PALL Water

Process optimization for your water treatment plant

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Webinar Moderator

Billie Emas
Sales Associate
American Water Works Association

Billie Emas is the Sales Associate to the NE and SE territories in the Sales Department at AWWA. She has been with AWWA for six months and she has been corresponding and building relationships with the members, advertisers, exhibitors and sponsors with AWWA. She has over 20 years of experience marketing, sales, event planning and membership. Billie has a BS in Business Administration from Bowling Green State University.

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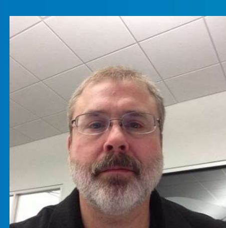

Rob Cormier
Principal Engineer
Pall Water

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Objective and agenda

Objectives

- Foundational understanding – defining process optimization
- Where to look for common process issues that cause premature membrane fouling
- How to use data to identify process optimization opportunities

Process optimization for your water treatment plant

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What is process optimization?

Updating or temporarily adjusting a standard treatment process to account for changes in:

- **Incoming water quality**
  (e.g., turbidity events or seasonal cycles)
- **Outgoing water requirements**
  (e.g., new downstream asset needs or current needs not being met)
- **A customer's financial and organizational goals**
  (e.g., new initiative to save on operating expenses)
- **Future capacity needs**
  (e.g., growing population)

Keep in mind

- The root cause of process issues or opportunities for improvement can require a test-and-learn approach.
- It is best to do this work in partnership with your system manufacturer and engineer to ensure any changes don't cause future issues.

Optimization can be reactive or proactive

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Added benefits of process optimization

Save on CapEx

- Membrane replacement accounts for a significant portion of lifecycle costs of a membrane plant.
- The number-one reason for membrane replacement is irreversible permeability loss.

Save on OpEx

- New technology and process knowledge can be applied to increase efficiency.
- Adapt water treatment process to changing needs, e.g., change in energy costs.

Best practices for maintaining long-term productivity

- Keep membranes clean.
- Take corrective action early.
- Customize cleaning regimes to address fouling.

Take corrective or proactive action early to reduce costs

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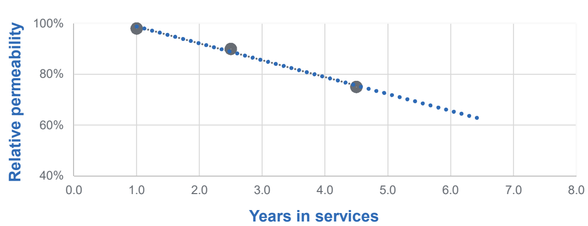
Case study A: reversing permeability decline

Plant description

- A 10-MGD plant filtered surface water source.
- The plant's process was river water → coagulation → sedimentation → microfiltration (MF) → disinfection.
- The sales contract included performance monitoring via biannual autopsy.



Item	Unit	Value
pH	SU	8.2 – 8.5
Alkalinity	mg/L as $CaCO_3$	167 – 197
Hardness	mg/L as $CaCO_3$	216 – 328
TDS	mg/L	276 – 359
Fe	mg/L	4.8 – 9.3
Mn	mg/L	0.16 – 0.28
TOC	mg/L	4.8 – 9.6
DOC	mg/L	4.3 – 6.1
UV_{254}	cm^{-1}	0.117 – 0.192
Color (True)	CU	10 – 100

Consistent decline in permeability much too early

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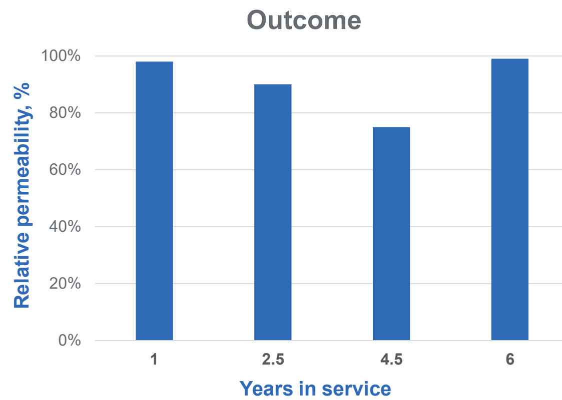
Case study A: reversing permeability decline CONTINUED

Corrective action taken

- Addressed rack valves not closing 100% (affected proper rack drain).
- Corrected potable rinse flow issue occurring during CIP rinse process.
- Established modified operational set points during turbidity excursions.
- Implemented both sides (feed/filtrate) clean during enhanced flux maintenance.
- Performed one-time high-concentration / high-circulation recovery clean to remove foulants from the membrane pores.



