

CASE STUDY

RO | UF | MBR |

Wastewater Treatment
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 sustainable economic growth. However, when the country experienced one of the worst droughts in its history in 2015, in addition to the frequently occurring typhoons that obstruct the availability of clean water, the government was forced to implement water security plans.

The result was the introduction of the “Reclaimed Water Resources Development Act” at the end of 2015 by Taiwan’s Ministry of Economic Affairs. This new legislation would aim to make up at least 10% of the public water supply with reclaimed water by 2031, and the government would invest around USD 465.8 million to build six wastewater reuse plants between 2016 and 2021 [1]. The first of these plants would become the Feng Shan Xi Wastewater Reclamation Project to supply 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 be treated by a two-stage high-pressure reverse osmosis system containing Toray RO 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 ³ /d; Phase 2: 45,000 m ³ /d
Toray membrane model	TML20D-400
Active area per element	400 ft ²
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.



MEMBRANE SELECTION

Since the wastewater after treatment is reused as cooling water, the RO permeate must meet stringent requirements, particularly removing ammonia. As indicated in Table 2, the RO feed water contains high levels of inorganics. As a result, Toray RO model TML20D-400 was selected to meet these requirements, which features fouling resistant properties to extend the membrane element's lifespan 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 has become an excellent example in shaping the public's perception of water reuse as a viable solution to sustain 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 ₃
Ammonia nitrogen	<0.5 mg/L

REFERENCES

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

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