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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
Protecting Texas by Reducing and Preventing Pollution

April 28, 2020

Mr. Sean Carter, P.E.
Toray Membrane USA, Inc.
13435 Danielson St.
Poway, CA 92064

Re: Toray HFU-2020AN Ultrafiltration Membrane
Review and Approval of Challenge Testing
Removal of Microbial Contaminants

Dear Mr. Carter:

Membrane filtration systems installed on, or replaced after, April 1, 2012 for the removal of *Cryptosporidium* and *Giardia* must undergo challenge testing to evaluate the membrane's removal efficiency and for the Texas Commission on Environmental Quality (TCEQ) to establish a challenge test log removal value (LRV_{C-Test}) as required by Title 30 of the Texas Administrative Code (30 TAC) §290.42(g)(3). In addition, these TCEQ regulations require a membrane manufacturer to provide the non-destructive performance test (NDPT) and associated quality control release value (QCRV) that will be used to verify that all manufactured membrane modules that were not subject to challenge testing will achieve at least the same log removal as those that were challenge tested.

CHALLENGE STUDY DATA FOR TORAY HFU-2020AN UF MEMBRANE MODULES

We reviewed the submitted challenge study data for compliance with the *Cryptosporidium* treatment requirements in the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR). The criteria for compliance are found in Title 40 of the Code of Federal Regulations (40 CFR) §141.719(b)(2). Additional guidance for compliance with these requirements can be found in the United States Environmental Protection Agency (USEPA) Membrane Filtration Guidance Manual (EPA 815-R-06-009). The TCEQ reviewed challenge study data presented in *Test Report*, prepared by NSF International (NSF) and dated August 15, 2019, for Toray Industries, Inc. providing the results of NSF International /American National Standards Institute (NSF/ANSI) Standard 419-2018 testing of the Toray HFU-2020AN ultrafiltration membrane. Based on our review, we have determined that the challenge study is compliant with LT2ESWTR requirements. Please review the conditions in the following pages regarding the approved log removal value demonstrated during challenge testing (LRV_{C-Test}) and the NDPT for production membrane modules that did not undergo challenge testing.

TCEQ-APPROVED LRV_{C-TEST}

For the Toray HFU-2020AN UF membrane modules, the TCEQ is approving a LRV_{C-Test} of 5.2 for the removal of *Cryptosporidium* for systems operated in deposition mode. The LRV_{C-Test} approval by the TCEQ does not apply to systems operated in a crossflow mode as this hydraulic configuration was not demonstrated in this challenge test study. The following are the parameters of the approved challenge study:

Full-scale Module Tested	Toray HFU-2020AN UF membrane Modules
Number of Independent Modules Tested	5
Criterion of Selected Modules	None*
Serial Numbers of Tested Modules	F418040102, F418040101, F418040100, F418050168 and F418050175
NDPT Process	Pressure-Decay Test
Quality Control Release Value (QCRV)	0.042 pounds per square-inch per minute (psi/min)
Challenge Particulate	<i>Bacillus atrophaeus</i> as a surrogate for <i>Cryptosporidium</i>
Detection Limit	1 colony forming unit (CFU) per 100 milliliters (mL)
Feed Concentration Range	1.67E+06 to 3.16E+06 CFU per 100 mL**
Test Flux Rate	120 gallons per square-foot per day (gfd)
Mode of Operation	Deposition mode

* In regard to the selection of modules for testing, there was no consideration of manufacturing variability. As required by 40 CFR 141.719(b)(2)(vii), a NDPT must be applied to each production module that did not undergo challenge testing in order to verify *Cryptosporidium* removal efficiency. As stated in the challenge study report, the NSF has set the QCRV to 0.042 psi/minute to match the worst-case NDPT result observed on the test runs that were considered for the LRV_{C-TEST}.

**The allowable feed concentration is limited to the demonstration of no more than 6.5 log removal ($3.16 \times 10^6 \times$ detection limit). Feed concentrations that exceeded maximum allowable concentrations during the testing were not considered in the determination of the LRV_{C-TEST}. The approved LRV_{C-TEST} of 5.2 was from a compromised module (hole poke) and this module is directly tied to the pressure decay test results that correspond to the QCRV of 0.042 psi/min.