Quick and sustained recovery to permeability after optimization

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Case Study B: planning to meet future demand

- **History**
  - BCMUD water treatment facility in 2006 – 6.1 MGD
  - 2009 upgrade module buildout – 8.2 MGD
- **Source water:** lake and ground water
- **Pretreatment**
  - Sodium permanganate – oxidation
  - Prechlorination – oxidization
  - Direct coagulation ACH
- **Auto strainers (300 micron)**
  - Microfiltration (0.1 micron)
  - Disinfection – monochloramine: sodium hypochlorite / liquid ammonium sulfate

Eight-million-gallon reservoir

To reduce risk and prepare for increased capacity, a two part optimization review was chosen

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Case study B: planning to meet future demand CONTINUED

Capacity review and optimization

- **CIP recipe:** initial cleaning (every two weeks) with standard CIP recipe (extended up to 60 days)
  - EFM weekly implemented to extend CIP interval
- **Integrity test:** performed before EFM and always after CIP (required by TCEQ)
- **Set point adjustments**
  - Strainer backwash frequency extended from 45 minutes to 4 hours
  - Rack flow rate maximum adjusted to TCEQ-approved rate (allowed for higher throughput when one rack was offline)

Optimizations enabled the capacity increase needed for future demand

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Case study B: planning to meet future demand CONTINUED

Membrane life review and optimization

- **MF system configuration:**
  - 8.2 MGD system (four racks with 116 modules each)
  - Newer UNA modules (2009) in rack 1
  - Earlier version USV modules (2006) in racks 2, 3, and 4
- **Challenge:** USV modules had lower permeability and had been in service
  - Can the system meet future demand?
- **Plan:** Evaluate membrane performance and assess membrane life

Membrane review to ensure the membranes could perform at the new capacity level

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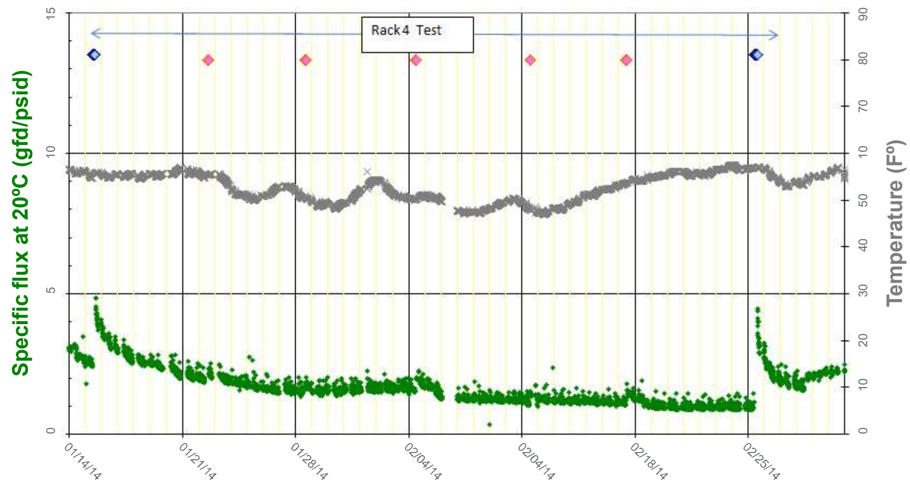
Case study B: planning to meet future demand CONTINUED



