

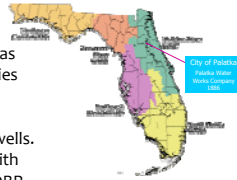
Ultrafiltration Lowers DBPs for Palatka, FL

David F. Edson, PE, Sr. VP, Hoyle, Tanner & Assoc, Hernando, FL – dedson@hoyletanner.com

Background

Located 50 miles northwest of Daytona Beach, Florida, the eleven thousand residents of the City of Palatka derive their potable water supply from groundwater. By 2003, the City was experiencing high trihalomethanes (THMs) in the distribution system and commenced studies aimed at finding a solution.

The City's R.C. Willis Water Treatment Plant had provided up to 4.2 mgd from eight on-site wells. Before filtration, the well water was treated with Aqua-mag, aerated and further treated with fluoride, chlorine and sodium hydroxide. Preliminary studies of treatment alternatives for DBP reduction were performed and coagulation / ultrafiltration was selected along with other process improvements including improved hydrogen sulfide removal and a secondary membrane filtration system for spent backwash recovery.



Project Goals and Features

- THM & HAA5 reduction
- Improved reduction of hydrogen sulfide
- Efficient water resource usage with backwash recovery providing 99% net water production
- Improve WTP and well supply SCADA system



Raw Water Quality

Parameter	Value
Hydrogen Sulfide, mg/L	4.7 ± 1.5
Carbon Dioxide, mg/L	24 ± 10
Alkalinity, mg/L	114 ± 15
pH	7.6 ± 0.2
Total Iron, mg/L	0.02 ± 0.02
Dissolved Iron, mg/L	0.01 ±
Manganese, mg/L	0.03 ± 0.02
Apparent Color, mg/L	12 ±
Total Organic Carbon, mg/L	1.9 ±
Dissolved Organic Carbon, mg/L	1.4 ±
THMFP, µg/L	120 – 190
HAA5FP, µg/L	22 – 61

MF/UF Design Parameters

Parameter	Primary System	Backwash Recovery System
Flow Rate	Initial = 2,800 gpm Future = 4,200 gpm	300 to 400 gpm
System Recovery	≥ 94%	≥ 80%
Flux @ 20°C	45 gpd/ft	45 gpd/ft
CIP Frequency	≥ 30 days	≥ 30 days
Backwash/Reverse Flow	≥ 50 minutes	Treat spent backwash within 60% of primary backwash frequency time

Results

- Average TOC reduction ± 40%
- DBPs within limits, system in compliance
- Typical alum dosage ± 2 ppm
- Total WTP recovery > 98%



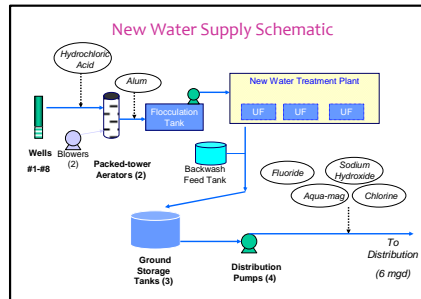
Pilot Studies

GE/Ionics – 2005/2006

- 8" X-Flow UF element, polyethersulfone
- Flow rate = 21 gpm, Reverse flow backwash @ 50 minutes
- Flux Rate = 43 gfd, Feed Water Recovery = 93%
- Use 2 ppm Al+3
- Recommendations
 - Remove H2S prior to filtration
 - TOC removal = 33.3% with pH = 6.0 and Al+3 dosage at 2 ppm
 - With RF @ 50 minutes and daily CEBs, system recovery = 94%
 - Flux Rate = 43 gfd

Layne Christensen – 2007/2008

- Norit inside-out flow path, pore size = 0.025 µm
- Flow rate = 32 gpm, Flux rate = 53 gfd
- Reverse flow backwash @ 50 minutes
- Backwash flow rate = 88 gpm, Backwash flux rate = 147 gfd
- Coagulants:
 - Alum: 4-6 mg/L as Al+3, stable performance, TMP < 10 psi
 - ACH (Aluminum Chlorohydrate): 6-12 mg/L, good TOC removal, higher TMP
 - Ferric Chloride: 4 mg/L, good TOC removal, low TMP, soluble iron in permeate because of pH reduction for H2S stripping
- Recommendations
 - Primary UF system: 50 gfd with 50-minute service cycles
 - Backwash recovery UF system: 35 gfd with 50-minute service cycles
 - Begin with Alum dosage at 4 mg/L as Al+3
 - Use Norit XIGA® membranes for primary system
 - Use Norit Aquaflex® membranes for backwash recovery



