Presentation Overview

• History of Parker Water & Sanitation
• Reclaimed Water Loop
• Rueter-Hess Reservoir
• Rueter-Hess Water Treatment Facility
  • Pilot Testing
  • Major Processes – Actiflo, Ceramic Membranes
  • Schedule
  • Startup and Commissioning Challenges
  • O&M Challenges
• Approximately 50,000 Customers
• 27,600 Acres (43 Square Miles)
• 17 Well Houses
• 30 Operational Deep Groundwater Wells
• Alluvial Water
• 2 Wastewater Reclamation Facilities
• 1 Surface Water Plant
First 404 Permit Granted in Feb 2004, 16,200 ac-ft

Amended 404

Phase 1 Dam/Reservoir Construction

Cherry Creek Diversion Structure Built

Membrane Testing/Actiflo Testing

Design RHWPF

Water First Pumped to RHR

RHWPF Construction

1985 Reservoir Concept

24,000 acre-ft in storage
Piloted Process Alternatives

- Microfiltration
  - Ceramic
  - Polymeric

- Oxidation of Fe and Mn
  - Potassium Perm.
  - Chlorine Dioxide

- Enhanced Organics Removal
  - Enhanced Coag.
  - Magnetic Ion Exchange (MIEX)
  - Conven-PAC addition
  - Recirc-PAC
Selected Treatment Process

Actiflo Turbo

Actiflo Carb

Ceramic Membranes
Selected Treatment Process

**Actiflo Turbo**

**Actiflo Turbo Special Features**
- Small footprint
- Uses Microsand for rapid settling
- Hydrocyclones recycle sand
- Option for enhanced coagulation

**Actiflo Turbo Water Quality Goals**
- pH for Enhanced Coagulation
- Turbidity - 1.5-3 NTU
- DOC removal - ~50%
Selected Treatment Process

Actiflo Carb Water

Quality Goals

• Turbidity 1-2 NTU
• DOC < 2 mg/L, 70% removal
• Fe < 0.3 mg/L
• Mn < 0.05 mg/L
• PAC conc. ≈ 1000 mg/L

Actiflo Carb

Actiflo Carb Special

Features

• PAC removes:
  • DOC/TOC
  • CEC
  • Taste and odor
• PAC particles recirculated for complete utilization

PAC coag sand poly

Raw Water coag PAC coag Filtrate

Poly
Selected Treatment Process

CM Water Quality

Goals
- 0.1 NTU 95% of the time
- Not to Exceed 0.5 NTU
- 4-log removal Crypto
- 0.5 log removal Virus

CM Special Features
- High flux → smaller footprint
- Absolute barrier: no solids/pollutant breakthrough
- Durable – can withstand PAC/microsand
- 20 year warranty
- FIRST of its kind in the North America

Ceramic Membranes
1. Coagulated raw water enters / microsand and polymer added
2. Rapid settling and material recirculation
3. Clarified water continues to Actiflo Carb
4. Settled solids microsand recirculated to hydrocyclones
Actiflo® Carb

1. PAC added
2. Coagulant added / floc formation begins
3. Microsand and polymer added to remove organics and turbidity
4. Rapid settling and material recirculation
5. PAC / microsand recirculation
Ceramic Membranes
How KCM differs from “conventional” membranes

- High Flux (approved to 175 gfd at 20 deg C)
- High Recovery (> 97%)
- Longest membrane warranty – 20 years
- High chemical and pressure tolerance
- Most durable element (microsand, PAC)
- Highest Quality Control – every element tested; others are batch tested
Ceramic Membrane Element

- 7.1 in x 59.1 in (D x L)
- 0.1 μm pore size
- 2000 channels per element
- Inside-out Flow
- Aluminum Oxide material

Courtesy: Kruger, 2014
Skid Layout

- Skids consist of 8 or 10 Racks
- Each rack consists of 10 elements
Startup and Commissioning
Schedule

• Pilot Testing – 2007
• Design – 2008 to 2012
  • One-Year Delay due to Economic Downturn
• Construction – 2012 to 2015
• Operational Startup – February 2015
• Water to Distribution
  • Original – February 2015
  • Revised – May 2015
  • Actual – July 2015
Startup and Commissioning

• First surface water plant for the District
• No prior standards/process due to first of its kind
• Planned operation of 8-10 hours per day and seasonal shutdowns
• Long start up duration, almost 6 months
• Operator intensive training throughout construction and startup
• Difficult contracting model
• SCADA integration
Chemical System Issues

- PAC Silo
  - Level sensors
  - Wetting cone sensors; low hopper levels
  - PAC bridging in silo
  - Air compressor

- Chlorine Dioxide System
  - Generator alarms
  - Recirculation pump would not hold suction

- Microsand
  - Seal water alarms / leaking pumps
Optimization

• Pre-treatment
  • Chemical dosing
  • PAC system / recirculation / wasting
• High metals (Fe/Mn)
  • Due ferric addition for coagulation
• Source water quality
  • Ammonia levels higher than anticipated
  • Source Water
    • Top of reservoir too clean
    • Bottom of reservoir too dirty

• Sequencing
  • Designed for 24 hours / day operation
  • Planned operation of 8-10 hours / day and seasonal shutdowns
Optimization

• Ceramic Membranes
  • Valves
    • ~ 700 Bray valves installed
  • Water quality
    • Low influent turbidity (~1 NTU from Actiflo®)
    • Consistent effluent turbidity (~0.1 NTU)
    • Fe Goal: 100 ppb (soluble)
    • Mn Goal: 50 ppb (soluble)
• CEB chemicals – residual issues
• Relocation of chemical dosing locations (ferric)
• Turbidimeter replacement
• Majority of Manganese through the system is dissolved
• SMCL = 0.05 mg/L
Total/Dissolved Iron Levels

- SMCL = 0.3 mg/L

Total Fe (mg/L)

Dissolved Fe (mg/L)

- Post Actiflo Turbo
- Membrane Feed
- Filter Effluent
- Raw
- Turbo
- Filter
- Effluent

Membrane Monitoring

T2S2 Permeability Norm

- **Permeability (gfd/psi)**
- **KCM - Train 2, Skid 2 Permeability - Normalized**
- **KCM - Train 2, Skid 2 Backwash Status**
- **KCM - Train 2, Skid 2 CEB Status**

**Decreased Permeability**

**Permeability Recovers**

- **Chemically Enhanced BW**
Membrane Monitoring

Influent Turbidity (NTU)

CFE 8/1/2015 6:30 AM to 4:30 PM

- Membrane Monitoring
- Plant Start
- Influent Turbidity
- Filter Effluent Turbidity
- 0.1 NTU, 95% of Operation
O&M Challenges – First 6 Months

- Ceramic Membrane System
  - Bray valves; actuator replacement
- PAC System
  - Bridging / Alarms / Compressor
- Compressor Room
  - Poor HVAC design
- Slide Gates
  - Failed bearings
  - Replacement of gate stems
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Questions?