

DuPont Water Solutions for Oil & Gas – **Injection Water**

DuPont's innovative portfolio of water technologies for high-performing and sustainable onshore and offshore systems



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About DuPont Water Solutions

Companies, communities and homes around the world choose DuPont Water Solutions to help make water safer and more accessible. Industries and markets count on us to become more efficient. Our innovation and collaboration with the world's best water experts enables ecosystems of innovation to deploy vital technologies in new, market-shaping ways.

With a global network of accessible knowledge and a market-leading portfolio of purification and separation technologies, we help enable improved water productivity from which improved health, profitability, and new possibilities emerge. In a world of increasing water scarcity, we provide a proven path that balances resource productivity and responsibility.



Our products are based on decades of industry experience, and include ion exchange resins, reverse osmosis and nanofiltration technology, ultrafiltration modules, degasification modules and wastewater treatment products, with globally recognized brands like FilmTec™ Fortilife™, Memcor® and the DuPont™ Amber™ series to meet your water, wastewater and other separation needs.



We provide support to markets and industries across the globe, including residential, municipal, power generation, oil & gas, healthcare, commercial industries, chemical & petrochemical, food & beverage and microelectronics, to meet the needs of a wide range of applications. We also provide consultancy services for minimal liquid discharge (MLD) applications.



Unmatched in our global reach, industry experience and expertise, our focus and dedication places us in a unique position to help industries, organizations, and communities prosper. We offer the broadest portfolio in the water treatment technology industry and provide leading innovations.

The broadest portfolio in the industry

Water is the largest by-product by volume in Oil & Gas production and requires treatment for use, reuse and discharge. To improve productivity, water with specific quality requirements is injected into the well for secondary and tertiary recovery. For discharge, the organic load (expressed as BOD, COD, TOC or oil & grease) is usually a limit for wastewater disposal permits.

From injection to produced water, we provide a complete set of treatment technologies to handle oil and gas production needs.

Like no other supplier, we can provide ultrafiltration (UF), reverse osmosis (RO) elements, sulfate-removal nanofiltration (NF) membranes, degassing membranes and wastewater solutions like membrane bioreactors (MBR), polymeric adsorbents and selective ion exchange (IX) resins. The use and details of these products are further described in this brochure, providing a sample of our expertise and growing portfolio of technologies that targets the unique needs of hydrocarbon exploration and production.

	MemPulse™ MBR	DuPont™ IntegraTec™ Ultrafiltration	FilmTec™ Reverse Osmosis Nanofiltration	DuPont™ Electrodeionization	
Wastewater					Ultrapure Water
	OxyMem™ MABR	DuPont™ B-Free™ Pretreatment	DesaliTec™ SOAR CCRO	Amber Series Ion Exchange Resins	

