



INCREASING WATER SUSTAINABILITY BY TREATING EVAPORATOR CONDENSATE IN A DISTILLERY USING REVERSE OSMOSIS

Case study

*Using SWC5-LD membranes to achieve low-cost
Zero Liquid Discharge at a distillery in India*

Use of ethanol for blending in fuel is increasing significantly in the recent times. One of the major sources of ethanol is from distilleries using molasses as raw material. The spent wash coming from distilleries is one of the most polluted wastewater. Conventional treatment methods are expensive to install and operate and are susceptible to disturbances.

A Distillery in western India produces ethanol by fermentation of molasses – a stream that generates from cane sugar manufacturing. The evaporator condensate coming out of this Distillery contained COD in the range of 2000-5000 ppm, primarily due to acetic acid. In the typical process, this stream would have mixed with other wastewaters and be treated in a Bio-Chemical Oxidation (BCO) plant. But this Distillery saw several obstacles in doing so:

1. The Distillery could not discharge treated wastewater as it came under the purview of Zero Liquid Discharge (ZLD) regulation. Thus all wastewater had to be re-used after treatment to higher quality standards.
2. The Distillery operated for only for 6-8 months every year. The BCO process could not be shut down for so long.
3. The BCO plant required large concrete tanks and space, that was not available.

The Distillery looked for a simple, space saving and economically viable solution.



<i>Location</i>	Western Maharashtra, India
<i>Feed water source</i>	Evaporator condensate
<i>Application</i>	Recovery of condensate for reuse in the fermentation process
<i>Start-up date</i>	May 2018



Hydranautics suggested Reverse Osmosis (RO) process instead of BCO treatment.

The condensate coming out at temperature of 60°C was stored in a tank to cool it to 40°C by natural evaporation. It was then passed through a sand filter followed by a 5-micron cartridge filter to remove suspended solids. Further, the pH was raised from 2.0 to 9.0 by addition of sodium hydroxide solution before passing it through a RO system. Increased pH converted organic acids to respective sodium salts.

The RO system was designed for 75% recovery with 35 m³/h feed flow. It used 49 Hydranautics' SWC5-LD membranes in 4x3-7 configuration. The 26 m³/h RO permeate flow was used for dilution of molasses in fermentation process. Balance RO reject was used to manufacture bricks. Table 1 specifies system design information.

The RO plant was commissioned in May 2018. In the past two years of operation, the performance of RO membranes remained outstanding. The feed pressure and pressure drop across the system has changed a little since the plant commissioning. Permeate quality has remained within +10% of the commissioning value. Table 2 specifies system operating information.

The concentrate COD has varied between 7000 ppm to 11000 ppm. But SWC5-LD membranes successfully managed the high COD waters and as a result no membrane cleaning was required in the past two years. Although operators do flush membranes every eight hours with RO permeate

Table 1: System Design Information

Parameters	Value
Permeate flow, m ³ /h	26
Recovery, %	75
Feed TDS, ppm	2000
Number of stages	2
Membrane module	SWC5-LD
Membrane area, m ²	37
Membrane quantity	49
Membrane flux, lmh	14.2

Table 2: System Operating Information

Parameters	Value
Feed TDS, ppm	2000-3000
Permeate TDS, ppm	150-250
Feed COD, ppm	2500-3500
Permeate COD, ppm	190-300
Cleaning frequency	Flushed with permeate water after every 8 hours of operation. No CIP was required in the first two years.

Hydranautics RO membrane condensate treatment system exhibited following benefits to the Distillery:

- It saved about 50% Capex as compared to the BCO system.
- It required about 50% footprint of the conventional BCO system.
- More than 75% of condensate was recovered and re-used in fermentation process, saving an equal amount of fresh water.
- RO Membrane plant execution time was shorter compared to the conventional BCO plant (4 months against 8 months).

- Shorter time was required to restart after the annual shutdowns (1 day against 4 weeks).

Hydranautics RO membrane-based treatment of distillery condensate was found to be much more beneficial over other conventional options. Even with high amount of organics SWC5-LD membranes demonstrated excellent stability and reliable performance.

Reverse Osmosis (RO) membrane process proved to be an economical and environment friendly option for implementing ZLD concept in the Distillery plants.

Author

MADHUSUDAN JOSHI
Technical Support Manager

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.