

Fluorochemical Removal by Household Filters
April 7, 2018

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Sampling Information:

Location: [REDACTED] Country Club Road
Wilmington, NC 28403

Date: 12/19/17

Time: 10:15 a.m.

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 (Installed: 6/21/17)

Refrigerator filter 1: Hydroviv Tailored Tapwater (Installed: 6/20/17)

Refrigerator filter 2: HDX Whirlpool 3 (Installed: 6/2/17)

*As reported by location contact

Case Narrative:

On December 19, 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 and HDX Whirlpool 3 refrigerator filters, 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 Filter:

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 40 ppt; the GenX concentration was below the LOQ (<10 ppt) in the water sample treated by the under the sink filter. Therefore, the GenX removal efficiency of this filter was >75%. The sum concentration of all fluorochemicals, for which analytical standards are available, was 213 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 filter.

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 20,705; the summed peak area counts for all targeted fluorochemicals in the water sample treated by the under the sink filter was 590. Therefore, the overall fluorochemical removal efficiency of this filter was 97%. Generally, a larger chromatographic peak area count is associated with a higher concentration.

Removal by Refrigerator Filter:

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 refrigerator filters. Therefore, the combined GenX removal efficiency of these two filters was >75%. Each fluorochemical, for which analytical standards are available, was below the LOQ (<10 ppt) in the water sample treated by the refrigerator filters.

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 refrigerator filters was 186. Therefore, the combined overall fluorochemical removal efficiency of these two filters was 99%.

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

Compound	Molecular Weight	Formula	CAS #
Perfluorocarboxylic acids (PFCAs)			
Perfluorobutanoic acid (C4)	214.0	C ₄ HF ₇ O ₂	375-22-4
Perfluoropentanoic acid (C5)	264.0	C ₅ HF ₉ O ₂	2706-90-3
Perfluorohexanoic acid (C6)	314.1	C ₆ HF ₁₁ O ₂	307-24-4
Perfluoroheptanoic acid (C7)	364.1	C ₇ HF ₁₃ O ₂	375-85-9
Perfluorooctanoic acid (C8)	414.1	C ₈ HF ₁₅ O ₂	335-67-1
Perfluorononanoic acid (C9)	464.1	C ₉ HF ₁₇ O ₂	375-95-1
Perfluorodecanoic acid (C10)	514.1	C ₁₀ HF ₁₉ O ₂	335-76-2
Perfluorosulfonic acids (PFSA)			
Perfluorobutane sulfonic acid (PFBS)	300.1	C ₄ HF ₉ SO ₃	375-73-5
Perfluorohexane sulfonic acid (PFHxS)	400.1	C ₆ HF ₁₃ SO ₃	355-46-4
Perfluorooctane sulfonic acid (PFOS)	500.1	C ₈ HF 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 ₃ HF ₅ O ₃	674-13-5
Perfluoro-3-methoxypropanoic acid (PFMOPrA)	230.0	C ₄ HF ₇ O ₃	377-73-1
Perfluoro-4-methoxybutanoic acid (PFMOBA)	280.0	C ₅ HF ₉ O ₃	863090-89-5
Perfluoro-2-propoxypropanoic acid (GenX)	330.1	C ₆ HF 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 ₄ HF ₇ O ₄	39492-88-1
*Perfluoro(3,5,7-trioxaoctanoic) acid (PFO3OA)	312.0	C ₅ HF ₉ O ₅	39492-89-2
*Perfluoro(3,5,7,9-tetraoxadecanoic) acid (PFO4DA)	378.1	C ₆ HF ₁₁ O ₆	39492-90-5
Perfluoroalkyl ether sulfonic acids (PFESAs)			
*Nafion byproduct 2 (Nafion BP2)	463.9	C ₇ H ₂ F ₁₄ O ₅ S	n/a

*No available authentic analytical standard

Table 2. Concentrations and chromatographic peak area counts of fluorochemicals. (Filters: (1) Hydroviv Tailored Tapwater under the sink filter and (2) Hydroviv Tailored Tapwater and HDX Whirlpool 3 refrigerator filters)

