Fluorochemical Removal by Home Filtration Devices
November 10, 2017

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Sampling Information:

Location:	[redacted]Country Club Road Wilmington, NC 28403
Date:	8/4/17
Time:	3:30pm
Sample Collector:	John Merrill (NCSU)
Sample Analyst:	Zachary Hopkins (NCSU)
Contact Name:	[redacted]
Phone:	[redacted]
Email:	[redacted]
Water Provider:	Cape Fear Public Utility Authority (CFPUA)
Primary Source:	Sweeney WTP (Cape Fear River)

*Treatment Systems:

Under the sink filter:	Hydroviv Tailored Tapwater
Installation: 6/21/17	
Inline refrigerator filter:	Hydroviv Tailored Tapwater
Installation: 6/20/17	
Refrigerator filter:	HDX Whirlpool 3
Installation: 6/20/17	

*As reported by location contact

Case Narrative:

On August 4, 2017 three water samples were taken from [redacted] Country Club Road, Wilmington, NC 28403, including (1) a sample treated by a Hydroviv Tailored Tapwater under the sink filter, (2) a sample treated by a Hydroviv Tailored Tapwater inline filter and a HDX Whirlpool 3 filter, and (3) a sample of untreated tap water. The samples were analyzed for fluorochemicals by liquid chromatography tandem mass spectrometry (LC-MS/MS). Fluorochemicals detected by LC-MS/MS are listed in Table 1. For each fluorochemical, the limit of quantification (LOQ) was 10 ppt (parts-per-trillion); any concentration below the LOQ is shown as <10 ppt.

Removal by Under the Sink Device:

Compounds with analytical standards. As shown in Table 2 and in Figure 1, GenX was measured in the tap water sample at a concentration of 66 ppt; the GenX concentration was below the LOQ (<10 ppt) in the water sample treated by the under the sink device. Therefore, the GenX removal efficiency of this device was >84%. The sum concentration of all fluorochemicals, for which analytical standards are available, was 206 ppt in the tap water sample, and each fluorochemical, for which analytical standards are available, was below the LOQ (<10 ppt) in the water sample treated by the under the sink device.

Compounds without analytical standards. As shown in Table 2 and in Figure 2, the summed peak area counts for all targeted fluorochemicals in the tap water sample was 53,029, with the dominant fluorochemicals being perfluoro-2-methoxyacetic acid (PFMOAA) and Nafion byproduct 2 (Nafion BP2). The summed peak area counts for all targeted fluorochemicals in the water sample treated by the under the sink device was 303. Therefore, the overall fluorochemical removal efficiency of this device was 99%. Generally, a larger chromatographic peak area count is associated with a higher concentration.

Removal by Refrigerator Devices:

Compounds with analytical standards. As shown in Table 2 and in Figure 3, the GenX concentration was below the LOQ (<10 ppt) in the water sample treated by the inline and refrigerator devices. Therefore, the combined GenX removal efficiency of these two devices was >84%. Each fluorochemical, for which analytical standards are available, was below the LOQ (<10 ppt) in the water sample treated by the inline and refrigerator devices.

Compounds without analytical standards. As shown in Table 2 and Figure 4, the summed peak area counts for all targeted fluorochemicals in the water sample treated by the inline and refrigerator devices was 2,093. Therefore, the combined overall fluorochemical removal efficiently of these two devices was 96%

Table 1. Fluorochemicals detected by LC-MS/MS analysis.

