

# Le Mourier Reservoir, Jersey

## ultrafiltration & reverse osmosis improves water resources

by Peter Harvey BSc, CEng, MChemE, MCIWEM

**T**he island of Jersey relies heavily on surface waters to meet demands which can peak at 30,000 m<sup>3</sup>/d during summer months. This can be augmented by the islands 6,000m<sup>3</sup>/d desalination plant if necessary albeit at a high energy cost. Also, because of agricultural practice on the island, nitrate levels in some surface waters have been higher than EU guideline levels, putting such sources out of use. An innovative scheme at the Le Mourier reservoir treats water containing high nitrates producing up to 4,000m<sup>3</sup>/d for blending with other water resources. Here, Zenon submerged membrane ultrafiltration followed by ULPRO reverse osmosis has been fitted into existing facilities at the Le Mourier site.



Work in progress at Le Mourier (courtesy Purac Ltd).

The original works at Le Mourier was commenced before the second world war but was not completed until 1947. The works comprised a 9,000m<sup>3</sup> capacity reservoir and two centrifugal pumps driven by Crossley horizontal single cylinder, heavy oil engines, which pumped collected surface water to the Handois Reservoir and the treatment works situated there. However, because operational costs and more recently increasing nitrate levels at Le Mourier, this site was used only intermittently and when other water resources became depleted.

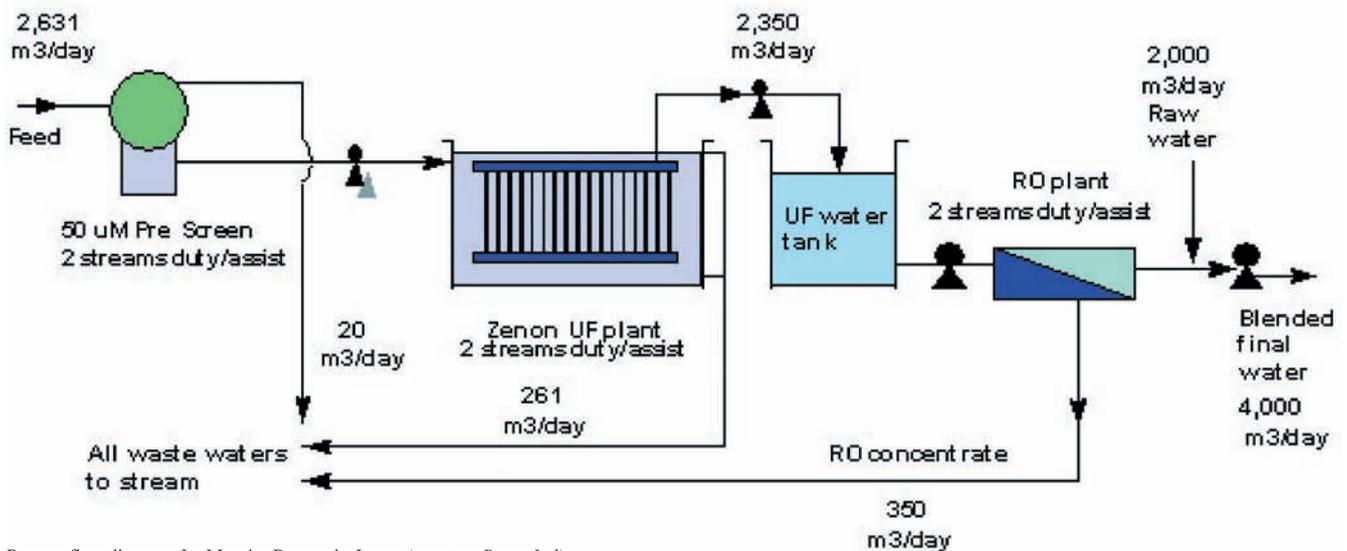
The raw water is low in colour (average 12 Hazen) and turbidity (average 5 NTU) with nitrate levels typically in the 60 to 100mg/l range. The plant is designed to produce up to 4,000m<sup>3</sup>/d of blended water, typically at a 50:50 mix of RO permeate and raw water, yielding a blended water with a nitrate level of <50 mg/l. The membrane plant was designed to reuse as much of the existing structures and buildings as practicable to both minimise cost and maintain the appearance at the site.

### Process

Raw water is pre-screened by duty/assist 50 micron drum screens before being pumped to the PURACtor SM ultrafiltration membrane

plant. This plant utilises Zenon 500 series submerged membranes modules. Four such modules are provided each having some 520m<sup>2</sup> membrane area with a 0.035 micron nominal pore size. The existing cooling water tank that served the abandoned diesel pumpsets was converted to house the membrane modules and also provide a permeate/backpulse tank.