	GenX	Fluorochemicals with analytical standards	All fluorochemicals
Tap water	40 ppt	213 ppt	20,705 peak area counts
Treated 1	<10 ppt	<10 ppt	590 peak area counts
Treated 2	<10 ppt	<10 ppt	186 peak area counts

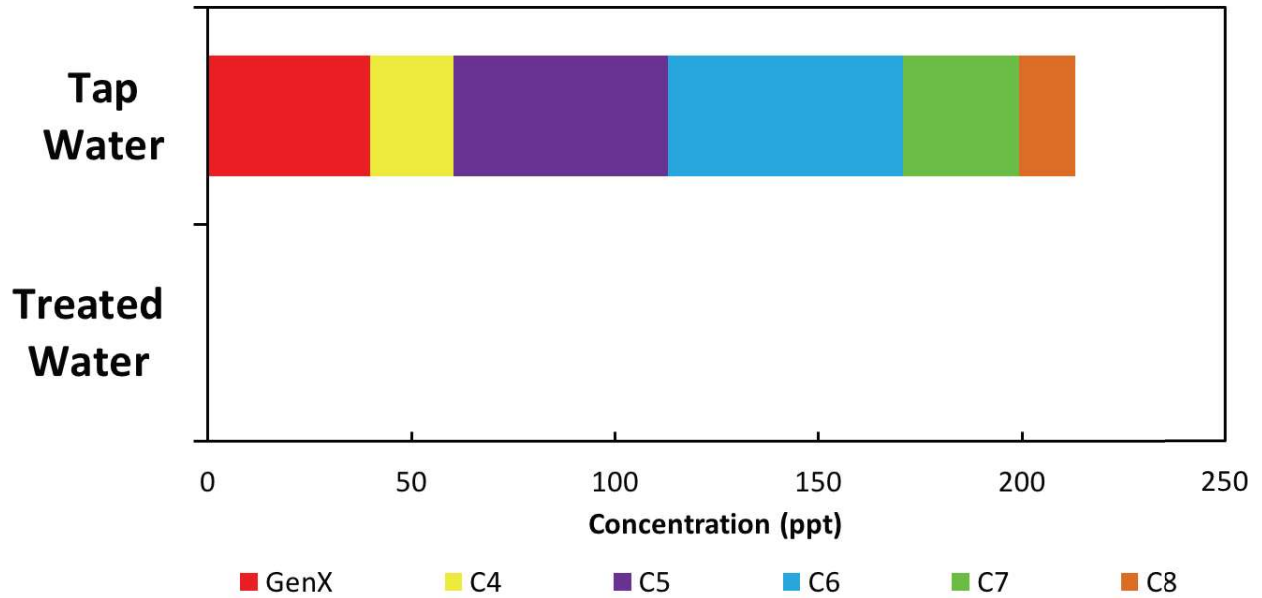


Figure 1. Concentrations of fluorochemicals with analytical standards. Only fluorochemicals with concentrations above the LOQ (>10 ppt) are presented. (Filter: Hydroviv Tailored Tapwater under the sink filter)

