Minnesota Technical Assistance Program

Compressed Air Efficiency Opportunities at Caterpillar Paving Products

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Company Overview: Cat® Paving Products

• Operations headquartered in Brooklyn Park, MN
  - 372,000 sq. ft. (8.5+ acre) facility
  - Over 736 employees

• Designs and manufactures road construction machinery
  - Asphalt pavers, screeds, compactors and road reclaimers

• Compressed air used extensively throughout fabrication and assembly processes
  - 11% of total electricity consumption
Incentives to Change

• Corporate Sustainability Goals
  - Intensity based
  - Maintain or reduce energy consumption as production rates increase

• Process Efficiency Program
  - Rebate opportunities
  - Access to technical assistance
  - Data logging
Project Approach

Supply
- Determine baseline energy consumption
- Profile air flow demands
- Model energy saving potential for system upgrades

Demand
- Determine minimum pressure requirements and down-regulate pressures
- Measure and catalog air flow to major end uses and determine costs
- Consider higher efficiency alternatives to air-driven systems

Distribution
- Determine leak flow rate
- Locate and tag existing leaks
Opportunities Overview

Step 1: Demand-Side Reductions
- Repair existing compressed air leaks
- Regulate pressures; reduce artificial demand
- Use alternatives to compressed air when possible

Step 2: Supply-Side Improvements
- Generate air more efficiently using a Variable Speed Drive (VSD) Compressor
- Upgrade central control system to optimize compressor outputs
Leak Reduction Opportunity

- Initial leak flow rate (approx.): 91 CFM
  Annual energy waste: 155,700 kWh/yr
  Annual cost: $14,560

<table>
<thead>
<tr>
<th>Number of Leaks Tagged</th>
<th>Labor Cost</th>
<th>Energy Saved (kWh/yr)</th>
<th>Cost Savings ($/yr)</th>
<th>Indirect Emissions Prevented (MT CO₂-eq)</th>
<th>Simple Payback</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>$5,500</td>
<td>116,752</td>
<td>$10,921</td>
<td>55.2</td>
<td>6 months</td>
</tr>
</tbody>
</table>
Artificial Demand Reductions

• Adjusted regulators throughout fabrication processes
  - Estimated 14 CFM reduction to average production demand

• Identified flow reduction potential for air pallets on Pavers Line
  - 61 CFM reduction to peak flow demand

• Identified flow reduction potential for RM air pallet
  - 55 CFM reduction to peak flow demand
Eliminating Pneumatic Inefficiencies

• Replace pneumatic drum pumps and mixers with electric
  Annual Energy Savings: 76,667 kWh
  Annual Cost Savings: $7,171
  Simple Payback: 1.3 years

• Engineer alternatives for RM and Paver air pallets
  - Eliminate need for 3rd compressor
    Annual Energy Savings: 21,257 kW
    Peak Billable Demand Reduction: 38 kW
    Annual Cost Savings: $6,052
Improving Supply-Side Efficiency

- Replace one of three compressors with VSD model and upgrade control system
# Energy, Costs & Savings Breakdown

<table>
<thead>
<tr>
<th></th>
<th>Primary System (Baseline)</th>
<th>With VSD &amp; Control Upgrades</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Cost of Upgrade:</strong></td>
<td>$51,639</td>
<td>$33,639</td>
<td></td>
</tr>
<tr>
<td><strong>Xcel Rebate:</strong></td>
<td>-$18,000</td>
<td></td>
<td>-$18,000</td>
</tr>
<tr>
<td><strong>Simple Payback:</strong></td>
<td>1.9 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Average Total Power (kW):</strong></td>
<td>74.0</td>
<td>51.9</td>
<td>22.1 kW</td>
</tr>
<tr>
<td><strong>Peak Total Power, Billable (kW):</strong></td>
<td>168</td>
<td>123</td>
<td>45 kW</td>
</tr>
<tr>
<td><strong>Annual Energy (kWh/yr):</strong></td>
<td>648,300</td>
<td>454,900</td>
<td>193,400 kWh</td>
</tr>
<tr>
<td><strong>Annual Cost ($/yr):</strong></td>
<td>$60,640</td>
<td>$42,550</td>
<td>$18,090</td>
</tr>
</tbody>
</table>

*92 MT CO₂-equivalent Emissions Prevented*
## Recommendation Summary

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Energy Saved per Year</th>
<th>Annual Cost Savings</th>
<th>Emissions Prevented (MT CO₂-eq)</th>
<th>Payback period</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repair all tagged leaks</td>
<td>116,752 kWh</td>
<td>$10,920</td>
<td>55</td>
<td>0.5 years</td>
<td>Implementation In Progress</td>
</tr>
<tr>
<td>Control upgrades and integration of VSD into Primary Compressor System</td>
<td>193,400 kWh</td>
<td>$18,090</td>
<td>92</td>
<td>1.9 years</td>
<td>Implementation In Progress</td>
</tr>
<tr>
<td>Regulator adjustments (fabrication)</td>
<td>15,126 kWh</td>
<td>$1,415</td>
<td>7.2</td>
<td>Immediate</td>
<td>Implemented</td>
</tr>
<tr>
<td>Pneumatic Pump/Mixers to electric</td>
<td>76,667 kWh</td>
<td>$7,171</td>
<td>36</td>
<td>1.3 years</td>
<td>Recommended</td>
</tr>
<tr>
<td>Engineer alternatives to large air pallets</td>
<td>21,257 kWh</td>
<td>$6,052 (peak based)</td>
<td>10</td>
<td>Unknown</td>
<td>Analysis Incomplete</td>
</tr>
</tbody>
</table>
Additional Opportunities

- Pollution prevention and waste reduction in painting operations
  - Find alternative solvent for flushing paint lines
  - Improve transfer efficiency
  - Recycle water with closed-loop pressure washing booths

TOTAL ELECTRICITY USE

- Lighting 31%
- HVAC 14%
- Compressed Air 11%
- Welders/Production 37%
- Other 7%

- Retrofit LED
- High-bay occupancy sensors
Personal Benefits

• Better understanding of industrial compressed air systems

• Real-world experience implementing projects within a large corporation

• Improved analytical skills

• Networking
Thank You

Questions?