Next step: 40 day test evaluation focusing on USV modules

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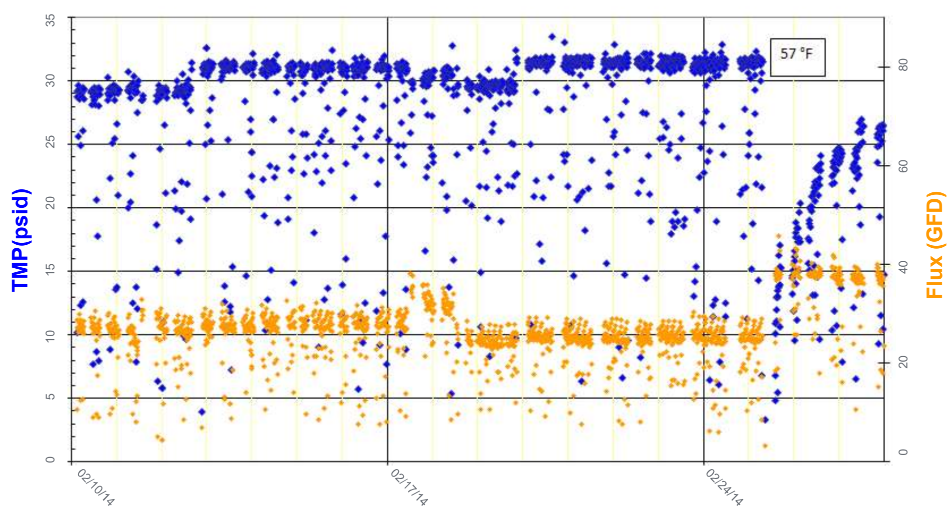
Case study B: planning to meet future demand CONTINUED



Design Flux (38 gfd) could not be sustained due to membrane feed pressure limits

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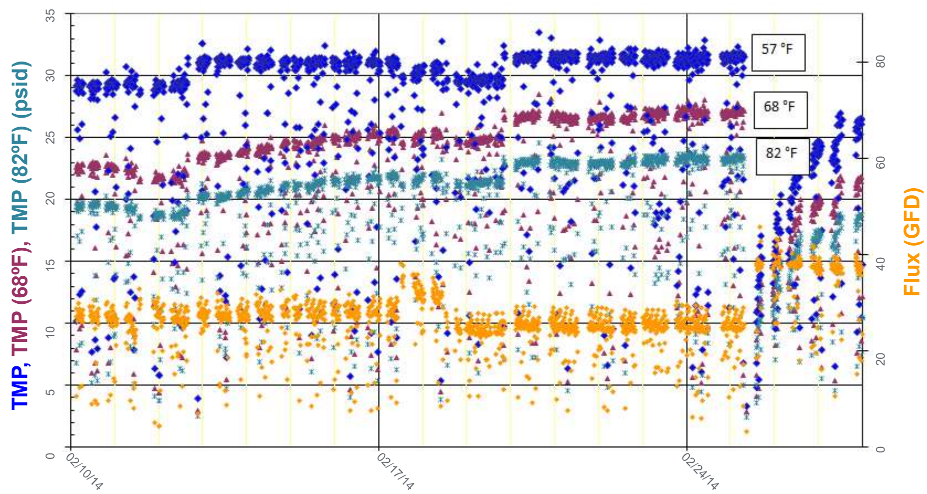
Case study B: planning to meet future demand CONTINUED



Design Flux (38 gfd) could not be sustained due to membrane feed pressure limits

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Case study B: planning to meet future demand CONTINUED

Membrane life assessment

- USV / UNA modules are robust; past performance is an indicator for the future; and gradual permeability decline is expected.
- As a best practice, monitor post-CIP permeability over time.
- Plan for replacement when CIP frequency required less than 30 days to meet demand; approaching TMP limit.
- Extend life with more frequent, stronger chemical cleans.

