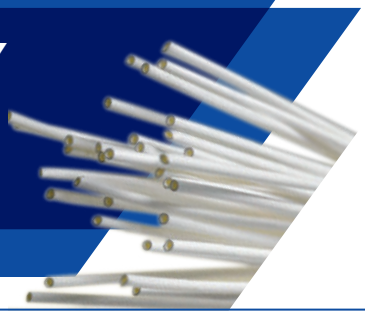
CASE STUDY

RO | NF | UF | MF

Municipal Drinking Water
Granbury, Texas



'TORAY'

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Retrofit Expansion of an Ultrafiltration System at Granbury's Surface Water and Treatment System

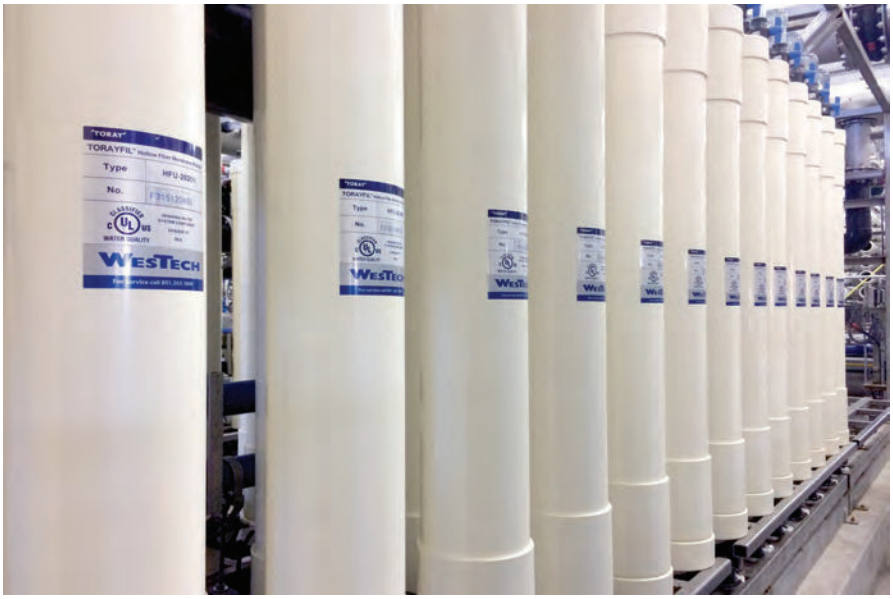

Figure 1: UF/RO system designed and constructed by WesTech Engineering

Table 1: UF comparison	Previous UF	HFU-2020N
Total no. of trains	5	
Max. no. of modules per rack	78	
No. of UF modules per rack	78	50
Total no. of UF modules	390	250
UF system capacity	9.2 MGD	10.0 MGD
Membrane material	N/A	PVDF
Nominal pore size of membrane		0.01 µm
Effective membrane area per module		775 ft^2
Commissioned	2008	March 2017

INTRODUCTION

The Brazos Regional Public Utility Agency (BRPUA) in Texas operates the Surface Water and Treatment System (SWATS) that treats water from Lake Granbury, fed by the Brazos River. The SWATS facility began operations in 1988 with clarification, dual media filtration, and electrodialysis reversal (EDR). The plant was upgraded in 2001 to include ultrafiltration (UF) and reverse osmosis (RO) membrane treatment to produce higher quality effluent.

The plant's first retrofit and expansion of the UF modules and system took place in 2008 to produce up to 10 MGD. After several years of operation, the membrane modules exhibited fiber breakage, and the utility recognized an opportunity to upgrade the existing UF system and consider room for future expansion.

CHALLENGE

BRPUA worked with the utility's consulting firm, Enprotec, Hibbs & Todd (eHT), to assess the pros and cons of a UF module retrofit versus system replacement. Below were the key observations:

1. Considering future water demands, a 1:1 replacement of the UF modules would limit room for expansion because the UF racks were already fully occupied.
2. Replacing the entire UF system would be uneconomical as much of the system components (instrumentation, valves, and pumps) had many years of serviceable life remaining.
3. However, if the system was retrofitted using UF modules with a higher flux, this would minimize system footprint modification and produce equal or better effluent. Furthermore, the plant could meet the current capacity with fewer modules and allow for expansion within the existing footprint and save costs for many years to come (Nay 2017).

