Energy Efficiency, Water Conservation, Chemical Optimization
Kerry Ingredients

By: Denzel Bibbs
MnTAP Advisor: Matt Domski
Kerry Supervisor: Brian Morgan
Company Background: Kerry

- **Food, ingredients, and flavours**
  - Sales in over 140 countries
  - Global HQ: Ireland
  - Americas HQ: Beloit, Wisconsin

- **Rochester Manufacturing Site**
  - Opened in 1970, acquired in 2004
  - Functional Ingredients & Actives
  - UpGrade™
  - Accel™
## Motivations for Change

<table>
<thead>
<tr>
<th>KERRY 2015-2020 ENVIRONMENT PROGRAMME</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Targets</strong></td>
</tr>
<tr>
<td><strong>BASELINE YEAR 2013</strong></td>
</tr>
<tr>
<td><strong>2016 Performance</strong></td>
</tr>
</tbody>
</table>

**2016 Performance**

- **Carbon Emissions**: -2.5%
- **Water Use**: -2.7%
- **Waste**: -10%
Reasons for MnTAP Assistance

• Assess energy and chemical usage
• Reduce environmental impact
  • Electric & natural gas
  • City and well water use
  • Cleaners/chemicals
• Evaluate savings for proposed ideas
Supporting Agencies

- Minnesota Pollution Control Agency
- U.S. Environmental Protection Agency Region 5
  - Pollution prevention in food processing industry
Approach

• Understand plant utilities
  • Steam usage, water treatment and usage
  • City and well water

• Contact chemical vendors for chemical inventory and usage

• Prioritized investigation
  • Opportunities for improvement
  • Importance to manufacturing process
Recommendation: Reverse Osmosis (RO)

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Waste Reduction, per year</th>
<th>Savings, per year</th>
<th>Payback Period</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Install RO Skid</td>
<td>2.1 million gal water, 68,100 therms</td>
<td>$38,600</td>
<td>2.5 years</td>
<td>Recommended/Implementing</td>
</tr>
</tbody>
</table>

- **Improve water chemistry**
  - Reduce boiler blowdown
  - Reduce treatment chemical use
  - Cleaner heat transfer surfaces
  - Increase equipment longevity

- **Environment**
  - 361 metric tons of CO$_2$
Current Sewer

Legend
- Wastewater
- Caustic Base
- Sulfuric Acid
- Asset

60000 gal sewer pit

Sulfuric acid

Plant

Caustic (basic pH)

Lift Pit

To Rochester Wastewater Treatment Plant
Recommendation: Equalization Tank

Legend
- Blue: Wastewater
- Purple: Caustic Base
- Red: Sulfuric Acid
- Green: Asset

Plant → Prescreen → Transfer Tank → Equalization Tank:
- Sulfuric acid
- Caustic (basic pH)

Equalization Tank → To Rochester Wastewater Treatment Plant
# Recommendation: Equalization Tank

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Waste Reduction, per year</th>
<th>Savings, per year</th>
<th>Payback Period</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equalization Tank</td>
<td>16,600 lb caustic, 9,400 lb sulfuric acid</td>
<td>$8,000</td>
<td>&gt;10 years</td>
<td>Recommended/Implementing</td>
</tr>
</tbody>
</table>

- **Chemical optimization**
  - Agitation and dosing within tank
  - Improve acid/base effectiveness
  - 50% caustic reduction & sulfuric acid reduction

- **Prescreen equipment**
  - Large debris
Current Single-Pass Cooling

Legend
- Water
- Asset

To Stream

Plant Cooling Load

Well Pump
Recommendation: Closed Loop Cooling

Water Storage

City Water

Heat Exchanger

Glycol Supply

Plant Cooling Load

Legend
- Water
- Asset
Recommendation: Closed Loop Cooling

- Significantly reduce well water consumption
- Reduce electricity consumption
- No need to constantly run well pump

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Waste Reduction, per year</th>
<th>Savings, per year</th>
<th>Payback Period</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closed Loop Cooling</td>
<td>200 million gal water</td>
<td>$27,000</td>
<td>Needs further review</td>
<td>Recommended</td>
</tr>
</tbody>
</table>
Recommendation: Improve Steam Traps

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Waste Reduction, per year</th>
<th>Savings, per year</th>
<th>Payback Period</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improve Pasteurizer HX Steam Traps</td>
<td>270,000 gal water 4,110 therms</td>
<td>$2,500</td>
<td>3.5</td>
<td>Needs further review</td>
</tr>
</tbody>
</table>

- Begin improvement with pasteurizer
- Reduce new make-up water
  - Natural gas and water savings
- Improve equipment operation and maintenance
  - Steam line longevity

Orifice Steam Trap
## Summary

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Waste Reduction, per year</th>
<th>Savings, per year</th>
<th>Payback Period</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Install RO Skid</td>
<td>2.1 million gal water, 68,100 therms</td>
<td>$38,600</td>
<td>2.5 years</td>
<td>Recommended/Implementing</td>
</tr>
<tr>
<td>Equalization Tank</td>
<td>16,600 lb caustic, 9,400 lb sulfuric acid</td>
<td>$8,000</td>
<td>&gt;10 years</td>
<td>Recommended/Implementing</td>
</tr>
<tr>
<td>Closed Loop Cooling</td>
<td>200 million gal water</td>
<td>$27,000</td>
<td>Needs further review</td>
<td>Recommended</td>
</tr>
<tr>
<td>Improve Pasteurizer HX Steam Traps</td>
<td>270,000 gal water 4110 therms</td>
<td>$2,500</td>
<td>3.5</td>
<td>Needs further review</td>
</tr>
</tbody>
</table>
Additional Ideas

• LED lighting throughout plant
  • 32W florescent to 18W LED
  • Save 89 kWh/yr-bulb, $8.48/yr-bulb
  • 138 pounds CO₂/yr-bulb

• Dry cleaning process
  • Reduce biological oxygen demand

• Install additional condensate pumps and steam traps

600 BHP Boiler
Personal Takeaways

• First engineering internship
• Industry experience and engagement
• Problem solving
• Technical knowledge
Questions?
Caustic Dosing

Caustic Dosing June 2017

Calendar Day

Caustic (lb)

Number of low pH Violations

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

0 50 100 150 200 250 300

Violations
Caustic

University of Minnesota
Current pH Neutralization
Additional Ideas: BOD Loading

June '17 BOD

BOD (lb)

Calendar Day

BOD
Limit

University of Minnesota
Additional Ideas: Sewer Charges

SEWER CHARGES

- Volume
- BOD
- Ammonia
- TP
- TSS
Additional Ideas

• BOD/TSS removal
  • Dissolved air flotation (Primary)
    • TSS, insoluble BOD
    • 15 year payback period
  • Biological treatment (Secondary)
    • Soluble BOD

<table>
<thead>
<tr>
<th>Treatment Type</th>
<th>BOD reduction (%)</th>
<th>TSS reduction (%)</th>
<th>BOD cost reduction ($)</th>
<th>TSS Cost Reduction ($)</th>
<th>Total Cost Savings ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>25</td>
<td>95</td>
<td>63,000</td>
<td>46,000</td>
<td>109,000</td>
</tr>
<tr>
<td>Primary + Secondary</td>
<td>85</td>
<td>95</td>
<td>214,000</td>
<td>46,000</td>
<td>260,000</td>
</tr>
</tbody>
</table>