Water and Energy Conservation at R&D Systems

Omar Hammami

MnTAP Advisor: Jon Vanyo

R&D Systems Supervisors: David Mack and David Clausen

University of Minnesota

Driven to Discoversm



About R&D Systems



- Laboratories located in Minneapolis, Minnesota
- Produce tools for biological research such as antibodies, enzyme assay kits, and recombinant proteins



Motivation

Go green

- Laboratories use 5-10 times more resources per sq. ft. than office spaces¹
 - Green Lab initiatives
- Company on board with reducing resource consumption
- Financial Savings
 - Sewer and Water Access charges
 - Electricity



1) www3.epa.gov

Project Goals

• Assess water conservation opportunities:

- Purified water plants
- Point of use polishers
- Autoclaves
- Washers

• Assess energy saving possibilities:

- Ultra Low Temperature (ULT) Freezers
- Purified water plants



Approach

- 1. Identify target
 - Measure consumption of resources





Picture: www.flaticon.com

Approach

- 1. Identify target
 - Measure consumption of resources
- 2. Gather information
 - People!
 - Suppliers and manufacturers
 - Internet
 - Data collection



| save water | |
|-------------------------------|--|
| save wa ter | |
| save wa ter drink beer | |
| save walter white | |



Approach

- 1. Identify target
 - Measure consumption of resources

2. Gather information

- People!
- Suppliers and manufacturers
- Internet
- Data collection/ testing
- 3. Identify solutions
 - KISS (Keep It Simple Stupid Silly)
- 4. Assess viability
- 5. Plan for implementation



Water Purification Process

Feed water pretreatment

Mn

Reverse Osmosis (RO)

Storage Tank/ Recirculation Point-of-Use Polishing





Reduce flow rate of purge stream from point of use polishers (PUPs)

- Purge stream on 16 PUPs drains 1.64 million gpy
 - Flow rates vary from 3.2 to 16 gph (0.2 to 1 liter/min)







Reduce flow rate of purge stream from point of use polishers (PUPs)

- Save 1.6 million gpy by using smaller orifices (97% reduction)
 - Flow rate reduced to 0.16 gph (10 mL/min)
 - Testing on two units showed no change in water quality, bacterial growth
 - Save \$14,640 on water
 - Save 8000 kWh (\$630)
 - Payback time: 20 days
- Implementation: in the good hands of QA





Picture: www.industrialspec.com

Increase Recovery of RO Units

By Using Smaller Venturi Injectors

- Four units four different recoveries
 - 30%, 50%, 60%, 75%
- Pretreatment system upgraded over the years
 - Concentrate wasn't much worse than city water

PERM

1.9 GPM

CONC

37 GPM

• Could push units harder





Increase Recovery of RO Units

By Using Smaller Venturi Injectors

- Improve recovery with smaller venturi injectors
 - venturi injectors are used to generate vacuum
 - Smaller venturi injector leads to less waste
 - Maintains adequate vacuum
- Save 520,000 gpy by replacing venturi injector on two RO Units
 - \$4,700 Payback: 4 months





Picture: mazzei.net/venturi_injectors/

Increase Recovery and Productivity of RO Unit By Adding Additional Membranes

- 2-membrane unit ran at 30% recovery, by far the lowest
 - Produced permeate at half speed, meaning pump needed to run more
- Add two membranes and smaller venturi injector
 - Save 230,000 gpy and 400 kWh
 - Save \$2,100, payback 14 months
- Implementation: coming soon



Increase Temperature of ULT Freezers from -80 °C to -70 °C

- Each unit consumes as much energy as a single family home
 - 103 units total (and counting)
- -80 °C not essential for preservation of samples
 - Marketing by manufacturers
 - SOP calls for <-60 °C
- Stanford, Harvard and others have switched to -70 °C







Increase Temperature of ULT Freezers from -80 °C to -70 °C

- Raising the temperature could save 1000 kWh/year per unit
 - Plus increase freezer lifespan
- Potential to save 100,000 kWH and \$8,000 per year with no cost
- Work to be done
 - Validate change with QA





Recommendations Summary

| Project | Environmental Savings | Annual Savings | Payback Period | Implementation Status |
|--|--------------------------|----------------|--------------------|--------------------------|
| Reduce PUP purge with small orifice | 1.6 mil gpy 8000 kWh | \$15,200 | 20 days | In progress |
| Increase RO recovery with small venturi | 520,000 gpy | \$4,700 | 4 months | In progress |
| Increase RO recovery with added membranes | 230,000 gpy 400 kWh | \$2,100 | 14 months | In progress |
| Increase Temp. of ULT Freezers to -70 °C | 1000 kWh per unit | \$80 per unit | Immediate | Recommended |
| Other projects | 400,000 gpy 8700 kWh | \$6,900 | Immediate- 2 years | Varied |



Recommendations Summary

Total annual savings:

- >2 million gallons
- 17,000 kWh
- \$20,000
- Cut total industrial water use by 15%





Personal Benefits: What I Learned

- Organizational skills
 - Not pictured: 40+ tabs open in Google chrome





Personal Benefits: What I Learned

- Change takes time
 - Summers are short



Personal Benefits: What I Learned

- Never Hesitate
 - You'll regret it



Acknowledgements

- David Mack
- David Clausen
- Jon Vanyo
- Joe Tholen
- John Beauchamp
- Robert Kubik
- Fitsum Wolde
- Michael Wu-Obrien
- Daniel Lundquist
- Alicia McDonald
- Barry Martin

- Keith Godfrey
- Jake Sandberg
- Isaac Hoff
- Lee Peters
- Dan Flemino
- Katia Pickar
- Xcel Energy
- MCES
- Et al.



Thank you!

RODSYSTEMS a **biotechne** brand



Minnesota Technical Assistance Program

UNIVERSITY OF MINNESOTA

Questions?

This project was sponsored in part by Metropolitan Council Environmental Services and Xcel Energy

