

CASE STUDY

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Industrial Water Reclamation
Ordos City, China



Innovation by Chemistry

Toray's MEMBRAY™ Membrane Bioreactor Reclaims Wastewater from a Coal Liquefaction Facility in Inner Mongolia

PROJECT BACKGROUND

Coal Liquefaction, also known as a "Coal to Liquid Fuels" (CTL) process, generates wastewater that requires advanced treatment for reuse and to meet strict guidelines for environmental discharge. Ordos City, located in the Inner Mongolia region of China, is home to some of the world's largest CTL facilities. A region with a semi-arid climate and little rainfall per year, a CTL facility in Ordos took initiatives to purify its wastewater to acceptable standards for reuse and meet zero liquid discharge (ZLD).

CHALLENGES

The industrial effluent generated by CTL facilities generally contains pollutants that are complex and difficult to break down. The Ordos CTL facility required a treatment system that could produce high-quality filtrate while being cost-effective and meet operational flexibility and safety. However, this site was the only CTL plant employing direct liquefaction (DCL) in China, and the plant could not model their wastewater treatment needs after reference sites. With the existing conventional treatment scheme, fluctuations in water quality recurred, and the color and COD parameters remained high. After unsuccessful trials using various biochemical treatment options, the end-user and consultants began evaluating membrane technologies.

PRODUCT SELECTION

For piloting purposes, the consultant examined several membrane bioreactor (MBR) modules in both hollow-fiber and flat-sheet configurations. Test results indicated that none of the hollow-fiber modules could meet the requirements, while Toray's flat-sheet MEMBRAY™ MBR module performed most reliably. MEMBRAY™ features a highly durable PVDF (polyvinylidene fluoride) material with improved resistance against chemicals and physical durability during air scouring. Its membrane pores are uniformly and densely distributed along the membrane surface, which increases permeability and reduces the build-up of foulants. Toray was selected according to these product



Figure 1: MBR tank at Ordos Coal-to-Liquid Facility

Table 1 – Quick Facts	
Flow capacity	9,840 m ³ /day
Start-up	May 2013
Plant influent	Industrial effluent from liquefaction plant
Membrane model	MEMBRAY™ TMR140-200D
System configuration	7 trains with 18 units each
Membrane material	PVDF (polyvinylidene fluoride)
Nominal pore size	0.08 μm
Effluent end-use	De-mineralized process and cooling water

Figure 2: ZLD process using membranes

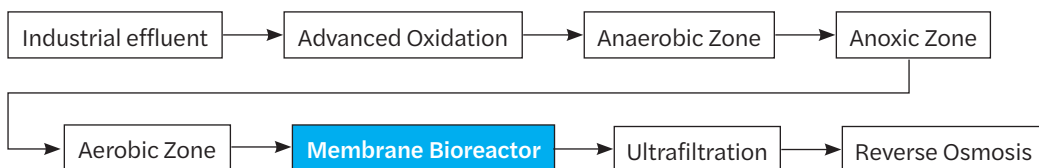


Figure 3:
MEMBRAY™
TMR140-200D



advantages in addition to quick lead times and reliable technical support. The final design of the ZLD process using membrane bioreactor is outlined in Figure 2.

RESULTS

The MBR system started up in May 2013 and has been running efficiently since. Toray provided full technical support and training for the installation and commissioning phases and has continued with regular visits to the site to help operators optimize the plant's performance.

Figure 4 shows the COD (chemical oxygen demand) values of the plant's influent, permeate, and removal rate. The permeate COD (in orange) is continuously at a low value when the influent quality rises, indicating a high tolerance of the MEMBRAY™ MBR module even during upsets in the influent.

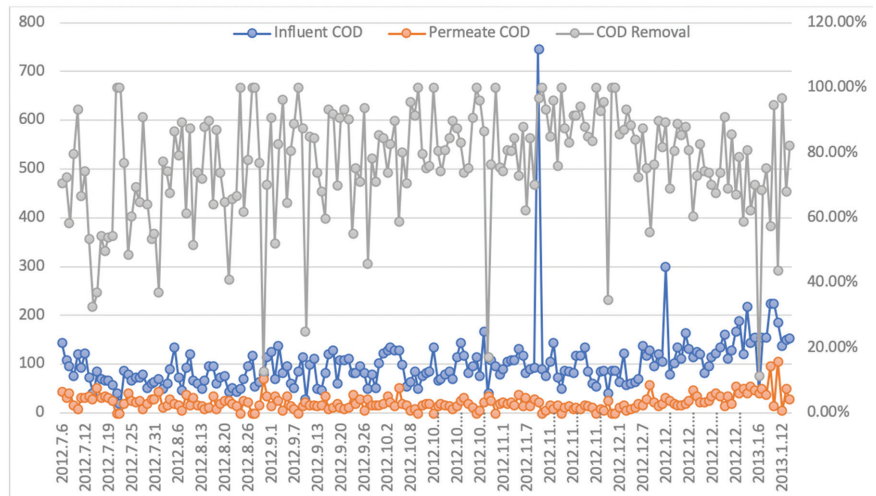


Figure 4: COD values



Figure 5: Water quality comparison – wastewater on the left and MBR effluent on the right

The raw water quality also experienced spikes in TDS, excessive oil, and sludge concentrations. However, Toray's MEMBRAY™ modules continued to operate stably and avoided shutdowns by means of process adjustment, chemical cleaning, and other maintenance procedures.

CONCLUSION

Wastewater from CTL plants is much more challenging to treat than other types of industrial effluent. Toray's MEMBRAY™ technology demonstrated the ability to deliver stable operation and long service life under complex feed water qualities. This project has helped cut down freshwater consumption and achieve ZLD goals with reduced footprint, and has become a key benchmark for other CTL facilities to recycle wastewater sustainably.

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