Energy Efficiency Opportunities at Carley Foundry

Aaron Carlson
MnTAP Advisors: Jon Vanyo
Company Supervisor: Randy Oehrlein
Company Background

Carley Foundry

- Founded in 1955 by Frank and Lois Carley
- Produce premium aluminum castings for a wide range of production needs
- Use a combination of permanent iron molds, sand molds, and wax molds to create castings
- Located in Blaine, Minnesota
- Have over 400 full time employees
Project Overview

• Reduce energy consumption at Carley
• Gain a better understanding of how energy is used

Incentive to change

• Lower operating costs
• Produce environmentally responsible castings
• Stay ahead of competition
Process

Mold/Core Making

+ chemical binders
Process

Mold/Core Making

Melt Aluminum
Process

Mold/Core Making

Pouring

Melt Aluminum
Process

Mold/Core Making

Pouring

Melt Aluminum

Cleaning and Finishing
Process

Mold/Core Making

Pouring

Cleaning and Finishing

Heat Treatment

Melt Aluminum
Approach

• Conduct an energy audit of Carley’s main production facility
  • Estimated energy use for major pieces of equipment

• Experimented on furnaces to find exact power draw and energy consumption
  • Attached amp clamps to furnaces and varied conditions

• Analyzed heat treatment practices and energy consumption of quench tanks
  • Attached amp clamps to quench tanks, analyzed demand data from Xcel Energy

• Assessed compressed air usage
  • Inflow was contracted to provide a supply side study from Xcel Energy Funding
Current Electrical Use

Carley Energy Breakdown

- Carley used 24 million kWh last year
- Furnaces will use 50-60% of all electrical energy
Findings of Furnace Experiment and Energy Audit

- Furnaces are only used during first shift to pour castings
- Furnaces are held at high temperatures during the night
- Significant energy savings opportunity
- Only 50% of the furnaces are used during production hours

<table>
<thead>
<tr>
<th>Temperature [F]</th>
<th>Lid Closed [kW]</th>
<th>Lid Open [kW]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1200</td>
<td>27.7</td>
<td>-</td>
</tr>
<tr>
<td>1300</td>
<td>30.7</td>
<td>50.9</td>
</tr>
<tr>
<td>1400</td>
<td>33.7</td>
<td>55.9</td>
</tr>
<tr>
<td>1500</td>
<td>36.7</td>
<td>60.8</td>
</tr>
<tr>
<td>Heating</td>
<td>70</td>
<td>-</td>
</tr>
</tbody>
</table>
Primary Recommendation – Reduce Set Point Temperature During Inactivity

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Environmental Savings</th>
<th>Implementation Cost</th>
<th>Annual Savings</th>
<th>Payback Period</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set back furnace set point temperature overnight</td>
<td>2,112,000 kWh annually</td>
<td>$2,000</td>
<td>$104,000</td>
<td>Immediate</td>
<td>50% Implemented</td>
</tr>
<tr>
<td>Set back furnaces not in use during production hours</td>
<td>220,000 kWh annually</td>
<td>$0</td>
<td>$30,000</td>
<td>Immediate</td>
<td>Implemented</td>
</tr>
</tbody>
</table>

**Benefits**

- Significantly reduce energy consumption
- No upfront costs to implementation
- No impact on production
- No effect on metal quality
## Solutions (examples below)

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Annual reduction</th>
<th>Total cost</th>
<th>Annual savings</th>
<th>Payback period</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set back furnaces overnight</td>
<td>2,112,000 kWh</td>
<td>$2,000</td>
<td>$104,000</td>
<td>Immediate</td>
<td>50% Implemented</td>
</tr>
<tr>
<td>Turn down furnaces not in use during production</td>
<td>220,000 kWh, 100 kW demand</td>
<td>$0</td>
<td>$20,000</td>
<td>Immediate</td>
<td>Implemented</td>
</tr>
<tr>
<td>Fix leaks identified in leak check</td>
<td>460,000 kWh</td>
<td>$8,250</td>
<td>$35,000</td>
<td>2.5 months</td>
<td>Implementing</td>
</tr>
<tr>
<td>Replace vortex coolers with AC coolers</td>
<td>450,000 kWh</td>
<td>$21,000</td>
<td>$26,000</td>
<td>10 months</td>
<td>Implementing</td>
</tr>
<tr>
<td>Turn off quench tanks when not in use</td>
<td>400,000 kWh</td>
<td>$0</td>
<td>$20,000</td>
<td>Immediate</td>
<td>Recommended</td>
</tr>
<tr>
<td>Fix furnace insulation</td>
<td>174,000 kWh</td>
<td>$2,500</td>
<td>$11,000</td>
<td>5 months</td>
<td>Implementing</td>
</tr>
<tr>
<td>Stagger heating of ovens V and W</td>
<td>60 kW Demand</td>
<td>$0</td>
<td>$10,000</td>
<td>Immediate</td>
<td>Recommended</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4,012,000 kWh, 210 kW demand</strong></td>
<td><strong>$33,250</strong></td>
<td><strong>$259,000</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Personal Benefit

• Gained practical experience
• Project management
• Problem solving in a real world environment
• Chance to apply coursework in real world applications
Special thanks and additional contributions

• Randy Oehrlein
• Jon Vanyo of MnTAP
• Travis Bodick
• Ron Ingalls
• Peter Vinck and Inflow
• David Baker and the rest of CAE
• Thermtronix
• The rest of Carley’s employees and operators!