Benefits of MF system process optimization:

- Challenge the status quo
- Chemical/energy cost savings potential
- Production capacity review → meet future demand
- Module life assessment review → plan for module replacement

Optimization resulted in cost savings and increased capacity

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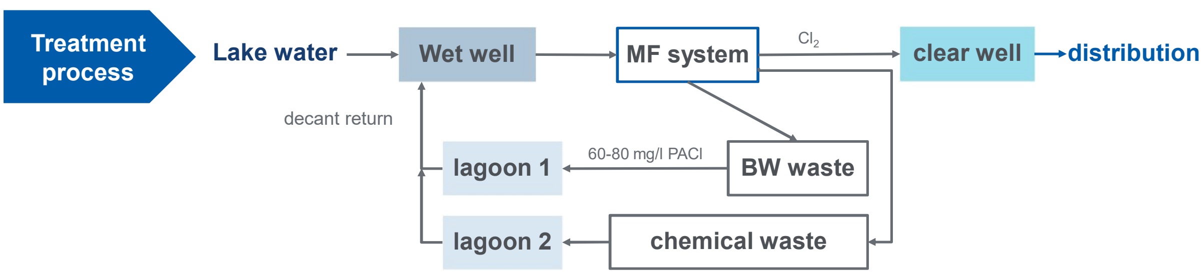
Case study C: new cleaning regime



Raw water quality

- **Turbidity:** < 2 NTU
- **TOC:** < 3 mg/L
- **Fe:** 0.04 mg/L, Mn: 0.02 – 0.03 mg/L

Cleaning protocol

- **EFM:** 300 mg/L NaClO daily
- **CIP:** 1,750 mg/L NaClO + 1% NaOH every 30 days

Early discovery: recycling chemical waste was an issue

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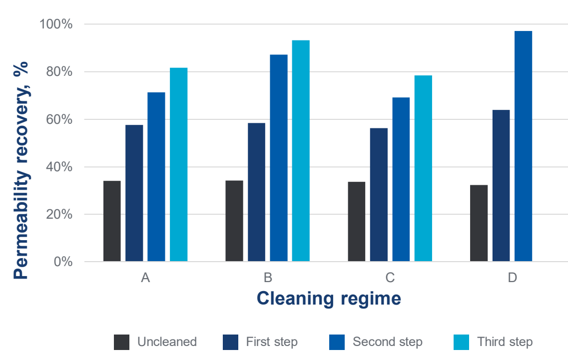
Case study C: new cleaning regime

Operating issues

- Recycling of chemical wastes increased DBPs in the recycling stream.
- Review of data indicated the decline in membrane performance.
- The practice of recycling chemical wastes was terminated.
- The decline in membrane performance continued, and cleaning was unable to restore membrane permeability.



I. D.	First step (16 hrs)	Second step (16 hrs)	Third step (4 hrs)
A	5000 ppm NaClO + 1% NaOH	1% iron reagent A [a]	1% iron reagent A [b]
B	1% iron reagent A	5000 ppm NaClO + 1% NaOH	1% iron reagent B
C	0.5% iron reagent A	1% iron reagent A	5000 ppm NaClO+ 1% NaOH
D	1% iron reagent B	5000 ppm NaClO + 1% NaOH	NA

Lab cleaning study used to determine best recipe for cleaning membranes

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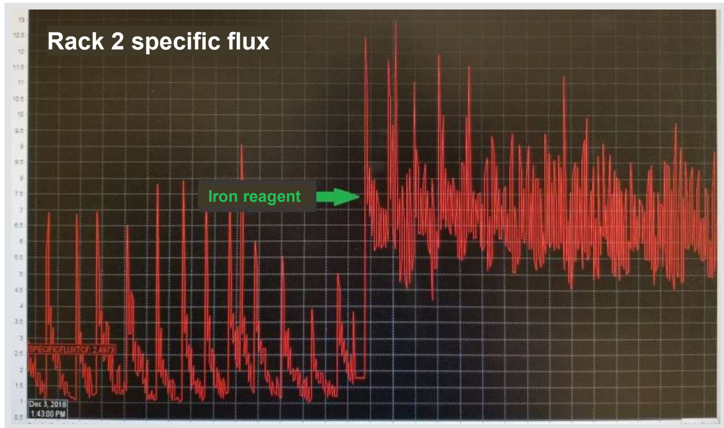
Case study C: new cleaning regime CONTINUED

Outcomes

- Lab cleaning study identified iron fouling to be the primary cause of permeability decline, and cleaning with iron reagents was the most effective.
- Implementing the new cleaning regime at the plant restored membrane permeability.
- Membrane performance following the adaption of new cleaning regime improved significantly.