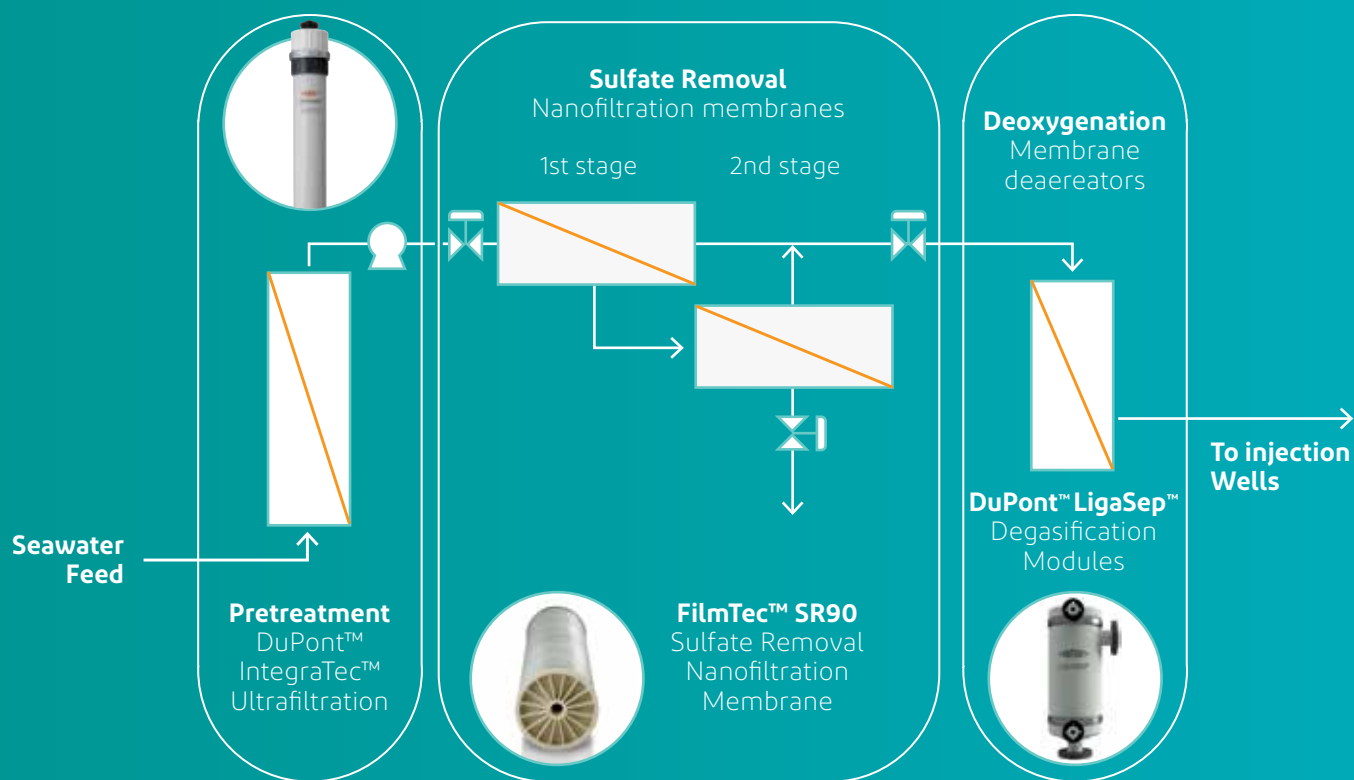
Injection Water

Experience lower costs and increased oil production with effective treatment for injection water

The prevention of sulfate precipitation is a major concern for oil and gas producers looking to extract the most out of the wells, reduce costs, protect downstream equipment and mitigate safety and environmental risks. Since injection water quality is

critical to improve oil recovery, DuPont Water Solutions provides membranes that can be used in various steps of injection water systems for safe and reliable operation.

Product Portfolio





Pretreatment for particle removal

DuPont is the pioneer of the patented ion-selective nanofiltration (NF) membranes used in the Oil & Gas industry to treat seawater for injection into oil reservoirs. We have vast experience treating seawater and extensive knowledge of the fouling behaviors of such water and its impact on the performance of NF membranes.

Proper pretreatment is a key factor for successful long-term performance of Sulfate Removal Units (SRUs). Without employing an SRU, operations that directly inject seawater can experience plugging problems in the oil formation. In both cases, reliable pretreatment can provide effective and stable operation, helping reduce downtime.

Offshore platform designs must consider important factors for pretreatment systems:

- Quality of filtrate & particle removal (algae, bacteria, sand)
- Footprint
- Weight
- Consistent and continuous operation
- Simple operation

DuPont provides a variety of ultrafiltration (UF) products that are advantageous in meeting these needs.

DuPont™ IntegraTec™ Ultrafiltration Portfolio for Onshore and Offshore Applications

Product	Design	MEV/Single	Cleaning mechanism	Footprint
Various PVDF Out-In UF Modules XP 52, OG 50, P20N	Vertical	Both	Air Scour	Low
PVDF Out-In Multi-Element-Vessel Solution	Vertical	Integrated MEV	Air scour/Backwash	Low
Various PES In-Out Modules MB PRO 64 H, MB 55 H	Horizontal	MEV	Backwash	Low
T-Rack® HP	Vertical	Integrated Single	Backwash	Standard

Pressure rating aligned to offshore requirement

DuPont can provide UF in two different configurations: multi-element vessel (MEV) or single-element racks, both of which are capable of delivering pressure ratings that are aligned to various platforms' needs. The MEV consists of a pressure vessel with a unique adaptor to house multiple ultrafiltration modules operating in parallel. It has a reduced footprint due to better packing and elimination of piping manifolds, which provides better access and less maintenance. Apart from vertically-stacked MEV systems, DuPont also provides UF cartridges that can fit into standard horizontal pressure vessels, organized similarly to a reverse osmosis (RO) system, offering a more flexible option for pre-built systems.



Diversity in fiber chemistry

DuPont offers UF modules with either PVDF (polyvinylidene fluoride) or PES (polyethersulfone) fibers. PVDF membranes are most common in Oil & Gas applications as they offer high chemical resistance and are tolerant to temperature variations,

promoting longer module life. Hollow-fiber PVDF membranes will provide exceptionally high filtrate quality and very stable and long-term filtration operation.

Backwash requirements

Our variety of products allow customers to select which of the different cleaning requirements better suit their needs, be it footprint, equipment performance or system reliability. For

instance, multi-element vessels do not always require backwash, whereas XP fibers may be air scoured during backwash to help maximize recovery.

