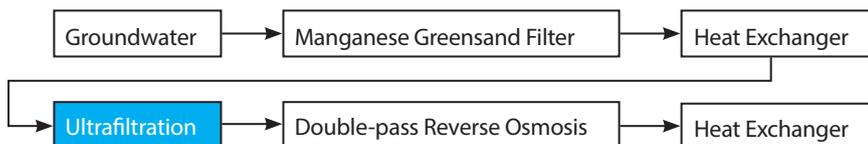




Industrial Wastewater Reuse Using Toray UF Membranes at Xiwu Thermal Power Plant

PROJECT BACKGROUND

A thermal power plant operated by Xiwu in the Inner Mongolia region of China started up in 2011 with the following treatment scheme:



The ultrafiltration (UF) system was comprised of two trains, each with 28 modules, using inside-out capillary type UF membrane modules to produce a permeate flow of 60 to 80 m³/hr. The UF membrane material was a polyethersulfone (PES) with a nominal pore size of 0.025 μm.

CHALLENGES

China's national policy for energy conservation and emissions reduction heavily scrutinized groundwater extraction by thermal power plants, and in 2015, the local government restricted the Xiwu power plant's withdrawal of freshwater. As a result, the plant began evaluating the reuse of secondary effluent reclamation from a nearby sewage treatment plant as an alternate source for raw water. The end-user compared the water quality of groundwater and reclaimed water (Table 1).

Furthermore, between July and August, during the slaughtering peak season of livestock in this region, the sewage treatment plant's effluent quality often exceeds the plant design. Pilot tests using the reclaimed secondary effluent as the feed revealed that the permeate flow in the capillary UF decreased rapidly, and the transmembrane pressure (TMP) rose quickly. The graph in Figure 1 shows both results.

After one day of operation, the permeate flow of the UF system decreased by 40%. Maintenance cleaning by chemically enhanced backwash (CEB) and recovery cleaning by clean-in-place (CIP) could not restore the permeate flow to its original values. After resuming operations, the membrane quickly fouled in just a few hours. The plant concluded that inside-out capillary-type UF membrane modules were unsuitable for reclaiming wastewater due to rapid fouling.

Table 1 — Water Quality

Parameters	Units	Groundwater	Reclaimed Water
Turbidity	NTU	<1	2–5
Conductivity	μS/cm	500	2,000
COD	mg/L	<2	20–50
Oil & Grease	mg/L	ND	1–6

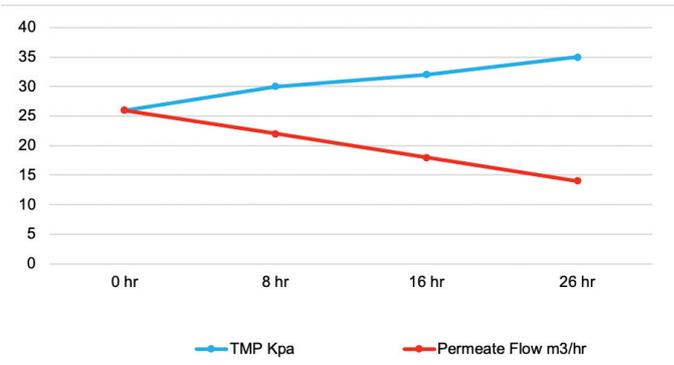


Figure 1: TMP and permeate flow of the capillary UF system

THE SOLUTION

Toray's UF membrane modules were operating at Xiwu's sister plant in Liaoyang for an industrial wastewater reuse system. Due to Toray UF modules' excellent performance at this site and other thermal plants using reclaimed secondary effluent as the feed, Xiwu evaluated Toray for retrofit alongside other leading UF manufacturers. The new UF system would require a minimum product water flow of 80 m³/hr and accept pre-treated circulating cooling blowdown water from the power plant. Evaluations revealed that Toray UF modules could exceed the minimum flux rate requirement with fewer modules than the previous installation with capillary UF modules. With Toray's UF modules, the existing backwashing and CIP ancillary equipment could be repurposed, further reducing capital costs. Xiwu selected Toray based on these advantages.

RESULTS

The new UF modules started operating in November 2017. The UF permeate flow was running between 90 to 110 m³/hr, at a stable TMP of around 50 kPa after running for a year (Figure 2). During upshots in the feedwater, regular backwashing and daily cleaning by Toray Maintenance Cleaning (TMC) helped maintain the flow.

Xiwu's power plant experienced the following benefits by using Toray pressurized hollow-fiber UF modules:

- At the beginning of 2019, the recirculating cooling water blowdown replaced 20 to 35% of the feed water, which was earlier than anticipated, demonstrating the Toray UF modules' high productivity;
- Toray membranes' low fouling properties successfully reclaimed the industrial wastewater even as the feed water quality decreased;
- Xiwu considerably reduced costs associated with purchasing secondary effluent from the sewage treatment plant and disposal fees related to the recirculating cooling water.

Figure 2: TMP and permeate flow of Toray UF

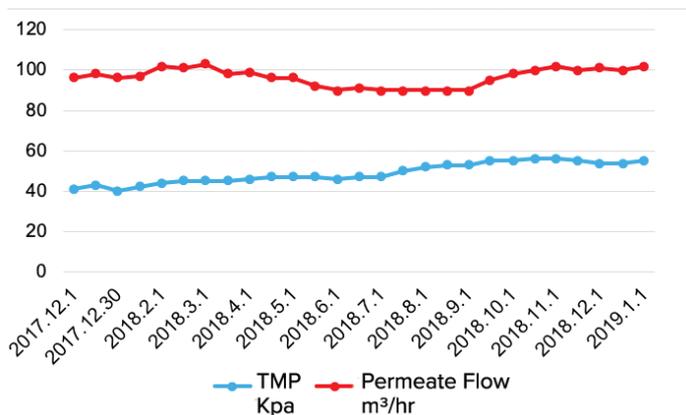


Figure 3: Toray UF system at Xiwu's thermal power plant

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