

# COLIBAN - VICTORIA, AUSTRALIA

## MEMCOR® CMF-S 6 x 576S10T

### Challenge

The AQUA 2000 Project is a build-own-operate-transfer (BOOT) project. It includes the construction and operation for 25 years of a water treatment scheme for the Coliban Water Authority in Victoria, Southeastern Australia. The scheme will comprise of three water treatment plants, the largest of which, at Sandhurst, will use CS technology. With a capacity of 33 million gallons a day (126ML/day), Sandhurst WTP will be the largest microfiltration plant in the world. Construction is well underway, and commissioning is expected to begin in September 2001.

The water treatment plants and distribution systems have been designed to achieve the performance measures set by Coliban Water for all possible raw water conditions. The performance measures include:

- Water quality targets to remove taste, odor, algal toxins, pathogens, disinfection by-products and other chemical contaminants
- Volume and pressure of supply
- Reliability
- Environmental Compliance
- On-going maintenance of life-time assets

Testing of the CS technology on this site began in 1998 during the bidding process. Once Siemens Water Technologies (then USFilter Australia) was awarded the project, the testing was scaled up to a simulation of the complete process over a long time period.

This trial, called the Process Verification Plant, was started in October 1999 and will continue up to and beyond the commissioning of the full scale plant.

Snapshot - Coliban	
Location	Australia
Source	Surface Water
Application	Drinking Water
Technology	Memcor® CS
Capacity	33 MGD
Commissioned	2001



Memcor CS Module Assembly

Memcor® Membrane Systems

Water Technologies

SIEMENS

Operational Data	Coliban
Number of cells	6
Modules per cells	576
Total capacity	33 MGD

### Solution

#### Raw Water Quality

The raw water comes from a mountain catchment that flows into storage reservoirs then flows along aqueducts some 70 km to supply reservoirs.

During the process validation period, taste and odor compounds (MIB and geosmin) were noticed to be close to or above the threshold value of 5ng/L. Originally thought to only occur briefly throughout the year, these high values have persisted for long periods through the year.

#### Treated Water Quality

The specification for the treated water from the treatment plants was designed to meet existing guidelines and anticipate future regulations in drinking water.

Penalties are imposed for excursions from the specification. A pass percentile figure is given for each parameter to show how many measurements are required to conform in order to pass.

#### Process Configuration

The raw water entering the Sandhurst WTP will be firstly screened then passed into the chemical mixing tanks. The first chemical pre-treatment is lime and carbon dioxide dosing to control alkalinity and corrosion. The water is then dosed with a coagulant, liquid ACH, and rapidly mixed to coagulate color, metals and particles. The water proceeds then to the plant for microfiltration.

The CS plant consists of eight cells (6 duty cells, 2 stand-by cells), each containing 576 submerged membrane modules. Water enters at the bottom of the cell and is drawn through the 0.2 micron porous membranes by a filtrate pump (one filtrate pump per cell). These cells are backwashed frequently, every 20-45 minutes using filtrate and air to scrub the fiber surface. Periodic chemical cleaning will also be performed when the maximum transmembrane pressure (TMP) is reached.

The filtrate from the CS plant is then pumped to the ozone/BAC system. Ozone will be mixed into the filtered water by an in-line static mixer. The ozonated water flows to an ozone contactor that allows 5 minutes of detention time at maximum plant flow. The addition of ozone acts as an

Parameter	Measure	Measurement Frequency	Pass %
Taste at Delivery Point	80/778/ECC	Weekly	95%
Odor at Delivery Point	80/778/ECC	Weekly	95%
Color at Delivery Point	<5 HU	Continuous	95%
Turbidity at Delivery Point	<0.1 NTU	Daily	95%
Turbidity at Each Filter	<0.1NTU or <0.2NTU change in 10 minutes	Continuous	95%
Particles in each Filter	<20counts /mL, <10cts/mL after 12 months	Continuous	95%
Crypto/Giardia across each filter	>4 log removal by PDT	Daily	95%
Primary Disinfection	1 log inactivation of giardia	Continuous	95%
Distribution Cl2 residual	Free or combined residual	Continuous	100%
THMFP	0.08mg/L	Monthly	95%
HAA5FP	0.06mg/L	Monthly	95%
Corrosion Stability	0 - 5 CCPP	Weekly	90%
Inorganics	NHMRC (1996)	Quarterly	100%
Manganese	0.1mg/L	Monthly	100%
Arsenic	0.007mg/L	Monthly	100%
Iron	0.2mg/L	Monthly	100%
Fluoride	0.7 - 1.0 mg/L		95%
Aluminum	<0.1mg/L	Daily	100%
Total Coliforms	Zero		
E. coli	Zero		
pH	6.5 - 8.5		95%
Organics (includes herbicides & pesticides)	NHMRC (1996)		100%
Radionuclides	NHMRC (1996)		100%

Table 2 Treated Water Quality Targets -AQUA 2000

oxidant, disinfecting and destroying algal toxins and breaking down the complex organic material to simpler forms for the downstream biological treatment.

#### Early Trials

	Min.	Avg.	Max.
Turbidity (NTU)	0.9	2	4
True Color (HCU)	12	22	35
pH	7.7	8.3	7.9
Temp (oC)	9	-	23
TOC (mg/L)	6	-	9
Alkalinity	40	-	50
Aluminum (mg/L)	-	0.04	-
Iron (mg/L)	-	0.5	-
Manganese (mg/L)	0.01	-	0.09

Table 1 Typical Raw Water Quality for Sandhurst Reservoir

### May 1998 - February 1999

During the bidding process, the CS process was tested at the Sandhurst Reservoir site for eight months. The main objective of this work was to determine the cleaning interval and flux on the reservoir water with both direct coagulant dosing and downstream of a Trident adsorption clarifier. The trial also briefly investigated the effect of dosing powdered activated carbon before the membranes.

