

To achieve Zero Liquid Discharge and Resource Recovery for Coal Chemical Wastewater Treatment: CHN Energy Ningxia Coal MLD project

Overview

CHN Energy Ningxia Coal Group, the industry leader of clean coal technology in China, has constructed a coal mine water and coal chemical wastewater treatment and reuse facility to achieve the goal of zero liquid discharge for Ningdong Energy and Chemical Industry Base, located in Ningxia, China.

With \$250MM investment and 21.26 hectares footprint, the facility produces 24.09 million cubic meters of clean water for reuse by the coal chemical production system annually, reducing reliance on freshwater sources. The facility also produces 39,900 tons of first-class sodium chloride, 43,200 tons of anhydrous sodium sulfate, and 14,400 tons of miscellaneous salts by-products per year, which are fully reused by the plant. The facility has set up a benchmark globally in terms of project scale, total investment, process route, product salt resource utilization, and low miscellaneous salt rate.



Fast Facts

Location: Ningxia, China

End User: CHN Energy

Application / Market:

Coal chemical

Technology: FilmTec™ Fortilife™ CR100/ XC70/ XC80, ultra-high pressure reverse osmosis elements and XC-N nanofiltration elements

Feed water source/quality:

Coal to chemical wastewater reuse

Start-up: March, 2019

Technological process:

Pretreatment + NF + RO

System treatment capacity:

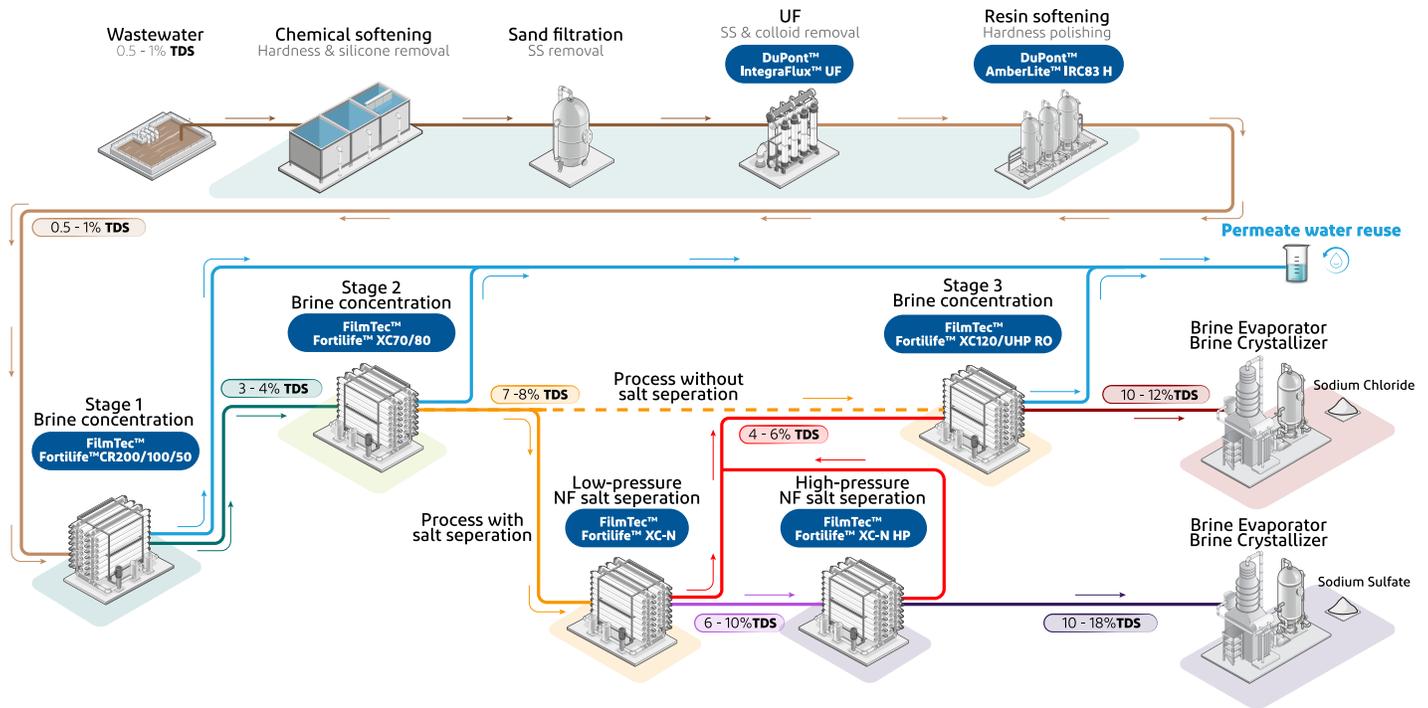
3,000 m³/d

Temperature range: 30-35°C

Challenge & Solutions

The high water demanding coal-to-chemical industry base is located in water stressed, Northern China and generates large amounts of highly polluted wastewater containing high salt content, high hardness, high suspended solids and high organic pollutants. Zero liquid wastewater discharge is necessary to comply with the strict local wastewater discharge regulations, which has become a bottleneck for CHN Energy Ningxia Coal Group to expand their production capacity and grow their business.

