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PWS CG_Travis_CO_20240909_challenge study

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

September 9, 2024

Mr. Stanton Smith, Vice President, Sales and Marketing
Crosstek Membrane Technologies
900 Technology Park Drive, Suite 100
Billerica, Massachusetts 01821

Re: Crosstek Ultressa® CPM Hollow Fiber Ultrafiltration Modules
Review and Approval of Challenge Testing
Removal of Microbial Contaminants

Dear Mr. Smith:

As requested by Dr. Winnie Shih, Director of Process and Applications at Crosstek Membrane Technologies in a May 11, 2023 e-mail, we have made two revisions to our May 8, 2023 challenge study approval letter for the Crosstek Ultressa® CPM Hollow Fiber Ultrafiltration Modules. As requested, we revised the maximum applied pressure parameter and added a comment regarding the Quality Control Release Value (QCRV). Both of these changes are on page 3 of this letter.

This letter replaces and supercedes the May 8, 2023 challenge study approval letter for the Crosstek Ultressa® CPM Hollow Fiber Ultrafiltration Modules.

Membrane filtration systems installed on, or replaced after, April 1, 2012 can receive removal credit for the removal of *Cryptosporidium* and *Giardia* if the system undergoes challenge testing to evaluate the membrane's removal efficiency and a challenge test log removal value (LRV_{C-Test}) is established, as required by Title 30 of the Texas Administrative Code (30 TAC) §290.42(g)(3). In addition, the Texas Commission on Environmental Quality (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 by the TCEQ to verify that all manufactured membrane modules, which were not subject to challenge testing, will achieve at least the same removal credit as those that were challenge tested.

On December 2, 2022, the TCEQ received a copy of the November 16, 2022 report of the challenge study conducted by BCS Laboratories (BCS) and witnessed by Underwriters Laboratory LLC (UL) on the Crosstek Ultressa® CPM hollow-fiber (HF) ultrafiltration (UF) membrane modules for *Cryptosporidium* oocyst removal efficiency.

The report contained the information required for review and approval in accordance with §29.42(g)(3)(A). The UL certified challenge study was conducted in accordance with NSF International (NSF) / American National Standards Institute (ANSI) Standard 419-2018: Public Drinking Water Equipment Performance - Filtration. According to the Test Record No. 1, the test record covers evaluation of Crosstek Ultressa® CPM UF modules to NSF/ANSI Standard 419. The NSF certification of performance is only based on reduction of *Cryptosporidium* as it is linked to QCRV.

CHALLENGE STUDY DATA FOR CROSSTEK ULTRESSA® UF MEMBRANE MODULES

We reviewed the submitted challenge study protocol and results for compliance with the *Cryptosporidium* treatment requirements in the US EPA Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR). The criteria for compliance is 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 USEPA Membrane Filtration Guidance Manual (EPA 815-R-06-009). Based on our review of the challenge study data for the Crosstek Ultressa® CPM UF membrane modules, 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 approved NDPT for production membrane modules that did not undergo challenge testing.

TCEQ-APPROVED LRV_{C-Test}

For the Crosstek Ultressa® CPM UF membrane modules, the TCEQ approves an LRV_{C-Test} of 4.0 for the removal of *Cryptosporidium* for membrane systems operated in deposition mode. The LRV_{C-Test} approval by the TCEQ does not apply to systems operated in cross flow 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	Crosstek Ultressa® CPM UF membrane modules
Number of Independent Modules Tested	5
Criterion of Selected Modules	Three of the five modules were randomly selected*
Serial Numbers of Tested Modules	R8574N100ES22E18C06413 (ID #2), R8574N100ES22E15C06270 (ID #3), R8574N100ES22E15C96266 (ID #4), R8574N100ES22A08C00169 (ID # 5) and R8574N100ES22A07C00099 (ID #6)
Nondestructive Performance Testing (NDPT) Process	Air Pressure Decay Rate over 10 Minutes
Quality Control Release Value (QCRV)	0.152 pounds per square inch (psi) per minute (min.)
Challenge Particulate	<i>Bacillus atrophaeus</i> endospores American Type Culture Collection (ATCC) number 9372 (as a surrogate for <i>Cryptosporidium</i> parvum oocysts) with an average diameter of 0.8 µm (microns) and an average length of 1.8 µm
Detection Limit	1 colony forming unit (CFU) per 100 milliliters (mL)
Feed Concentration Range	6.54×10^5 to 7.09×10^6 CFU per 100 mL**
Max Filtrate Flux Rate	366 gallons per square-foot per day (gfd) @ 20°C
Mode of Operation / Flow Configuration	Deposition mode / Inside Out

*The challenge study established a quality control release value (QCRV) of 0.152 psi/min. based on the highest observed average pressure decay results for the five modules that were tested to establish the LRV_{C-Test} as required by 40 CFR 141.719(b)(2)(vii). A correlation between the decay rate and the LRV_{C-Test} was identified with module ID #2 having the highest observed pressure decay rate of 0.152 psi/min and the lowest observed LRV_{C-Test} of 4.00-log. Any Crosstek Ultressa® CPM UF membrane module that does not meet the QCRV established by the challenge study is not eligible for the approved LRV_{C-Test} of 4.0-log.

