Supermarket Experiences Managing Refrigeration Systems in Small-Format Stores

December 5, 2017
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Stratospheric Protection Division
GreenChill Partnership
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Tom has worked to protect the earth’s ozone layer and fight climate change for almost 20 years in the EPA’s Office of Atmospheric Programs. He is now running the GreenChill Partnership program to help the supermarket industry reduce emissions of ozone-depleting substances and greenhouse gases.
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- Hosts (1)
- Presenters (0)
- Participants (2)

Chat (Everyone)
Sending Questions via Chat

Chat (Everyone)

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- Text Size
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- Help

Chat interface with options menu open.
Raising Your Hand
Today’s speaker...
Derek Gosselin
Director of Technical Product Support
Hillphoenix
Mobile: 678-372-4111
Email: derek.gosselin@hillphoenix.com

Derek has more than 30 years of heating, ventilation, air conditioning, and refrigeration industry experience and currently serves as Manager of Hillphoenix’s Technical Product Support group supporting the development and application of all products and the advancement of new technologies. Hillphoenix, a Dover Company, is located in Conyers, GA.
Supermarket Experiences Managing Refrigeration Systems in Small-Format Stores
Today’s Agenda

Small format retail stores move to implementing carbon dioxide (CO₂) technology

► Regulatory impact in the decision making process
► Natural refrigerants and CO₂
► Overcoming the challenges of moving to new technology
► Understanding total cost of ownership (TCO) and return on investment (ROI)
► Growth of CO₂ installation and our impact on the environment
Regulatory Impact on the Decision Making Process

One of our original goals was to develop a long term refrigerant management program to get out in front of the regulatory impact at both the State and National levels that will provide us a long term solution.
Regulatory Impact on the Decision Making Process

California Air Resources Board (CARB) Rules Making Process: Updated October 24, 2017

► Stationary Refrigeration Measures in 2021
  — Refrigerants $\geq 150$ global warming potential (GWP) prohibited new systems $\geq 50$ lbs.
  — Refrigerants $\geq 1,500$ GWP prohibited in new systems containing 20-50 lbs.

► Stationary Air Conditioning Measures in 2021
  — Refrigerants $\geq 750$ GWP prohibited new systems containing $\geq 2$ lbs.

► Sales Restrictions on Refrigerants
  — 2020 – No production, imports, sales, distribution or entry into commerce of refrigerants with a GWP $\geq 2,500$.
  — 2024 – No production, imports, sales, distribution or entry into commerce of refrigerants with a GWP $\geq 1,500$.

► Visit CARB’s website for official information
  — [https://ww2.arb.ca.gov/hfc-reduction-measures-rulemaking](https://ww2.arb.ca.gov/hfc-reduction-measures-rulemaking)
Regulatory Impact in the Decision Making Process

- EPA’s Final Rule, July 20, 2015 and September 26, 2016
- Changed listing status of certain hydrofluorocarbons (HFCs)
- Understanding the need to move away from high GWP refrigerants and future proof our business

<table>
<thead>
<tr>
<th>Phase-out Refrigerant</th>
<th>Supermarket (New)</th>
<th>Supermarket (Retrofit)</th>
<th>Remote Condensing Unit (New)</th>
<th>Remote Condensing Unit (Retrofit)</th>
<th>Refrigerated Food Processing and Dispensing Equipment (New)</th>
<th>Cold Storage Warehouses (New)</th>
<th>Ice Machines (New)</th>
<th>Very Low-Temp Refrigeration (New)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HFC-134a</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>OK</td>
<td>Jan. 1, 2019</td>
<td>^Jan. 1, 2023</td>
<td>OK</td>
<td>R-407C only</td>
</tr>
</tbody>
</table>

Likely alternatives (Emerson perspective)

- R-448A/449A          | OK               | OK                    | OK                           | OK                               | OK                                                         | OK                       | OK               | -                               |
- R-450A/513A          | OK               | OK                    | OK                           | OK                               | OK                                                         | OK                       | OK               | OK                               |
- R-290                | -                | -                     | -                            | -                                | -                                                         | -                        | -                | -                               |
- R-744                | OK               | -                     | OK                           | OK                               | OK                                                         | OK                       | OK               | -                               |
- R-717                | OK (in primary loop of secondary system) | OK (in primary loop of secondary system) | OK (in primary loop of secondary system) | OK (in primary loop of secondary system) | OK (in primary loop of secondary system) | OK (in primary loop of secondary system) | OK (in primary loop of secondary system) | OK (in primary loop of secondary system) |

Includes ice machines connected to a supermarket rack refrigeration system. Term does not apply to upgrades to existing equipment where the refrigerant is not changed.
Natural Refrigerants and CO₂

Benefits of CO₂

► 1 – GWP
► 0 – ODP (ozone depletion potential)
► American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) classified A1 refrigerant
► Non-toxic and non-flammable
► Avoids future refrigerant retrofits
► No charge restriction

