

# CASE STUDY

RO | NF | UF | MF

Feng Shan Xi Water Reclamation Project  
Kaohsiung, Taiwan



## Taiwan Mandates Water Reclamation for Economic Sustainability

### BACKGROUND

As a leading global supplier of semiconductors and other related IT components, access to a consistent supply of clean water is essential in Taiwan for sustaining a growing economy. However, in 2015, the country experienced one of the worst droughts in its history. Combined with frequently occurring typhoons that hamper the availability of clean water, this sparked the government to implement countermeasures immediately.

Taiwan's Ministry of Economic Affairs set in place the "Reclaimed Water Resources Development Act" at the end of 2015. One of the goals of this new legislation would be to make up at least 10% of the public water supply with reclaimed water by 2031. The government would invest around US\$465.8 million to build six wastewater reuse plants between 2016 and 2021 (Freyberg 2016). The first of these plants would become the Feng Shan Xi Wastewater Reclamation Project that supplies treated water to the Linhai Industrial Park in Kaohsiung.

### PROJECT TENDER

Two of the largest EPC firms in Taiwan, HDEC Corporation and CTCI Corporation, formed a joint venture called Blue Whale Corporation to build and operate the wastewater treatment and reuse facilities. The result would be Taiwan's first integrated wastewater treatment and water recycling facility at Feng Shan Xi. The pre-treatment consists of pressurized hollow-fiber ultrafiltration membrane modules to remove turbidity. The UF effluent would then feed a two-stage high-pressure reverse osmosis system with membrane elements supplied by Toray to reduce impurities. As part of two phases, a 25,000 cubic meter per day reuse facility came online in August 2018 followed by a 45,000 cubic meter per day facility in August 2019. A 109,600 cubic meter per day sewage treatment plant supplies effluent to the recycling facility.

The water recycling facility also is integrated into neighboring parks and riverside corridors to promote environmental protection, sustainable landscaping, ecological preservation through public outreach and education. This facility would become Taiwan's first educational park with a water recycling theme.



Figure 1: Feng Shan Xi Water Reclamation Facility

Table 1 – Quick Facts (RO system)

Feed source	Secondary effluent from the sewage treatment plant
Pretreatment	Pressurized hollow-fiber UF
System capacity	Phase 1: 25,000 m <sup>3</sup> /day; Phase 2: 45,000 m <sup>3</sup> /day
Toray membrane model	TML20D-400
Active area per element	400 ft <sup>2</sup>
Membrane material	Polyamide
System design	30:15 (7 elements per vessel)
System recovery	75%
End use	Boiler feed for steel manufacturer
Consultant	Stantec
Commissioned	August 2018

The Feng Shan Xi Wastewater Reclamation Facility was shortlisted for the 'Wastewater Project of the Year' at the 2019 Global Water Summit.



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### MEMBRANE SELECTION

As can be seen in Table 2, the RO feed water contains high levels of inorganics. The treated water must meet stringent permeate requirements as the wastewater is reused as cooling water, particularly the removal of ammonia. As a result, Toray's ROMEMBRA™ TML20D-400 was selected to meet these requirements, which features fouling resistant properties to extend the lifespan of the membrane element while maintaining optimal permeate flow and rejection rates.

In addition to fouling resistance, this membrane is part of Toray's durable 'D-Family' series that features higher tolerance against foulants, cleaning (pH range) and oxidation. The Feng Shan Xi Water Reclamation Facility is a key example to help shape the public's perception of water reuse as a viable solution and for sustaining Taiwan's growing economy and population.



Figure 2: RO system containing Toray's low-fouling membrane elements

Table 2 – RO feed water quality

Item	influent
Temperature	15–30 °C
pH	7.4
Ammonium nitrogen	7 mg/L
TDS	620 mg/L
SDI	<3
Turbidity	<1 NTU

Table 3 – RO permeate target guideline

Item	influent
Temperature	15–30 °C
pH	5.5–8.0
Conductivity	<50 µs/cm
Turbidity	<0.2 NTU
Suspended solids	<1 mg/L
TOC	<3 mg/L
Total hardness	<20 mg/L as CaCO <sub>3</sub>
Ammonia nitrogen	<0.5 mg/L

### REFERENCES

Freyberg, Tom. "Taiwan: Water Reuse to Feed Booming Industry." *Water & Wastewater International*, Plymouth, Minnesota. January 1, 2016.

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