emerging contaminants

Are PFCs the next public water concern?

By Thomas Palkon

Like other manmade chemicals that have been polluting our drinking water over the years, perfluorochemicals (PFC) are not naturally occurring chemicals; they were developed in a laboratory to meet an industry need. PFCs are carbon chains (typically four or eight carbon atoms) that are bonded to fluorine atoms. PFCs can be used as an ingredient in a manufacturing process or as part of a finished product. Companies have used them for a number of years for products that resist heat, oil, grease and water.

Table 1: Safe Eating Guidelines for Men & Women

Type of fish	How often can you eat it?
Fish Caught in Minnesota:	
Sunfish, crappie, yellow perch, bullheads	Unlimited amount
Walleyes, northern pike, smallmouth bass, largemouth bass, channel catfish, flathead catfish, white sucker, drum, burbot, sauger, carp, lake trout, white bass, rock bass, white fish, other species	1 meal a week
Commercial Fish:	
Limit the following species: shark, swordfish, tile fish, king mackerel	1 meal a month
In general, adults who eat fish only during vacation or one season can eat fish twice as often as recommended in these guidelines.	

Examples of these products include nonstick cookware; furniture and carpet that uses a stain-resistant treatment; clothing treated with water, stain or dirt repellents; packaged food containers or fast-food containers such as pizza boxes and microwave popcorn bags; makeup; and personal care products. As evident by the numerous products, a variety of industries use PFCs because of their vast number of applications.

Some of the most common PFC chemicals found in drinking water today include:

- Perfluorooctane sulfonate (PFOS);
- Perfluorooctanoic acid (PFOA);
- Perfluorobutanoic acid (PFBA);
- Perfluoropentanoic acid (PFPeA);
- Perfluorohexanoic acid (PFHxA);
- Perfluorobutane sulfonate (PFBS); and
- Perfluorohexane sulfonate (PFHxS).

These chemicals are very stable and soluble in water and do not degrade readily over time. Therefore, if they contaminate a water source—unless they are physically removed by a water treatment process—they will remain stable in the water supply for a number of years.

Where are PFCs Found?

Although most of the attention that has been raised concerning PFCs has come from the Minnesota Department of Health (MDH), it is important to recognize that PFCs have been found in the blood of species throughout the world. This fact demonstrates that PFC water contamination issues may reach much further than the Mississippi River or other lakes and rivers near Minneapolis and St. Paul, Minn.

Because PFCs are so stable, they will not break down over time in the natural environment. Some experts suggest that PFCs can even travel long distances through the air, deposit on soil and leach into groundwater.[1]

Documentation of groundwater contaminated with PFCs is not readily available. Most states and water utilities are not required to test for PFCs so it is unclear how widespread the problem may be.

Minnesota has found that fish from the Mississippi River, Lake Calhoun and the St. Croix River have tested positive for PFCs. The MDH has established a fish consumption guideline for fish from these waters on their website. The recommended consumption ranges from one meal per week to one meal per month.

It is important to note that PFCs found in contaminated water sources are at very low levels. The Minnesota water sources mentioned in this article that have tested positive for PFCs are safe to use for recreation such as swimming and boating. PFCs are not absorbed through the skin and the small amount of water ingested while swimming will not expose people to significant levels of PFCs.

Studies have also demonstrated that all species, even humans, have some level of PFCs in their blood. People are therefore exposed to PFCs

Corporate/Product Profile
Coway

About Coway

Founded in 1989, Coway is a global leader in the manufacturing of health and environment-related products that eternalizes a well-being for life philosophy which translates around the world. At its core, Coway develops and manufactures healthy-living products that promote a restorative and wholesome lifestyle.

The company owns and operates five overseas networks – China, Japan, Thailand, Malaysia and the United States – and intends on an European expansion in the near future. Their all-encompassing reach represents the accessibility and market impact of their consumer brand. A product line deep in innovation includes their award-winning water filtration system, water softener, air purifier and humidifier. Coway also produces a distinctive line of healthy living and bath electronics that include a vacuum cleaner, rice cooker, food waste treatment system, megasonic cleaning system, bidet and ionizer. With such an extensive product offering, Coway's position is solidified as the leader in the global wellness industry.

But it's not just the product line that gives Coway its stellar reputation. Coway places their customers first and has invested heavily in Research & Development to guarantee the finest, most advanced products in the market. With more than 200 R&D and quality management professionals on staff in three independent centers, COWAY ensures a 'quality first' commitment to their technology-oriented management and culture. Between its Environmental Technology Institute, Water Analysis & Research Center and Quality Management Institute, Coway produces a revolutionary product line and a rich customer service tradition.

Coway's water filtration units

Coway's flagship products, CHP-06DL and, P-06CR represent the most advanced water filtration systems in the world.

CHP-06DL:

The, *reddot design*, award winning CHP-06DL model offers the same top-notch Coway filtration, but comes in an ultra slim design to allow for space efficiency. This unit with contaminant-free air-tight tank also has several other key features such as an automatic temperature control, ensuring the best possible water temperature, one-touch three way valve system, one cup capacity of 120 to 300 ml pour with cold/hot/room temperature through one outlet, and hot water lock and alarm devices, preventing severe burns when accidentally or curiously activated by children.

