Kitchen Projects: A Big Dishroom Retrofit and Small Refrigeration Upgrade

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Two Projects – Four Phases

- Dishmachine Replacement
- Dishmachine Commissioning
- Dishroom Operations
- ECM Walk-in Evaporator Motor Retrofit
The Punchline: Sometimes the hardest project gets done before the easiest

Proactive vs Reactive

Reactive is not the best way to operate but it can be useful!
Dishroom Replacement

Opportunity: Old steam system removed – dishmachine had to be replaced.
Case Study – Large Institutional Kitchen Dishwasher Upgrade and data from sub-metering

Initial goals of this research project with Stanford

• Measure energy and water use of baseline and replacement high-efficiency dishwasher
• Compare unit specifications versus actual operations
• Measure operating hours and develop metrics for baseline and optimized dishwashers and pre-rinse units
• Understand how staff operations and maintenance affects water and energy use
Original dishwasher

- Steamy room even with 3 fans going
- Large amount of water and energy use due to old steam distribution system, dishwasher, table layout
Flow profile of water/energy process

Dishmachines are Complex!
What we monitored and why?

• Measured water and energy use and temperature
  – Inlet water and temperature
  – Prewash tank, wash tank, rinse tank and drain temps
  – Electricity use of the conveyor and booster (if applicable)
  – Estimated gas use at water heater

• Needed the whole data “picture”
Old Dishwasher Interim Results

- Rinse flow rate: 6.6 gpm (3.8 gpm spec)
- Total water use: 1372 gallons per day
- Natural gas use: boiler is 30 therms/day
- Dishwasher energy use: 21 kWh/day
- AVG Sanitizing rinse temperature: 194°F
- Dishroom operating span: 12.7 hours
- Conveyor operating time: 5.1 hours
- Water flow operating time: 2.2 hours
Dishwashers with Heat Recovery 101

• Exhaust-air heat recovery (EAHR) preheats incoming cold water saving energy at the water heater.

• Cold water passes through copper pipes while a fan extracts steam and forces it through thin aluminum plates. The steam condenses on the cold fins and the latent heat is transferred to the cold incoming water.
New Dishwasher w/ Heat Recovery

- Significantly more comfortable work environment
  - Removal of steam system
  - Insulated doors
  - Door seal system
- Door actuated drain closure
- Vent fan control
- Energy saver mode
- Built-in booster heater
- Final rinse flow rate specification of 2.2 gpm
New Dishwasher Preliminary Results

- Rinse flow rate: 2.5 gpm (2.2 gpm spec)
- Total water use: 628 gallons per day
- Natural gas use at boiler: 2.2 therms/day
- Total electricity use: 276 kWh/day
- AVG Sanitizing rinse temperature: 193°F
- Dishroom operating span: 12.8 hours
- Conveyor operating time: 8.5 hours
- Water flow operating time: 3.0 hours
# Preliminary Results From Replacement Project

<table>
<thead>
<tr>
<th></th>
<th>Water Use (gal/day)</th>
<th>Electricity Use (kWh/day)</th>
<th>Gas Use (therms/day)</th>
<th>Utility Cost ($/day)</th>
<th>Total Energy Use (therms/day)</th>
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</thead>
<tbody>
<tr>
<td>Original 108” Rack</td>
<td>1372</td>
<td>21</td>
<td>31.2</td>
<td>$58</td>
<td>31.9</td>
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<tr>
<td>Conveyor Dishwasher</td>
<td></td>
<td></td>
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<tr>
<td>Replacement 86” Rack</td>
<td>628</td>
<td>276</td>
<td>2.2</td>
<td>$51</td>
<td>11.6</td>
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<tr>
<td>Conveyor Dishwasher</td>
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<tr>
<td>Savings Percentage</td>
<td>54%</td>
<td>-92%</td>
<td>93%</td>
<td>11%</td>
<td>64%</td>
</tr>
</tbody>
</table>

Fuel Switching and low hot water supply temp of 120°F responsible for low cost savings
Challenges/Issues – Behavior Change

• Commissioning issues
  – Replacement dishwasher not commissioned in the first 80 days of operation, using too much hot water
  – Training of manufacturer’s technicians on heat recovery models is needed

• Operating issues
  – Staff not yet trained to operate the machine appropriately, higher savings potential possible
  – Improper tank filling operation is wasting 100 gallons per day
Lessons Learned

• The importance of sub-metering
  – To build the business case for replacement
  – To verify that the new dishwasher is operating properly
  – Ensuring staff are using the machine correctly

• The importance of commissioning and training staff

• The importance of communication and collaboration with all members of the retrofit project team to maximize success and savings potential
Bonus Metering of Pre-rinse Operations

- 3 Hoses, total use of 1,282 gallons per day
- High flow rate of 5 to 7.0 gpm
- Using two times the water use vs new dishwasher
- Savings potential of 1,000 gallons from changing to 1.15 gpm spray valves
Next Steps

• Improve pre-rinse operations in the dishroom
• Train staff on the operation and daily maintenance of this new dishwasher
• Make a operations and maintenance plan for all dishrooms
• Annual refresher training in operations in the dishroom
• Highlight other kitchens on campus where dishroom saving opportunities exist
• Add permanent submetering to periodically check on the efficiency of the equipment and operations
Summary / Conclusions (Cont.)

• **Real time Information:**
  – Real-time metering and sub-metering are building blocks for factual information about water and energy use and to quantify savings

• **Opportunities surround us:**
  – Be alert to seize opportunities here at the Water Showcase and through your networks!
  – Always room for new opportunities and ways to grow and evolve due to new technology and information. We’re not done yet!

• The processes and approaches in our presentation are applicable to other institutions and water agencies
Download the Project Fact Sheet

Electronically Commutated Motor (ECM) Replacement Project

Walk-in Refrigerator

Evaporator

Fan
Inefficient Motors

The fan motors inside a walk-in spin 24/7/365
The shaded-pole motors are old school workhorses - reliable but not efficient.
Replace shaded pole motors with Electronically Commutated Motors (ECM)

1/3 the energy to do the same work

1/3 the heat released to the space
ECM is also State and Federal Law for all new installs
The Stanford Project:

- 83 potential ECM change-outs for Shaded Pole
- Estimated Annual Savings (fan + refrigeration)
  - 100,000 kWh
  - $12,000
- Estimated capital cost
  - $150/fan
  - $12,500 total capital cost.
- Estimated ROI = 1 year (2 years incl. labor?)
Slam Dunk? Not!

Challenges:
- Finding correct size ECM replacement
- Verifying correct fan direction
- Motivation to install replacement
- Motivation to trouble-shoot incorrect install

This is a behavior change challenge not a tech challenge!
Conclusions?

- Dishmachine upgrade can save big on energy and water!
- Behavior change in the dishroom is as important as efficient equipment
- Take advantage of “reactionary” situations to improve equipment
- Move from “reactive” to “proactive” and pick up additional easy savings
Thanks for Listening!

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