Fact Sheet

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WCWC Walkerton Clean Water Centre
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CWAE Centre de Walkerton pour l'assainissement de l'eau
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PFAS in Water Systems: A Canadian Perspective

Key Words: Perfluoroalkyl substances, polyfluoroalkyl substances, synthetic chemicals

What is PFAS?

Perfluoroalkyl and polyfluoroalkyl substances (PFAS) are a large group of synthetic compounds that are used for various products, such as firefighting foams, cookware, flame retardants, and stain protectors and removers[1,2]. PFAS are made up of compounds arranged in long or short chains or in branches[3]. Longer chain PFAS are less water soluble and shorter chain PFAS are more water soluble[4]. PFAS are often referred to as the "forever chemicals"[5]. This group of chemicals are resistant to heat, water, oils, and grease, which allows them to be highly persistent in the environment and can accumulate in living tissues, taking several years to decades for the body to eliminate the group of chemicals[6].

What are PFOS and PFOA?

PFAS are a large group of synthetic compounds that include perfluorooctane sulfonate (PFOS) and perfluoroctanoic acid (PFOA) and many other compounds. Each compound has different characteristics and health effects. PFOS and PFOA are the two most studied chemicals[7].

PFOS is water soluble and is not volatile nor metabolized[8].

PFOA is found in stain/water-resistant coatings, in firefighting foams, stain removers, and non-stick coatings on cookware[9]. Elevated levels of PFOA have been detected in surface water near fluorochemical manufacturing plants[9].

In Canada, PFOS and PFOA can be found in dust and drinking water; but the main exposure is from food and consumer products[8,9]. When found in surface water or groundwater it is typically associated with the use of firefighting foam or near discharges from industrial facilities, wastewater and stormwater[8,9] (Figure 1). Due to the persistent nature of PFOS and PFOA, the chemical can enter drinking water wells by leaching into groundwater[8,9].

Canada has prohibited the manufacture, import, sale, and use of PFOS and PFOA, with exceptions for specific applications such as firefighting foam or certain water-based inks and photo coatings[8,9].

