Water and Energy Conservation at R&D Systems

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University of Minnesota
Driven to Discover℠
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 spaces\(^1\)
    • 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
Approach

1. Identify target
   • Measure consumption of resources

2. Gather information
   • People!
   • Suppliers and manufacturers
   • Internet
   • Data collection
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
- 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
    • 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

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

Questions?

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