P-06CR (Tankless Undersink Type):

With its maximum filtration efficiency, self-cleaning filter, P-06CR's tankless under-the-sink unit protects customers from any potential secondary contamination, providing a simple and effective way to access their drinking water. P-06CR contains the R/O membrane system and automatic overflow protection, allowing up to 700GPD and is the only product of its kind manufactured specifically for household usage.

Coway takes global vision to bring such integrity to the creation of products and services to the consumer marketplace. Through its R&D efforts, Coway has earned a reputation as a design and innovation leader, garnering some of the most prestigious awards in product design and technology, including Industrial Design Award, Technology Frontier Award and Good Design Award, several years running.

COWAY continually proves it is committed to producing innovative and quality products that reflect a healthy, eco-friendly lifestyle.

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everywhere they live. Even though it is not known how the PFCs have gotten into everyone's blood, the most likely cause is from food, water and air.

Are PFCs Safe to Drink?

There is not a lot of risk-assessment data that has been made available to the public concerning PFCs. Laboratory studies on animals have demonstrated PFCs are harmful to the liver and can cause cancer when exposed to high concentrations over long periods of time. Studies have also demonstrated that rats and mice exposed to PFCs while pregnant have developmental problems with their offspring.

There are few studies that have been published concerning the health effects in people that have been exposed to PFCs. There currently is a study underway of 70,000 people exposed to PFOA in drinking water in Ohio and West Virginia.

The U.S. Environmental Protection Agency, the MDH, the West Virginia Department of Environmental Protection and others have attempted to determine what level of PFCs in drinking water is safe. Due to limited toxicological research on PFCs, however, it has been difficult to determine what the safe level for PFCs should be in drinking water.

The MDH has issued Health Based Values (HBVs) for PFOA and PFOS. HBVs are criteria the MDH considers safe for human consumption over a lifetime. The level set by the MDH is 0.5 micrograms per liter (ppb) for PFOA and 0.3 ppb for PFOS. As additional toxicological studies are performed on PFC chemicals to determine their toxicity to humans, it is clear that additional regulatory agencies will be looking into setting allowable PFC levels for drinking water.

Can PFCs be Removed from Water?

Early evidence suggests that PFCs can be removed from drinking water using reverse osmosis (RO) or activated carbon technologies. Although limited testing has been conducted on POU systems for the reduction of PFCs, the testing that has been completed demonstrates that RO systems should do the job.

The MDH released a request for proposal from independent testing organizations for a study to evaluate the ability of point-of-use (POU) water treatment equipment to remove three PFCs from drinking water. The three PFCs are PFOS, PFOA and PFBA. The goal of this project is to provide research-based advice on which POU water treatment devices will likely be effective in reducing PFCs to acceptable levels.

The MDH proposed that the testing be conducted in two phases. Phase I would include laboratory testing of POU devices using spiked challenge water with the following characteristics:

- Test 1: PFOA and PFOS at concentrations of 3 ppb.
- Test 2: PFBA alone at a concentration of 10 ppb.
- Test 3: Mixture of all three at the same concentrations listed above.

The POU water treatment technologies included in the study were RO and under-the-counter or counter-top activated carbon filtration. The testing of RO and activated carbon POU systems was conducted in a similar manner to the testing procedures outlined in the NSF/ANSI standards 58 and 53, respectively.

Phase II testing would be conducted in the field using products that performed well during Phase I

testing, which took place on two municipal well houses in Minnesota that are known to have PFC contamination.

The passing requirements for Phase I and Phase II testing are to reduce influent PFC levels below 0.2 ppb for each individual PFC and less than 0.5 ppb for the sum of all PFCs under normal operating conditions for each POU device.

Water Science and Marketing, LLC, collaborated with the Water Quality Association (WQA) and were awarded the project. The WQA was utilized to execute Phase I of the project and Water Science and Marketing is executing Phase II.

Initial results of the study demonstrate that POU RO systems that utilize pre- and post-carbon filtration should reduce PFCs to nondetectable levels. Also, activated carbon systems reduced PFCs from the challenge water but the capacities of the units appear to be lower than expected.

Probable Removal Devices

The WQA has completed the first round of Phase I testing. Testing demonstrated that RO systems, without pre- and post-filters, were capable of reducing PFCs to acceptable levels. The WQA also determined that activated carbon filters also reduce PFCs in drinking water. Although activated carbon filters alone did not perform as well as RO membranes, the combination of RO membrane and activated carbon (how RO systems are typically sold today) should be an excellent means to remove PFCs to undetectable levels.

As additional testing is conducted on existing products, results are analyzed and equipment is modified, I am confident that the industry will continue to develop additional products and media to remove PFCs from drinking water in order to protect consumers from this new contaminant.

Now that the WQA has identified technologies that can effectively reduce PFCs in drinking water, the NSF/ANSI 53 and 58 standards need to be revised to include PFC reduction test parameters. Through the NSF standards writing process, the WQA plans to establish a task force to begin working on the development of a protocol for testing PFCs. Once the protocol has been adopted into the NSF/ANSI standards, companies will be able to evaluate their current products or newly developed products for their ability to reduce PFCs in drinking water. This will allow companies to receive a certified PFC reduction claim from their certification agency, which in turn will inform states and regulatory agencies of products that have been certified to reduce PFCs in drinking water. This will allow consumers the option of certified products that reduce PFCs in drinking water. *wqp*

References:

[1] *Hazardous Substances in Minnesota, Perfluorochemicals and Health*, August 2007. www.health.state.mn.us/divs/eh/hazardous/topics/pfcshealth.html.

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