Refrigeration Optimization and Water Conservation
Lorentz Meats

Nicholas Drews
MnTAP Advisor: Karl DeWahl
Lorentz Meats Supervisor: Rob Lorentz

Financial Support from Dakota Electric
Company Background

• Located in Cannon Falls, Minnesota
• Founded in 1968 by Ed and Mary Lorentz
• Sons Rob and Mike purchased company in 1997
• Built new facility in 2000
  • Expanded in 2013
• Humane slaughter to retail-ready meat processing
  • Serves small to medium producers
Incentives for Change

- Money spent on utilities
  - Large portion spent on refrigeration
- Dedication to community
- Dedication to the environment
Reasons for Seeking MnTAP Assistance

• Determine where utilities are used most often
  • Electricity
  • Water and sewage
  • Gas

• Fresh Eyes
• Great Reputation
Approach to the Project

- Learn about the facility and processes
  - Learning why for everything
  - Map out important equipment
- Talk to operators, managers, and contractors
- Identify areas for efficiency improvement and source reduction
Approach to the Project

- Quantify
  - Measure the utilities allocation throughout the facility
  - Create water, energy, and gas balances

- Contact vendors and technical support for pricing
Background and Solutions
Industrial Refrigeration Management

- Refrigeration cycle
  - Compressor
  - Condenser
  - Expansion Device
  - Evaporator

- Floating Head Pressure
  - Temperature Variation
  - Energy-Saving Opportunity
  - Fixed Head Pressure set at 100°F
  - Floating Head Pressure with 70°F min SCT
  - Condenser TD = 15°F
  - Ambient

New Rack-Lower Minimum Condensing Head Pressure

• Leave hardware “as is”
• Lower set-point gradually until reliability wavers
• Go from 97°F minimum condensing to 90°F
• Emerson Climate Technologies Annual Energy Analysis
Old Rack-Lower Minimum Condensing Head Pressure

• Same idea as new rack
• Difference:
  • Go from 92°F minimum condensing to 90°F
• Emerson Climate Technologies Annual Energy Analysis
## Lower Minimum Condensing Head Pressure

<table>
<thead>
<tr>
<th>Waste Reduction Option</th>
<th>Waste Reduced (Annually)</th>
<th>Implementation Cost</th>
<th>Cost Savings (Annually)</th>
<th>Payback Period</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Rack</td>
<td>76,000 kWh</td>
<td>$100</td>
<td>$7,900</td>
<td>5 days</td>
<td>Recommended</td>
</tr>
<tr>
<td>Old Rack</td>
<td>13,000 kWh</td>
<td>$100</td>
<td>$1,400</td>
<td>27 days</td>
<td>Recommended</td>
</tr>
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New Rack - Lower Minimum Condensing Head Pressure Further

• Replace Thermostatic Expansion Valves with Electronic Expansion Valves
• Go from 97°F minimum condensing to 50°F
• Many other requirements already in place
  • Still some other minor adjustments
• Emerson Climate Technologies Annual Energy Analysis
Old Rack- Lower Minimum Condensing Head Pressure Further

• Same idea as in new rack
  • Replace Thermostatic Expansion Valves with Electronic Expansion Valves

• Go from 92°F minimum condensing to 70°F
  • Compressors on rack are older
  • Range of Reliable Operation smaller

• Emerson Climate Technologies Annual Energy Analysis
Lower Minimum Condensing Head Pressure Further with EXV

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<tr>
<td>New Rack</td>
<td>314,000 kWh</td>
<td>$40,800</td>
<td>$32,400</td>
<td>1.3 years</td>
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<td>Old Rack</td>
<td>114,000 kWh</td>
<td>$36,000</td>
<td>$11,700</td>
<td>3.1 years</td>
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Electronic Refrigeration Controls

• Fan Motor Affinity Law
  • 80% speed equates to 50% power draw
  • Shared condenser load more efficient than cycling fans on/off

• Energy efficient fan motors

VFD on Condenser Fans

- Variable Frequency Drive (VFD)
- Share the cooling load on the condenser between multiple fans
- Tighter head pressure control

www.chrisronk.net
# VFD on Condenser Fans

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<td>New Rack</td>
<td>40,700 kWh</td>
<td>$2,400</td>
<td>$4,200</td>
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<td>Old Rack</td>
<td>14,800 kWh</td>
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<td>1.6 years</td>
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Sterilization of Carcasses

• 190°F water used just before fresh carcass is cooled
• Important to kill bacteria and other pathogens
• Large wash cabinet used
• 11 rows per side with many nozzles
  • Not all water hits carcass
Install Shut-off Valves on Carcass Cleaner

• Bottom two rows rarely need to be used
• Installing shut-off valves would give an option to use when needed
• Save water and gas
• Potential for automation
# Install Shut-off Valves on Carcass Cleaner

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<td>Shut-off Valves</td>
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<tr>
<td></td>
<td>1,400 therms</td>
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Additional Solutions
Clean Condenser and Evaporator Coils

• Increase cooling capacity
• Run entire HVAC system more efficiently
• Condenser coils quantified
  • Overall Fan usage
• Evaporator Coils harder to quantify
  • Qualitative positive results seen
    • No changed settings
    • Cooler room temperatures observed
## Clean Condenser and Evaporator Coils

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<tr>
<td>Condensers</td>
<td>9,400 kWh</td>
<td>Labor = $800</td>
<td>$900</td>
<td>10 months</td>
<td>Implemented</td>
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<tr>
<td>Evaporators</td>
<td>Undetermined</td>
<td>Labor = $3,600</td>
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Summary Table of Recommendations
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Regarding Lighting

- Change to LED Lighting
- Occupancy Sensors

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<tr>
<td>Install LED Lighting</td>
<td>47,800 kWh</td>
<td>$10,300</td>
<td>Utilities = $4,900</td>
<td>1.6 years</td>
<td>In Progress</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Maintenance = $1,400</td>
<td></td>
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<tr>
<td>Install Motion Sensors</td>
<td>24,900 kWh</td>
<td>$1,800</td>
<td>$2,600</td>
<td>1.4 years</td>
<td>Recommended</td>
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Potential Future Projects

• Install Electronically Commutated Motors on evaporators
  • Favorable if implemented on a replace-upon-failure basis

• Reduction in sanitation water usage
  • Still looking to meet in the middle with contractor

• Reduction of water used in thawing frozen meat
  • Study being done in house to determine necessity
Personal Benefit as a Result of MnTAP Experience

• Bridged the gap between academic studies and technical education

• Guided me out of the student thought process
  • Value in talking to managers and operators in addition to observation
  • Asking why a process was done a certain way

• Helped me realize the value of quantifying changes
  • From measurements of utilities savings to equipment and contractor pricing
Questions?

This project was sponsored in part by Dakota Electric