CASE STUDY

RO | NF | UF | MF

Lake Granbury SWATS
Municipal Drinking Water
Granbury, Texas

TORAY

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

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 has been in operation since 1988 and initially comprised of clarification, dual media filtration, and electrodialysis reversal (EDR) until 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/expansion of the UF modules took place in 2008 with the goal of producing up to 10.0 MGD. After several years of operation, the membrane modules exhibited fiber breakage, and in anticipation of a projected increase in demand for water, the utility decided it was time for another upgrade.

CHALLENGE

As the UF racks were already fully populated (5 trains with 78 modules per train), this eliminated the possibility for future expansion with a 1:1 replacement of the modules. The alternative would be to replace the entire system, but much of the system components, such as instrumentation, valves, and pumps, still had many years of functional life remaining, and this option too would be unfavorable. The last option considered was to retrofit with another type of UF module that would have higher flux while maintaining the same footprint, have minimal modifications to the existing racks, and produce equal or better effluent. With this solution, the plant could meet not only the current capacity with fewer modules but also allow for expansion within the existing footprint and save costs for many years to come (Nay. 2017).

As a result, the utility teamed up with the consulting firm Enprotec, Hibbs & Todd to draft and release a Request for Proposal (RFP) to system manufacturers. The RFP would require manufacturers to provide a membrane treatment scheme that could maximize the 'repurposing' of existing racks and trains. Additionally, within the same footprint, the RFP would also require each of the UF trains to produce a minimum of 2.0 MGD up to a maximum of 3.0 MGD.

UF/RO system designed and constructed by WesTech Engineering (WWW.WESTECH-INC.COM)

Quick Facts — 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
Membrane material	N/A	PVDF
Nominal pore size of membrane		0.01 µm
Effective membrane area per module		775 ft^2
Total no. of UF modules	390	250
UF system capacity	9.2 MGD	10.0 MGD
Commissioned	2008	March 2017

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SOLUTION

Technical reviews and projections showed that Toray's TORAYFIL™ pressurized UF modules (p/n HFU-2020N) could meet the prequalification requirements. To satisfy the minimum total system capacity of 10.0 MGD, it would require a total of 250 Toray UF modules, which was a considerable 140 modules less than the previous installation. Secondly, to meet the maximum total system capacity of 15.0 MGD, there would be required a total of 380 modules, which still left room for installation of additional modules. For evaluation of performance based on the Texas Commission on Environmental Quality's (TCEQ) guidelines and requirements, Toray's UF module would be selected for piloting from December 2015 to January 2016.

Successful piloting confirmed design projections (results shown in Table 2), and the utility/consultant partnered with the OEM WesTech Engineering to use Toray's UF modules for the retrofit.

CONSIDERATIONS

This study exemplifies the key factors that go into deciding on whether or not a retrofit is the best option for a plant and to examine further 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 and advancement of membrane technologies and meet the needs of the customer by offering flexible options that are also viable in the long run.

REFERENCES

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.

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.

Table 2: piloting results

Membrane module	TORAYFIL™ 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

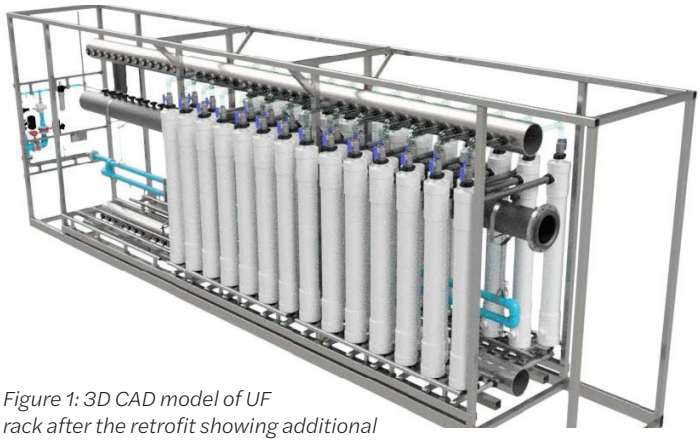

Figure 1: 3D CAD model of UF rack after the retrofit showing additional room for installation. Image courtesy of WesTech Engineering, Inc.

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