**As allowed by 40 CFR 141.719(b)(2)(iii), the maximum allowable feed concentration is $3.16 \times 10^6 \times \text{Filtrate Detection Limit}$. The feed concentrations for module ID #6 exceeded the maximum allowable feed concentration; however, the approved LRV_{C-Test} of 4.0-log was based on the results from module ID #2 (the lowest LRV observed of the 5 modules tested).

LIMITS OF TCEQ-APPROVED LRV_{C-Test}

The TCEQ-approved LRV_{C-Test} is valid for only the Crosstek Ultressa® CPM 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 Crosstek Ultressa® CPM UF membrane module must comply with the following specifications to receive the TCEQ-approved LRV_{C-Test} :

- 1) Specifications of the approved Crosstek Ultressa® CPM UF membrane module:
 - Silicon carbide (SiC) ceramic membrane fiber material
 - Nominal membrane pore size of 0.04 μm
 - Fiber inner diameter – 3.15 millimeters (mm)
 - Fiber outer diameter – ceramic extrudate
 - Module outside diameter – 250 mm
 - Nominal membrane surface area of 269.1-ft²
 - An inside-to-outside flow path
 - Filtrate flux: 50 - 450 gfd
 - Filtrate flow: 9.2 - 84 gallons per minute (gpm)
 - Operating temperature range: 33° - 113° F
 - Maximum applied pressure at 45° C: 100 psi
 - Operating pH range: 2 - 12
 - Continuous free chlorine: less than 5 parts per million (ppm)
- 2) For use by public water systems in Texas for microbial contaminant removal credit, only Crosstek Ultressa® CPM UF modules that have passed a NDPT with a QCRV of 0.152 psi/min are allowed. In accordance with the QCRV established by the challenge study, the NDPT is a pressure decay test as outlined below:
 1. Ensure membrane is fully wetted, feed tank is isolated, and the feed piping drained less than 5 minutes prior to starting the pressure decay test.
 2. Open isolation valves to atmosphere to drain the membrane, then close drain and vent valves after approximately one minute.
 3. Set air regulator pressure to 8 ± 0.25 pounds per square inch gauge (psig) and open air-supply valve to membrane skid to allow air into the test membrane from the lower inlet port. Keep airline open for one minute to expel residual water and for pressure to stabilize to 8 ± 0.25 psig.

At the request of the membrane manufacturer, we are providing the following comment from the manufacturer: *“the QCRV applied pressure does not apply directly to commercial systems DIT applied pressure, which needs to be set in compliance with the Membrane Filtration Guidance Manual minimum pressure requirements for the specific membrane”*. The TCEQ concurs with this statement and notes that the Direct Integrity Test (DIT) parameters for individual public water system facilities in Texas, which use low-pressure membranes for microbiological treatment, are reviewed and approved by the TCEQ on an individual site-specific basis as required by 30 TAC §290.42(g)(3)(B).

 4. Shut off the air supply line and begin timer for the pressure decay test, recording pressure and time every minute starting at time 0 through 10 minutes.
 5. At end of test, vent air pressure to complete test. Ensure the pressure decay rate did not exceed the QCRV as required by the USEPA Membrane Filtration Guidance Manual. Leave filtrate valve open.
- 3) The manufacturer, Crosstek Membrane Technologies, must record the results of each Ultressa® CPM UF membrane module's NDPT with the module's assigned unique serial

number. The NDPT result for each Ultressa® CPM UF membrane module delivered to a Texas PWS must be provided upon delivery of the Ultressa® CPM UF membrane modules to a system.

- 4) The manufacturer, Crosstek Membrane Technologies, must notify the TCEQ in writing if the Ultressa® CPM 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 Ultressa® CPM 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_{DIT}).
- 6) Each Ultressa® CPM UF membrane module must conform to American National Standards Institute/NSF International (ANSI/NSF) 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 Crosstek Ultressa® CPM 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 Crosstek Ultressa® CPM UF membrane module; or
- TCEQ approval for the Texas PWS's required concentration time (CT) study.

Mr. Stanton Smith
September 9, 2024
Page 5

If you have questions concerning this letter, or if we can be of additional assistance, please contact David Williams, P.E. at david.williams@tceq.texas.gov or (512) 239-4674, or any member of the Technical Review and Oversight Team at PTRS@tceq.texas.gov.

Sincerely,

A handwritten signature in black ink, appearing to read "David Williams".

David Williams, P.E.
Technical Review and Oversight Team
Plan & Technical Review Section
Texas Commission on Environmental Quality

A handwritten signature in black ink, appearing to read "Joel Klumpp".

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

JPK/daw