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HYDRANAUTICS
Nitto Group Company

MEMBRANE TECHNOLOGY TAILORED TO ACHIEVE THE DESIRED PERFORMANCE

Case study

A 3-way Pilot Test between Competing Brands won by Hydranautics' Hybrid Design comprising ESPA4-LD and ESNA1-LF2-LD membranes

The EXECUTIVE SUMMARY

Palm Beach County (PBCo) – Water Treatment Plant 3 (WTP-3) is a 30.0 MGD facility that membrane softens their Surficial Aquifer wells, high in organics, color, moderate in hardness, and serves over 100,000 residents around the Delray Beach area. This plant was commissioned in 2004 with Brand-Z membranes that rejected hardness and organics sufficiently.

The plant wanted to find the best replacement, so, in 2016 they pilot-tested 3 different membrane brands simultaneously to eventually choose a hybrid design by Hydranautics that fit their permeate quality goals and ran at the lowest operating costs. In 2017, all 10 Nanofiltration (NF) units were replaced with the Hydranautics hybrid design and currently the plant is operating at full capacity with the same quality of permeate and lower operating pressures as seen during pilot proof testing.

The PROBLEM

After 12+ years of service, the original Brand-Z membranes were no longer available for replacement into this plant, so PBCo wanted to find a current membrane that best fit their hardness passage goals, organic rejection, and NF units that would run at lower operating pressures.

By 2016, WTP-3 had got to the point where the old membranes required more feed pressure than their system was capable of pumping, the permeate production was lower than original targets of 2.5 MGD, and more post-treatment chemicals were requried to increase alkalinity for stabilizing the finished water because the permeate was a bit too pure.

PBCo was paying more for electricity, cleaning and post treatment chemicals, and also brought in less revenue from the reduced production. Each NF unit did not have a way to balance the internal flux (achieved by restricting permeate flow from the 1st stage), and therefore, fouling was faster, yielding less production from 2nd stage.

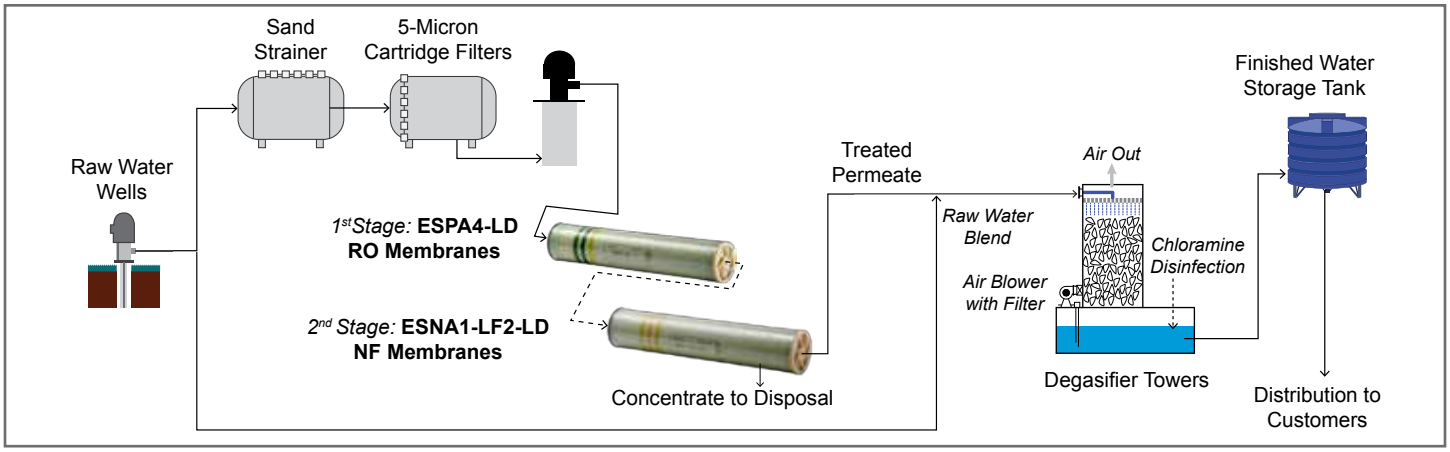
Location	Delray Beach, FL, USA
Feed water source	Surficial wells
Application	Municipal drinking water
Capacity	30 MGD
Start-up date	2004
NF Design	10 NF units, 40:21 array of 7M vessels. ESPA4-LD in the 1st stage and ESNA1-LF2-LD in the 2nd stage

