

St Saviour's WTW, Island of Guernsey

new treatment works to improve water supply

by
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St Saviour's WTW, the Island of Guernsey's main water treatment works, was upgraded by the States of Guernsey Water Board (SWB) in 1947 following construction of the reservoir and dam structure at St Saviour's Reservoir. The nominal 10 Ml/d capacity works comprising coagulation, clarification, rapid gravity filtration and chlorination has performed satisfactorily. However, raw water from the reservoir can be high in algae and total organic carbon (TOC) during certain times of the year, and low in turbidity and solids during the winter months and the works was unable to produce the water quality capable of consistently achieving the high standards demanded by the latest UK and European Water Quality Regulations.



St. Saviours Water Treatment Works, Guernsey

courtesy: Purac Ltd

Scheme background

Consideration was given to the most efficient means of producing reliable high quality water for the island's community in the 21st Century. *Purac Ltd*, in conjunction with Anglian Water and assistance of SWB, carried out pilot work on the raw water from the reservoir to determine suitable processes which, together with subsequent feasibility studies were used to determine the optimum solution.

Following pilot plant trials with two different *Zenon* membranes, as the UK licensee for the product *Purac Limited* was appointed to build a new £2.5 million plant under an IChemE form of contract. The works included a micro strainer, upgraded chemical dosing and

Zenon submerged membrane technology. The membrane system (Membranes supplied by *Zenon Environmental* but system designed by *Purac Ltd*) is marketed under licence by *Purac* as the PURACTor SM.

Spiralling civil engineering costs in Guernsey have enabled innovative retrofitting of the membrane process technology into the existing tankage, thereby ensuring a very efficient package arrangement.

Design

The new treatment plant is being designed to produce improved treated water quality with an output of 13 MLD.



Inlet micro-strainers at St. Saviours WTW

courtesy: Purac Ltd

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Zenon submerged membranes have an enviable record on potable water installations and are particularly beneficial for retrofitting into existing clarifier or rapid gravity filter structures such as in Guernsey, or as a compact add-on stage to an existing works for quality improvements. They are versatile and robust because the 0.04 micron pore size membrane is supported on a strong nylon woven fibre centre core. The whole membrane can be backflushed, chemically cleaned in-situ with hypochlorite and periodically cleaned in stronger chemical solution if necessary. For potable water treatment the membrane can replace both the clarification and media filtration stage while its pore size will retain oocysts.

Process

The proposed process design at St Saviour's is for a two stage water treatment process. The first stage will comprise a 40 micron rotating drum screen to remove large suspended solids and algal cells, followed by combined coagulation and flocculation. The second stage involves ultrafiltration to remove the remaining suspended solids, precipitated solids and micro organisms.

Raw water enters the water treatment process under gravity head from the reservoir. It is screened to remove any particulate matter larger than 40µm in a duty/standby drum screen followed by coagulation with alum and pH correction with sulphuric acid. Flocculation is achieved in existing feed channels as only pin point flocs are required.

The flocculated water is presently clarified and filtered in the four existing conventional hopper bottom upflow clarifiers, which are now to be converted to contain *ZW500C Zenon* membrane cassettes. The solids are removed by auto-desludging as well as a constant overflow via a modification to the existing overflow launders. The resultant concentrate is sent to a separate processing plant for thickening and dewatering.

The *PURACTor SM* ultrafiltration plant will comprise a total of 24 *Zenon* cassettes arranged in four streams.

Permeate is extracted through the membrane cassettes by dedicated self priming pumps installed adjacent to the clarifier. Permeate is discharged into a flow through backwash storage tank prior to discharging into the existing filtrate collection channel. The backwash storage tank will provide storage capacity for periodic cleaning of the membranes. The flow is periodically reversed to backpulse the membranes with either permeate or chlorinated permeate to control trans-membrane pressure using a separate set of duty/standby centrifugal pumps. These backpulse cycles are controlled automatically. Should the membranes show an increasing baseline trans-membrane pressure they can be more rigorously chemically cleaned using a dedicated cleaning tank. Such cleaning is manually initiated and controlled and will utilise a sodium hypochlorite or citric acid cleaning solution.

The plant will remove precipitated suspended solids and micro organisms from the water achieving a water quality well within EU guidelines. To ensure this level of water quality membrane integrity will be monitored and recorded. The current method for directly monitoring membrane integrity is the pressure decay test (PDT). The PDT is conducted by pressurising a membrane sub-unit and then isolating the sub-unit and measuring the rate of drop in air pressure. Results of the PDT are reported in terms of a parameter referred to as Log Reduction Value.

The filtered permeate is chlorinated using the existing chlorination equipment and then pH corrected with 'Kalic' solution before being pumped into supply

Scope

Purac was responsible for the design, supply, construct and commission of the water improvement scheme including:

Phase 1 – Inlet Micro-strainers;

Phase 2 – Installation of *Zenon* ultrafiltration cassettes to replace existing clarifiers and gravity filters, associated chemical dosing equipment and membrane cleaning equipment, including associated Civil works.

Phase 3 – Additional works by SWB to include further washwater facilities, new treated water high-lift pumps and refurbishment of existing buildings.

Logistics and project management

As a mainland contractor, *Purac's* pre-planning and logistical calculations have been critical to the project. The remoteness of Guernsey from the UK and mainland Europe has meant that equipment selection and plant reliability are key criteria. Good knowledge of the geography and terrain of the island, in addition to shipment methods, have ensured delivery and logistical details were fully researched prior to commencement of the project on site. This includes delivery of the membranes from Canada into the main Guernsey port and installation of the three consignments into existing 9m concrete clarifier tanks.

Factors such as these can hamper construction programmes, but *Purac's* knowledge and careful planning ensured that any delays were negligible. Overall, effective project planning ensures that key milestones are met, resources are used effectively and project costs are monitored against budget. *Purac* will be able to assess the status of the plant and, if required, make minor changes from the company's headquarters in Kidderminster, thus avoiding costly abortive visits to the island.

Status

Phase one was completed in November 2003, with phase two commencing in August 2003 and due for completion in July 2004. Mechanical and electrical works were underway (February 2004). A flexible approach is being taken to the installation and commissioning of the new process, to maintain flows at the works. Each tank being converted and phased into the process in sequence, with one of SWB's existing plants being used to supplement supply.

The first clarifier was installed in February 2004. Overall contract completion date was set for August 2004. ■

Project team

The project team includes: *Guernsey based Geomarine (civils subcontractors) and Dorey Lyall and Ashman (civils designer); CAP Technology (phase 1 inlet micro strainer); Alpha Plus and Team (phase 2 mechanical and electrical installation); Blackburn Starling (MCC Supplier) and Zenon Environmental (UK) Ltd for which Purac Limited holds a licence agreement.*

Note: *Matthew Ely is Project Manager and Roy Stevens, Bid Manager both with Purac.*