Cleaning protocol adjusted to restore membrane permeability

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Where to look for optimization opportunities

Common signs

- Membrane permeability declines
- Increasing operating costs (e.g., increased cleanings)
- Water quality issues

Common pain points

- **Pretreatment:** Anything used to modify the quality of the water between the raw water source and the membranes
  - Oxidation
  - Screening
  - Coagulation
  - Clarification and settling

Act early to save on costly asset replacement and unnecessary operating expense

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Common improvements

Improve the life of your membranes

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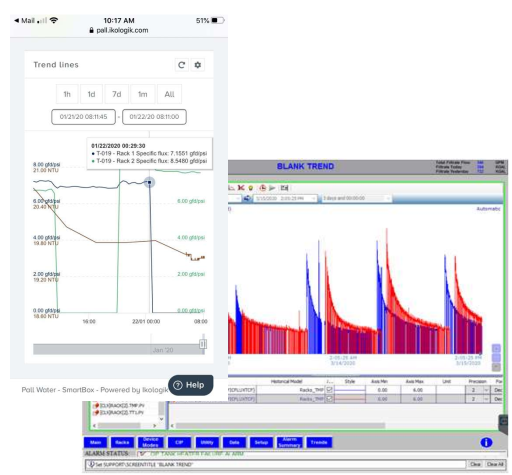
How to identify process optimization opportunities

Learning and understanding SCADA set points

- Train staff on SCADA, process optimization, and data analysis

Digging deeper into your data

- SCADA trend line analysis
  - Cannot customize easily
- Advanced SCADA analysis (e.g., downloading into Excel)
  - Time consuming
- Advanced data visualization (e.g., Aria™ SMARTBOX)
  - Can be pulled as-needed, easy data manipulation



The symptoms may be obvious, but data is the key to identifying the solution

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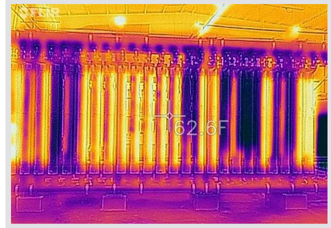
How to identify process optimization opportunities

Partner with your manufacturer

- Best-in-class process review tools and procedures
- Expertise to interpret data and design changes to set points to resolve underlying issues or achieve goals (e.g., OpEx savings)
- Back your warranty by standing behind optimization choices
- Understand the costs and tradeoffs among different scenarios (e.g., membrane replacement versus membrane recovery)



Learn how to troubleshoot with help from the experts

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Add temporary capacity during an optimization project

Consider temporary, supplemental water treatment

- Mobile water treatment solutions add capacity to your plant quickly for short-term emergency or planned downtime relief during upgrades or plant expansion projects.
- MF and ultrafiltration (UF) membrane technology as well as high-recovery reverse osmosis (RO) systems are available for municipal and industrial applications.
- All mobile systems are equipped with SMARTBOX technology to support future optimization efforts.

Maintain capacity temporarily or add it as a permanent optimization solution

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Partner with Pall Water on your next process optimization project.

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Thank you

Questions?

Protecting what matters most

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PRESENTER BIOGRAPHY INFORMATION

Rob is a Licensed Professional Engineer in the State of New York with a BS in Chemical Engineering from the University of Maine. He has 35 years of engineering experience including: work in the paper industry focused in the areas of wet end chemistry and process control at several specialty paper mills and as a consulting engineer involved in industrial process design and process control projects. For the last 17 years Rob has been with Pall Water and has held a variety of roles in the Process Systems group. During that time, he has worked on Pall Water hollow fiber membrane systems with responsibilities including design, quotation, execution and management of municipal and industrial projects. Rob has also been involved with integrated membrane system design incorporating low pressure membranes with NF and RO in the treatment of fresh water and wastewater.

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