Award-winning Program in Terneuzen, The Netherlands, Taps Municipal Wastewater for Industrial Processes

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As fresh water supplies around the world continue to shrink, efficient water management becomes a hallmark of a company's sustainability and responsibility. More and more often, industry teams up with municipal water providers and utility companies to look for alternatives to fresh water usage in industrial processes. Water recycling and reuse is one solution – especially in areas that already struggle with shortages of potable water from natural sources. The town of Terneuzen, in the Zeeland province of The Netherlands, is one example of a successful collaboration between an industrial water user and the water and utility companies.

Smart Water Management as a Corporate Mandate

Terneuzen lies on the southern shore of the Westerschelde, the estuary of the River Scheldt. The city is an important port – the third largest in The Netherlands – and is the site of Dow Benelux, a large chemical manufacturing complex of The Dow Chemical Company (Dow). Ever since operations began at Dow Benelux, water management has been high on the agenda for Dow, especially since the region lacks a fresh water source. Today, the facility relies on recycled water streams, process water and rain water to meet half of its 60,000 m^3/day needs. As part of the company's 2015 Sustainability Goals, Dow is also working toward reducing its total water intake at the facility by 35 percent compared with the quantities used in 2005.

Dow's focus on water issues goes back almost two decades. In 1990, Dow Benelux began meeting with the region's utility company Evides Industriewater B.V., which treats and supplies water to the industry and for domestic use, and with Zeeuws-Vlaanderen Waterboard, which owns and operates the public water infrastructure in the province. The organizations worked together to devise a practical and sustainable plan to draw Dow's process water from Terneuzen's municipal waste water effluent rather than from the Westerschelde estuary.

"Smart water management was a common goal for all of us," said Fabien Creus, global water reuse and waste water market development manager for Dow Water Solutions, a business unit of The Dow Chemical Company. "Treating municipal wastewater to be reused in manufacturing would clearly help both the community and industry develop a more responsible and efficient way to deal with limited water resources."

Aerial view of the Dow Terneuzen site

From Seawater to Wastewater

Initially, Dow was using the demineralized estuary water produced by the water treatment facility DECO, operated by Evides. DECO, equipped with an integra-ted membrane system consisting of a continuous microfiltration unit and a two-pass reverse osmosis (RO) unit with FILMTEC™ membranes, was designed to desalinate seawater, but the process had considerable drawbacks. The estuary water had seasonally driven variance in quality, in both chemical and biological terms. In addition, there were fluctuations in suspended solids load due to the tides and the location of the intake, next to a harbor dock with incoming and outgoing ships and barges. This led to operational challenges such as biofouling and high maintenance costs due to corrosion. Furthermore, the high salinity of the water meant the RO feed pumps required lots of pressure, significantly increasing energy consumption for the facility.

RO elements at Terneuzen treat 7,500 m^3/day of challenging feed water (Photo courtesy of Evides Industriewater B.V).

In a move to tap a different supply sources, DECO was re-engineered in 2006 to treat municipal wastewater from 55,000 Terneuzen inhabitants. Re-engineering consisted of new RO membrane design, low pressure feed pumps and process automation adjustments. In contrast to estuary water, the effluent of the community wastewater treatment plant (WWTP) was very consistent in quality, which benefits the RO operation.

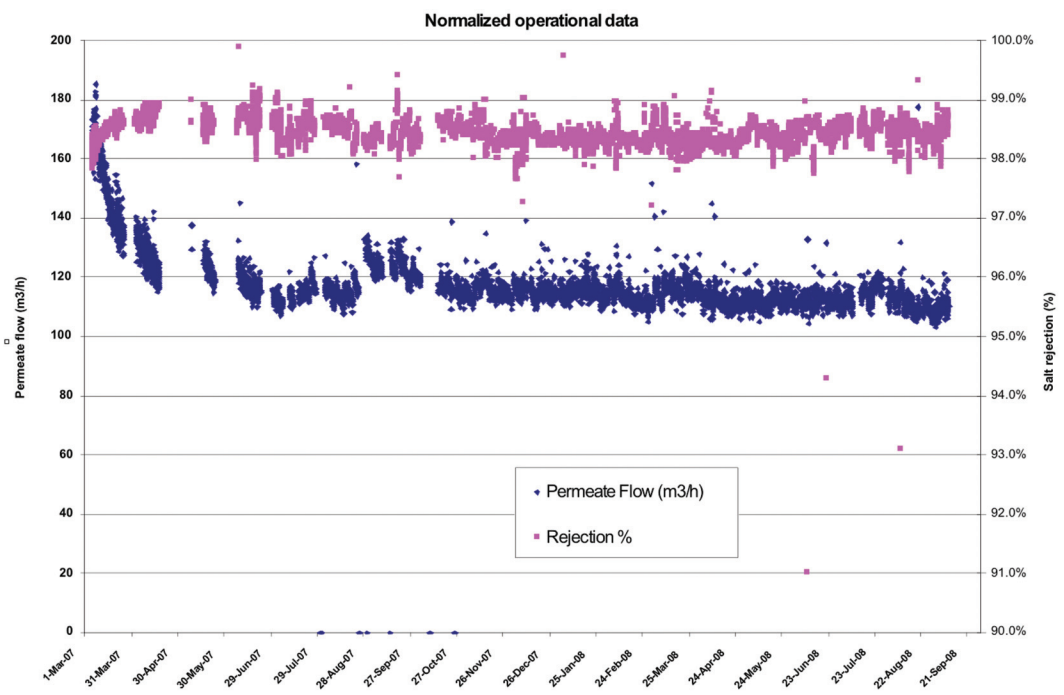
Reverse Osmosis – An Efficient Route to Water Reclamation

