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HYDRANAUTICS

WATER INJECTION SOLUTIONS FOR THE OIL AND GAS INDUSTRY USING NANOFILTRATION

Case study

New Hydranautics NANO-SW-LD MAX membranes help reduce differential pressure in the Sulphate Removal Unit of a Brazilian offshore plant

The PROBLEM

To efficiently extract oil, seawater is injected into the formation. Before injection, a sulfate removal unit (SRU) with Nanofiltration membranes removes sulfate from the seawater to avoid scaling the formation.

A specific SRU was struggling with high differential pressures. A clean in place (CIP) was required every 7-10 days. The goal was to reduce the high differential pressure without sacrificing membrane surface area.

Up-time and CIP is governed by the increase in differential pressure in the first stage of the SRU and is usually limited to 3 bar. On an offshore platform, differential pressure usually increases when biological or particulate fouling gets lodged in the brine spacer. Thinner spacers cause higher differential pressures and higher rates of fouling. The elements used on the platform had thinner 28 mil spacer in order to utilize the 440 ft². To exacerbate the fouling problems, the pre-treatment for the SRU was limited to coarse filters (80 µm) only.

B R A Z I L

Location	Brazil
Feed water source	Seawater
Application	Sulfate removal for water injection
Capacity	507 m³/h (permeate)
Recovery	75%
Pretreatment	Coarse filter (80 µm)
NF Membrane	NANO-SW-LD MAX
NF Design	Two stages (56:28 x 6M)
Permeate back-pressure	Up to 7 bar in 1st stage, up to 3 bar in 2nd stage

The SOLUTION

To address the high differential pressures, Hydranautics proposed the use of a new element construction with a thicker spacer (34 mil) and the same membrane area as the existing elements (440 ft²).

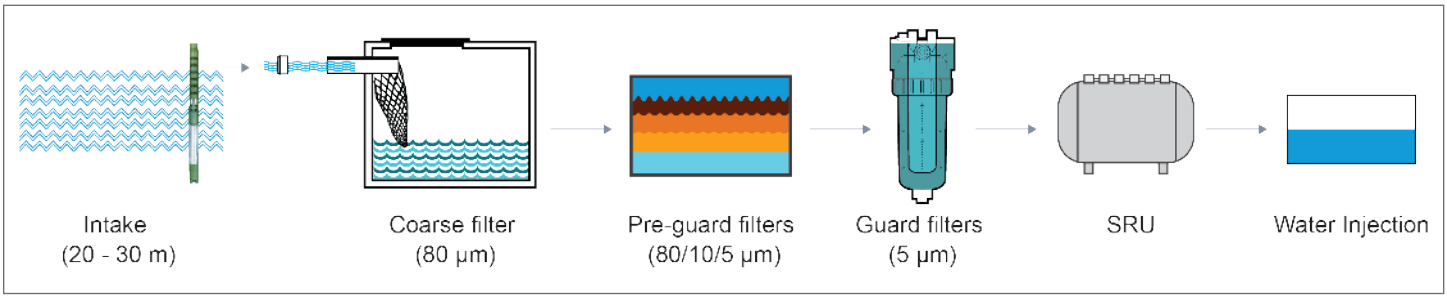
NANO-SW-LD MAX has both thicker spacer and higher area to provide both a lower dP and lower rate of fouling.

The thicker, 34 mil, spacer provides a wider space between membrane leaves to reduce the tendency for foulant to accumulate.

The customer also installed a set of guard filters (cartridge filters with a micron rating of 80, 10 and 5 µm).

Hydranautics suggested improvements to the pre-treatment process and the use of the new Nano-SW-LD MAX with thicker brine spacer and higher surface area.

