

CASE STUDY

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Municipal Wastewater Treatment
Hong Kong, China

TORAY

Innovation by Chemistry

Wastewater Treatment Upgrade with Toray's MEMBRAY™ Membrane Bioreactor at Mui Wo Sewage Treatment Works

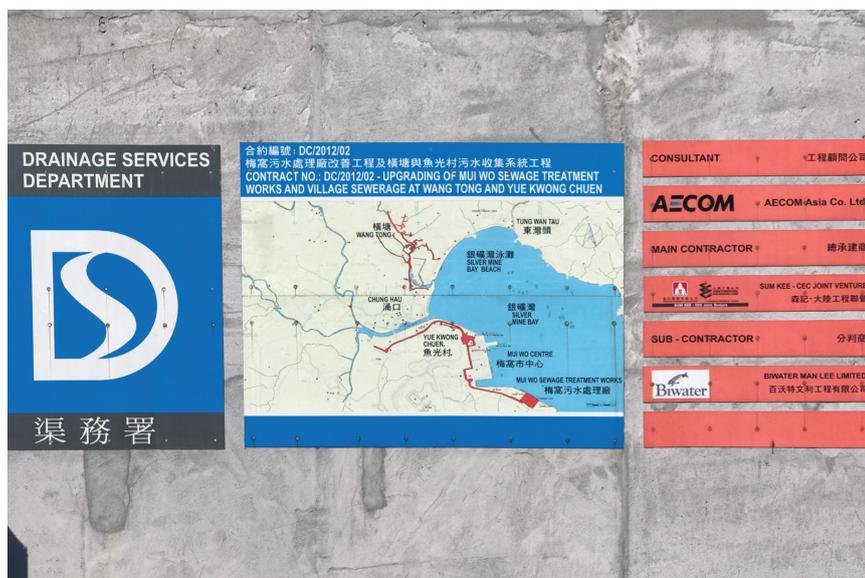


Figure 1: Mui Wo Sewage Treatment Facility

PROJECT BACKGROUND

Mui Wo is a rural town located in Lantau Island, Hong Kong, with one of its main attractions being Silver Mine Bay and Beach. Rises in population and tourism to this region have resulted in an increased volume of sewage and the need to upgrade the existing wastewater treatment system.

Mui Wo Sewage Treatment Works (MWSTW) was commissioned in 1985 to treat sewage water via conventional secondary treatment consisting of screening and degritting facilities, an oxidation ditch, and ultraviolet (UV) disinfection. With a capacity of 1,190 cubic meters per day, MWSTW treats wastewater from Mui Wo's sewerage network, septic waste collected by private contractors and the Food and Environmental Hygiene Department, and sludge from other Drainage and Services Department (DSD) treatment works. The plant

would not have extra capacity to treat the increasing volume of wastewater, increasing the risk of poor effluent quality that would contaminate nearby beaches.

Hong Kong's Special Administrative Region (SAR) government took action to expand the existing wastewater treatment plant. The goal would be to provide public sewerage services to Mui Wo and surrounding villages and protect the water quality of Silver Mine Bay.

PROJECT DETAILS

Toray partnered with Bewater Man Lee, a local E&M contractor approved by the DSD of Hong Kong SAR. Bewater won the contract for the upgrade needed at MWSTW with Sum Kee CEC Joint Venture, the main contractor. The improvement would replace the existing oxidation ditch with a membrane bioreactor (MBR) system, which would significantly reduce the system footprint while producing higher quality effluent. The MBR system would use Toray's MEMBRAY™ flat-sheet MBR technology for the final design.

MEMBRANE BIOREACTOR

The MBR system is designed to handle a peak flow of 0.086 cubic meters per second. The system incorporates pre-treatment using a 3-millimeter punch-hole drum screen (2 duty, 1 standby), four MBR trains (3 duty, 1 standby), and ancillary equipment. Each of the trains has an anoxic and aeration tank that houses the MBR modules.

Table 1 – Quick Facts

Plant design	4 trains with 7 modules per train	
Model	MEMBRAY™ TMR140-400DW	
Start-up	March 2016	
Design capacity	Avg. dry weather flow: 3,700 m ³ /day	
	Peak wet weather flow: 7,400 m ³ /day	
Design influent quality	BOD	629 kg/day
	COD	1,332 kg/day
	TSS	666 kg/day
	NH ₃ -N	85 kg/day
	TKN	170 kg/day
Design effluent quality	BOD	<20 mg/L
	SS	<30 mg/L
	TN	<10 mg/L (annual average)
	E. coli count/100 mL	<100 (monthly average)
Actual effluent quality	BOD	<3 mg/L
	COD	<10 mg/L
	TSS:	<3 mg/L
OEM	Bewater Man Lee	
Consultant	AECOM	

Listed below are some of the key characteristics and advantages Toray's MEMBRAY™ TMR140-400DW at MWSTW:

- Toray's proprietary polyvinylidene fluoride (PVDF) microfiltration membrane provides high resistance to chemicals and superior mechanical strength;
- The membrane pores, with a nominal size of 0.08 micrometers, are uniformly distributed along the surface, delivering high quality and volume of filtrate;
- One unit consists of four element blocks in a double-deck arrangement for a total of 560 square meters of membrane area per module;
- The double-deck arrangement helps increase the aeration efficiency and was integral to saving system footprint with the given limited space at the plant;
- Chemical cleaning is required less, and membrane performance can be restored simply by allowing the membranes to relax for one minute in every 10-minute cycle, further reducing operational costs.



Figure 2: Mui Wo Sewage Treatment Works with MBR

START-UP AND OPERATION

The operation of the membrane modules started up in 2016. Due to the ongoing construction and because the sewage treatment plant was built along the water, the plant experienced seawater intrusion. Salinity levels in the feed increased to as high as 18,000 ppm causing corrosion of some stainless steel SS316 components throughout the plant including the manifolds on some of the MBR modules. Eventually, sludge leaked into the permeate side and resulted in high turbidity levels. In response, Toray provided replacement parts made of polypropylene and brought the MBR system online without interrupting operations for an extended amount of time.

The flexibility of Toray's MEMBRAY™ MBR modules allowed for the trains to run independently and efficiently with the anticipated increase in influent flow to the plant.

At the time operations were handed over to the DSD in 2019, the Mui Wo Sewage Treatment Works was the largest active MBR plant in Hong Kong.



Figure 3: Double-deck arrangement of MEMBRAY™ TMR140-400DW.

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