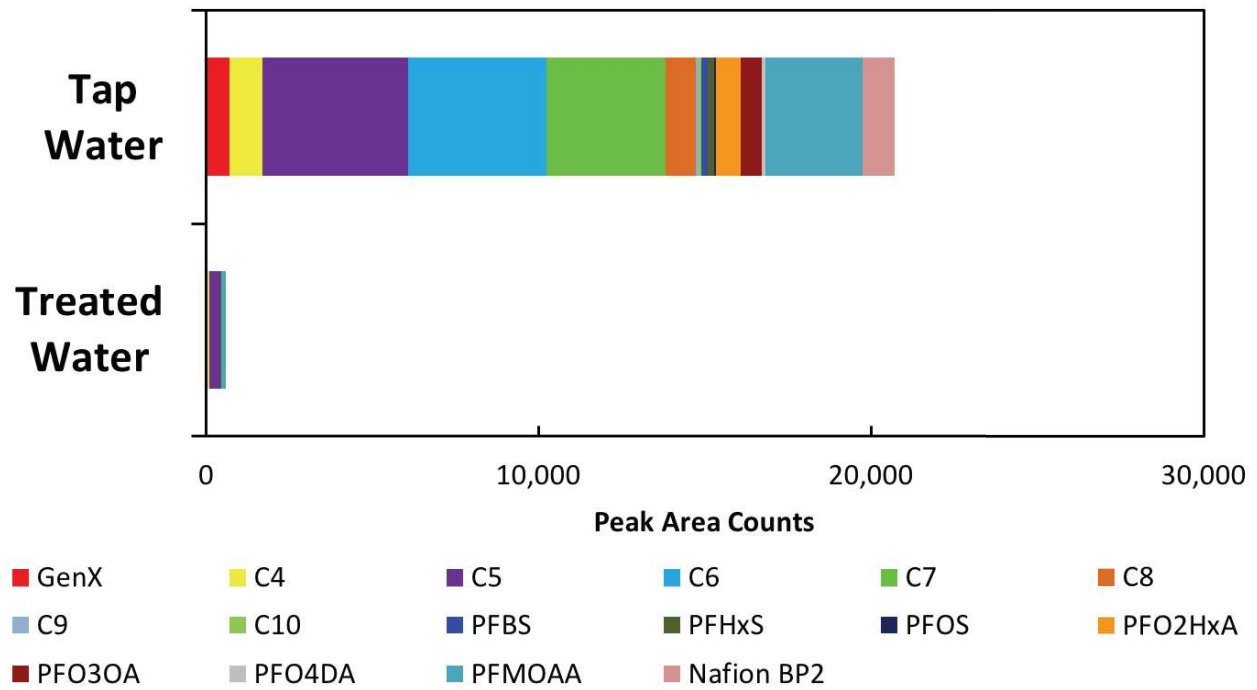


Figure 2. Chromatographic peak area counts for all detected fluorochemicals. (Filter: Hydroviv Tailored Tapwater under the sink filter)