Sulfate removal nanofiltration

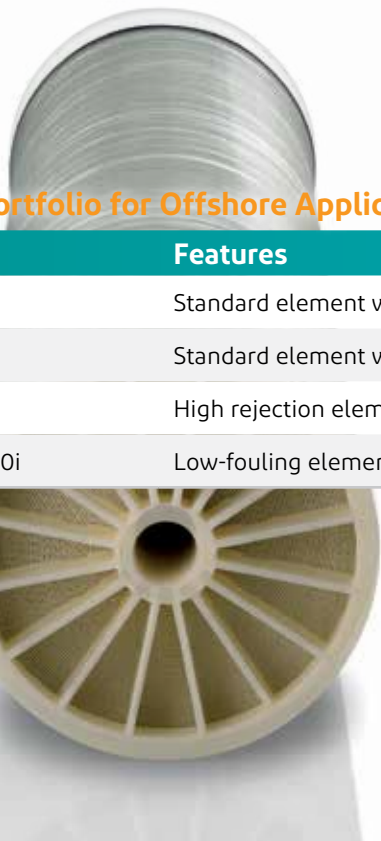
DuPont has been in the Oil & Gas industry since 1987, when we introduced the first patented nanofiltration membranes for sulfate mitigation in the North Sea. Our ion-selective NF membranes have been used for over 30 years to treat seawater prior to injection into oil reservoirs. They remove sulfates to prevent and control reservoir scaling and souring.

- Sulfate Removal Units (SRUs) offer two main advantages:
- Removal of sulfate eliminates the primary constituents from injection water that cause scale formation, thus reducing or eliminating this scaling problem.
 - By removing the sulfate from the injected seawater – the source of sulfur that is converted to hydrogen sulfide by sulfate reduction – bacteria is eliminated, reducing the potential of souring inside the wells.

The FilmTec™ SR90 product family is the first and ideal option to selectively remove sulfates from seawater used for waterflooding injection operations.

Sulfate Removal Portfolio for Offshore Applications

Product	Features
FilmTec™ SR90-400i	Standard element with excellent permeability, ideal for cold-water SRU systems
FilmTec™ SR90-440i	Standard element with excellent permeability, ideal for cold-water SRU systems (higher area)
FilmTec™ SR90HR-440i	High rejection element for demanding requirements in water permeate quality
FilmTec™ Fortilife™ SR90i	Low-fouling element with enhanced chemical resistance for systems prone to biofouling



Why should you choose FilmTec™?

- DuPont™ FilmTec™ SR90 has been the pioneer and has the longest track record in sulfate removal for offshore enhanced oil recovery (EOR).
- DuPont Water Solutions has more than 30 years of operational experience and excellence.
- DuPont has over 80+ successful offshore operation references
- More than 80,000 FilmTec™ SR90 elements are installed worldwide
- More than 12 MM barrels of water per day (BWPD) installed capacity
- Multiple long-term partnerships with leading system integrators
- Largest portfolio of sulfate removal membranes in the market

A solution for every problem



High productivity elements for efficient operation: FilmTec™ SR90-440i Nanofiltration Element



High rejection elements for high quality permeate: FilmTec™ SR90HR-440i Nanofiltration Element



Nanofiltration elements with an antifouling design for sustained operation in biofouling-prone areas: FilmTec™ Fortilife™ SR90i Nanofiltration Element

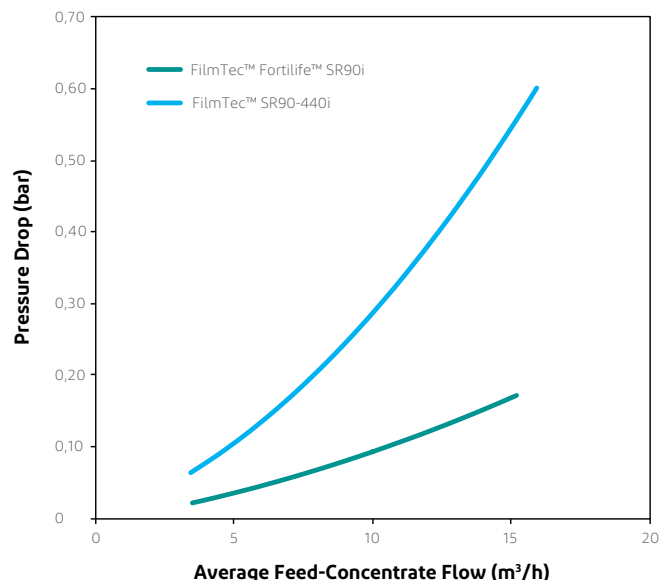
FilmTec™ Fortilife™ SR90i

The Next Generation of Low Fouling elements for Sulfate Removal

FilmTec™ Fortilife™ SR90i

FilmTec™ Fortilife™ SR90i elements are specifically designed to handle biofouling in sulfate removal systems in oil production. These elements are equipped with advanced fouling resistance and cleanability features, helping plants reduce the number of cleanings while maintaining high sulfate rejection and permeability. With FilmTec™ Fortilife™ SR90i elements, operators can expect to improve SRU operations by reducing maintenance costs and downtime on offshore platforms. This is made possible by:

