

Bryan W. Shaw, Ph.D., P.E., *Chairman*  
Toby Baker, *Commissioner*  
Jon Niermann, *Commissioner*  
Richard A. Hyde, P.E., *Executive Director*



PWS\_6000800\_CO\_20151105\_Challenge Study

## Texas Commission on Environmental Quality

*Protecting Texas by Reducing and Preventing Pollution*

November 5, 2015

Ms. Irene Körbl, Coordinator Approvals, X-Flow BV  
P.O. Box 739  
7500 AS Enschede  
Netherlands

Re: Pentair X-Flow Aquaflex HP and Xiga HP Ultrafiltration Membranes  
Revision to Previous Approval of Challenge Test Data  
Removal of Microbial Contaminants

Dear Ms. Körbl:

On April 1, 2015, the Texas Commission on Environmental Quality (TCEQ) received supplemental information for the previously approved challenge study for the Pentair X-Flow ultrafiltration (UF) membranes. On November 20, 2014, the TCEQ approved a  $LRV_{C-Test}$  of 4.95 (log removal value demonstrated during challenge testing) for the Pentair X-Flow Aquaflex HP 55 square-meter ( $m^2$ ) membranes. According to your submittal, Pentair developed a new range of Aquaflex HP (vertical configuration) and Xiga HP (horizontal configuration) modules with an increased membrane filtration area. The increased filtration area is from a change in the inner membrane fiber diameter from 0.8 millimeters (mm) to 0.9 mm. In accordance with Title 40 of the Code of Federal Regulations (40 CFR) §141.719(b)(2)(viii), any significant change to the membrane media, hydraulic configuration, or any other modification that could potentially affect the removal efficiency or the non-destructive performance test (NDPT) parameters would require additional challenge testing of the modified module. However, based on our review of the module specifications and the supporting documentation, additional challenge testing is not required for the Aquaflex HP and Xiga HP modules.

With this letter, the TCEQ is extending the approved  $LRV_{C-Test}$  of **4.95** to include all Pentair X-Flow Aquaflex HP and Xiga HP modules with active membrane areas of 55  $m^2$  and 64  $m^2$ . **This letter replaces the previous challenge study approval letter for the Pentair X-Flow Aquaflex HP modules dated November 20, 2014.**

This approval does not apply to the Pentair X-Flow Aquaflex and Xiga modules with active membrane areas of 40  $m^2$  and 46  $m^2$  based on the differences in the packing density from the challenge-tested Aquaflex HP modules.

**CHALLENGE STUDY DATA FOR PENTAIR X-FLOW AQUAFLEX HP 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 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 United States Environmental Protection Agency (USEPA) [Membrane Filtration Guidance Manual](#)

(EPA 815-R-06-009). The TCEQ reviewed challenge study data presented in *Pentair Challenge Testing Results, Technical Memorandum, X-Flow Aquaflex HP Ultrafiltration Membrane Systems*, prepared by Carollo Engineers, in a report dated March 2014, for Pentair. 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  $LRV_{C-Test}$**

The TCEQ is approving a  **$LRV_{C-Test}$  of 4.95** for the removal of *Cryptosporidium* for systems operated in deposition mode for the Pentair X-Flow Aquaflex HP and Xiga HP UF membrane modules specified in this letter. 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	Pentair X-Flow Aquaflex HP UF Membrane Modules
Number of Independent Modules Tested	2
Criterion of Selected Modules	Modules that had failed the Non-Destructive Performance Test (NDPT) were selected for testing in accordance with California Department of Public Health Requirements
Serial Numbers of Tested Modules	12DA6709 and 12HA3282
Nondestructive Performance Testing (NDPT) Process	Diffusive Airflow Test
Quality Control Release Value (QCRV)	350 milliliters per minute (mL/min)
Challenge Particulate	0.5-micron microspheres (as a surrogate for <i>Cryptosporidium</i> )
Detection Limit	1 microsphere per 100 mL
Feed Concentration Range	$1.7 \times 10^4$ to $3.7 \times 10^4$ microspheres/mL
Test Flux Rate	75 gallons per square-foot per day (gfd) @ 20° C
Mode of Operation	Deposition mode

**LIMITS OF TCEQ-APPROVED  $LRV_{C-Test}$**

The TCEQ-approved  $LRV_{C-Test}$  is valid for only the Pentair X-Flow Aquaflex HP and Xiga HP membrane modules operated under the parameters used for the challenge testing and only for modules that have passed the NDPT. An acceptable Pentair X-Flow Aquaflex HP or Xiga HP UF membrane module must comply with the following specifications to receive the TCEQ-approved  $LRV_{C-Test}$ :

- 1) Specifications of the approved Pentair X-Flow Aquaflex HP and Xiga HP UF membrane modules:
  - a) Constructed of hydrophilic Polyethersulfone (PES)/Polyvinylpyrrolidone (PVP) polymer blend hollow-fiber membranes
  - b) Number of fibers per element is 15,120
  - c) Active membrane area: 592-ft<sup>2</sup> or 690-ft<sup>2</sup>

- d) A nominal membrane pore size of 0.02 microns
  - e) A fiber inside diameter of 0.8 millimeters (mm)
  - f) A fiber outside diameter of 1.2 mm
  - g) Module length of 60 inches
  - h) An inside-to-outside flow path
  - i) Operational mode: Deposition
  - j) Maximum operating temperature range of 40° C (104° F)
  - k) Maximum trans-membrane pressure (TMP) of 43.7 pounds per square-inch (psi)
  - l) Maximum feed pressure of 43.7 pounds per square-inch (psi)
- 2) Prior to shipment to a Texas public water system (PWS), each new Pentair X-Flow Aquaflex HP and Xiga HP UF membrane module must have passed the NDPT, a diffusive airflow test as specified below:
    - a) Flushed for 10 minutes with reverse osmosis water
    - b) Drain the water from one side of the membrane
    - c) Pressurize the drained side of the wetted membrane to 1.4 bar (20.3 psi).
    - d) Set and maintain a constant pressure on the airside of the membrane lumen
    - e) Monitor the diffusive airflow for 5 minutes
    - f) For the Pentair X-Flow Aquaflex HP and Xiga HP UF membrane module, the QCRV is 350 milliliters per minute
  - 3) If the Pentair X-Flow Aquaflex HP or Xiga HP UF membrane module fails the NDPT (where the measured air flow was greater than the QCRV), the TCEQ shall not allow that Pentair X-Flow UF membrane module to be installed at any Texas PWS for microbial contaminant removal credit.
  - 4) Pentair must notify the TCEQ in writing if the Pentair X-Flow Aquaflex HP and Xiga HP 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 Pentair X-Flow 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 Pentair X-Flow Aquaflex HP and Xiga HP 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 Pentair X-Flow Aquaflex HP and Xiga HP 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 Pentair X-Flow Aquaflex HP or Xiga HP UF membrane module; or

Ms. Irene Körbl  
Page 4  
November 5, 2015

- 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](mailto:david.a.williams@tceq.texas.gov), or by telephone at (512) 239-0945.

Sincerely,



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



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

JPK/DAW

**Ms. Irene Körbl**  
**Page 5**  
**November 5, 2015**

**bcc: William R. Melville, P.E., TCEQ Technical Review and Oversight Team**