A Request for Proposal (RFP) was released, calling for system manufacturers to submit a membrane treatment design that maximized the 'repurposing' of the existing racks and trains and produce a minimum of 2.0 MGD and a maximum of 3.0 MGD.

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TORAY UF MODULES

Technical reviews and projections showed that Toray's pressurized UF modules (p/n HFU-2020N) could meet the prequalification requirements. They are listed below:

- The system would require a total of 250 Toray UF modules to satisfy the minimum total system capacity of 10.0 MGD, which is a sizable 140 modules less than what the previous UF system was using.
- A total of 380 Toray UF modules would be required to meet the maximum total system capacity of 15.0 MGD, which still left room for expansion.

Toray UF modules were selected for piloting from December 2015 to January 2016 to confirm that the UF modules can meet the full-scale plant's design conditions and drinking water requirements based on the Texas Commission on Environmental Quality (TCEQ) guidelines.

The pilot study was conducted in two phases where an RO unit would mimic the full-scale design and study how UF as a pretreatment to the RO system affects performance. Phase 1 of the study measured the UF membrane's performance and whether it could meet design objectives, while Phase 2 evaluated both UF and RO performances. Table 2 shows the pilot results of Phase 1.

Table 2: piloting results	
Membrane module	HFU-2020N
Flux at design temperature (20°C)	60.3 gfd
Production cycle time	34 minutes
Backwash flow rate	1.1 times x production flow rate
Average TMP	11.0 psi
Average recovery	97%
Maintenance clean frequency	2 times per week
MC chemical solution	Sodium Hypochlorite 250 ppm
Fiber breakage	zero fiber breaks or repairs

Successful piloting confirmed design projections, and the utility/consultant selected WesTech Engineering (www.westech-inc.com) as the OEM using Toray UF modules for the retrofit.

CONSIDERATIONS

This study illustrates the key factors of whether or not a retrofit is the best option for a plant to examine the pros and cons of maintaining a proprietary system versus implementing a non-proprietary system as we observe the market shifting towards the latter (Berryhill. 2016). Such cases help drive the improvement of membrane technologies and meet the customer's needs by offering flexible options that have long-term benefits.

REFERENCES

Berryhill, Joshua. "Membrane troubleshooting and replacement at Brazos Regional Public Utility Agency Surface Water and Treatment System." South Central Membrane Association Workshop, Broken Arrow, Oklahoma. April 2018.

Nay, Jason. Linton, Libbie. Richard, Alain. Berryhill, Joshua. Dye, Dan. "Retrofit and expansion of a 10 MGD UF system in Granbury, Texas." AMTA/AWWA Membrane Technology Conference, Long Beach, California. February 2017.

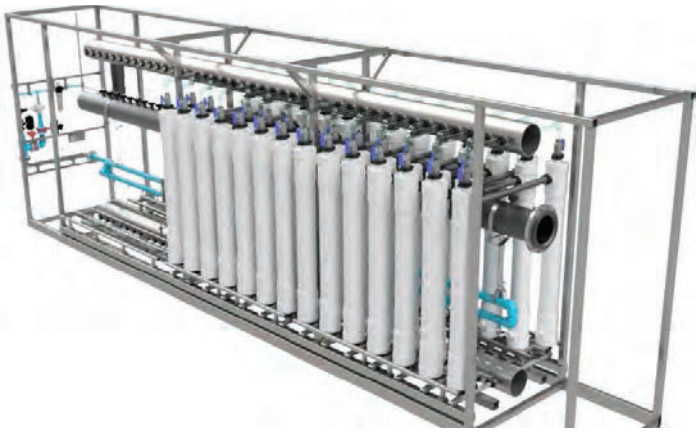

Figure 2: 3D CAD model of UF rack after the retrofit showing additional room for installation. Image courtesy of WesTech Engineering, Inc.

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