A major finding of this trial was the validation of the direct dosing of coagulant before the membranes to remove color and dissolved metals. The performance of the CS unit was not affected by the addition of up to 20mg/L of ACH upstream

### Process Verification

#### October 1999 - Present

In October 1999, a process verification plant (PVP) was commissioned at Sandhurst Reservoir to simulate the entire process train of the future water treatment plant. The trial work tested numerous process configurations to observe their ability to meet the water quality objectives, particularly in the areas of the formation of disinfection by-products, taste and odor.

The trial work investigated:

- The performance of the CS microfiltration plant downstream of a Trident absorption clarifier and an Actiflo clarifier
- The effect of polymer and powdered activated carbon carryover on the CS plant
- The long term cleaning efficiency of the CS plant
- The performance of the final design, CS plant followed by ozone and BAC

Due to the nearly constant need to treat taste and odor compounds, a life cycle economic analysis showed that the ozone/BAC process was cheaper than dosing PAC upstream of a clarifier stage. This finding influenced the final process design to dose coagulant directly upstream of the membranes followed by ozone/BAC treatment.

The PVP has proved that the process can achieve these targets, as shown in the following charts.

As expected for a microfiltration process, the turbidity of the CS filtrate was consistently less than 1 NTU.

The contract calls for particle counters to be installed



#### Water Quality Results

*The specification for the treated water demands stringent water quality standards, anticipating future regulatory requirements in the areas of particle counts, disinfection by-products and organic removal.*

downstream of each CS cell. For the first year of operation, the filtrate must have less than 20 counts per mL in the 2 to 5 micron size range, to ensure removal of pathogens like cryptosporidium and giardia.

After the first year, this level will drop to less than 10 counts per mL in the 2 to 5 micron range.

The graph in Figure 2 shows the results at the PVP from an online particle counter installed after the CS trial unit. As expected, the CS process removed virtually all particles greater than the pore size of the membrane, so the particle counts are routinely less than the target.

A lot of trial work was used to evaluate different methods of tackling organic removal, particularly disinfection by-products.

Coagulation and activated carbon dosing, using an upstream absorption clarifier or Actiflo clarification followed by CS was tested and the water quality compared to using CS followed by ozone and BAC. Economic considerations favored the use of activated carbon in the BAC bed rather than dosing.

The trial work has proven the reliability of the CS process and the ability of the process to meet the specified performance targets both in terms of water quality and operation.

The reduction of color and DOC across the process. Dosing of

coagulant before the CS plant removes part of the organic content. The results at the PVP show that most of this removal is achieved with a small dose of coagulant, 5mg/L, increasing the dose to 10 and 20mg/L did not greatly improve the removal performance. The treated water quality targets can be met easily by the ozone/BAC process downstream of the CS.

**CS Performance**

The 4 module CS trial unit has provided long term data on the operation of the process on this feed stream. The graph below shows the transmembrane pressure (TMP) on the CS unit over one month of operation at the typical flux of the large-scale plant.

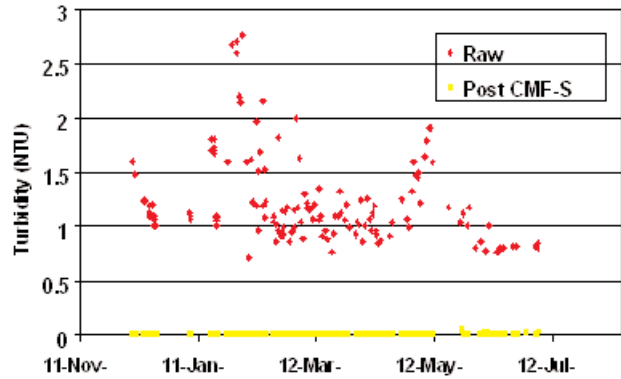


Figure 1. Raw water and CMF-S filtrate turbidity at Sandhurst Reservoir PVP

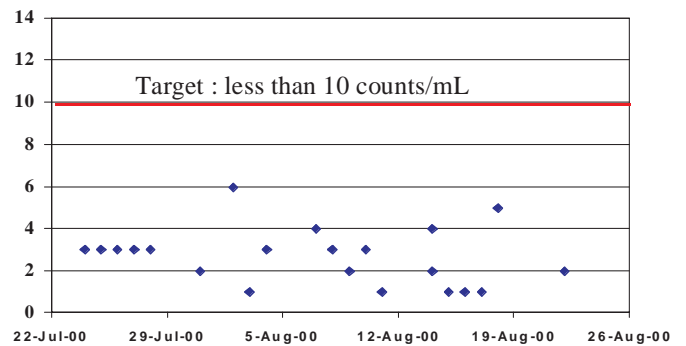


Figure 2. Particle counts 2-5 mm ub CMF-S filtrate at Sandhurst Reservoir

**Membrane Solutions**

Memcor® membranes from Siemens Water Technologies represent the broadest range of low-pressure membrane filtration products -- submerged, pressurized, large capacity or small systems. They continue to be successfully employed in applications as diverse as wastewater reuse, potable water, RO pretreatment, high solids and sand filter retrofits.

Memcor® Products								
Product	Pres-surized	Sub-merged	Water Reuse	Potable Water	High Solids	Sand Filter Retrofits	Large Capacity	Small Systems
CP	■		■	■	■		■	
CS		■	■	■	■	■	■	
XP	■		■	■	■			■
XS		■	■	■	■			■

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