

Water Desalination: Zhuanghe Power Plant



Overview

To produce electricity, power plants require large volumes of high quality water for boiler make-up and for cooling. However, in most locations in China, where water resources are scarce, no surplus water is available and the government will not allow power plants to place additional demands on the already scarce water supply. New power plants must either find alternative sources of water, such as seawater or wastewater to gain government approval, or they must pay very high fees for surface water or ground water.

At the new electrical power plant in the Liaoning Province coastal city of Zhuanghe, seawater was a natural choice to supply the water needed to run the facility. The plant supports the region's thriving economy, which is driven in large part by the governing sub-provincial city of Dalian, a prosperous industrial center with the third largest port in China and the country's northernmost ice-free seaport.

Seawater must be desalinated before it can be used in industrial processes. Reverse osmosis (RO) is a filtration process known to be the most energy efficient method of removing dissolved salts from water. To optimize the performance of RO systems, and to protect them from fouling, an effective pretreatment system is required.

The Challenge

To design an effective RO pretreatment system to produce a water supply suitable for boiler make-up and cooling.

Solution

Ultrafiltration (UF) pretreatment for RO systems is an increasingly common combination in desalination plants and other large-scale reverse osmosis systems in China and around the world.

Zhuanghe plant officials chose TARGA®-10 UF hollow fiber cartridges from Koch Separation Solutions (KSS) after visiting two power plants that successfully employ the membranes for very similar RO pretreatment applications.

Hollow fiber UF systems incorporating TARGA -10 cartridges occupy a small footprint and provide higher permeate quality compared to conventional pretreatment systems. Fully automatic control and relatively low investment costs were also important factors in the selection of UF technology.



“The most important reason that ultrafiltration was selected for seawater pre-treatment is the high quality of the permeate,” said Mr. Zhang, plant manager. “The high permeate quality results in less frequent RO cleanings and ensures longer RO element life. With the TARGA® II ultrafiltration system, we are able to cost-effectively tap the limitless seawater and avoid draining our scarce surface water resources.”

The Treatment Plant

The construction of the Zhuanghe plant was divided into two phases. The first phase, completed in 2006, provided 1200 megawatts. The second phase, completed in 2007, expanded the total capacity to 3200 megawatts. During the first phase, the plant drew surface water from a reservoir located 19 kilometers away. In the second phase, the plant switched over to seawater for all cooling water and boiler makeup needs.

Two trains of UF membranes were commissioned in October 2006, and three additional trains were commissioned in 2007 for the second phase of the plant's construction. The trains operate in parallel, and are each equipped with 44 TARGA cartridges having a total capacity of 232 m³/h per train.

Prior to the UF system, the seawater is pretreated with coagulation and sedimentation, both performed in the same tank. FeCl₃ or Poly FeSO₄ is used as coagulant, and if needed, anionic PAM is used as coagulant aid. To control biological growth, sodium hypochlorite is added to the feed of the sedimentation tank. The controlled free chlorine before the UF is about 0.3 to 1.0 mg/l. A 100 µm screen web pre-filter, that can be automatically backwashed, is installed before the UF to remove the large particles.

Product Overview

TARGA-10 cartridges are used in a variety of industrial water treatment applications but are particularly effective for seawater RO pretreatment.

In 2011, KSS launched the TARGA II system, which offers cost effective, high quality water for a variety of treated water applications, from drinking water to seawater RO pretreatment, industrial water treatment, and tertiary wastewater treatment. The TARGA II system is seawater compatible to meet the unique challenges of RO pretreatment for seawater desalination, and offers consistently good filtrate at low overall operating costs.

The TARGA II system features several significant advantages:

Optimal System Design

- Smaller footprint
- Easily expandable
- Reduced capital costs

Proven 4-log Virus Removal

- Fiber ideally suited to meet stringent regulations
- Prevents contaminant breakthrough
- Cost-effective compliance for drinking water treatment

Intelligent Controls

- Reduced chemical usage
- Reduced energy cost
- Minimized operator involvement
- Efficient handling of feed water quality upsets

Robust Fiber

- Robust PES fibers
- Reduced fiber breakage
- Wide range of pH cleaning - 1.5 to 13



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