New filter removes run-off chemicals

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De-icing of aircraft pollutes the ground. Now, new filter technology will be tested against the problem at Sola Airport, after successful laboratory trials. Credit: Thinkstock

Surface water run-off in urban areas is often highly contaminated. It is therefore important to make it as clean as possible before it pollutes the natural environment.

SINTEF and NTNU have been conducting experiments with a new filter that can decontaminate surface run-off from airport runways. Following several laboratory tests, they have found that a correctly-designed filter

with an optimal filter medium can remove the chemicals used during de-icing. But the system can also be used in towns and cities where asphalt and other surface materials contribute to run-off that is often highly contaminated. This winter, the filter will be tested at Sola airport in south-west Norway.

Sucks up chemicals and polluted water

"In the lab, we tested the filter using samples of surface water from Værnes airport that contained chemicals and sediments," says SINTEF researcher Kamal Azrague. "The filter medium worked very well, but we saw that it was necessary to add some nutrients in order to enhance biological activity and make the decontamination process more efficient," he says.

Azrague is the man behind the experiments, in collaboration with his colleague Gema Raspati, NTNU Professor Tone Merete Muthanna and student Hanna Kristine Haug Lindseth.

The filter, which was originally used for water decontamination, has now been modified and tested, and will this winter be ready for use at Sola airport. This is important because the use of chemicals increases during the winter months, causing surplus water to contain higher concentrations of biologically decomposable organic materials. When it runs off into the fjord adjacent to the airport, it promotes biological activity and reduces the oxygen content of the seawater, thus reducing its quality.

Once the filter has removed the chemicals, these are then decomposed by the bacteria in the filter and end up as biological residues.

This research project is part of the "Klima 2050" programme organised by SINTEF and NTNU to address issues linked to the effects at airports

of increasing levels of climate change. Researchers are working together with Avinor and industrial partners Leca and the Skjæveland Group.

Originally used in wastewater systems

The filter is based on so-called filter bed technology. The device contains a filtering system that includes a bed of Filtralite, which is a specialised product manufactured by Leca for water and wastewater decontamination.

The advantage of this system, according to the researchers, is that it combines a large, moist surface area with a porous core that acts as an excellent habitat for the microorganisms used to remove the aircraft de-icing chemicals. Results so far indicate that a 20 centimetre-thick filter bed is the most efficient.

The company Storm Aqua (a subsidiary of the Skjæveland Group) has built the filter system containing Filtralite.

"We have implemented this in the pilot system that will be tested at Sola," says Raspati. "There we will see how the filter works in the real world," he says. "It will be exciting to see how much decontamination we can succeed in removing. If the results are positive, this system could be used at airports as a means of improving the ecosystems in adjacent fjords. Our industrial partners are also excited, and are envisaging major economic opportunities," says Raspati.

Testing for microplastics generated by car tyres

Originally, the researchers developed the filter only for use at airports, but it is now going to be tested for run-off decontamination in urban areas and for the recovery of chemicals generated along roads and in

tunnels.

They are already building a pilot that will be tested on the E6 motorway.

"Here the filter will remove contaminants such as heavy metals, organic environmental toxins, salt and particles from run-off water before they flow into rivers or seep into the groundwater system," says Azrague. "The filter is also designed to remove microplastics. This is important because plastic generated by car tyres is a major problem," he says.

However, when the filter is used for this purpose, it is not possible to use bacteria to decompose the unwanted compounds.

"The function of the filter here is to collect the particles and store them, thus preventing them from being released into the natural environment," says Azrague.

In towns and cities, the filter can be installed, among others, in sand traps as a component of so-called green drainage systems and in connection with porous road surfacing materials. In such systems, it will recover contaminants such as heavy metals, fuel run-off, microplastics, and other organic substances generated by road traffic.

"It is particularly important during the first rainfall following a dry period, because the filter then recovers the large volumes of contaminants that have accumulated on the asphalt since the last time it rained," says Azrague.

The SINTEF researchers have also tested the water capacity of the filter medium in connection with flooding events.

"In lab experiments, the filter medium has been shown to work over prolonged periods and recover large amounts of particles," say the

researchers. "However, in spite of the fact that this is a deep filtering device, there will be a risk of blockage. We will be looking at this more closely in the future," they say.

Provided by SINTEF