



Texas Commission on Environmental Quality

Protecting Texas by Reducing and Preventing Pollution

March 11, 2015

Ms. Andrea Lima
The Dow Chemical Company
Dow Water & Process Solutions
14465 Misty Meadow Lane
Houston, Texas 77079

Re: Dow IntegraFlo™ DW102-1100 Ultrafiltration Membrane
Review and Approval of Challenge Testing
Removal of Microbial Contaminants

Dear Ms. Lima:

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

On August 28, 2014, the TCEQ received notice from the Dow Chemical Company of their request for approval of the DOW DW102-1100 ultrafiltration (UF) membrane modules. The submittal consisted of a NSF International Certification Test Report - *Public Drinking Water Equipment Performance Final Report: The Dow Chemical Company, Dow Water and Process Solutions IntegraFlo™ DW102-1100 Ultrafiltration Module Product-Specific Challenge Tests for Cryptosporidium and Virus Removal Credits under LT2ESWTR*. You also provided a NSF International letter with an amended table showing challenge data for only the results that corresponded to the maximum allowable challenge particulate concentration (demonstrating a maximum removal of no more than 6.5-log). The test report submitted presents the challenge test results for microbial reduction performance under the membrane challenge requirements of the United States Environmental Protection Agency (USEPA) Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR).

CHALLENGE STUDY DATA FOR DOW INTEGRAFLO™ DW 102-1100 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 USEPA Membrane Filtration Guidance Manual (EPA 815-R-06-009). The TCEQ reviewed challenge study data as mentioned above for the Dow IntegraFlow™ DW102-1100 UF membrane modules. 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}

For the Dow IntegraFlo™ DW102-1100 UF Membrane modules, the TCEQ is approving a **LRV_{C-Test} of 6.3** 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 suspension 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	Dow IntegraFlo™ DW102-1100 Ultrafiltration (UF) Membrane Modules
Number of Independent Modules Tested	5
Criterion of Selected Modules	None*
Model Number / Part Number / Serial Numbers of Tested Modules	DW102-1100 / 00370545 / IF-201200102 through IF-201200106
Nondestructive Performance Testing (NDPT) Process	Pressure Decay Test
Quality Control Release Value (QCRV)	0.06 pounds per square inch (psi) per minute
Challenge Particulate	<i>Bacillus atrophaeus</i> (as a surrogate for <i>Cryptosporidium</i>) with an average diameter of 0.8 µm and an average length of 1.8 µm
Detection Limit	1 CFU per 100 mL
Feed Concentration Range	1.7 x 10 ⁴ to 3.7 x 10 ⁴ microspheres/mL
Max Filtrate Flux Rate	70 gallons per square-foot per day (gfd) @ 25° C
Mode of Operation / Flow Configuration	Deposition mode / Outside In

* In regards to the selection of modules for testing, there was no consideration of manufacturing variability. However, the challenge study established a quality control release value (QCRV) of 0.06 psi/min. based on the pressure decay test results (both pre- and post-challenge study) 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 6.3-log.

LIMITS OF TCEQ-APPROVED LRV_{C-TEST}

The TCEQ-approved LRV_{C-Test} is valid for only the Dow IntegraFlo™ DW102-1100 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 Dow IntegraFlo™ DW102-1100 UF membrane module must comply with the following specifications to receive the TCEQ-approved LRV_{C-Test}:

- 1) Specifications of the approved Dow IntegraFlo™ DW102-1100 UF membrane modules:
 - a) Constructed of Polyvinylidene fluoride (PVDF) hollow fiber membranes;
 - b) Module outside diameter of 8.6 inches;