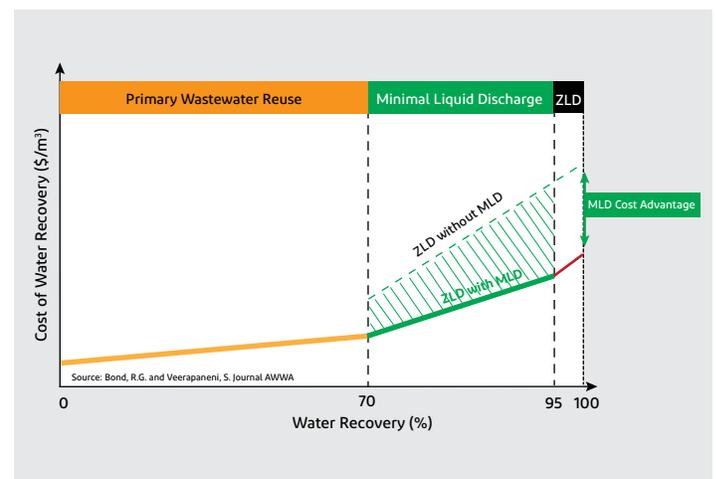
DuPont Water Solutions offers the complete minimum liquid discharge total solution with multiple advanced membrane technologies including DuPont™ IntegraFlux™ ultrafiltration pretreatment, FilmTec™ Fortilife™ nanofiltration salt separation and FilmTec™ Fortilife™ reverse osmosis multi-stage salt concentration. Featuring a compact and efficient design with precisely manufactured membranes from DuPont Water Solutions, the system has achieved stable performance and good tolerance to membrane fouling and cleaning, ensuring a long service life of the whole facility.



With DuPont MLD, a plant can improve circular water economy by recovering up to 95 percent liquid discharge for reuse — but at a fraction of ZLD's costs.

The cost of using RO to recover and reuse up to 70 percent of wastewater is competitive with treating local, fresh-water sources, but it leaves behind 30 percent of the water. When water prices are high and/or water availability is limited, recovering more water becomes necessary.

The thermal processes used in ZLD treatment to recover more water often result in higher costs that are not feasible. But by practicing DuPont MLD, it can recover up to 95 percent of the wastewater using membranes prior to thermal processing, which significantly lowers the cost of the recovered water and the overall cost of ZLD, by up to 60 percent.



Technical Advantages of DuPont Membrane Product

DuPont™ IntegraFlux™ ultrafiltration membranes are used in the whole process for treating the different streams of raw wastewater, as well as the high salinity concentrates of RO & NF membranes. The stable and uniform chemistry of DuPont UF membranes contributes to the reliability of the ultrafiltration system which ensures the efficient and stable operation of the downstream RO and NF systems.



FilmTec™ Fortilife™ RO/NF product series are widely used in the whole process of this project, including CR100, XC70, XC80, ultra-high pressure reverse osmosis elements and XC-N nanofiltration elements. The state-of-the-art anti-fouling technologies implemented by FilmTec™ Fortilife™ elements ensures the efficiency and stability of RO system operation for treating the most challenging coal chemical wastewater.



FilmTec™ Fortilife™ XC-N nanofiltration elements were used for salt separation & recovery from the coal chemical wastewater. The highly selective membranes effectively separated sodium chloride and sodium sulfate with a sulfate rejection rate greater than 98%. Paired with the evaporative crystallization unit, the nanofiltration system produces sodium sulfate and sodium chloride with a final purity exceeding 99.0%. In addition, XC-N elements are also used to re-concentrate the frozen mother liquid and return it to the crystallizer, not only improving the salt yield and quality, but also reducing the amount of final miscellaneous salts.

FilmTec™ Fortilife™ ultra high pressure reverse osmosis elements are also used in this project. With operating pressure upper limit as 120bar, this product has been used to further recover clean water from the concentrated wastewater, so as to reduce the final volume of concentrate for evaporation and crystallization, and achieve significant cost saving of the investment and operation of the whole system.

Since the system commenced trial operations in March 2019, the recovered clean water has consistently met the requirements for reuse, successfully reducing freshwater consumption. The by-products have all surpassed design requirements: The salt quality of recycled sodium chloride and sodium sulfate both exceeds the Class I standard defined in the Industrial Salt Standard.



Conclusion

The project has not only successfully addressed the water scarcity issue that the company is always facing but also minimized the environmental impacts. In addition, the facility is an important demonstration of the value that ZLD systems can bring to the mining and chemical coal industries, setting up a role model to inspire the design and operation of similar projects.

DuPont has provided the minimum liquid discharge total solution to this project as well as the core membrane product including DuPont™ IntegraFlux™ ultrafiltration and FilmTec™ Fortilife™ RO/NF series, making sure the most efficient and stable operation of the whole system and achieving the maximum benefits on both economy and sustainability.



Water Solutions
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