Duckweed as radioactive sponge

The green carpet of plants that grows on canals and ponds in the summer is duckweed. This little plant not only tinges the water green, it also has the property to filter radionuclides out of contaminated water.

> *“Our research shows that duckweed is very suitable to remove radionuclides from water.”*

Phytoremediation is the process whereby living plants are used for the decontamination of water, air and soil. “Our research focuses on the use of aquatic plants to remove radioactive particles from water”, explains researcher Nathalie Vanhoudt. “In certain situations, this can be preferable compared to conventional water treatment techniques, for example in the event of contamination with low doses of radioactivity. Once its use has been demonstrated on a small scale, we can develop a method to deploy aquatic plants for larger-scale remediation.”

Potential of aquatic plants

The project was launched in 2014. “Commissioned by ENGIE, we did desktop research into whether it would be possible to use plants, macro and micro algae, cyanobacteria and the dead matter originating from these organisms to remove radionuclides from contaminated water”, explains Nathalie Vanhoudt. “This research showed that a number of organisms, including aquatic plants, can potentially purify contaminated water.” In further research, the researchers focused on aquatic plants and radionuclides caesium-137 (Cs-137) and cobalt-60 (Co-60). The choice of these radionuclides is not haphazard. “Caesium-137 is released in serious nuclear disasters like Chernobyl. Kobalt-60, on the other hand, is rather found in other accident scenarios, for example whereby the cooling water of a nuclear plant is contaminated”, explains Nathalie.

Promising plant

This follow-up study show that three types of aquatic plants are suitable to remove radionuclides from water: water-lettuce, water hyacinth and duckweed, in this case common duckweed (*Lemna minor*). “Common duckweed was found to be the most promising aquatic plant in our tests”, says Nathalie. The small aquatic plant floats on the water and has 3 to 4 leaf blades, each maximum 5 mm long, from which a thin root reaches down in the water. “The little plants can remove a large amount of Cs-137 and Co-60 from the water very quickly. They also store a relatively large amount of these radionuclide per gram of biomass, whereby the amount of radioactive waste produced is minimised.”

Then the question arises: how does *Lemna minor* do that precisely? “Duckweed has tiny roots. The leaves grow quickly and have a large contact area. After shaking it a few times vigorously, you shake off a lot of the caesium or cobalt present. Therefore, we presume that it has mainly to do with adherence of these radionuclides to the plant, but further research will give us a better insight. How does the mechanism fit together? Does it work via active absorption via the root and leaves? Or is it mainly sorption?”, muses Nathalie.

Higher uptake

In this study, researchers at SCK•CEN compared living *Lemna minor* plants with their dead biomass. “According to scientific literature, dead *Lemna minor* biomass can remove radionuclides from contaminated water just as well, but that’s not what we have been observing so far in our research”, explains Nathalie. “Meanwhile, we have tweaked our test rig several times, but we still have no confirmation that dead biomass works as well.” However, Nathalie and her researcher colleagues could demonstrate that living biomass can remove a lot more cobalt than similar amounts of dead biomass. “For dead biomass, we reach 20 percent, for living plants 97 percent.”

The ‘Biosphere Impact Studies’ research group, of which Nathalie is a member, will expand this research to other radionuclides and mixtures of radionuclides and heavy metals. “We also want to develop a model that would enable us to predict the performance of *Lemna minor*”, concludes Nathalie.

“Lemna minor is already being used for the remediation of waste water.”

Practical applications

So, there is a lot going on as far as research is concerned, but what about practical applications? “Hopefully, we will be able to use *Lemna minor* to remove radionuclides from surface water following accidental scenarios and/or historical contamination on the one hand, and to remove them from waste water produced by industrial processes on the other hand. But first, you need to know and be able to predict the result of deploying such a plant for different scenarios”, says Nathalie Vanhoudt knowingly. “Otherwise, businesses can’t assess the potential of this water decontamination method. Moreover, *Lemna minor* is a very handy plant to work with: its amount doubles every two days and there are already duckweed harvesters on the market, because duckweed is already being used for the purification of normal waste water.”

Dedication

Our expertise for the benefit of humans and the environment

Our actions are based on Care and Respect. We invest in innovation and quality improvement to face the challenges for humans and the environment. This mindset is embedded in our DNA, flows through our veins. It is tightly interwoven in every single project we undertake. The constant guiding principle is that everything is based on our nuclear expertise.

Peter Baeten
Deputy Director-General