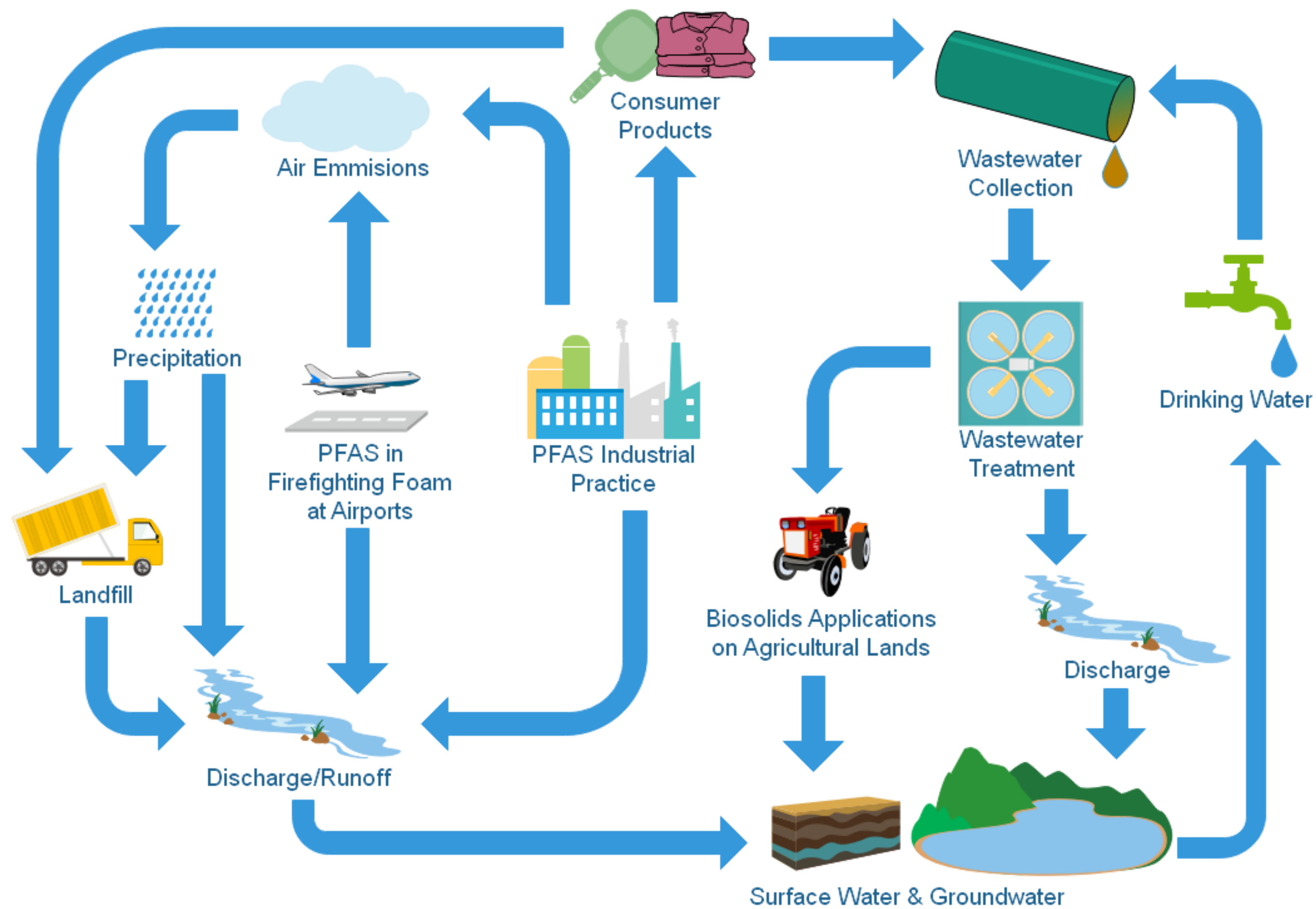

Figure 1. PFAS have been introduced into the environment by consumer products, firefighting training activities at airports, industrial practices, wastewater treatment discharge and biosolid applications on pasture lands. The persistent nature of these chemicals allows them to remain in the environment for a long time after they are introduced.

Health Effects

There have been no clear links with the carcinogenicity of PFOS; however, PFOA is classified as possibly carcinogenic to humans (Class 2B, International Agency for Research on Cancer)[8,9].

PFOS and PFOA are associated with high cholesterol, hormone disruption, auto-immune disorders, thyroid disorders, liver and kidney complications, and pregnancy complications[5,7].

It takes approximately 5.4 years for PFOS and 2.9 - 8.5 years for PFOA to reduce their concentration by half in the human body[3].

Health Canada has set a maximum acceptable concentration (MAC) of 0.0006 mg/L and 0.0002 mg/L of perfluorooctane sulfonate (PFOS) and perfluoroctanocic acid (PFOA), respectively[8,9].

Wastewater and PFAS

PFAS are frequently detected in discharges from wastewater treatment plants and are considered a major contributor of PFAS in drinking water plant intakes[10]. In Canada, PFAS was measured in liquid and solid waste from 20 wastewater treatment plants and found higher PFAS levels at warmer temperatures and in processes with longer retention times[11]. Some studies have found that PFAS can be formed in wastewater processes from precursors found in raw sewage entering these plants[11]. Applying PFAS-rich biosolids to land can cause plants to take up the compounds, possibly contaminating agricultural lands[10].

Drinking Water and PFAS

Although full-scale studies are limited, conventional treatment, such as coagulation, flocculation and sedimentation, or microfiltration and ultrafiltration are not effective at removing PFAS[3,8,9]. Additionally, typical oxidation and disinfection conditions do not remove PFAS[6].

Granular activated carbon (GAC) can remove PFAS to below the MAC, but the effectiveness can be reduced in water containing high concentrations of organics[8]. Longer chain PFAS will adsorb to GAC better than shorter chain PFAS[3]. The performance of GAC decreases as the media ages, therefore GAC may need to be replaced more frequently to maintain PFAS removal[3,6].

Reverse osmosis and nanofiltration can substantially reduce PFAS due to molecular weight cut-off/pore size exclusion[3,8]. However, waste from these processes is concentrated and disposal requirements need to be considered[3].

Anion exchange consists of resin that removes negatively charged ions[3]. PFAS can be reduced by anion exchange resin and its effectiveness can vary based on the resin characteristics and whether the PFAS consist of predominately shorter or longer chains[3,8].

Although there are no residential treatment units that are certified to remove PFAS, it is expected that point-of-use water treatment options, such as GAC, reverse osmosis, and nanofiltration may be effective[8]. However, site-specific conditions need to be considered when selecting drinking water treatment options to reduce PFAS[12].

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