Texas Commission on Environmental Quality

Protecting Texas by Reducing and Preventing Pollution

November 14, 2017

Mr. Scott Caothien, Head of Membrane Solutions, North America
BASF
43 Robinson Drive
Irvine, CA 92602

Re: Review of Challenge Testing for the Removal of Microbial Contaminants
BASF Inge® dizzer® XL 0.9 MB 80 WT, 0.9 MB 80 W, XL 0.9 MB 60 W, XL 0.9 MB 70 W, XL 1.5 MB 40 W, and L 0.9 MB 40 PB Ultrafiltration Membrane Modules

Dear Mr. Caothien:

On March 21, 2017, the Texas Commission on Environmental Quality (TCEQ) received your letter, dated March 16, 2017, requesting to allow the BASF Inge® dizzer® XL 0.9 MB 80 WT and XL 0.9 MB 80 W modules to be approved under the previously approved challenge study for the BASF Inge® dizzer® XL 0.9 MB 60 W, XL 0.9 MB 70 W, XL 1.5 MB 40 W, and L 0.9 MB 40 PB ultrafiltration (UF) membrane modules. Both the BASF Inge® dizzer® XL 0.9 MB 80 WT and XL 0.9 MB 80 W use the same multibore (seven capillaries per fiber) polyethersulfone fiber as the BASF Inge® dizzer® challenge tested modules approved by the TCEQ in the September 9, 2016 letter. The proposed modules also have the same inside to outside flow configuration. Unlike the challenge tested modules, the proposed modules have a larger filtration area of 80 square meters and have been rated at a higher sodium chlorite tolerance. Nevertheless, because these modules use the same fiber, same inside to outside flow configuration, and have the same allowable operating parameters, the module differences should not affect the microbial removal efficiency. **With this letter, we are revising and replacing the September 9, 2016 letter to include the BASF Inge® dizzer® XL 0.9 MB 80 WT and XL 0.9 MB 80 W modules.**

As required by Title 30 of the Texas Administrative Code (30 TAC) §290.42(g)(3), membrane filtration systems must undergo challenge testing to evaluate the membrane's removal efficiency in accordance with the criteria established by Title 40 of the Code of Federal Regulations (40 CFR) §141.719(b)(2). In support of this requirement, you submitted challenge study data prepared by NSF International (NSF).

CHALLENGE STUDY FOR BASF INGE® DIZZER® ULTRAFILTRATION (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 required criteria 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 *Final Report: Product-Specific Challenge Tests for Cryptosporidium Removal Credits under LT2ESWTR, BASF inge® dizzer® XL 0.9 MB 60 W, XL 0.9 MB 70 W, and XL 1.5 MB 40 W Ultrafiltration Modules* prepared by NSF International and dated May 30, 2014. 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 ($LRV_{C\text{-}Test}$) and the Non-Destructive Performance Test (NDPT) for production membrane modules that did not undergo challenge testing.

TCEQ-APPROVED $LRV_{C\text{-}TEST}$

The TCEQ is approving a **$LRV_{C\text{-}Test}$ of 6.2** for the removal of *Cryptosporidium* oocysts for the BASF inge® dizzer® XL 0.9 MB 60 W, XL 0.9 MB 70 W, XL 1.5 MB 40 W UF, L 0.9 MB 40 PB, XL 0.9 MB 80 WT and 0.9 MB 80 W modules for systems operated in deposition mode.

The following are the parameters of the approved challenge study:

Full-scale modules tested	BASF inge® dizzer® XL 0.9 MB 60 W, XL 0.9 MB 70 W, and XL 1.5 MB 40 W UF Modules
Number of Independent Modules Tested	7
Criterion of Selected Modules	None*
Model Number / Part Number / Serial Numbers of Tested Modules	Basf inge® dizzer® XL 0.9 MB 60 W Serial Nos: 13L01020, 13L070144, 13L01022, 13L01021, and 13L01019; Basf inge® dizzer® XL 0.9 MB 70 W Serial No: 13N05013; and, Basf inge® dizzer® XL 1.5 MB 40 Serial No: 14A08075
Nondestructive Performance Testing (NDPT)Process	Pressure Decay Test*
Quality Control Release Value (QCRV)	0.015 psi/minute*
Challenge Particulate	Bacillus endospores as a surrogate for *Cryptosporidium*
Detection Limit	1 colony forming unit (CFU) per 100 milliliters (mL)
Feed Concentration	6.2-log to 6.5-log (for challenge tests conducted on the inge® dizzer® XL 0.9 MB 70 W and XL 1.5 MB 40 W UF Modules)**
Mode of Operation	Deposition mode

* In regards 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 non-destructive performance test (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 NDPT QCRV to 0.015 pounds per square-inch (psi) per minute to match the NDPT result observed on the modules evaluated for the $LRV_{C\text{-}TEST}$.

