

## Membrane Deaeration (MDA™) - Frequently Asked Questions

### Overview

***Why should I choose Water Standard to supply my Liqui-Cel® membrane system?***

WS is a qualified OEM for Liqui-Cel® membranes and has extensive operating experience with the technology. WS brings a unique blend of oil & gas industry veterans and water treatment experts to each application.

***Where have Liqui-Cel® membranes been used before? Are they suitable for oil & gas environments?***

Liqui-Cel® membranes are a proven technology in the electronics, power, and other industrial applications, which reduces the risk associated with bringing the technology to oil & gas environments.

### Design

***I don't have enough space on my existing facilities for a vacuum tower. Can I use MDA™?***

WS's MDA™ design is modular, consisting of separate small skids and multiple pressure vessels in parallel. This increases installation flexibility on space-constrained offshore platforms.

***How does the vacuum system for membrane deaeration compare to traditional vacuum tower deaeration?***

The MDA™ vacuum system is considerably smaller. MDA™ requires lower vacuum pressure and a reduced volumetric gas flow rate.

***What type of vacuum equipment is used in the MDA™ package?***

Liquid ring vacuum pumps such as those included in vacuum tower deaeration packages. If motive fluid is available, then **MDA Tornado™** can be selected as a size, weight, and cost saving alternative.

***What level of pretreatment is required to successfully operate the unit?***

MDA™ can operate downstream of RO, SRP, MF, media filters, or cartridge filters only.

***Can I eliminate injection booster pumps with membrane deaeration?***

Yes. However, there is a pressure drop across the membranes, which will have to be compensated for by the intake pumps or any upstream feed pump.

### Operation

***Can I use nitrogen from my existing facilities to supply the membrane deaeration unit?***

Often, existing nitrogen is not high purity (approx. 97%). MDA™ performance is dependent on high nitrogen purity (99.9% or above), so WS recommends a dedicated PSA nitrogen generator. However, existing nitrogen can sometimes be “polished” to meet the desired purities.

***How much nitrogen is required to operate a full-scale membrane deaeration unit?***

MDA™ requires roughly 0.5 scfm per pressure vessel. This equates to approximately 30 scfm for a 125,000 bpd water injection system.

***How often do I have to clean the membranes? What is the expected life of the membranes?***

Cleaning frequency is dependent on feedwater quality, but it's expected to be once every few months. With proper pretreatment, membrane life can be greater than 10 years, but 5 years is a conservative estimate.

***Do I still need anti-foam chemical with membrane deaeration?***

No. The nature of the gas-liquid contact in the membrane is not conducive to foaming.

***Can I eliminate chemical oxygen scavenger addition with membrane deaeration?***

Yes. MDA™ will remove oxygen to below 10 ppb without oxygen scavenger.