



DOW™ Ultrafiltration

DOW™ Ultrafiltration Membranes Ensure Quality RO Feed from Domestic Waste Water

Site Information

Location:

ShanXi, China

Capacity:

218 m³/h (960 gpm)

Purpose:

Pretreat feed water to RO system

Time in Operation:

Since September 2006

Performance:

Turbidity = 0.05 NTU;
SDI ≤ 1



Ultrafiltration skids with DOW™ Ultrafiltration SFP-2660 modules in the ShanXi DaTong installation. (Photo courtesy of ShanXi DaTong Co-gen Ltd.)

Introduction

ShanXi DaTong Co-gen Ltd. is located in the city of DaTong in ShanXi province. This facility has supplied over 300 MW of heat and electricity to local communities and industries for the past 50 years. In order to meet the increasing demand for energy, DaTong invested in a reconstruction in 2001 for an extra 100 MW of electricity.

DaTong uses domestic waste water from the factory and the municipality and a portion of industrial waste water from the factory's daily operation. Ultrafiltration (UF), reverse osmosis (RO), and electrodeionation (EDI) unit operations are used to treat municipal water for boiler make-up water. DOW™ Ultrafiltration membranes were selected to ensure quality RO feed water. Despite the challenge posted by high chemical oxygen demand (COD), this UF membrane successfully demonstrates reliable performance with product water of turbidity averaging 0.05 NTU and silt density index (SDI) ≤ 1.

DOW™ Ultrafiltration Modules

The SFP-2660 module is ideal for systems with capacities of 50 m³/h (220 gpm) or less, although customers with larger facilities also choose this module because of construction or economic constraints. At 6 inches (15 cm) diameter, the SFP-2660 module allows an alternative design for space-constrained installations.

DOW™ Ultrafiltration Modules, cont.

DOW™ Ultrafiltration modules are made with high-strength, hollow-fiber membranes that have excellent features and benefits:

- 0.03 µm nominal pore diameter for removal of bacteria, viruses, and particulates (including colloids) to protect downstream processes such as reverse osmosis
- Polyvinylidene fluoride (PVDF) polymeric hollow fibers for high strength and chemical resistance that lead to longer membrane life
- Hydrophilic PVDF fibers for easy cleaning and wettability that help maintain long-term performance
- Outside-in flow configuration for high tolerance to feed solids that helps reduce the need for pretreatment processes
- Unplasticized polyvinylchloride (U-PVC) housing, which helps eliminate the need for costly pressure vessels

Water Treatment Process

Table 1 indicates the average raw water analysis, showing the high chemical oxygen demand (COD).

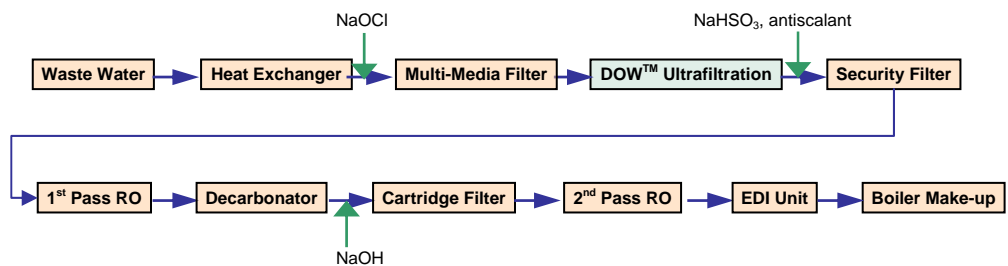
Table 1. Raw water analysis

Parameter	Unit	Value
Fe	mg/L	0.113
Chemical oxygen demand (COD)	mg/L	38.25
Total suspended solids (TSS)	mg/L	16.8
Temperature	°C	26 to 35
Total dissolved solids (TDS)	mg/L	714
pH	—	7.71
Total SiO ₂	mg/L	9.26
Total hardness	mmol/L	6.36

Figure 1 is a diagram of the water treatment process. Sodium hypochlorite (NaOCl) at a dosage of 3–3.5 ppm is primarily used to oxidize Fe for removal and control biofouling. A reducing agent (sodium bisulfite, NaHSO₃) is used to counter-react with the oxidizing agent remaining in the UF permeate water. An antiscalant is dosed at 3–4 ppm to prevent the RO membranes from scaling.

