

PROGRESS UPDATE NO. 5

Emerging Contaminants Treatment Strategy Pilot Study

B&V PROJECT NO. 196369



PREPARED FOR

Cape Fear Public Utility Authority

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1.0 Purpose

This document presents the status of ongoing bench- and pilot-scale testing to evaluate the performance of several proposed treatment technologies in their removal of perfluoroalkyl substances (PFASs), including perfluoro-2-propoxypropanoic acid (commonly known as GenX).

2.0 Introduction

PFASs have been detected in the Cape Fear River, which is the source of raw water for the Sweeney Water Treatment Plant (WTP). The Sweeney WTP provides drinking water to Cape Fear Public Utility Authority (CFPUA) customers in the city of Wilmington and New Hanover County in North Carolina.

In response to the detection of GenX and other PFASs in the Cape Fear River and because of concern over potential health effects, CFPUA is proactively investigating the feasibility and effectiveness of PFAS removal technologies. CFPUA is one of the first utilities in the United States to pursue treatment to target removal of these compounds. Initial evaluations performed by Black & Veatch were provided in Technical Memoranda 1 and 2. As a result of those evaluations, bench- and pilot-scale testing of granular activated carbon (GAC) filter media and ion exchange (IX) resins was initiated. The details of the bench- and pilot- scale testing are presented herein.

3.0 Testing and Analysis

Granular activated carbon filter media and ion exchange resin were selected for bench- and pilot-scale testing. Reverse osmosis/nanofiltration was excluded because of much higher life-cycle cost and potential challenges related to disposal of the concentrate, but the technology will be considered if testing of GAC and IX fail to meet testing goals. The following sections provide information on the testing.

3.1 TESTING GOALS

The primary goal of the testing is to establish the adsorption characteristics for PFASs and other contaminants of emerging concern (CECs) on GAC media and IX resin. These characteristics will be used to refine the previous study-related evaluations and identify the most advantageous short- and longer-term treatment strategies for removal of PFASs and CECs at the Sweeney WTP. The data will help define a design basis for full-scale implementation of the selected technology. Ancillary benefits are also being identified as part of the study, such as reductions in total organic carbon (TOC), disinfection byproduct (DBP) formation, and inorganic compounds.

3.2 MEANS AND METHODS

Means and methods for the bench- and pilot-scale testing were included in a previous progress report dated Nov. 3, 2017. Refer to the previous report for details.

3.3 PILOT MODIFICATIONS

The configuration of the pilot columns was modified for the second phase of testing in mid-January. Refer to the Project Update No. 4, dated Feb. 26, 2018 for details.

3.4 GAC INTERIM RESULTS TO DATE

Operation of the second phase of piloting for GAC began on Jan. 16, 2018. Interim results of the pilot testing are presented in Table 3-1.

3.5 IX INTERIM RESULTS TO DATE

Column 9 began operation on Jan. 9, 2018. Columns 7 and 8, which are run in series, began operation on Jan. 17, 2018. Interim results of the pilot testing are presented in Table 3-1. Test results on column 8 are not yet available.