Treatment Process

The treatment process includes:

- Packed-tower aeration
 - Coagulation/flocculation
 - Ultrafiltration
 - Final chemical treatment
- The well water is acidified to optimize hydrogen sulfide removal prior to aeration. The aerated water is at a pH of about 6.5 optimizing coagulation with alum. The filtered water is stored in three ground-level concrete tanks. Final treatment is achieved with fluoride, Aqua-mag, sodium hydroxide and chlorine.

Pilot Filtration Results

Parameter	Coagulated	Filtered	Reduction
TOC, mg/L	1.9	1.1	39%
DOC, mg/L	1.4	0.7	48%
THMFP, µg/L	173	65	62%
HAA5FP, µg/L	49	41	16%
Apparent Color, mg/L	11	1	90%

Pilot Aeration Results

Parameter	Before	After	Reduction
Hydrogen Sulfide, mg/L	4.7	0.06	98%
Carbon Dioxide, mg/L	24	14	41%
Alkalinity, mg/L	114	16	85%
pH	Chemically lowered to 6.3	7.4	

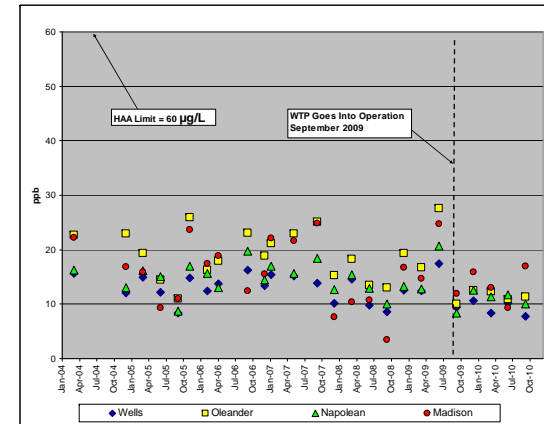
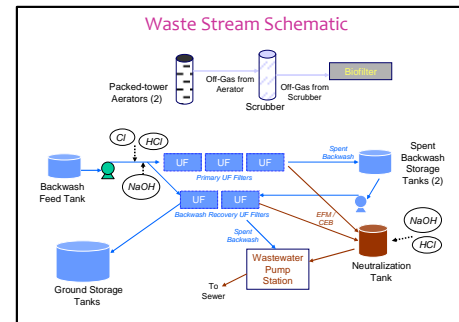
Acknowledgements

- City of Palatka, Florida
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- Layne Christensen – membrane system supplier
- Norit – membrane manufacturer

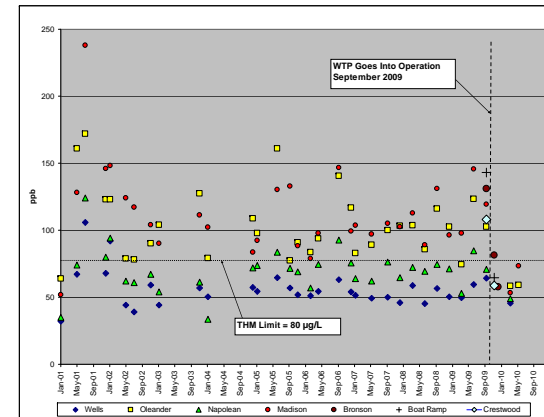
Waste Handling

The off-gas from the air stripper passes through a scrubber and then to a biofilter before discharge to the atmosphere.

Spent backwash from the primary ultrafiltration system is collected in two backwash holding tanks. The spent backwash is pumped through a secondary ultrafiltration system for recovery. The filtrate is discharged to the filtered water tanks. The spent backwash from the secondary system is discharged to a pump station which pumps to the City sewer. CIP waste is similarly discharged to the City sewer after neutralization.



TTHM Reduction



HAA5 Reduction

Hoyle, Tanner & Associates, Inc.