Energy Conservation At Kraft Foods, Albany

Boyang Li
Advisor: Karl DeWahl
On-site Supervisor: Clinton Buchner

Minnesota Technical Assistance Program

UNIVERSITY OF MINNESOTA
Driven to Discover
Plant Overview

Plant:
Began in 1929, Albany, MN
Square Footage: 84,800 sq. ft.
Employees: 69

Production Lines:
• 3 Spray Dryers (Cheese Powder)
• 1 Dry Blend (Flavored Powder)
• 2 Thermal Reactors (Grill)
• 1 Semi-Soft (Liquid Cheese)
Motivations for Change

• Sustainability Project in Kraft
• Sustainability Team Formed in 2009
• Rising Energy Costs
• Energy Curtailment
Reasons for MnTAP Assistance

• Assist Sustainability Team
• Benchmarking
• Compartmentalizing Energy Consumption
• Compressed Air System Study
• Efficiency Study (Boiler, Steam Coil, and Burner)
• Discover Future Improvement Opportunities
Approach

• Understand Current Systems
• Literature Review
• Data Logging
• Using PLC to Collect Real Time Data
• Interaction and Feedbacks from the Operators
• Vendor Contacts
Fig. Schematic Process Diagram

1) Air
   - Steam Coil
   - Burner Room
   - Burner

2) Inlet Air
   - Steam Coil
   - Condensate
   - Natural Gas
   - Burner
   - Burner Room

Cheese Slurry
Cheese Powder
Compressed Air System

- 3 Compressor
  - 125 hp
  - 100 hp
  - 40 hp

- System Pressure: 115±2 psi
- Annual Electricity Cost on 125 hp Compressor: $29,200
- Current Efficiency: 28 kw/100 cfm delivered
Compressed Air System (Ctd.)

1) Repairing the Air Leaks

2) Compressed Air System Pressure Reduction

3) Applying Advanced Control Strategy (VFD retrofitting)
Compressed Air System (Ctd.)

Determine Air Leaks

<table>
<thead>
<tr>
<th>Initial Pressure (psig)</th>
<th>End Pressure (psig)</th>
<th>Time (min)</th>
<th>Leakage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>115 ± 1</td>
<td>58 ± 1</td>
<td>11'21</td>
<td>37</td>
</tr>
</tbody>
</table>

Table. Draw Down Test Result

Helped to Develop Air Leak Preventive Maintenance

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Utility Savings</th>
<th>Annual Savings</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repairing air leaks (Air leak percent drops down to 15%)</td>
<td>107,000 KWH</td>
<td>$6,400-7,500</td>
<td>In Progress</td>
</tr>
</tbody>
</table>

Table. Savings for Repairing Air Leaks
Compressed Air System (Ctd.)

Supply

117 psig

Pressure Drop Across Compressor System
+
Regulator

Demand

97.5 psig

Distribution System Pressure Drop

Regulated Uses

92 psig

60 psig

Figure. Current System Pressure Profile
## Compressed Air System (Ctd.)

**Figure. Improved System Pressure Profile**

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Utility Savings</th>
<th>Implementation Cost</th>
<th>Annual Savings</th>
<th>Payback Period</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowering the system pressure from 115 psi to 85 psi</td>
<td>73,000 KWH</td>
<td>$2,400</td>
<td>$4,400-$5,100</td>
<td>6 months</td>
<td>Pending</td>
</tr>
</tbody>
</table>
Compressed Air System (Ctd.)

Fig. Average Power vs. Capacity of compressor with different control

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Utility Savings</th>
<th>Implementation Cost</th>
<th>Annual Savings</th>
<th>Payback Period</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>VFD retrofitting</td>
<td>38,700 KWH</td>
<td>$7,250</td>
<td>$5,300 - $6,200</td>
<td>1.2 to 1.4 years</td>
<td>Recommended</td>
</tr>
</tbody>
</table>
Steam Conservation

Reduce Unnecessary Steam Use

Air Intake → Preheating

Preheating → Dryer room

Dryer room → Drum Dryer

Drum Dryer → Dehumidifier

Dehumidifier → Burner

Burner → Spray Dryer

Figure. Current Preheating System Diagram in Dryer 3
Steam Conservation (Ctd.)