The cartridge filters prevent particles from transferring into the treated water and damaging the membrane. These 5 µm particle size polypropylene (PP) cartridge filters are each rated for a capacity of 60 m³/h (264 gpm). Sodium hydroxide (NaOH) is dosed to the system for pH adjustment between the two RO stages to reduce CO₂ and improve the downstream EDI operation.

Figure 1. Water treatment process



Water Treatment Process, cont.

Table 2 provides the operating parameters for the ultrafiltration, reverse osmosis, and electrodeionation unit operations. Table 3 further describes the ultrafiltration process.

Table 2. Operating parameters for unit operations

Parameter	Unit	UF	RO	
			1 st pass / 2 nd pass	EDI
Component	—	SFP 2660	FILMTEC™ BW 30-400	DOW™ EDI-210
Capacity	m ³ /h	218	165.5 / 72	68
Number of skids	—	4	3 / 2	2
Number of modules per skid	—	36	—	—
Total number of modules	—	144	—	—
Capacity per skid	m ³ /h	54.5	42.2x2+81.1 / 36	34
Recovery	%	95	—	—
Flux	L/m ² h	45.8	—	—

Table 3. Ultrafiltration operating process

Parameter	Frequency	Duration	Chemical Consumption
Filtration	—	56 min	—
Air scour	Every 56 min	40–60 s	—
Backwash	Every 56 min	1–2 min	15 ppm NaOCl
Forward flush	Every 56 min	60 s	—
CEB ^a	None	None	—
CIP ^b	Every 6 months	8 h	<i>Alkaline:</i> 0.05% NaOH, 0.2% NaOCl <i>Acid:</i> 0.36% HCl

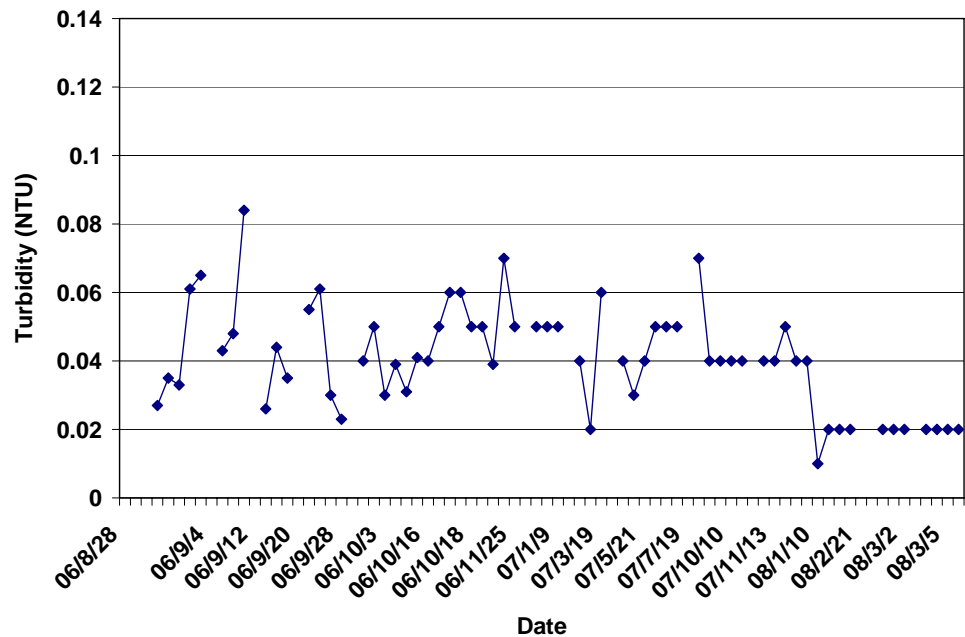
^aChemically Enhanced Backwash

^bClean-in-Place

UF System Performance

Figure 2 shows the product water turbidity vs time. DOW™ Ultrafiltration modules lowered the feed turbidity from over 1 NTU to an average turbidity of 0.05 NTU over a year of operation. Since November 2006 the turbidity has decreased with a slight fluctuation around 0.05 NTU. Silt density index (SDI) averages less than 1. The stable product water turbidity and low SDI demonstrate the reliability of DOW™ Ultrafiltration.

