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PWS_6000800_CO_20160913_Challenge Study

Texas Commission on Environmental Quality

Protecting Texas by Reducing and Preventing Pollution

September 13, 2016

Mr. Aaron Balczewski
Evoqua Water Technologies, LLC
725 Wooten Road
Colorado Springs, Colorado 80915

Re: Evoqua Water Technologies Memcor L40N Hollow-Fiber Ultra-Filtration Modules
Review and Approval of Challenge Testing for the Removal of Microbial
Contaminants

Dear Mr. Balczewski,

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 membranes' 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) to verify that all manufactured membrane modules not subject to challenge testing will achieve at least the same log removal as those which were challenge tested.

On May 5, 2016, the TCEQ received a copy of the April 22, 2016 report of the challenge study conducted on the Evoqua Memcor L40N ultra-filtration (UF) modules. This letter addresses the review and approval of the challenge study conducted on the Evoqua Memcor L40N UF modules.

The NSF International challenge study was conducted in accordance with NSF International (NSF)/American National Standards Institute (ANSI) Standard 419-2015: Public Drinking Water Equipment Performance - Filtration. According to the Test Report, NSF/ANSI Standard 419 is based on the Environmental Technology of Microfiltration Verification (ETV) *Generic Protocol for the Product Specific Challenge Testing of Microfiltration or Ultrafiltration Membrane Modules* (May 2011) and the product-specific challenge testing requirements in the United States Environmental Protection Agency (USEPA) Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR). The criteria for compliance are found in Title 40 of the Federal Code of Regulations (40 CFR) §141.719 and described in the USEPA *Membrane Filtration Guidance Manual* (MFGM). The NSF certification of performance is only based on the reduction of *Cryptosporidium* as it is linked to the QCRV.

CHALLENGE STUDY DATA FOR MEMCOR L40N ULTRA-FILTRATION MEMBRANE MODULES

We reviewed the submitted challenge study data for compliance with the *Cryptosporidium* treatment requirements in the LT2ESWTR. Specifically, the criteria for compliance is found in 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 Evoqua Memcor L40N Ultra-Filtration membrane

modules, the TCEQ has 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 Evoqua Memcor L40N Ultra-Filtration Modules, the TCEQ is approving a LRV_{C-Test} of 6.14 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 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	Evoqua Memcor L40N Ultra-Filtration Modules
Number of Independent Modules Tested	5
Criterion of Selected Modules	None *
Model Number / Part Number / Serial Numbers of Tested Modules	WRE2I62P, WRE2I92E, WRE2I61-, WRE2I91P, and WRE2I71K
Nondestructive Performance Testing (NDPT) Process	Diffusive Air Flow (DAF) Test from 17.8 pounds per square inch (psi) air pressure
Quality Control Release Value (QCRV) for Diffusive Air Flow (DAF) Test	≥ 5 seconds (sec) per milliliter (mL)
Challenge Particulate	<i>Bacillus atrophaeus</i> (as a surrogate for <i>Cryptosporidium</i>) with an average diameter of 0.8 microns (µm), and an average length of 1.8 µm
Detection Limit	1 colony forming unit (CFU) per 100 mL
Feed Concentration Range	1.32 x 10 ⁶ to 1.78 x 10 ⁶ CFU per 100 mL
Max Filtrate Flux Rate	85 gallons per square-foot per day (gfd) at 20 °C
Mode of Operation / Flow Configuration	Deposition mode / Outside In

* Several modules supplied by Evoqua to NSF for challenge testing were intended to have DAF values lower than the established QCRV, in order to demonstrate log removal capabilities under worst case conditions. The challenge study established a QCRV of ≥ 5 sec per mL, based on diffusive air flow test results of the modules used to establish the LRV_{C-Test} (as required by 40 CFR §141.719(b)(2)(vii)). Any membrane module that does not meet the QCRV established in the challenge study is not eligible for the approved LRV_{C-Test} of 6.14-log.