Compound	Molecular Weight	Formula	CAS #
Perfluorocarboxylic acids (PFCAs)			
Perfluorobutanoic acid (C4)	214.0	$C_4HF_7O_2$	375-22-4
Perfluoropentanoic acid (C5)	264.0	$C_5HF_9O_2$	2706-90-3
Perfluorohexanoic acid (C6)	314.1	$C_6HF_{11}O_2$	307-24-4
Perfluoroheptanoic acid (C7)	364.1	$C_7HF_{13}O_2$	375-85-9
Perfluorooctanoic acid (C8)	414.1	$C_8HF_{15}O_2$	335-67-1
Perfluorononanoic acid (C9)	464.1	$C_9HF_{17}O_2$	375-95-1
Perfluorodecanoic acid (C10)	514.1	$C_{10}HF_{19}O_2$	335-76-2
Perfluorosulfonic acids (PFSAs)			
Perfluorobutane sulfonic acid (PFBS)	300.1	$C_4HF_9SO_3$	375-73-5
Perfluorohexane sulfonic acid (PFHxS)	400.1	$C_6HF_{13}SO_3$	355-46-4
Perfluorooctane sulfonic acid (PFOS)	500.1	$C_8HF_{17}SO_3$	1763-23-1
Perfluoroalkyl ether carboxylic acids with one ether group (mono-ether PFECAs)			
*Perfluoro-2-methoxyacetic acid (PFMOAA)	180.0	$C_3HF_5O_3$	674-13-5
Perfluoro-3-methoxypropanoic acid (PFMOPrA)	230.0	$C_4HF_7O_3$	377-73-1
Perfluoro-4-methoxybutanoic acid (PFMOBA)	280.0	$C_5HF_9O_3$	863090-89-5
Perfluoro-2-propoxypropanoic acid (GenX)	330.1	$C_6HF_{11}O_3$	13252-13-6
Perfluoroalkyl ether carboxylic acids with multiple ether groups (multi-ether PFECAs)			
*Perfluoro(3,5-dioxahexanoic) acid (PFO2HxA)	246.0	$C_4HF_7O_4$	39492-88-1
*Perfluoro(3,5,7-trioxaoctanoic) acid (PFO3OA)	312.0	$C_5HF_9O_5$	39492-89-2
*Perfluoro(3,5,7,9-tetraoxadecanoic) acid (PFO4DA)	378.1	$C_6HF_{11}O_6$	39492-90-5
Perfluoroalkyl ether sulfonic acids (PFESAs)			
*Nafion byproduct 2 (Nafion BP2)	463.9	$C_7H_2F_{14}O_5S$	n/a

*No available authentic analytical standard

Table 2. Concentrations and chromatographic peak area counts of fluorochemicals. (1) Hydroviv Tailored Tapwater under the sink filter and (2) Hydroviv Tailored Tapwater inline filter and HDX Whirlpool filter.

	GenX	Fluorochemicals with analytical standards	All fluorochemicals
Tap Water	66 ppt	206 ppt	53,029 peak area counts
1	<10 ppt	<10 ppt	303 peak area counts
2	<10 ppt	<10 ppt	2093 peak area counts

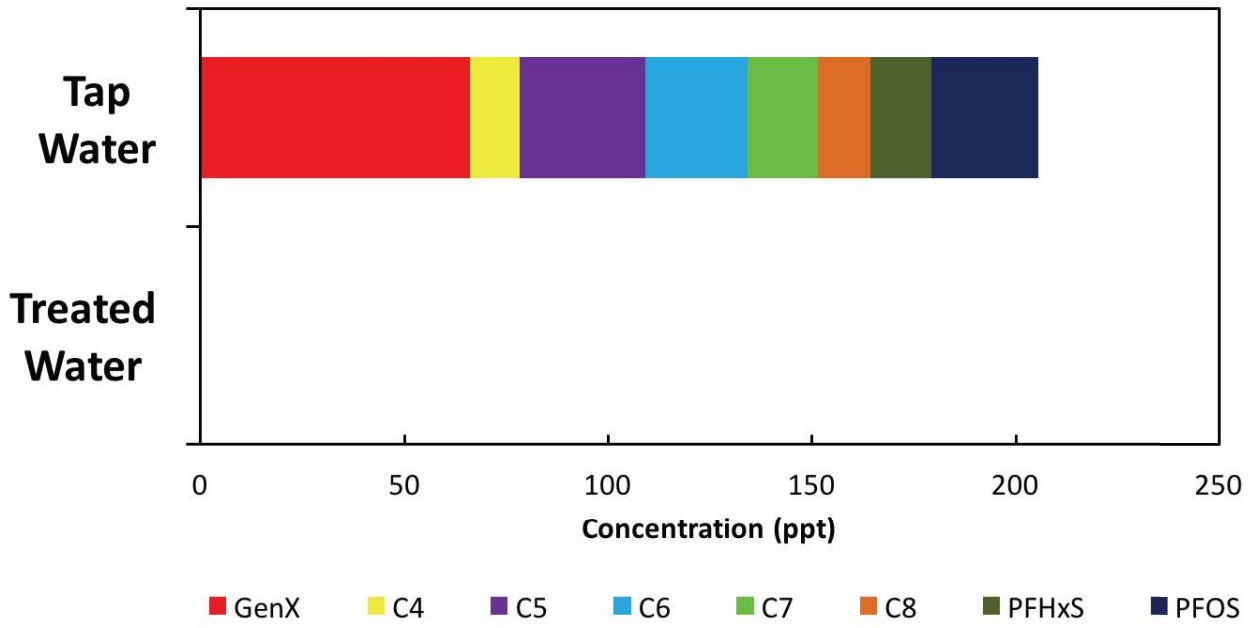

Figure 1. Concentrations of fluorochemicals with analytical standards. Only fluorochemicals with concentrations above the LOQ (>10 ppt) are presented. (Device: Hydroviv Tailored Tapwater under the sink filter)