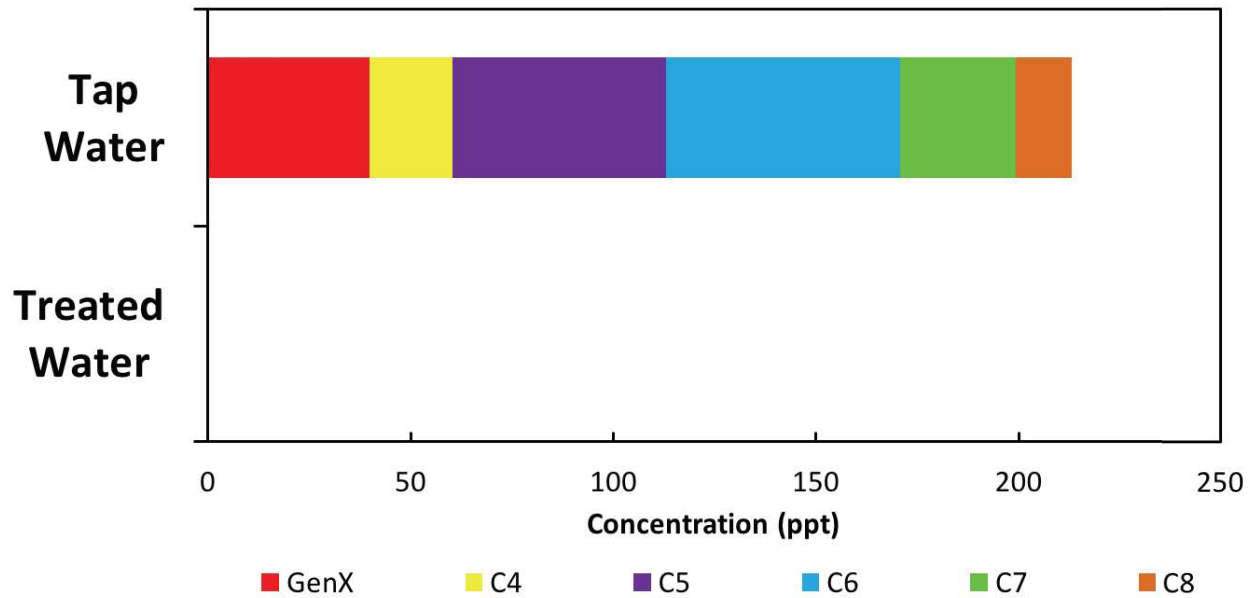


Figure 3. Concentrations of fluorochemicals with analytical standards. Only fluorochemicals with concentrations above the LOQ (>10 ppt) are presented. (Filters: Hydroviv Tailored Tapwater and HDX Whirlpool refrigerator filters)

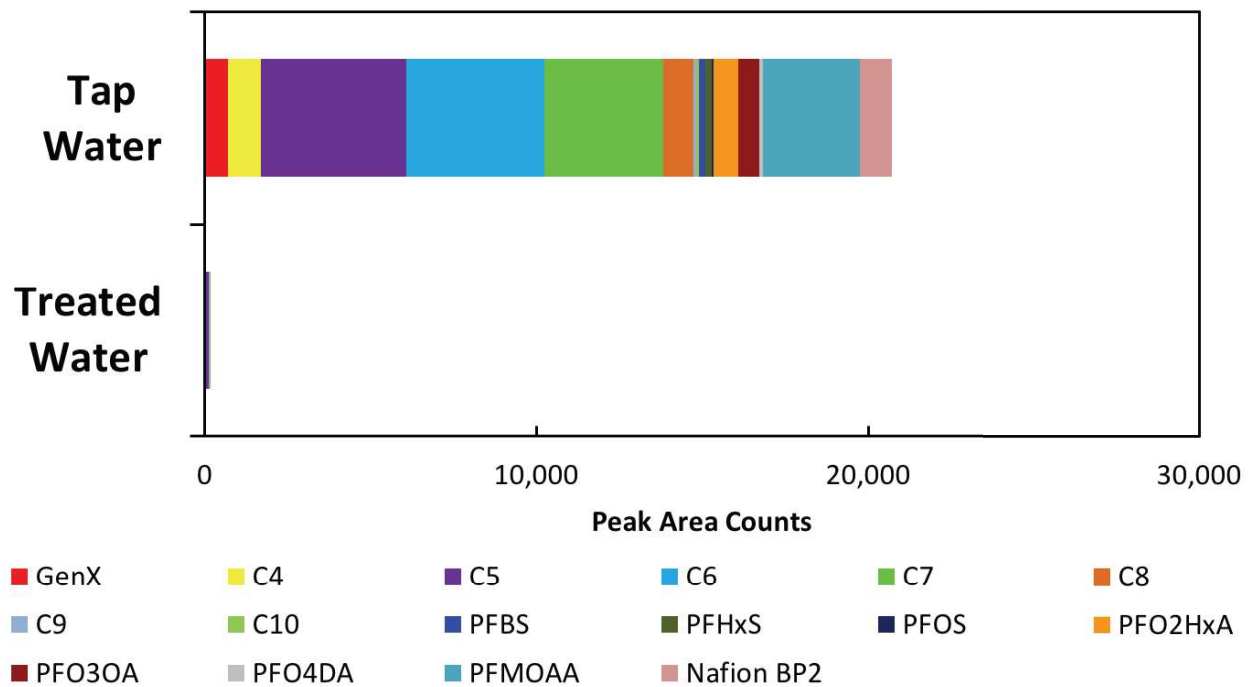


Figure 4. Chromatographic peak area counts for all detected fluorochemicals. (Filters: Hydroviv Tailored Tapwater and HDX Whirlpool refrigerator filters)