LIMITS OF TCEQ-APPROVED LRV_{C-TEST}

The TCEQ-approved LRV_{C-Test} is valid only for the Evoqua Memcor L40N UF modules operated under the parameters used for this challenge testing and only for modules that have passed the NDPT. From our review of the challenge study, an acceptable Memcor L40N UF module must comply with the following specifications to receive the TCEQ-approved LRV_{C-Test} :

- 1) Specifications of the approved Evoqua Memcor L40N UF modules:
 - a) Polyvinylidene fluoride (PVDF) hollow fiber membranes;
 - b) Nominal membrane surface area of 721-ft²;
 - c) Nominal membrane pore size of 0.04 µm (microns);
 - d) Module diameter - 7.2 in (inches);
 - e) Module length - 70.9 in;
 - f) An outside-to-inside flow path;
 - g) Operational mode: deposition (no cross-flow);
 - h) Maximum filtrate flux at 20 °C: 85 gallons per square-foot per day (gfd);
 - i) Maximum filtrate flow at 20°C: 42.6 gallons per minute (gpm);
 - j) Maximum operating temperature range: > 0 - 40°C;
 - k) Maximum inlet pressure: 75 psi;
 - l) Maximum trans-membrane pressure (TMP) of 22 psi at ≤ 30°C, 17 psi at > 30°C;
 - m) Operating pH range: 6 - 9 typically;

- n) Allowable pH range for cleaning: 2 - 10 typically (occasional exposure to pH 10.5 is acceptable); and,
 - o) Maximum chlorine concentration during cleaning: 1,000 mg/L.
- 2) Prior to shipment to a Texas public water system (PWS), each new Evoqua Memcor L40N UF membrane module must have passed the NDPT, a diffusive air flow test, as specified below:
 - a. Open the filtrate port to the atmosphere with the feed side of the membrane closed.
 - b. Drain the water from the filtrate side of the membrane.
 - c. Pressurize the drained side of the membrane to 17.8 pounds per square inch gauge (psig) and allow stabilizing for 1 minute.
 - d. Record the time required for a volume of 5 mL to flow into a sight tube (with elevation approximately equal to the upper potting of the membrane) connected to the feed side of the membrane.
 - e. Calculate the time required per milliliter of flow.
 - f. For the Evoqua Memcor L40N UF membrane module, the QCRV is 5 seconds per milliliter.
 - 3) If the Memcor L40N UF membrane module fails the NDPT (membranes having DAF values lower than 5 seconds per milliliter), the TCEQ will not approve the Evoqua Memcor L40N UF membrane module to be installed at any Texas PWS for microbial contaminant removal credit.
 - 4) For use by a public water system (PWS) in Texas for microbial contaminant removal credit, only Evoqua Memcor L40N UF membrane modules that have been certified by performance by NSF International are allowed. As defined in the NSF International challenge study report (page 7), this means that only modules that have passed a NDPT with a QCRV for the diffusive air flow (DAF) test of 5 seconds per milliliter (membranes having DAF values lower than 5 seconds per milliliter are rejected).
 - 5) The Evoqua Memcor L40N UF membrane module must record the results of the L40N UF membrane module's NDPT with the module's assigned unique serial number. The NDPT result for each Memcor L40N membrane module delivered to a Texas PWS must be provided upon delivery of the L40N UF membrane module to a system.
 - 6) Evoqua Water Technologies must notify the TCEQ in writing if the Memcor L40N UF membrane modules or the NDPT method are modified in any manner. After receiving written notification, the TCEQ shall determine if the modified Memcor L40N UF membrane modules will be required to undergo challenge testing or if the modified NDPT method is acceptable.
 - 7) 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}).
 - 8) Each Evoqua Memcor L40N 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.
 - 9) Please note that the approved LRV_{C-Test} is for the current Federal and Texas statutes, and the USEPA and TCEQ rules. If these statutes or rules are revised, the TCEQ-approved LRV_{C-Test} in this letter may also be revised.

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

- A granted TCEQ exception for any Texas PWS to use the Evoqua Memcor L40N UF membrane module. Each Texas PWS must request and receive site-specific approval to use membrane filtration in accordance with 30 TAC §290.42(g)(3) and §290.39(1);
- TCEQ approval for a Texas PWS to install an Evoqua Memcor L40N UF membrane module. All engineering plans and specifications must be approved by the TCEQ prior to installation; 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 Ms. Katie Cunningham, at the letterhead address, by e-mail at katie.cunningham@tceq.texas.gov, or by telephone at (512) 239-1374.

Sincerely,



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Technical Review and Oversight Team
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