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PWS_6000800_CO_20151021_Challenge Study

Texas Commission on Environmental Quality

Protecting Texas by Reducing and Preventing Pollution

October 21, 2015

Mr. Scott Caothien
Technical Sales Support Manager, Membrane Solutions N.A.
BASF
43 Robinson Drive
Irving, CA 92602

Re: BASF Inge d5000 Ultrafiltration Membrane
Review of Challenge Testing for the Removal of Microbial Contaminants

Dear Mr. Caothien:

On August 5, 2015, the Texas Commission on Environmental Quality (TCEQ) received your submittal, dated October 2004, providing challenge study data for the BASF Inge d5000 ultrafiltration (UF) membrane module. This challenge study replaces previous challenge study documentation for the BASF Inge Dizzer® UF modules, received on August 15, 2014. The previous submittal was insufficient for the TCEQ to grant pathogen removal credit. 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 Carollo Engineers.

CHALLENGE STUDY DATA FOR BASF INGE d5000 ULTRAFILTRATION 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 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 *California Department of Health Services (CDHS) Challenge Study Inge d5000 - Final Report* prepared by Carollo Engineers and dated March 2004. 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 Non-Destructive Performance Test (NDPT) for production membrane modules that did not undergo challenge testing.

TCEQ-APPROVED LRV_{C-TEST}

For the BASF Inge d5000 UF modules, the TCEQ is approving a **LRV_{C-Test} of 4.5** for the removal of *Cryptosporidium* for systems operated at 93.3% recovery, or greater. This LRV_{C-Test} value was the lowest value measured during Period 3 of the challenge study. Period 3 corresponded to testing of the modules which had one or two capillaries of the 7-capillary fiber compromised. Carollo Engineers conducted Periods 1 and 2 of the challenge study on intact membranes; however, we had

insufficient information for correlating the pressure decay tests of the Period 1 and 2 modules with the manufacturer's Quality Control Release Value (QCRV).

The Carollo Engineering report stated that the manufacturer associates a decay rate of 0.2 pounds per square-inch per minute (psi/min.) with an intact module. This was not specifically identified as the manufacturer's Non-Destructive Performance Test (NDPT) in the Carollo report. Although the challenge testing of intact modules (Periods 1 and 2) demonstrated log removals greater than 6.3, the measured pressure decay rates ranged from 0.01 to 0.15 psi/min (at a P_{test} of 10 psi) and the Carollo Engineering report provided no data to tie these results to the manufacturer's NDPT. However, the measured pressure decay rates during Period 3 (with 1 or 2 compromised capillaries) ranged from 0.26 to 0.42 psi/min (with a P_{test} of 10 psi). It was reasonable to assume that the compromised modules in Period 3 would not have passed the manufacturer's NDPT; therefore, any module that passes the manufacturer's NDPT would likely have superior log removal compared to the compromised Period 3 modules.

The following are the parameters of the approved challenge study:

Full-scale module tested	BASF Inge d5000 UF Modules
Number of Independent Modules Tested	2
Criterion of Selected Modules	None*
Model Number / Part Number / Serial Numbers of Tested Modules	04D 06009 04G 06038
Nondestructive Performance Testing (NDPT) Process	Pressure Decay Test*
Quality Control Release Value (QCRV)	0.2 psi/minute*
Challenge Particulate	1-micron (µm) green fluorescent dyed polystyrene microspheres as a surrogate for <i>Cryptosporidium</i>
Detection Limit	1 object per unit volume
Feed Concentration	6.4-log
Mode of Operation / Flow Configuration	Deposition mode / Inside Out

* 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. The manufacture's NDPT has not been revised with this letter based on the results of the challenge study because the approved LRV_{C-TEST} is based on compromised modules (one or two capillaries cut).

LIMITS OF THE TCEQ-APPROVED LRV_{C-TEST}

The TCEQ-approved LRV_{C-Test} is valid for only the BASF Inge d5000 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 d5000 UF module must comply with the following specifications to receive the TCEQ-approved LRV_{C-Test}:

- 1) Specifications of the approved BASF Inge d5000 UF modules:
 - a) Polyethersulfone (PES) hollow fiber membranes with 7 capillaries per fiber;

- b) Molecular Weight Cut-Off 100 - 150 kD (kilodaltons);
 - c) Fiber inner diameter - 0.04 inches (in.);
 - d) Fiber outer diameter - 0.17 in.;
 - e) Module diameter - 9.84 in.;
 - f) Module length - 66.14 in.;
 - g) Symmetry - Asymmetric;
 - h) Nominal membrane surface area of 485-ft²;
 - i) An inside-to-outside flow path;
 - j) Operational mode: deposition or cross-flow;
 - k) Maximum filtrate flux: 140 gallons per square-foot per day (gfd);
 - l) Maximum operating temperature of 40° C (104°F);
 - m) Maximum trans-membrane pressure (TMP) of 11.5 psi;
 - n) Maximum feed pressure - 72.5 psi
 - o) Operating pH range: 3 – 10; and,
 - p) Cleaning pH range: 1-13.
- 2) The manufacturer must ensure that all modules provided to Public Water Systems in Texas have passed the manufacturer's NDPT.
 - 3) BASF must record the results of each BASF Inge d5000 UF membrane module's NDPT with the module's assigned unique serial number. The NDPT result for BASF Inge d5000 membrane module delivered to a Texas PWS must be provided upon delivery of the BASF Inge d5000UF membrane modules to a system.
 - 4) BASF must notify the TCEQ in writing if the BASF Inge d5000 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 Inge d5000 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 BASF Inge d5000 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 BASF Inge d5000 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 d5000 UF membrane module; or
- TCEQ approval for the Texas public water system's required concentration time (CT) study.

Mr. Scott Caothien
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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) 239-0945.

Sincerely,



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



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

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bcc: Mr. William R. Melville, P.E., TCEQ Technical Review and Oversight Team (MC-159)