**Challenge tests conducted on the BASF inge® dizzer® XL 0.9 MB 60 W modules exceeded the maximum feed concentration of 6.5-log (3.16×10^6) allowed by 40 CFR §141.719(b)(2)(iii) although the over seeding (6.6-log to 7.0-log feed concentrations) did not result in excessively high log removal values. Nevertheless, we are accepting the minimum $LRV_{C\text{-}Test}$ demonstrated on the other two models that were not over seeded, BASF inge® dizzer® XL 0.9 MB 70 W and XL 1.5 MB 40 W, as the approved $LRV_{C\text{-}Test}$ for all three models. We concur with the challenge study report that all three models tested in the challenge study are significantly similar as to not affect membrane performance. Therefore, challenge tests results from any one of the three tested models should be appreciably similar to the other two models.

LIMITS OF THE TCEQ-APPROVED $LRV_{C\text{-}Test}$

The TCEQ-approved $LRV_{C\text{-}Test}$ is valid for only the BASF inge® dizzer® XL 0.9 MB 60 W, XL 0.9 MB 70 W, XL 1.5 MB 40 W, L 0.9 MB 40 PB, XL 0.9 MB 80 WT and 0.9 MB 80 W UF 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 BASF inge® dizzer® XL 0.9 MB 60 W, XL 0.9 MB 70 W, XL 1.5 MB 40 W, L 0.9 MB 40 PB, XL 0.9 MB 80 WT or 0.9 MB 80 W UF module must comply with the following specifications to receive the TCEQ-approved $LRV_{C\text{-}Test}$:

1) Module Specifications:
   a) Specifications of the approved BASF inge® dizzer® XL 0.9 MB 60 W UF modules:
      i) Polyethersulfone modified (PESM) hollow fiber membranes with 7 capillaries per fiber;
      ii) Nominal membrane pore size - 0.02 microns (µm);
      iii) Fiber inner diameter - 0.9 millimeters (mm);
      iv) Fiber outer diameter - 4.0 mm;
      v) Module diameter - 9.875 inches (in.);
      vi) Module length - 58.5 in.;
      vii) Nominal membrane surface area of 645-ft^2;
      viii) Operational mode: deposition;
      ix) Maximum filtrate flux: 105 gallons per square-foot per day (gfd) at 20˚C;
      x) Operating temperature range of 0˚C (32˚F) to 40° C (104˚F);
      xi) Maximum trans-membrane pressure (TMP) of 1.5 bar;
      xii) Maximum feed pressure - 5 bar (at 40° C);
      xiii) Operating pH range: 1 to 13; and,
      xiv) Maximum chlorine tolerance: 200,000 milligram per liter (mg/L) hours.

   b) Specifications of the approved BASF inge® dizzer® XL 0.9 MB 70 W UF modules:
      i) Polyethersulfone modified (PESM) hollow fiber membranes with 7 capillaries per fiber;
      ii) Nominal membrane pore size - 0.02 µm;
      iii) Fiber inner diameter - 0.9 mm;
      iv) Fiber outer diameter - 4.0 mm;
      v) Module diameter - 9.875 in.;
      vi) Module length - 67.7 in.;
      vii) Nominal membrane surface area of 753-ft^2;
      viii) Operational mode: deposition;
      ix) Maximum filtrate flux: 105 gfd at 20˚C;
      x) Operating temperature range of 0˚C (32˚F) to 40˚ C (104˚F);
      xi) Maximum trans-membrane pressure (TMP) of 1.5 bar;
      xii) Maximum feed pressure - 5 bar (at 40˚ C);
      xiii) Operating pH range: 1 to 13; and,
      xiv) Maximum chlorine tolerance: 200,000 mg/L hours.

   c) Specifications of the approved BASF inge® dizzer® XL 1.5 MB 40 W UF modules:
      i) Polyethersulfone modified (PESM) hollow fiber membranes with 7 capillaries per fiber;
      ii) Nominal membrane pore size - 0.02 µm;
      iii) Fiber inner diameter - 0.9 mm;
      iv) Fiber outer diameter - 4.0 mm;
      v) Module diameter - 9.875 in.;
      vi) Module length - 58.5 in.;
      vii) Nominal membrane surface area of 430-ft^2;
      viii) Operational mode: deposition;
      ix) Maximum filtrate flux: 105 gfd at 20˚C;
      x) Operating temperature range of 0˚C (32˚F) to 40˚ C (104˚F);
      xi) Maximum trans-membrane pressure (TMP) of 1.5 bar;
      xii) Maximum feed pressure - 5 bar (at 40˚ C);

xiii) Operating pH range: 1 to 13; and,
xiv) Maximum chlorine tolerance: 200,000 mg/L hours.