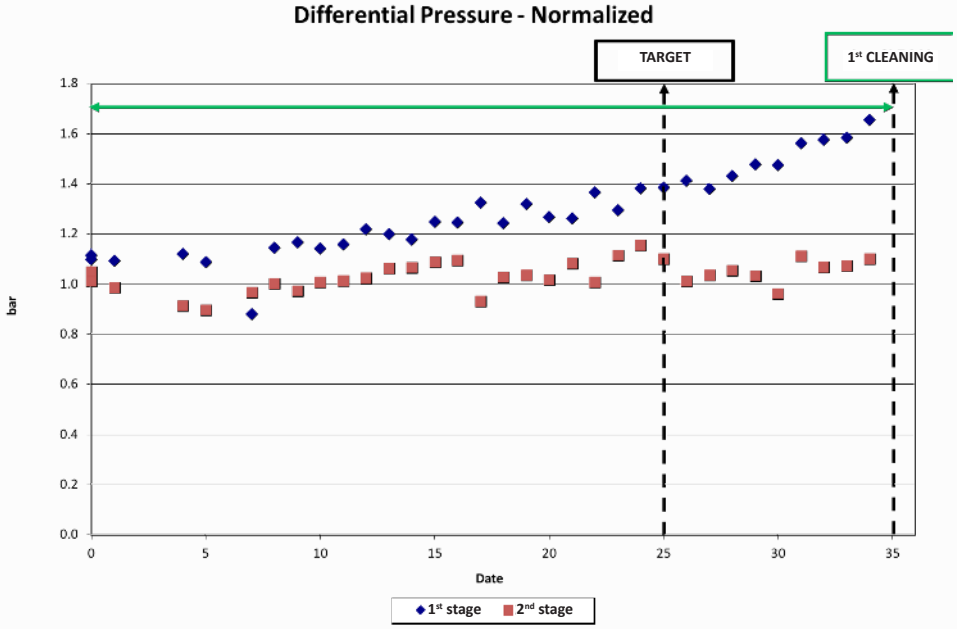
This would reduce differential pressures and improve cleaning efficiency without having to increase the size, weight, and footprint of the SRU.



The IMPACT

In February 2020, Hydranautics engineers embarked to assist with the loading and startup of NANO-SW-LD MAX. Because of the element's thicker, 34 mil spacer, differential pressure in the first stage started at only 1.1 bar, which was lower than previously installed elements. After successful startup, the objective was to operate for 25 days before cleaning. In reality, the first cleaning was not performed until 45 days after start-up. The NANO-SW-LD MAX, with thicker spacer, successfully replaced the previously installed, thinner spacer elements without sacrificing surface area, system flux, or feed pressure.

Train B - Hydranautics membranes	**Start-up (February 9, 2020)**	**Projection (NANO-SW-LD MAX)**
1st stage dP baseline (bar)	0.98	1.10
2nd stage dP baseline (bar)	1.01	1.10
Feed Pressure (bar)	16.68	18.40
Sulphate combined (ppm)	4.6	11.58



Thanks to the innovative element construction, no additional elements or pressure vessels were added, which saved on capital cost. No modifications were made to the Sulfate Removal System.

The new NANO-SW-LD MAX has an innovative, thinner membrane backing that makes room for thicker spacer and more membrane area. The lower feed pressure and lower differential pressure further reduced the energy consumption. The membranes produced a permeate with less than 8 mg/l of sulfate; well below the 40 mg/l required for injection water. NANO-SW-LD MAX not only exceeded expectations for lower dP, but feed pressure and permeate sulphate levels were also lower than expected.

These new membranes exceeded customer's expectations and made them an ideal choice for optimizing the performance of the offshore SRUs.

The NANO-SW-LD MAX operateed at lower differential pressures when compared to regular products with 28 mil spacer and 440 ft². The thicker spacer reduced cleanings and chemical consumption. Overall, more permeate can be produced considering the longer uptime. Less fouling and lower differential pressures decreases the operating cost while producing the same quantity and quality of permeate.

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For more information about Hydranautics case studies, contact us at **hy-marketing@nitto.com** or visit our website at **membranes.com**

About Hydranautics

Since our founding in 1963, Hydranautics has been committed to the highest standards of technology research, product excellence and customer fulfillment. Hydranautics entered the Reverse Osmosis (RO) water treatment field in 1970 and is now one of the global leaders in Integrated Membrane Solutions. Hydranautics became a part of the Nitto Group in 1987. Nitto is Japan's leading diversified materials manufacturer. The group offers over 13,000 high value specialty products worldwide including optical films for liquid crystal displays, automotive materials, reverse osmosis membranes for desalination and transversal drug delivery patches.

As leaders of high quality membrane solutions, we believe our commitments extend beyond manufacturing and selling our products. Our skilled staff of technicians, engineers and service professionals assist in designing, operating and maintaining a robust, reliable and efficient membrane system to meet your requirements and exceed your expectations.

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