The SOLUTION

In 2016, pilot testing was done to give Brand-X, Brand-Y and Hydranautics, a chance to run side-by-side and show the performance of their respective design proposals.

During the pilot proof test, a hybrid design comprising Hydranautics ESPA4-LD low-pressure reverse osmosis and ESNA1-LF2-LD nanofiltration membranes provided the desired range of alkalinity and hardness passage, great organic rejection to eliminate the potential of Disinfection By Products (DBP's), and the lowest feed and differential pressures.

Without valves to flux balance the system as the units start to foul from a matrix of salts and organics, the hybrid design from Hydranautics naturally allows a higher flow into the 2nd stage because the NF membranes are positioned in the back. This hybrid combination gave the best rejection up front (1st stage) with the ESPA4-LD's and bled the desirable amount of alkalinity in back (2nd stage) with the ESNA1-LF2-LD's.



The below table shows the performance of the Hydranautics membranes.

PBCo WTP-3 Parameters	**Brand-Z Membranes** *(2004 - 2016 performance)*	**Hydranautics Hybrid Design** *(2018 performance with Hydranautics replacements in 2017)*
Permeate TDS	20 - 50 mg/L	> 50 mg/L
Permeate Color	< 2.0 color units	< 2.0 color units
Permeate Total Hardness	< 15 mg/L as $CaCO_3$	> 30 mg/L as $CaCO_3$
Permeate Bicarbonate	< 15 mg/L as $CaCO_3$	> 30 mg/L as $CaCO_3$
TTHM Formation Potential	< 0.042 mg/L	< 0.042 mg/L
HAA5 Formation Potential	< 0.030 mg/L	< 0.030 mg/L
Feed Pressures	100 - 130 psi	85 psi
dP 1st Stage (ESPA4-LD)	30 - 45 psi	15 psi
dP 2nd Stage (ESNA1-LF2-LD)	15 - 20 psi	10 psi

The IMPACT

In 2017, Hydranautics installed 10 NF units of its hybrid design into WTP-3. Currently, the plant is seeing the same quality of permeate and rejection of DBP's like it saw during the pilot proof test. There is better flux distribution to both stages as the higher permeable NF membranes reside in 2nd stage, which also bleed back the desired alkalinity and hardness in the composite permeate.

We are also seeing a 30 psi lower feed pressure than the original Brand-Z membrane. The plant generates more revenue today as it continues to produce the original target of 2.5 MGD / NF unit, while consuming less post treatment chemicals and saving with lower energy costs annually.

About the author

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***Kirk Lai** is the Field Service Engineer for Hydranautics and has been with the company for 14 years. He provides on site services and support to plants all across the United States.*

For more information about Hydranautics case studies, contact us at **hy-info@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 one of the most respected and experienced firms in the membrane separations industry. We joined the Osaka, Japan based Nitto Denko corporation in 1987 which was founded in 1918 and now has 117 companies in more than 20 countries, with over 30,000 employees worldwide. Our alliance with this global film industry giant boosts Hydranautics to a superior level of technological sophistication, product performance and customer response.

We are not simply product manufacturers; we are your membrane technology partners. As leaders of high quality membrane solutions, we believe our obligations 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. Our support is offered from early stage conceptual design and engineering to start-up and maintenance, no matter the location globally whether it is on land or off-shore.

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