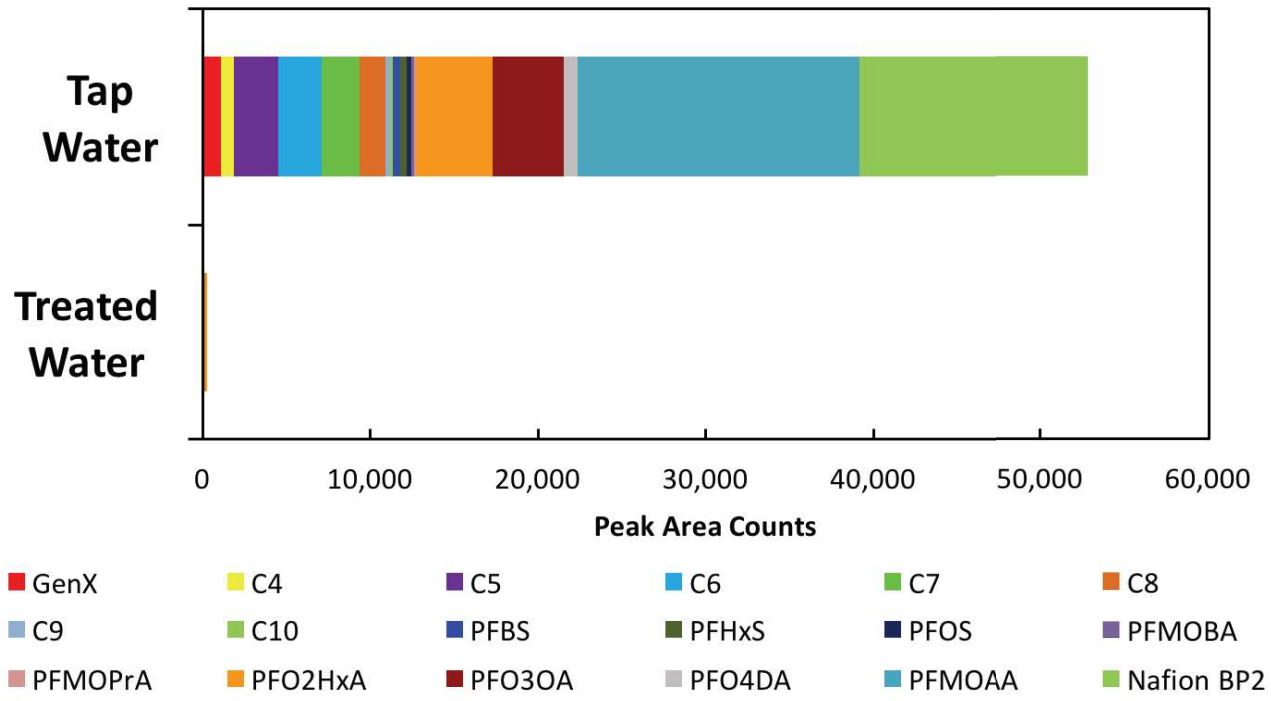

Figure 2. Chromatographic peak area counts for all detected fluorochemicals. (Device: Hydroviv Tailored Tapwater under the sink filter)

