatment-plants-would-be-ready-for-the-removal-of-nanoplastics