d) Specifications of the approved BASF inge® dizzer® L 0.9 MB 40 PB UF modules:
   i) Polyethersulfone modified (PESM) hollow fiber membranes with 7 capillaries per fiber;
   ii) Nominal membrane pore size - 0.02 µm;
   iii) Fiber inner diameter - 0.9 mm;
   iv) Fiber outer diameter - 4.0 mm;
   v) Module diameter - 7.87 in.;
   vi) Module length - 60.1 in.;
   vii) Nominal membrane surface area of 430-ft^2;
   viii) Operational mode: deposition;
   ix) Maximum filtrate flux: 105 gfd at 20˚C;
   x) Operating temperature range of 0˚C (32˚F) to 40˚ C (104˚F);
   xi) Maximum trans-membrane pressure (TMP) of 1.5 bar;
   xii) Maximum feed pressure - 5 bar (at 40˚ C);
   xiii) Operating pH range: 1 to 13; and,
   xiv) Maximum chlorine tolerance: 200,000 mg/L hours.

e) Specifications of the approved BASF inge® dizzer® XL 0.9 MB 80 WT UF
   i) Polyethersulfone modified (PESM) hollow fiber membranes with 7 capillaries per fiber;
   ii) Nominal membrane pore size - 0.02 µm;
   iii) Fiber inner diameter - 0.9 mm;
   iv) Fiber outer diameter - 4.0 mm;
   v) Module diameter - 9.875 in.;
   vi) Module length (incl. T-piece) - 82.7 in.;
   vii) Nominal membrane surface area of 861-ft^2;
   viii) Operational mode: deposition;
   ix) Maximum filtrate flux: 105 gfd at 20˚C;
   x) Operating temperature range of 1˚C (34˚F) to 40˚ C (104˚F);
   xi) Maximum trans-membrane pressure (TMP) of 3 bar;
   xii) Maximum feed pressure - 5 bar (at 40˚ C);
   xiii) Operating pH range: 1 to 13; and,
   xiv) Maximum chlorine tolerance: 250,000 mg/L hours.

f) Specifications of the approved BASF inge® dizzer® 0.9 MB 80 W UF
   i) Polyethersulfone modified (PESM) hollow fiber membranes with 7 capillaries per fiber;
   ii) Nominal membrane pore size - 0.02 µm;
   iii) Fiber inner diameter - 0.9 mm;
   iv) Fiber outer diameter - 4.0 mm;
   v) Module diameter - 9.875 in.;
   vi) Module length - 67.7 in.;
   vii) Nominal membrane surface area of 861-ft^2;
   viii) Operational mode: deposition;
   ix) Maximum filtrate flux: 105 gfd at 20˚C;
   x) Operating temperature range of 1˚C (34˚F) to 40˚ C (104˚F);
   xi) Maximum trans-membrane pressure (TMP) of 1.5 bar;
   xii) Maximum feed pressure - 5 bar (at 40˚ C);
   xiii) Operating pH range: 1 to 13; and,
   xiv) Maximum chlorine tolerance: 250,000 mg/L hours.

2) <u>The manufacturer must ensure that all modules provided to Public Water Systems in Texas have passed the manufacturer's NDPT</u>.

3) BASF must record the results of each BASF inge® dizzer® XL 0.9 MB 60 W, XL 0.9 MB 70 W, XL 1.5 MB 40 W, L 0.9 MB 40 PB, XL 0.9 MB 80 WT, or 0.9 MB 80 W UF membrane module NDPT with the module's assigned unique serial number. The NDPT result for each BASF inge® dizzer® XL 0.9 MB 60 W, XL 0.9 MB 70 W, XL 1.5 MB 40 W, L 0.9 MB 40 PB, XL 0.9 MB 80 WT or 0.9 MB 80 W UF membrane module delivered to a Texas public water system (PWS) must be provided upon delivery of the membrane modules.

4) BASF must notify the TCEQ in writing if the BASF inge® dizzer® XL 0.9 MB 60 W, XL 0.9 MB 70 W, XL 1.5 MB 40 W, L 0.9 MB 40 PB, XL 0.9 MB 80 WT or 0.9 MB 80 W 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 BASF 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 $LRV_{C\text{-}Test}$; or,
   b) The maximum removal efficiency that can be verified through a membrane unit's site-specific direct integrity test (LRV_{DIT}).

6) Each BASF inge® dizzer® XL 0.9 MB 60 W, XL 0.9 MB 70 W, XL 1.5 MB 40 W, L 0.9 MB 40 PB, XL 0.9 MB 80 WT, and 0.9 MB 80 W 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 $LRV_{C\text{-}Test}$ 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 $LRV_{C\text{-}Test}$ 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 BASF inge® dizzer® XL 0.9 MB 60 W, XL 0.9 MB 70 W, XL 1.5 MB 40 W, L 0.9 MB 40 PB, XL 0.9 MB 80 WT, or 0.9 MB 80 W 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 BASF inge® dizzer® XL 0.9 MB 60 W, XL 0.9 MB 70 W, XL 1.5 MB 40 W, L 0.9 MB 40 PB, XL 0.9 MB 80 WT, 0.9 MB 80 W UF membrane module; or

- TCEQ approval for the 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 at the letterhead address, by e-mail at david.a.williams@tceq.texas.gov, or by telephone at (512) 239-2509.

Sincerely,

David A. Williams, P.E.
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DAW/JPK