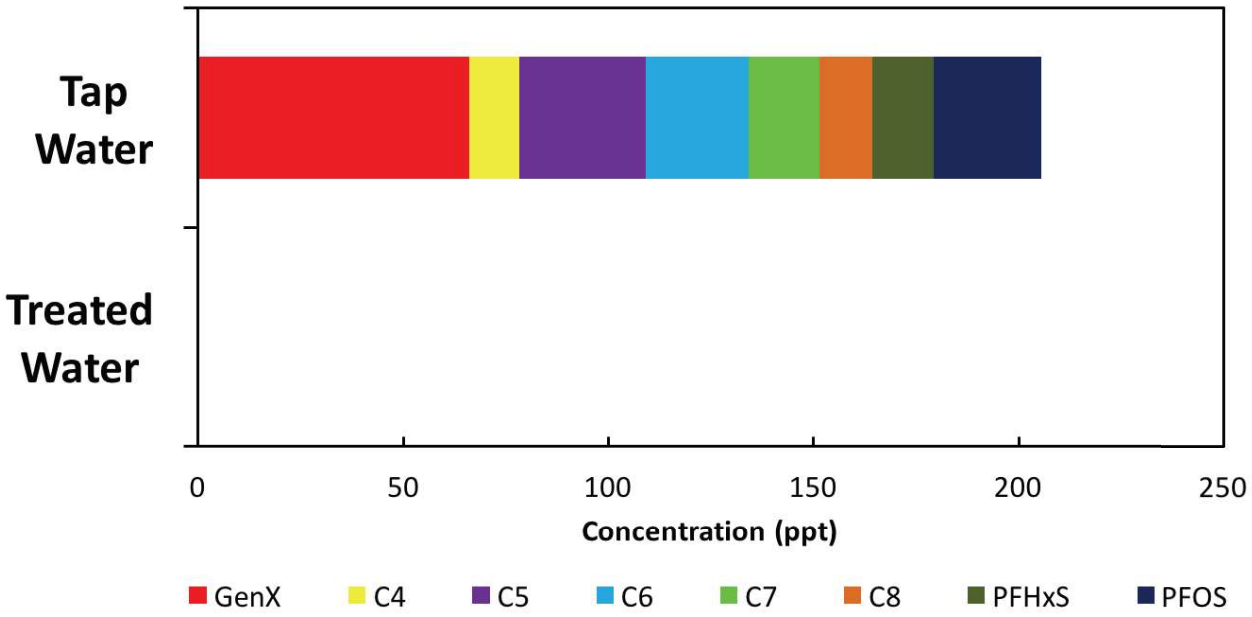

Figure 3. Concentrations of fluorochemicals with analytical standards. Only fluorochemicals with concentrations above the LOQ (>10 ppt) are presented. (Devices: Hydroviv Tailored Tapwater inline filter and HDX Whirlpool filter)

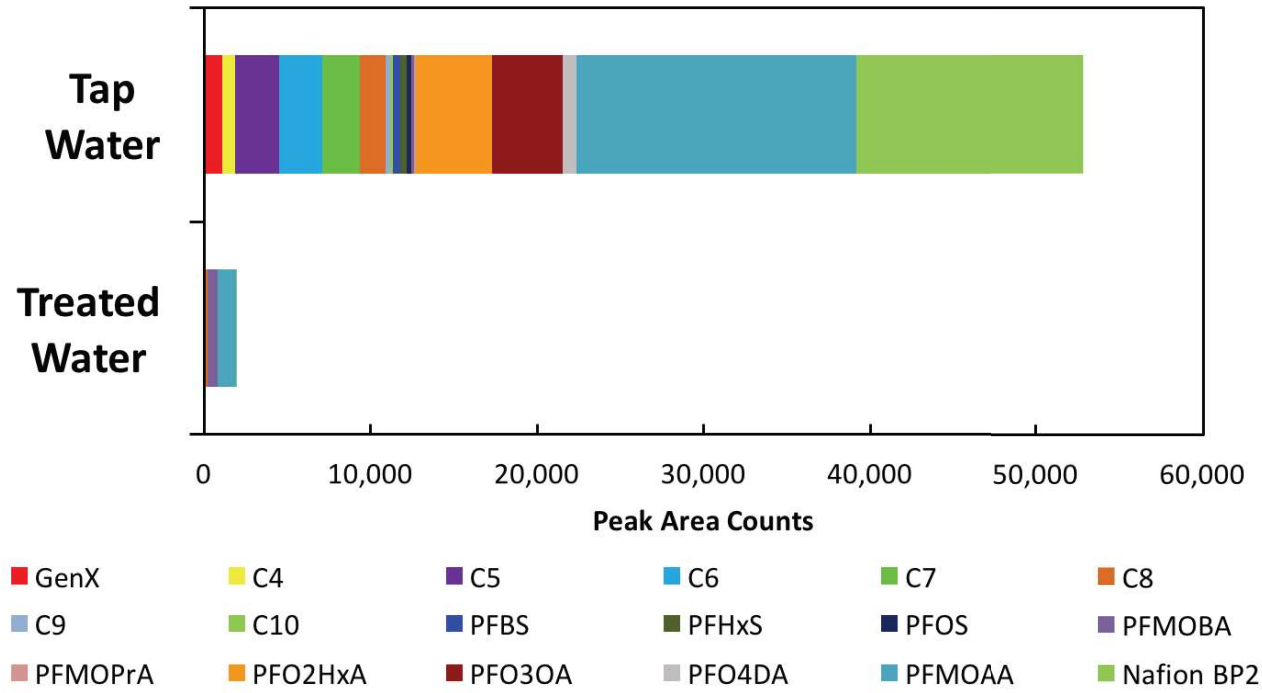

Figure 4. Chromatographic peak area counts for all detected fluorochemicals. (Devices: Hydroviv Tailored Tapwater inline filter and HDX Whirlpool filter)