Table 3-1 Sampling Results as of March 13, 2018

	Column Influent	Col. 7 IX	Col. 9 IX	Col. 10 GAC	Col. 11 GAC	Col. 12 GAC	Col. 13 GAC
Bed Volumes	---	53,100	60,800	8,000	8,000	8,000	8,000
Empty Bed Contact Time (min)	---	1.5	1.5	10	10	10	10
Perfluoroalkyl Carboxylic Acids (PFCAs)	ng/L	Percent Breakthrough					
PFBA	10	115	111	88	ND	125	118
PFPeA	22	105	85	60	ND	100	70
PFHxA	29	37	11	44	ND	74	41
PFHpA	21	ND	ND	31	ND	46	21
PFOA	11	ND	ND	27	ND	35	ND
PFNA	2.1	ND	ND	ND	ND	ND	ND
PFDA	ND	ND	ND	ND	ND	ND	ND
PFUdA	ND	ND	ND	ND	ND	ND	ND
PFDoA	ND	ND	ND	ND	ND	ND	ND
PFTTrDA	ND	ND	ND	ND	ND	ND	ND
PFTeDA	ND	ND	ND	ND	ND	ND	ND
Perfluoroalkyl Sulfonates (PFSs)	ng/L	Percent Breakthrough					
PFBS	3.4	ND	ND	ND	ND	ND	ND
PFPeS	ND	ND	ND	ND	ND	ND	ND
PFHxS	5.5	ND	ND	ND	ND	ND	ND
PFHpS	ND	ND	ND	ND	ND	ND	ND
PFOS	12	ND	ND	ND	ND	ND	ND
PFNS	ND	ND	ND	ND	ND	ND	ND
PFDS	ND	ND	ND	ND	ND	ND	ND
Perfluoroalkyl Sulfonamides (PFSAs)	ng/L	Percent Breakthrough					
PFOSA	ND	ND	ND	ND	ND	ND	ND

	Column Influent	Col. 7 IX	Col. 9 IX	Col. 10 GAC	Col. 11 GAC	Col. 12 GAC	Col. 13 GAC
Bed Volumes	---	53,100	60,800	8,000	8,000	8,000	8,000
Empty Bed Contact Time (min)	---	1.5	1.5	10	10	10	10
Perfluoroalkyl Ether Carboxylic Acids (PFECAs)	ng/L	Percent Breakthrough					
PFMOAA*	890 (Est.)	146	157	74	4	99	146
PFMOPrA*	ND	ND	ND	ND	ND	ND	ND
PFO2HxA*	58 (Est.)	207	96	45	ND	38	60
PFMOBA*	ND	ND	ND	ND	ND	ND	ND
PFO3OA*	23 (Est.)	70	ND	ND	ND	ND	ND
PFPrOPrA/GenX	20	70	ND	60	ND	95	65
PFO4DA*	13 (Est.)	ND	ND	ND	ND	ND	ND
Other Per- and Polyfluorinated Compounds	ng/L	Percent Breakthrough					
ADONA	ND	ND	ND	ND	ND	ND	ND
F-53B Major	ND	ND	ND	ND	ND	ND	ND
F-53B Minor	ND	ND	ND	ND	ND	ND	ND
Nafion Byproduct 1*	ND	ND	ND	ND	ND	ND	ND
Nafion Byproduct 2*	12 (Est.)	ND	ND	ND	ND	ND	ND
N-MeFOSAA	ND	ND	ND	ND	ND	ND	ND
N-EtFOSAA	ND	ND	ND	ND	ND	ND	ND
* Measurement is considered an estimate as there is currently no known authentic standard for measurement of this compound. ND - Not detected Est. - Estimated							

4.0 Discussion

- The bench-scale and pilot testing is ongoing and scheduled to continue through the first quarter of 2018 until testing goals are achieved.
- The first phase of piloting of IX media (columns 5 and 6) has been completed.
- PFASs are being observed in the pilot GAC media effluent at 8,000 bed volumes.
 - Columns 10, 12, and 13 are exhibiting breakthrough of some of the shortest carbon chain PFASs and are trending consistently with the results from the first phase of pilot testing.
 - Column 11, which is run in series after column 10, is exhibiting partial breakthrough of only one PFAS compound: PFMOAA.
 - Test results thus far are consistent with the first phase of pilot testing.

- PFASs are being observed in the pilot IX resin effluent at 53,100 to 60,800 bed volumes.
 - Columns 7 and 9 are exhibiting breakthrough of some of the shortest carbon chain PFASs.
 - Testing results for column 8 are not yet available.
 - Test results thus far are consistent with the first phase of pilot testing.
- Testing will evolve as data is received to refine short- and long-term treatment strategies.

5.0 Conclusions/Recommendations

The following conclusions and recommendations can be developed based on the interim testing results.

- Pilot testing is ongoing and should continue in order to fully characterize the performance of GAC and IX technologies for PFAS removal.