Title: Prediction of removal of Per- and Poly-fluoroalkyl Substances (PFAS) from drinking water by nanofiltration and reverse osmosis membranes: Analysing membrane flux variation over time and their ion removal efficiency

There are some harmful chemicals in the environment that pose significant health risks. These chemicals are called PFAS. Like many things, PFAS can end up in water and if that water is used as a drinking water source, PFAS can enter the human body and cause potential health issues including cancer and other chronic diseases. Therefore, it is important to ensure the safety of drinking water. To do this, water needs to be treated before using it for drinking purposes. Besides PFAS, there can be other harmful substances and minerals in the water that make it unsafe to drink. One way to treat water is through filtration, which helps separate the dirt or contaminants from the water.

Filtration can be considered as a filter paper that is used to make coffee, which separates the coffee grounds from the water. In water filtration, the water passes through membranes (similar to filter paper) that hold back the contaminants or dirt present/mixed in the water. There are different types of filter papers (membranes), and this study evaluated eight different water filter papers, known as nanofiltration (NF) and reverse osmosis (RO), to see how well they can remove the other contaminants from drinking water and thereby predict their effectiveness in removing PFAS.

Using a laboratory setup, the membranes were tested to measure their performance in terms of water flow and their ability to separate contaminants. The water quality was tested before and after filtration to determine how effective the filtration process was with the two different types of filter papers (membrane) used. It was found that NF membranes allowed more water to flow through over time because they have larger openings, similar to a coffee filter with bigger holes. The opposite was seen in the case of RO membranes because they have tighter openings, like a coffee filter with smaller holes. Because RO membranes have smaller openings, they were better at stopping contaminants from passing through, making the treated water much cleaner than water treated with NF membranes. However, one of the NF membranes also performed well at removing contaminants. As both NF and RO membranes were able to remove many contaminants, they are expected to be good at removing PFAS as well.

However, one limitation is that these membranes can get clogged over time. This is like filter paper getting dirty and jammed, making it harder for water to pass through. RO membranes usually have more of this problem because their openings are smaller, but this clogging behavior was not evident in this study. Membranes have another limitation; again, considering coffee filters, once coffee is ready, the coffee grains left on the paper are thrown afterwards in the waste, they cannot be broken down into smaller particles. Similarly, membrane filtration cannot break down the contaminants present in water and are released as waste which eventually end up in the environment.

Therefore, future research should focus on finding ways to minimize clogging and integrating new technologies with NF and RO membranes to break down these contaminants and make the treatment technologies even more effective.