Commonly used in desalination, reverse osmosis membranes are being used more and more in water reclamation applications due to their superior organics removal capabilities. In fact, the process of reverse osmosis is the finest level of filtration currently available. RO systems employ semi-permeable membranes that allow water to pass through, but block unwanted particles and ions, such as salts.

Several factors affect membrane performance at the DECO plant. Due to the natural characteristics of wastewater, the feed water is still biologically active. Potential biofouling, which occurs when organisms collect on the membrane, can greatly hinder water flux and require more downtime for cleaning or even membrane replacement. Keeping the RO system working smoothly requires a good plant design and good operational practices.

The system at Terneuzen was retrofitted with fouling resistant membranes (FILMTEC BW30-400/34i-FR). These elements are specially targeted for high-fouling and challenging feed water.

The unique surface chemistry of these membranes increases the resistance against biofilm build-up while providing constant salt rejection. The membrane is wound into an element with a wide (34 mil) feed spacer which lessens the impact of the fouling even further and enhances the cleaning effectiveness. A feed spacer creates an area where the feed water can pass through from the feed to the concentrate end of the element. It helps prevent fouling by allowing turbulent flow against the membrane surface. Wider feed spacers allow for more turbulence and flow dynamics so that foulants do not attach themselves to the membrane.



While some elements are held together by o-rings, sliding couplers that connect one element to another, the elements at Terneuzen feature iLEC™ interlocking endcaps. Leaks are more frequent with o-rings and can compromise the productivity of the element, which in turn can prolong system downtime if the element needs to be replaced. The interlocking endcaps are stationary seals that reduce leaks, contribute to better water quality and prevent unnecessary downtime. The seal is also maintenance-free for the life of the element.

The brackish water elements in use at the DECO plant are 8-inches in diameter with an active area of 400 square feet. They have the highest rejection and the widest pH cleaning range in the industry (pH 1-13). Each membrane is made of short, thin film composite leaves manufactured through an automated process that achieves a uniform product for consistent performance.

Evides has taken a proactive approach with frequent preventive cleanings, only possible with robust membranes, combined with regular maintenance cleanings. This has proven to be very successful as can be seen from operational data above. Membrane performance has been very stable in terms of permeate flow and the consistently good quality of the produced permeate (< 10 microsiemens/cm).

Giving Water a Second – and Third – Life

After the water is treated and demineralized at the DECO plant, it is ready to be used as process water at the Dow Benelux production facility. The site uses 7,500 m^3/day of treated wastewater to produce steam and then re-uses it as process water for the cooling tower.

Dow Benelux reports that the wastewater project has been a big component of their reduction strategy and that the facility has already reached one-third of its reduction goal. At the Evides wastewater treatment plant, energy consumption has been considerably reduced, as well. The wastewater treatment uses less energy than desalination with the added benefit that no discharge goes into the River Scheldt .

Both Dow and Evides maintain that it is critical for industries to work alongside local organizations and communities to find sustainable ways to operate and employ shared resources.

A Recognized Achievement

With the new feed water source and the implementation of low pressure feed pumps and process automation adjustments, the water recovery of the reverse osmosis unit at the DECO plant has increased by 20 percent and operational expenses are half of a seawater-fed membrane system. Besides the savings in the energy costs, the environmental impact is reduced by the lower pretreatment chemical consumption. In addition, the city's waste water is no longer discharged to the sea, but given another life as process water.

The DECO plant is an excellent example of how a full scale industrial process can be adjusted to contribute to the preservation of valuable fresh water resources. The ability to minimize the environmental impact by reducing the energy costs and to maximize water recovery through closure of water loops also makes chemical industry more sustainable.

The water treatment system described here represents the first time that domestic waste water has been re-used on an industrial scale in The Netherlands. The success of the plant can be leveraged to other similar locations. The initiative has been awarded the Environmental Award 2007 of the Province of Zeeland (Zeeuwse Milieuprijs), the Dutch VNCI Responsible Care Award 2007, the European Cefic Responsible Care Award 2007, and the ICIS Innovation Award 2008 for the Most Innovative Corporate Social Responsibility Project.