Performing with Pretreatment

Industries with large demand for process water often rely on reverse osmosis (RO) water treatment units for safe and predictable operation. RO continuously provides process water at a high level of quality and a comparably low cost. RO systems, however, are delicate and require sufficient pretreatment of the feedwater to prevent membrane fouling.

By Eric Shao

UF pretreatment enables optimal RO processes

Pretreatment is especially important when the feedwater is located in challenging conditions such as those encountered at the NingBo Jiufeng Co-gen, Ltd. Co. (Jiufeng) plant in China. The designers of the plant chose an economic ultrafiltration (UF) pretreatment solution for their RO unit. Since the start-up of the facility in August 2005, the Jiufeng plant has run with stable performance, resulting in equally good performance of the RO system.

Challenging Feed Water

Jiufeng participates in many public sectors, including heat and electricity development. The first-phase heat and electricity production site handles the generation, installation and repair of electrical services for the entire NingBo province. The site also maintains a steady supply of steam and hot water throughout the province with its 270-ton-per-hour production capacity.

The planned expansion to a second site will result in doubling the existing heat-generation capacity. Jiufeng uses the nearby XiePu River as source water for the factory's water treatment plants, one of which produces boiler make-up water. Because the intake of the plant is close to the estuary, which causes seasonal, tidal and weather-related seawater intrusion into the river, the water treatment plant of Jiufeng is supplied with water of constantly changing salt content, turbidity and temperature. The average content of the river water is total suspended solids of 134.5 mg/L and total iron of 0.3 mg/L. In addition, the temperature can range from 64°F to 77°F on any given day.

"One of the biggest challenges that customers, such as Jiufeng, face is finding an economical solution that is able to handle variable swings in dissolved solids and feedwater conditions while removing turbidity to a very low level without the addition of pretreatment prior to the utlrafiltration system," said Christina Fang, area commercial development manager for Dow Water Solutions. "Our ultrafiltration modules provide steady performance, making the membranes a reliable, economical and efficient solution for the NingBo site."

Economic Solution

With these tough conditions in mind, plant designers were looking for an economically viable solution for their water pretreatment unit. Their top choices were conventional filters or a pretreatment method using UF membranes.

The relatively small SFP-2660 UF modules appealed to the Jiufeng designers in regards to both performance and capital cost requirements. The module, with a length of 60 in., offers higher efficiencies over a wider range of feedwater conditions compared to some modules that are longer in length.

The unplasticized polyvinylchloride (U-PVC) housing eliminates the need for costly pressure vessels and the 6-in. diameter allows for a compact design in space-constrained installations. The outside-in flow configuration of its hydrophilic double-walled hollow fibers with 0.03-µm nominal pore diameter enables cleaning through simple backwashing and air scouring to remove the fouling layer. The double-walled hollow fibers also help reduce the need for additional pretreatment processes.

The 288 UF modules installed at Jiufeng are, therefore, as sufficient as the sole pretreatment process for the feedwater of the RO unit.

Pretreatment Performance

The performance of the pretreatment unit has been satisfactory since start-up in August 2005. The product water turbidity is on average 0.1 nephelometric turbidity units (NTU), at less than 0.2 NTU 90% of the time. The silt density index (SDI) has remained at less than 2. In addition, not a single chemically enhanced backwash has been needed since the start-up.

Once every six months, a clean-in-place (CIP) is needed by Jiufeng to restore the initial performance of the UF membranes. The transmembrane pressure (TMP) dropped down to less than approximately 5 psi immediately after each CIP, and remained relatively constant over the following six months. The flow pressure index, calculated as the skid's permeate

flow (m^3/h) divided by TMP (bar), was restored to its initial value after each CIP, showing the reliability and cleanability of the UF modules. This is largely due to the high strength and chemical resistance of its PVDF polymeric fibers, allowing longer UF membrane life.

The UF pretreatment at Jiufeng has provided high-quality RO feedwater, enabling optimal flux and high recovery operation of the installed Filmtec BW30-400 membranes. So far, only four cleanings of the RO membranes have been necessary, allowing UF as the sole pretreatment at Jiufeng to not only provide feedwater of constant high quality without showing signs of weakening over time, but also helping operate the RO unit at lower cost due to less downtime of the unit and a decreased demand for costly cleaning chemicals.

In addition, less cleaning helps prolong the lifespan of the RO membranes, reducing the need for replacement and reducing capital costs. Jiufeng is a solid example of how using UF pretreatment for RO membranes is an economically viable and sustainable solution for industries with large process water demand, even when the supply water is of challenging conditions and the need for a reduced footprint is key. *wqp*

Eric Shao is marketing development specialist for Dow Water & Process Solutions. Shao can be reached by e-mail at shao3@dow.com.

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