

# Case Study: Yangmei Taihua Coal-to-Chemical ZLD

## Using MBC to meet stricter-than-ever treatment standards

### Background - Qingxu, Taiyuan, PRC

Heavy industries in China are facing more stringent water usage guidelines and tougher effluent treatment regulations than ever before. New projects in the power, chemical, and manufacturing industries have been required to implement zero liquid discharge (ZLD) processes into their plant designs. In the coal belt of Western China, the Taiyuan Chemical New Materials Co., Ltd. (阳煤集团太原化工新材料有限公司) has developed a coal-to-chemical complex which generates multiple wastewater streams comprised of undesirable constituents, from process units within the complex and from utility systems such as the central steam generation plant. Oasys Water and Beijing Woteer teamed up to provide an integrated water treatment solution to convert a portion of the plant's challenging wastewater into fresh, reusable water and a crystallized salt byproduct to achieve complete ZLD.

### The Solution

Oasys Water partnered with Beijing Woteer to offer a complete solution to meet the needs of the Yangmei Taihua ZLD Project. This solution includes pretreatment to condition the wastewater ahead of the Oasys ClearFlo Membrane Brine Concentrator (MBC™), as the primary step for wastewater volume reduction and reuse. The MBC is a forward osmosis (FO) based technology that uses a highly effective draw solution to create a natural osmotic gradient against a strong and stable semi-permeable membrane for water extraction. The concentrated brine leaving the MBC is sent to a crystallizer system to complete the ZLD process. The MBC is the brainchild of Oasys Water and offers a new approach for meeting reuse and recycling requirements with difficult industrial wastewaters. This project was executed under a build-operate-transfer (BOT) project structure, where Beijing Woteer assumes ownership of the brine concentrator and crystallizer systems, operates the systems, and the customer pays a fee per quantity of water processed.

### The Design

The Yangmei Taihua ZLD Project was implemented in early 2017, and includes a number of unique design elements within the process flow.

- Cross flow tubular microfiltration**  
 The process design includes an innovative pretreatment technology which utilizes a single unit operation to replace the typical chemical softening clarifiers and media filtration pretreatment steps. The TMF system offers a streamlined, membrane-based approach for softening that integrates chemical addition, precipitation, and filtration in a single process step. A self-cleaning design is employed for optimal filtration performance and reliable operation.
- Low TDS and high recovery**  
 The project requires treatment of relatively low total dissolved solids (TDS) feed water to a high level of water recovery, of greater than 90%. It outputs 1,180 m<sup>3</sup>/d of fresh water for reuse within the plant.

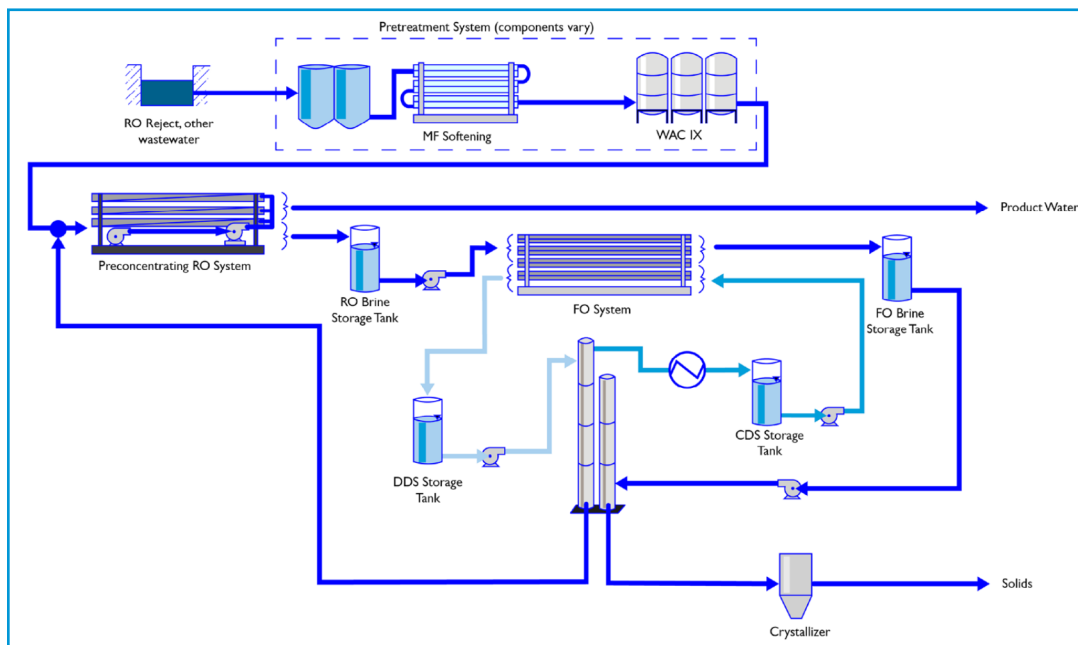


MBC System Skids at the Taihua Plant

## The Process Design

Proper pretreatment design enables FO technology to achieve greater separation, higher concentrations of TDS, and higher levels of water recovery than competitive technologies. The Yangmei Taihua ZLD Project integrates a pretreatment system – provided by Beijing Woteer – consisting of a TMF unit and ion exchange polishing. In the MBC system, pretreated water enters a pre-concentrating reverse osmosis (RO) unit before entering the FO membrane array. The MBC with RO pre-concentration takes advantage of the benefits of both conventional RO and novel FO, by integrating the two such that they each operate in their ideal osmotic pressure ranges.

1,200 m<sup>3</sup>/day of raw water is fed into the pretreatment system. After RO pre-concentration, 320 m<sup>3</sup>/day is eventually fed into the FO membrane system. The FO process dilutes a high strength draw solution as water is recovered from the wastewater stream. The diluted draw solution is fed into a recovery system where thermal energy is used to separate the draw solutes and recovered water. The draw recovery system operates as a closed loop, recovers and recondenses the draw species at full strength, while at the same time recovering fresh water



for final polishing by RO to <100 mg/L TDS, for use as make-up to the steam generator feed plant. Concentrated brine exits the MBC as feed to the crystallizer at 80 m<sup>3</sup>/day and greater than 240,000 mg/L TDS. The crystallizer system outputs solids at <2% moisture content, ready to be discarded to complete the ZLD process.

## The Results

The ZLD system at Taiyuan Chemical New Materials Co. is the first BOT project in China executed by the Oasys Water and Beijing Woteer partnership. This project demonstrates the MBC capabilities on a commercial level, with 1,180 m<sup>3</sup>/d of wastewater being treated to full ZLD. The versatility and scalability of Oasys Water's technology and the fully membrane-based approach has effectively minimized this project's footprint and costs, while optimizing its production.

In partnership with:



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