LIMITS OF TCEQ-APPROVED LRV_{C-TEST}

The TCEQ-approved LRV_{C-TEST} is valid for only the Toray HFU-2020AN UF membrane modules operated under the parameters used for the challenge testing and only for modules that have passed the NDPT. From our review of the challenge study, an acceptable Toray HFU-2020AN UF membrane module must comply with the following specifications to receive the TCEQ-approved LRV_{C-TEST}:

- 1) Specifications of the approved Toray HFU-2020AN UF membrane modules:
 - Constructed of hydrophilic polyvinylidene fluoride (PVDF) hollow-fiber membranes;
 - Number of fibers per element is 9,100;
 - Molecular weight cutoff rating - 150,000 Daltons;
 - A fiber inside diameter of 0.8 millimeters (mm);
 - A fiber wall thickness of 0.3 mm;
 - Fiber active length of 1816 mm (71.5 inches);
 - Active membrane area per module of 775-ft²;
 - An outside-to-inside flow path;
 - Operational mode - Deposition;
 - Maximum operating temperature range of 40°C (104°F);
 - Maximum transmembrane pressure (TMP) at any temperature of 29 psi
 - Maximum TMP of 43.5 psi at 20°;
 - A pH operating range of 1 to 10;
 - Allowable pH range for cleaning of 0 to 12; and
 - Maximum oxidant tolerance during cleaning of 3,000 mg/L Cl.

- 2) Prior to shipment to a Texas public water system (PWS), each new Toray HFU-2020AN UF membrane module must have passed the NDPT, a pressure-decay test as specified in the NSF International *Test Report*:
 - The outside of the membrane is filled with water.
 - Close valves except at the filtrate port.

- Apply 18.85 psi of air pressure to the side port.
 - Allow pressure to stabilize for 5 minutes.
 - Apply 18.85 psi of air pressure to the side port with opening the air inlet valve.
 - Close the air inlet valve to the side port.
 - Record the change in feed port air pressure for 10 minutes.
 - For the Toray HFU-2020AN UF membrane module, **the TCEQ accepts a QCRV is 0.042 psi/min**. Note that this is a change from the manufacturer's QCRV of 0.26 psi for a 10-minute test (or 0.026 psi/min.)
- 3) If the Toray HFU-2020AN UF membrane module fails the NDPT (where the measured decay rate was greater than the QCRV), the TCEQ shall not allow that Toray HFU-2020AN UF membrane module to be installed at any Texas PWS for microbial contaminant removal credit.
 - 4) Toray must notify the TCEQ in writing if the Toray HFU-2020AN UF membrane modules are modified or if the NDPT method is modified in any manner. After receiving written notification, the TCEQ shall determine if the modified Toray HFU-2020AN UF membrane module shall be required to undergo challenge testing or if the modified NDPT method is acceptable.
 - 5) The TCEQ shall grant log removal credits to Texas PWSs using membrane filtration for *Giardia* and *Cryptosporidium*. The log removal credits shall not exceed the lower of:
 - a) The TCEQ-approved LRV_{C-Test} ; or
 - b) The maximum removal efficiency that can be verified through a membrane unit's site-specific direct integrity test (LRV_{DIR}).
 - 6) Each Toray HFU-2020AN UF membrane module must conform to American National Standards Institute/NSF International Standard 61 and must be certified by a testing organization accredited by ANSI.
 - 7) Please note that the approved LRV_{C-Test} is for the current Federal and Texas statutes, and the EPA and TCEQ rules. If any of these statutes or rules are revised, the TCEQ-approved LRV_{C-Test} in this letter may also be revised.

Please provide a copy of this letter to each of your Texas PWS customers. This letter is **not** to be construed as:

- A granted TCEQ exception for any Texas PWS to use the Toray HFU-2020AN UF membrane modules. Each Texas PWS must request and receive site-specific approval to use membrane filtration in accordance with 30 TAC §290.42(g) and §290.39(l);
- TCEQ approval for a Texas PWS to install a Toray HFU-2020AN UF membrane module; or
- TCEQ approval for a Texas PWS's required concentration time (CT) study.

If you have any questions about this letter, or if we can be of additional assistance, please contact David Williams, P.E., at the letterhead address, by e-mail at david.a.williams@tceq.texas.gov, or by telephone at (512) 962-8022.

Sincerely,

A handwritten signature in black ink, appearing to read "Joel Klumpp". The signature is fluid and cursive, with a large initial "J" and "K".

Joel Klumpp, Section Manager
Plan and Technical Review Section
Water Supply Division
Texas Commission on Environmental Quality

JPK/daw/av