Duty assist rotary lobe pumps extract the permeate through the membranes and into the permeate tank. These pumps are periodically reversed to backpulse the membranes with either permeate or chlorinated permeate to control trans membrane pressure. These backpulse cycles are controlled automatically. Should the membranes show an increasing baseline trans membrane pressure they can be more rigorously chemically cleaned in situ. Such cleaning is manually initiated and controlled and will take place typically every 6 to 12 months and will utilise hypochlorite and citric acid. While the membranes are being chemically cleaned the plant is taken out of service. On larger plants or where forward flow cannot be interrupted a separate cleaning tank facility would be provided. The resultant ultra filtered water is of excellent quality for reverse osmosis feed with turbidity and suspended solids <1 mg/l with an SDI of 1.5 to 2.5.



Process flow diagram -Le Mourier Reservoir, Jersey (courtesy Purac Ltd).

From the PURACTor plant the pre-treated water is pumped to the reverse osmosis plant which is housed in the old pump house building. The RO removes virtually all the salts in the water by 85 to 95%, the nitrate in particular being removed by > 90% to give a final nitrate value of around 7 to 10mg/l. The RO plant comprises two streams each arranged in a 4:2:1 pressure vessel array using four Koch TFC ULP Magnum membrane elements per vessel.

**Narrow roads - tight bends**

Both streams were installed on a prefabricated skid along with high pressure feed pumps and protection cartridge filters. The final journey of the skid from St Helier port to the remote Le Mourier

site, through the island's narrow roads was interesting to say the least, with a helping hand required on some of the tighter bends. The planning of deliveries and installation in the existing building was important as all equipment had to be finally positioned without the aid of a crane.

The high pressure variable RO feed pumps operate at 9 to 15 barg at 20 and 7 degrees centigrade respectively to provide a constant output going forward for blending. Chlorine monitoring and bisulphite dosing are installed before the RO plant to protect the RO membranes from any free chlorine coming forward from the ultrafiltration plant, hypochlorite being periodically used to clean



RO Membrane skid in existing pumphouse (courtesy Purac Ltd).

or backpulse the ultrafiltration membranes. DWI approved antiscalant *Permatreat 191* is also dosed on the RO feed to control scaling on the concentrate side.

Nitrate levels in the raw RO permeate and blended water are monitored with *Trescon Monitors*, these have been found to be very reliable. The RO permeate is very aggressive with a Langelier index of about minus 6 to 7 and the resultant blend typically being minus 2 to 3. As a result, final blended water can be pH corrected with soda ash to 8 to 8.5.

The plant is controlled by *Allen Bradley* PLC controllers with a *Rockwell RS View ME* enhanced operator interface. The operator set the required blended water flow and blended nitrate level. A *ProEnSys* plant feedback and monitoring system is installed that allows the process contractor *PURAC* to monitor performance and provide after sales support from their Kidderminster base.

During performance tests the nitrate levels from the RO were typically 3 mg/l resulting in blended water levels of between 18 and 38 mg/l depending on the raw water quality. At the time of writing it is perhaps early days, however, the plant does operate very well in auto mode requiring only a daily visit with little or no intervention.

Overall, the project went very smoothly commencing in August 2001 and completing two weeks early in December 2002. *PURAC* as a mainland contractor had to get certain working formalities on the island sorted out. Logistics were important and the major loads and lifts needed careful planning with respect to access. Whilst the small access bridge to the site compound was just wide enough to accept the crane being used to offload the heaviest items of equipment,

it was too weak to take the weight and not wide enough to allow delivery of the RO skids onto the site compound. The bridge was subsequently temporarily strengthened with steel work and props. Delivery was further hampered because of the delivery vehicle size restrictions on the island and the restricted width of the site access track.

The RO skid was off loaded at the docks onto a special bogie cradle for transportation to site. Likewise, the MCC sections were off loaded from the mainland delivery vehicle at the docks and reloaded onto smaller delivery vehicles for transportation to the site.

The unmade access track leading to the site (approximately 500m long) was just wide enough to safely allow access for the maximum size crane (30 tonne) but due to prolonged heavy rainfalls experienced on the island, it was found that the edge of the narrow track would not now support the crane. It was decided, therefore, to widen the track by some one metre along the majority of its length and this was subsequently carried out in record time. Delay to the construction programme was negligible due to careful planning beforehand.

The works itself is situated close to a popular coastal walking route of natural beauty frequented by local walkers and tourists, so site security and public relations were important.

The Ultrafiltration-RO process at Le Mourier has been a success and opens the way for other membrane applications on both island and mainland. ■

**Note:** *The author of this article, Peter Harvey, is Development Director, Purac Ltd*

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