With Preheating System Turned Off

Air Intake → Preheating

Dehumidifier → Drum Dryer

Dryer room

Burner → Spray Dryer

Figure. Improved Preheating System Diagram in Dryer 3
Steam Conservation (Ctd.)

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Utility Saving</th>
<th>Implementation Cost</th>
<th>Annual Savings</th>
<th>Payback Period</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shutting down Steam Use in SA-4</td>
<td>411,000 lbs Steam</td>
<td>$0</td>
<td>$2,800</td>
<td>0 months</td>
<td>Pending</td>
</tr>
<tr>
<td>Turn off the Supply Fan</td>
<td>11,700KWH</td>
<td>$0</td>
<td>$900</td>
<td>0 months</td>
<td>Pending</td>
</tr>
</tbody>
</table>

Table. Savings if Preheating System is turned off in the Summer

Future Opportunities

- Research in the possibility that if preheating system can be turned off in the winter
Future Opportunities

1) Reduce Unnecessary Steam Use
2) Increase Boiler Efficiency
3) Improve Current Dryer Performance
Approach

1) Programming in PLC, collecting and processing real time data

Figure. Display Panel for Dryer Utility Use
Approach

1) Programming in PLC, collecting and processing real time data

Figure. Display Panel for Boiler Utility Use
Approach

1) Collecting Real Time Data to Assist Decision Making

110 PSI BOILER 2 EFFICIENCY / STEAM GENERATION

Figure. Analysis of Boiler Efficiency vs Boiler Load
Approach

2) Understanding the Influence of Moisture Content on Dryer Performance.

\[
\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + \{2\text{H}_2\text{O}\} + \text{energy}
\]
Approach

2) Understanding the Limitation of Steam and Reduce Unnecessary Steam Use

![Diagram showing the relationship between temperature and steam use, and natural gas use and steam use.]

**Steam Use (lb/hr)**

**Temperature (F)**

**Natural Gas Use (scf)**

**Steam Use (lb/hr)**

Wasted Energy
Approach

3) Computational Model to Assist Decision Making

![Graph showing Dryer 3 Cost based on Steam use](image-url)
### Approach

3) Computational Model to Assist Decision Making

<table>
<thead>
<tr>
<th>Season</th>
<th>Estimated Maximum Saving</th>
<th>Operating Hours</th>
<th>Estimated Annual Saving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer</td>
<td>$ 7/hr</td>
<td>3120 hrs</td>
<td>$ 21,800</td>
</tr>
<tr>
<td>Winter</td>
<td>$ 25/hr</td>
<td>3120 hrs</td>
<td>$ 78,000</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>$ 99,800</td>
</tr>
</tbody>
</table>

**Table. Estimated Maximum Savings in Dryer 3**

---

*Minnesota Technical Assistance Program  
[www.mntap.umn.edu](http://www.mntap.umn.edu)*
## Recommendation Summary

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Annual Utility Saving</th>
<th>Annual Savings</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowering the system pressure from 115 psi to 85 psi</td>
<td>73,000 KWH</td>
<td>$4,400-5,100</td>
<td>Pending</td>
</tr>
<tr>
<td>VFD retrofitting If reached 21.8 kw/100acfm</td>
<td>38,700 KWH</td>
<td>$5,300-6,200</td>
<td>Recommended</td>
</tr>
<tr>
<td>Repairing air leaks (Air leak percent drops down to 15%)</td>
<td>107,000 KWH</td>
<td>$6,400-7,500</td>
<td>In Progress</td>
</tr>
<tr>
<td>Shutting down Preheating Unit in Dryer 3</td>
<td>411,000 lbs Steam</td>
<td>$2,800</td>
<td>Pending</td>
</tr>
<tr>
<td>Turn off the Supply Fan in Preheating Unit</td>
<td>11,700 KWH</td>
<td>$ 900</td>
<td>Pending</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>$19,800-22,500</strong></td>
<td></td>
</tr>
</tbody>
</table>
Personal Benefits

• Technical Understanding Acquired
• Industrial Environment Exposure
• Data Analysis
• Programming Skills
• Project Cost Understanding
• Vendor Contact
• Working Alone As Well As in Groups
Questions

Thanks!