



**RECLAIMING EVAPORATOR  
CONDENSATE REDUCES EXPANSION  
INVESTMENTS FOR MALAYSIAN  
BIODIESEL INDUSTRY**

*Case study*

*Treating evaporator condensate from Biodiesel  
Industry using Hydranautics PRO-XT1 RO Membrane*

The

## PROBLEM

Malaysia's Johor Bahru state is home to several palm oil industries, some manufacturing biodiesel. They faced high treatment cost of the condensate emanating from byproduct glycerin concentrating evaporators. This condensate is treated in biological treatment plants (WWT)

because they contained high COD and BOD values. The company planned to expand plant capacity that required a new WWT, requiring additional investment. They sought an alternative less expensive and environment friendly treatment solution.



*Feed water* Evaporator condensate

*Application* Condensate treatment & product recovery

*Feed Flow* 10 m<sup>3</sup>/h

*Permeate Flow* 8 m<sup>3</sup>/h

*Start-up date* May 2012

*UF Design* 4 x HYDRAcap60

*RO Design* 10 x PRO-XT1

*RO Array* 1x1-5

The

## SOLUTION

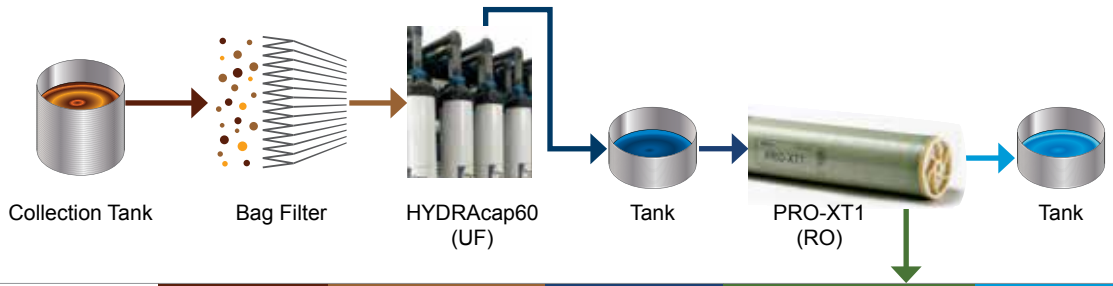
A different idea is to treat the condensate and recover product using Reverse Osmosis (RO) membranes. Because condensate is pure water, containing very low salts, addition of chemicals has to be avoided and RO offers benefits of chemical-free treatment.

In this process the condensate is passed through a set of RO membranes. RO membranes separate the feed stream into two parts. One part is the purified water devoid of the main product but may contain smaller polar organics. The second part is concentrated stream that has all the product and other organics. The concentrate is sent back to the evaporator and permeate is reused based on its quality and possible uses.

**PRO-XT1** is a polyamide spiral wound reverse osmosis membrane. It was chosen because it is specially designed for this application to get a stable performance in the presence of several types of organics.

Process condensate normally contains more organics and less inorganic and this membrane resists fouling by organics even at high temperature operation. During the plant's performance it was found that a good amount of glycerine could be recovered and the plant performance remained stable.

Module	HYDRAcap60	PRO-XT1
Recovery	90%	80%
Net flux	54 l/mh	22 l/mh



	Raw Feed	UF Feed	UF Permeate	RO Concentrate	RO Permeate
Glycerin, ppm	5600	5600	5600	28000	0.0
Turbidity, NTU	32	30	0.1	0.55	0.01
COD, ppm	7200	7192	7142	32000	950
TDS, ppm	67	67	67	320	5

Hydranautics offered an integrated solution comprising of HYDRAcap60 UF followed by PRO-XT1 RO membranes. The client conducted a pilot plant study of 250 lph capacity for two months and based on its performance decided to use the membrane in the main plant. The treatment scheme of the main plant is as shown in the block diagram above.

Treatment starts with a bag filter of 25 microns and then HYDRAcap60 UF membrane and PRO-XT1 RO membranes.

HYDRAcap60 UF membrane reduced raw condensate turbidity from 30-35 NTU to less than 0.5 NTU. PRO-XT1 RO membrane reduced the glycerin content to low levels

and the concentrate, which was five times concentrated than feed, was sent back to the evaporator inlet for glycerin recovery.

RO permeate contained high amount of COD. This was due to presence of methanol, formic acid and such other low molecular weight organics such as methanol. This stream was passed through an activated carbon filter that reduced the COD to 400 to 500 ppm range.

This stream could be used for low end uses of cooling water makeup and washing purposes. Figure table above shows the results obtained in the main plant.

## The IMPACT

Capital cost of this plant comprising of UF-RO skids, all pumps, tanks, piping and instrumentation was US\$95,000 in 2012. Treatment cost (power, chemicals, and membrane replacements) was less than US\$0.2 per m<sup>3</sup> of condensate treated. Raw water cost was Malaysian Ringgit MYR 2.2 (US\$0.62) per m<sup>3</sup>.

Because the concentrate went back for recovery of glycerin, all the energy required to remove 7000 ppm BOD was saved. Because of the low volume of the condensate, savings

in the energy, water and glycerin were lower compared to the savings in investment cost of membrane based alternative.

But the main benefit came about in saving installation of another waste water treatment plant to treat 7000 ppm COD. This cost was about 1 million Ringgit. Operating cost would have been also higher. Thus, for this customer it was the case of zero payback. After this first installation other three companies went for similar systems in Malaysia.



*About the author*

## **RICH FRANKS**

*Rich Franks is working as Senior Manager – Spiral Membrane Technology for Hydranautics – A Nitto Group Company. He is an environmental engineer having more than 17 years' experience in membrane technology. He is responsible for developing new products, applications and simulation software for Hydranautics' membrane products globally.*

For more information about Hydranautics case studies, contact us at [hy-info@nitto.com](mailto:hy-info@nitto.com) or visit our website at [membranes.com](http://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.