- c) Module length of 92.9 ± 0.2 inches
 - d) Module volume of 8.5 gallons;
 - e) Nominal membrane pore size of $0.03 \mu\text{m}$ (0.03 microns);
 - f) Nominal membrane surface area of 1,103-ft²;
 - g) An outside-to-inside flow path;
 - h) Operational mode: dead-end filtration mode;
 - i) Maximum filtrate flux at 25 °C: 70 gallons per square-foot per day (gfd);
 - j) Maximum filtrate flow at 25 °C: 50.2 gallons per minute (gpm);
 - k) Temperature operating range of 1 to 40° C (33.8 to 104°F);
 - l) Maximum trans-membrane pressure (TMP) of 30 psi (2.1 bar);
 - m) Maximum feed pressure of 87 psi (6.0 bar);
 - n) Operating pH range: 2 – 11;
 - o) Cleaning pH range: 2 – 12;
 - p) Maximum backwash pressure: 36 psi (2.5 bar);
 - q) Maximum sodium hypochlorite exposure: 2,000 mg/L;
 - r) Maximum feed TSS: 100 mg/L; and
 - s) Maximum turbidity: 300 Nephelometric Turbidity Units (NTU).
- 2) For use by public water systems in Texas for microbial contaminant removal credit, only Dow IntegraFlo™ DW102-1100 UF membrane modules that have been certified for performance by NSF International are allowed. As defined in the NSF International challenge study report (Section 4.3), this means that only modules that have passed a Non-Destructive Performance Test with a Quality Control Release Value (QCRV) of 0.06 psi/min.
 - 3) The Dow Chemical Company must record the results of each Dow IntegraFlo™ DW102-1100 UF membrane module's NDPT with the module's assigned unique serial number. The NDPT result for each Dow IntegraFlo™ DW102-1100 UF membrane module delivered to a Texas PWS must be provided upon delivery of the Dow IntegraFlo™ DW102-1100 UF membrane modules to a system.
 - 4) The Dow Chemical Company must notify the TCEQ in writing if the Dow IntegraFlo™ DW102-1100 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 Dow IntegraFlo™ DW102-1100 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 $\text{LRV}_{\text{C-Test}}$; or,
 - b) The maximum removal efficiency that can be verified through a membrane unit's site-specific direct integrity test (LRV_{DIT}).
 - 6) Each Dow IntegraFlo™ DW102-1100 UF membrane module must conform to American National Standards Institute/National Sanitation Foundation (ANSI/NSF) Standard 61 and must be certified by a testing organization accredited by ANSI.
 - 7) Please note that the approved $\text{LRV}_{\text{C-Test}}$ 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 $\text{LRV}_{\text{C-Test}}$ in this letter may also be revised.

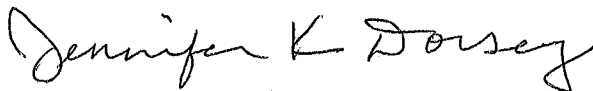
Ms. Andrea Lima
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Please provide a copy of this letter to each of your Texas PWS customers. This letter is **not** to be construed as:

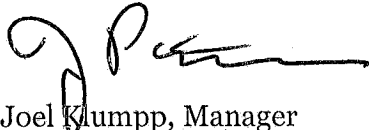
- A granted TCEQ exception for any Texas PWS to use the Dow IntegraFlo™ DW102-1100 UF membrane modules. Each Texas PWS must request and receive site-specific approval to use membrane filtration in accordance with 30 TAC §290.42(g) and §290.39(l);
- TCEQ approval for a Texas PWS to install a Dow IntegraFlo™ DW102-1100 UF membrane module; or
- TCEQ approval for the Texas public water system's required concentration time (CT) study.

If you have any questions about this letter, or if we can be of additional assistance, please contact Jennifer K. Dorsey, P.E., at the letterhead address, by e-mail at jennifer.dorsey@tceq.texas.gov, or by telephone at (512) 239-4635.

Sincerely,



Jennifer K. Dorsey, P.E.
Technical Review and Oversight Team
Plan & Technical Review Section
Texas Commission on Environmental Quality



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

JPK/JKD

cc: Ms. Kelly Lange-Haider, The Dow Chemical Company, kplange-haider@dow.com
Ms. Andrea Lima, The Dow Chemical Company, AGLima@dow.com