

Chertsey Microfiltration Plant

first submerged membrane plant for Three Valleys Water

by Andrew Bailey MSc (Hons)

Chertsey Water Treatment Works (WTW) is located on the bend of the River Thames opposite Laleham Park in Surrey. The existing works was originally constructed in 1900 and has since been extended and upgraded during the 1970s and 1990s and more recently with the installation of a new submerged membrane plant completed in 2003. The WTW has a current total treatment capacity of 65MI/d and treats water pumped from two sources of very differing water quality characteristics; Abbeymeads, a gravel well water source and River Thames water fed from the Northern Burway reservoir. To ensure that water produced from this works remains consistently of a high quality and free from contamination such as cryptosporidium Three Valleys Water has invested in a 41MI/d submerged membrane plant.



Chertsey WTW: Main membrane filtrate pumps & pipework

courtesy: Black & Veatch Limited

The Chertsey project was awarded to *Black & Veatch* after extensive on-site Pilot Trials carried out on both water sources from which *Memcor Ltd* Continuous Microfiltration Submerged (CMF-S) system proved to be the preferred membrane option. The application of low pressure submerged membrane systems for potable water supplies has seen significant growth over the last ten years. The increased popularity in membrane systems has been due to the technology having the ability to deliver potable water to a high standard whilst maintaining a modular design, sophisticated automation at a competitive cost.

The Chertsey project saw the successful development of a partnership between *Black & Veatch Ltd*, *Veolia Water Partnership* and *Three Valleys Water* with the sole aim of the successful completion of their first potable submerged membrane plant. The principal goal was to provide a barrier against *Cryptosporidium* to a greater than 5 log removal rate. *Black & Veatch* was responsible for the design and supply of all mechanical, electrical and instrumentation for the treatment plant.

Membrane operation

The membrane plant is designed to achieve a maximum output of

41.2 ML/D, through the operation of five duty CMF-S cells, operating at a design flux of $140\text{lh}^{-1}\text{m}^{-2}$ and one standby cell. Each CMF-S cell consists of 192 submerged membrane modules, the modules hold approximately 14,000 hollow fibres constructed from PVDF material with a nominal fibre size of 0.2 μm . When in filtration the Filtrate Pump creates suction on the inside of the hollow fibres, drawing water through the membrane walls leaving solids on the surface of the membrane. The membranes are submerged in feed water within the cell and the water level is automatically maintained at a level above the membranes by a modulating inlet valve.

The membrane modules are cleaned with a low pressure air assisted backwash to maintain the filtrate flow rates. Filtered water is used as the backwash water medium, flowing from the inside of the fibres, through the membrane wall removing any accumulated suspended solids from the membranes outer surface. The CMF-S units are chemically cleaned in place (CIP), using either sulphuric acid or sodium hypochlorite, to remove scaling and biological growth and other forms of fouling which can not be removed by backwashing alone.

The integrity of the membrane barrier is maintained on a daily basis



External view of Chertsey Microfiltration Plant

courtesy: Black & Veatch Limited



View of top of CMF5 units showing the filtrate and air headers

courtesy: Black & Veatch Limited

through the use of a Pressure Decay Test (PDT) to ensure a greater than 5 log removal rate. A manual test may be initiated from the SCADA. This test applies air pressure to the filtrate side of the membranes and monitors the pressure drop over a time interval. The results are logged and alarms may be raised if the results are outside of pre-determined limits. If the pressure drop is excessive, the unit will shutdown and may only be returned to service after the integrity failure has been repaired.

Throughout the construction phase of the project *Black & Veatch* maintained a strong site management presence with technical support being provided by the design team at *B & V* Head Office. The Civil construction and plant M & E was started in January 2002 and completed in September 2002. The civil subcontractor used at Chertsey was *JBS Construction* with the piping contractor being *B-Meck*. All purchased equipment and materials for construction of the plant was done so using *B & V's* approved suppliers listing. Each supplier was selected and managed by *B & V* to ensure that the end product fulfilled the client's expectations within budget and on time whilst still maintaining a high standard of engineering.

Commissioning phase

The commissioning phase of Chertsey MF plant was completed over a 12 week period from November 2002 to January 2003. *B & V* provided project management along with on-site technical support throughout this period with each contractor taking responsibility for commissioning of equipment in their scope of supply. *Memcor*,

suppliers of the membranes modules, the process control and SCADA system led the onsite process commissioning with *B & V* on-site support.

Overall automation of the microfiltration plant is achieved with the use of a centralised control and distributed flex input/output architecture supported by a distributed high speed control network. The membrane plant status and water quality parameters and alarms are transmitted via telemetry to Three Valleys Water Operations Centre at Clay Lane WTW close to Watford.

During this period *B & V* worked closely with the Three Valleys Water managerial and operational staff to maximise the integration of the new *Cryptosporidium* barrier into the existing conventional works. Together with *Memcor*, *B & V* provided continuous 24 hour technical support and troubleshooting throughout the commissioning period up to the point of plant Take-Over which was achieved in early May 2003.

Design development, operational experience and lessons learned from the Chertsey Project have allowed *Black & Veatch Ltd* to complete design and build submerged membrane projects for other valued clients such as Portsmouth Water at Farlington WTW (84MI/d) and Southern Water at Otterbourne (58MI/d) and Arundel WTW (4.5MI/d) over the last three years. ■

Note: The author of this article, Andrew Bailey, is Senior Project Engineer with *Black & Veatch Limited*.