- Fouling-resistant technology reducing cleanings by 50%
- Low differential pressure
- Durable membrane chemistry
- More effective and efficient cleaning of biofilm and organic compounds



Desalination for low-salinity injection

Low-salinity waterflooding is one of the emerging enhanced oil recovery (EOR) techniques that has gained popularity in the past decade.

The injection of low-salinity water into aging oil reservoirs has been found to enhance oil recovery compared to the more traditional high-salinity water injection technique. The improvement is brought by the alterations to the wettability of the rock formations which oil occupies. Typically, the salinity used in this type of management strategy requires concentrations of 0.1% to 1% salinity, depending on the oil well chemistry. The incremental oil recovery was attributed to the redirection of clay swelling and plugging of pore spaces available to oil and water.

DuPont carries a range of **reverse osmosis and nanofiltration membranes** that can achieve the desired water quality for successful low-salinity injection.



Membrane Degasification

When industrial equipment is in contact with water used in the process, or water is used as an ingredient for production, oxygen and carbon dioxide in that water may damage the asset due to corrosion or may cause production issues. Various grades of water used in Oil & Gas installations may regularly require degasification to prevent oxidation and reduce the ionic load on downstream processing equipment: demineralized water, boiler feed water, injection water or oil recovery or ultrapure water for high-grade products.

On the other hand, some water streams or production effluents may become rich in hydrogen sulfide, ammonia or methane. These streams cannot be discharged in the environment

without treatment, and the appropriate extraction of these dissolved gases may enable the recovery of valuable resources.

In order to remove dissolved gases from water, one may find three main types of solutions: chemicals, stripping towers, or membrane degasifiers.

The DuPont™ Ligasep™ degasification product line is a hollow-fiber-based technology that enables the removal of gas from the water by physical means. These modules can be installed in series within the water treatment system, ensuring efficient degasification and achieve parts-per-billion (ppb) levels of dissolved gases for a wide range of flow rates in water treatment applications.

Compared to the use of chemicals or stripping towers, the Ligasep™ product features:

- Chemical-free operation and residual-free removal vs. the use of chemical scavengers
- High packing density, which translates into smaller footprint, reduced weight and height vs. stripping towers
- A membrane barrier which helps prevent contaminants on the gas side to transfer to the water side.
- Flexibility and robustness: the Ligasep™ product adapts to variable production demands
- Unattended and fully automated operation. Compared to other membrane degasifiers, the Ligasep™ product family is based on a thin gas permeable membrane which translates into the following advantages:
 - Ability to remove oxygen without using nitrogen gas
 - Reduction of water vapor transfer, which may cause auxiliary and piping equipment damage.



Degasification Module Portfolio for Onshore and Offshore Application

Product	Max. waterflow per module	Application
Ligasep™ LDM-040-LS	Up to 11 m³/h	Preferred for the removal of low solubility
Ligasep™ LDM-120-LS	Up to 50 m³/h	Gases (O ₂ and CH ₄)
Ligasep™ LDM-040-HS	Up to 11 m³/h	Preferred for the removal of high solubility
Ligasep™ LDM-120-HS	Up to 50 m³/h	Gases (CO ₂ , H ₂ S, and NH ₃).

Learn more about our product offering in the Oil & Gas industry here:



Ion Exchange Resins



FilmTec™ Reverse Osmosis Elements



FilmTec™ Nanofiltration Elements



DuPont™ IntegraTec™ Ultrafiltration



DuPont™ Ligasep™ Degasification Modules

Just scan QR-code





Powering performance worldwide

With a large global manufacturing footprint, strong R&D expertise and technical support services and systems, we supply high market volumes with high quality. DuPont partners with you, our customer, to understand unmet needs and develop tailored solutions.

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Midland, MI, USA
Shanghai, China
Singapore
Soma, Japan
Tarragona, Spain*
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Shanghai, China
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Tokyo, Japan
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Soma, Japan
Windsor, Australia

*Global Water
Technology Center

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Water Solutions
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Form No. 45-D03549-en B28
February 2023