Case Study: Zhongtian Hechuang Energy Ordos Project
Converting combined process wastewater to ZLD

Background - Ordos, Inner Mongolia Region, PRC
In 2013, SINOPEC Engineering Group (SEG) partnered with China Coal Corporation to form the Zhongtian Hechuang Energy Corporation to create the world’s largest coal-to-olefin project. The project includes the engineering, procurement, and construction of units for coal gasification, purification, synthetic methanol, olefin catalytic cracking, and various chemicals such as polypropylene and polyethylene. This multi-process plant consumes an abundance of water and is subject to strict zero discharge regulations under China policy to minimize both water intakes and discharges for industrial processes.

The Solution
Through the combined efforts of Oasys Water and Beijing Woteer, the Ordos ZLD project criteria were met through the installation of the ClearFlo Membrane Brine Concentrator (MBC™) in conjunction with a full pretreatment system, reverse osmosis (RO), and crystallizer system. The innovative forward osmosis (FO) technology allows for high recovery of product water for reuse, with reduced electricity and steam consumption, and is designed to be flexible in regards to volumetric feed rate, water hardness, alkalinity, total dissolved solids (TDS), and other operating parameters.

The Design
The Zhongtian ZLD plant, which first came on line in April of 2017, met stringent criteria necessary for processing a wide range of feed water constituents and flow rates.

- **Treatment of variety of wastewater**
The MBC feed is an RO reject with a TDS of 50 – 60 g/L. This waste is made up in large part of Na, Cl, and SO₄ all at greater than 10,000 ppm. Additionally, NO₃ at ~1000 ppm, COD at ~500 ppm, K at ~500 ppm, and F at ~75 ppm exist along with a total hardness of ~200 ppm as CaCO₃.

- **Output of highly concentrated brine**
The MBC concentrates the feed 4x, to greater than 240,000 mg/L TDS, recovering nearly 80% as fresh reusable water. A large crystallizer system then processes the MBC brine at a capacity of 630 m³/day.

- **Scalable technology**
Oasys has implemented the MBC technology in other similar processes, but the Zhongtian project is by far the largest. At feed rates of 2,880 m³/day, this system is 4.6x larger than other industrial ZLD projects in China.
The Plant Process Design

The feed to the ZLD system enters pretreatment at 5,760 m³/day and 25,000 ppm. After undergoing chemical softening and an RO pre-concentration step, the pretreated wastewater enters the FO membrane array of the MBC system at 2,880 m³/day. Two independent MBC systems, each at 1,440 m³/day feed rate, operate in parallel. Each of the systems is configured with three parallel FO membrane arrays, in order to provide a high degree of flexibility in operation. The separation of water from dissolved solids is driven by an osmotic pressure gradient across the semi-permeable FO membrane. The draw solution is a patented composition of thermolytic salts, maintained at a precise concentration, to drive natural, forward osmosis. The combination of thermolytic salts and recovered water is thermally separated in a draw recovery system powered by low pressure steam at 5 bar(A) and 152°C. A two-pass RO system is used to polish the FO product water to achieve less than 100 mg/L TDS.

The Results

Together, Oasys Water and Beijing Woteer are revolutionizing the high recovery wastewater treatment industry. Ordos is today experiencing the benefits of FO technology in the form of reduced costs and energy requirements, making their wastewater process the most economically and environmentally sustainable solution. The MBC reaches 2256 m³/day of product water at less than 100 ppm, and a product brine of 630 m³/day at greater than 240,000 ppm that is crystallized to form greater than 90% ZLD solids. As the availability of resources becomes a greater global issue, Ordos is doing its part through the revolutionary technology of Oasys Water and Beijing Woteer to recycle and reuse wastewater in the most strategic way possible.