

## Liqui-Cel<sup>®</sup> Contactor and Celgard<sup>®</sup> Membrane Analysis Services

In order to provide more comprehensive support for the Liqui-Cel<sup>®</sup> Membrane Contactors that have been in the field for a period of time, Membrana can perform technical evaluations on Liqui-Cel products. These evaluations can be used to help determine the best cleaning protocol or to get a better picture of the useful life of the membrane in your unique application. Our highly trained technical service engineers perform all these tests in our facility. We offer three basic types of evaluations for our products that are outlined below.

### General performance evaluation

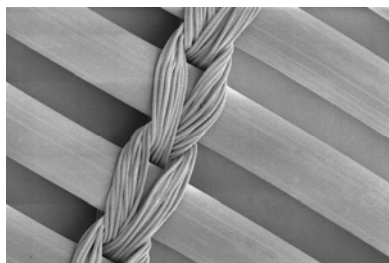
The general performance test is a non-destructive test that will allow us to evaluate if any contamination has deposited on the surface of the membrane or if any fiber damage has occurred.

This includes the following services:

1. Test for oxygen removal performance and compare to internal manufacturing specification.
2. Test the pressure drop and compare to internal manufacturing specification.
3. Leak test the contactor to evaluate integrity of the membrane.

### Fiber analysis evaluation

The fiber analysis is a destructive test that will allow us to evaluate if any degradation of the fiber has occurred. A significant change in the tensile properties indicates that the membrane is reaching the end of its useful life. The membrane cannot be put back into service after this test.



SEM of Hollow Fiber Array taken prior to tensile strength tests

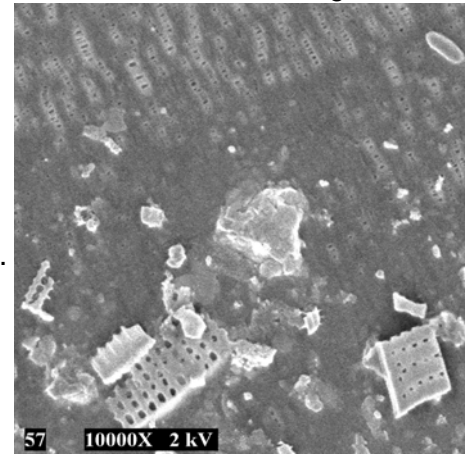
This includes the following services:

1. Test the tensile strength of fibers inside the contactor and compare to internal manufacturing specification.
2. Test the percent elongation of fibers in the contactor and compare to internal manufacturing specification.

3. Scanning electron micrograph of the fiber (typically only performed when a decrease in oxygen removal performance is noted during the overall performance test).

### Cleaning Evaluations

This evaluation can be used to develop a cleaning protocol for membranes that have been fouled or contaminated in the field. Most often the fouling is related to some mineral or biological fouling and our technical service staff can develop a cleaning procedure for your unique water system.

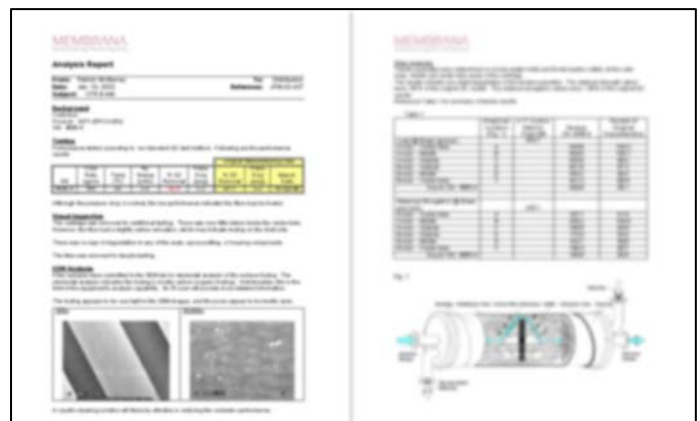


SEM photograph showing contamination of the membrane

This includes the following services:

1. Perform an evaluation on the membrane.
2. Rinse and dry the contactor.
3. Complete a performance test.
4. Provide a written cleaning recommendation.

Please contact your local representative to discuss these evaluations in more detail and to get pricing on these services. A complete report summarizing all relevant data will be provided upon completion of the testing.



Example of summary report you would receive at the end of the testing

This product is to be used only by persons familiar with its use. It must be maintained within the stated limitations. All sales are subject to Seller's terms and conditions. Purchaser assumes all responsibility for the suitability and fitness for use as well as for the protection of the environment and for health and safety involving this product. Seller reserves the right to modify this document without prior notice. Check with your representative to verify the latest update. To the best of our knowledge, the information contained herein is accurate. However, neither Seller nor any of its affiliates assumes any liability whatsoever for the accuracy or completeness of the information contained herein. Determination of the suitability of any material and infringement of any third party rights, including patent, trademark, or copyright rights, are the sole responsibility of the user. Users of any substance should satisfy themselves by independent investigation that the material can be used safely. We may have described certain hazards, but we cannot guarantee that these are the only hazards that exist. Nothing herein shall be construed as a recommendation or license to use any information that conflicts with any patent, trademark or copyright of Seller or others. Please read our Operating Manuals carefully before installing and using these modules.

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