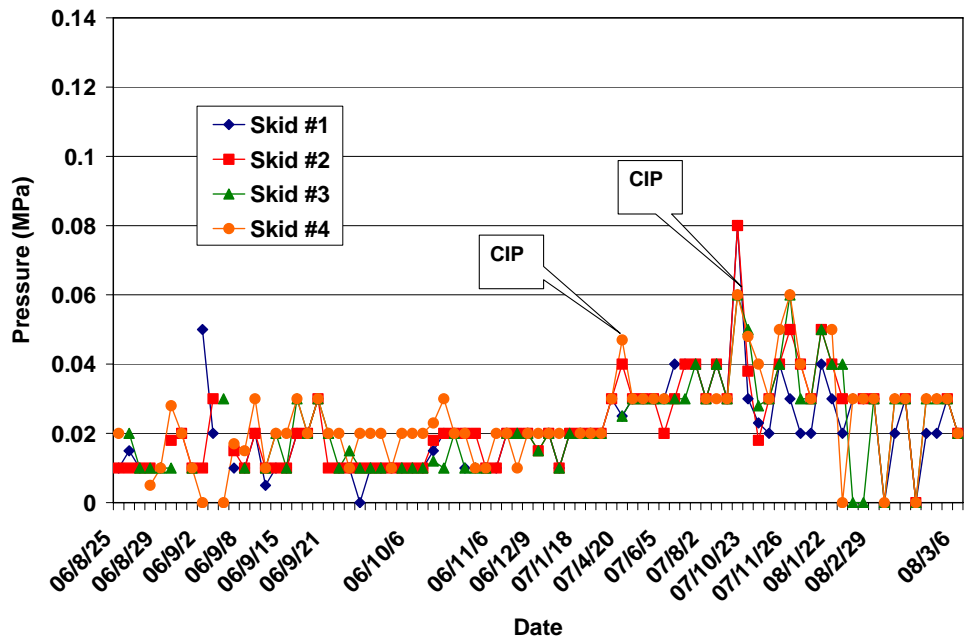
Figure 2. Product water turbidity versus time.



**UF System
Performance, cont.**

The average transmembrane pressure (TMP) value for all UF skids has been stable over the period of September 2006 to March 2008 (Figure 3). The TMP increased slightly over time, from 0.01 MPa to 0.03 MPa; however, the TMP remained at a very low level during this time. A Clean-in-Place (CIP) was performed in April 2007. The TMP decreased to 0.03 MPa after cleaning and remained stable. For this installation, it was recommended that a CIP be performed every 6 months, and the scheduled second cleaning was performed on October 20, 2007, as seen in Figure 3. Slight fluctuation of the TMP was due to system maintenance.

Figure 3. Ultrafiltration operating transmembrane pressure versus time.



Summary

Despite the high COD challenge, DaTong obtains acceptable feed water quality for RO using only a medium filter and DOW™ Ultrafiltration modules as pretreatment. No coagulation, sedimentation, or sand filtration pretreatment unit operations are needed. DOW™ Ultrafiltration modules provide an economical and effective solution for municipal waste water treatment.

The DOW™ Ultrafiltration modules produced water with SDI less than 1 and turbidity averaging around 0.05 NTU over a year of operation. This further enhances and ensures the performance of the RO system, resulting in optimal flux, high salt rejection, and high recovery. The UF system and RO system only require chemical cleaning once every 6 and 8 months respectively, further showing the reliability of the DOW™ Ultrafiltration as a pretreatment unit operation.

DOW™ Ultrafiltration

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