<table>
<thead>
<tr>
<th>Refrigerant</th>
<th>ODP</th>
<th>GWP</th>
</tr>
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<tbody>
<tr>
<td>CO₂</td>
<td>0.00</td>
<td>1</td>
</tr>
<tr>
<td>Hydrochlorofluorocarbon (HCFC)</td>
<td>0.05</td>
<td>1,810</td>
</tr>
<tr>
<td>HFC</td>
<td>0.00</td>
<td>3,922</td>
</tr>
<tr>
<td>HFC</td>
<td>0.00</td>
<td>2,107</td>
</tr>
<tr>
<td>Hydrofluoro olefin (HFO)</td>
<td>0.00</td>
<td>1,273</td>
</tr>
<tr>
<td>HFO</td>
<td>0.00</td>
<td>1,397</td>
</tr>
<tr>
<td>Ammonia</td>
<td>0.00</td>
<td>0</td>
</tr>
</tbody>
</table>
Natural Refrigerants and CO₂

- Availability of a compact CO₂ booster system design for a small format to help standardize selection and support a lower first cost

- Compact, small format CO₂ booster systems can be used as a centralized refrigeration system for small format stores or as a distributed system for larger format stores

Drivers to Develop
- Indoor package (with or w/o enclosure) and remote air-cooled condenser or adiabatic condenser
- Outdoor package with field-installed condenser
- Outdoor package w/integral air-cooled condenser – future evolution
- Compact package to keep costs at a minimum
- Platform development

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Traditional</th>
<th>New</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimension</td>
<td>138”x34”x87”</td>
<td>133”x39”x72”</td>
</tr>
<tr>
<td>Weight</td>
<td>5,000 lbs.</td>
<td>4,000 lbs.</td>
</tr>
</tbody>
</table>
Understanding Challenges & Benefits with CO₂ Booster Systems

**CHALLENGES**

**Increased Capital Cost**
CO₂ systems do currently cost more
- Driving systems cost reduction to a closer parity with HFC direct expansion (DX) systems
- Cases require electronic expansion valves (EEVs) and case controllers

**Availability of Refrigeration Contractors**
- The CO₂ Booster systems are similar to traditional DX systems, but require some additional training for installation, start-up and maintenance
- Training available with growing numbers of contractors

**Impact on Energy Performance**
With the low critical point of CO₂ versus traditional HFC systems, ambient conditions impact the performance of the systems. Adiabatic condensers and parallel compression are recommended in warmer climates.
Understanding Challenges & Benefits with CO₂ Booster Systems

**Tangible Benefits**

**Things We Can Calculate**
- Savings on start-up refrigerant charge
- Savings on refrigeration installation
- Savings on electrical installation
- Savings on case performance with EEV’s
- Savings on energy

**Intangible Benefits**

**Things We Know, but are Hard to Calculate**
- Future cost avoidance of HFC retrofits
- Relief from leak and recordkeeping requirements
- Savings preventative maintenance program w/ lower cost refrigerant
- Better quality product w/ better case controls
- Impact on social responsibility
Understanding TCO and ROI with CO₂ Booster Systems

Impact of an ROI on understanding installed cost vs. equipment's first cost

► Reduced refrigerant cost (reduced charge and cost/lbs.)
► Refrigeration Installation (smaller pipe sizing)
► Electrical Installation (single point electrical with case controllers)

Impact of annual savings and refrigerant management on TCO

► Annual saving for refrigerant management with lower cost CO₂
► No future refrigerant retro-fit cost
► Improved technology in warmer climates for energy efficiency
► Support from local utilizes with incentives
Understanding TCO and ROI with CO₂ Booster Systems

Baseline system designs and ROI formats are different and can impact the comparison of the system and location used.

<table>
<thead>
<tr>
<th>ROI Summary</th>
<th>Base Design</th>
<th>Optional CO₂ Booster</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refrigeration Systems</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Refrigerated Cases</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Estimated Capital Cost</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Estimated Start-up Refrigerant Cost</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Refrigerant ($/lb.)</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Estimated Charge (lbs.)</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Estimated Refrigeration</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Estimated Electrical</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Estimated Installation Cost</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Estimated Annual Refrigerant (%)</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Estimated Annual Usage (kWh)</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Estimated Annual Operating Cost ($)</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Estimated Annual Totals</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Utility Incentives</td>
<td>$</td>
<td></td>
<td>$</td>
</tr>
<tr>
<td>Equipment Installed Cost (Equipment &amp; Installation)</td>
<td>$</td>
<td></td>
<td>$</td>
</tr>
<tr>
<td>Balance</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Annual Maintenance and Operating Cost Savings</td>
<td>$</td>
<td></td>
<td>$</td>
</tr>
<tr>
<td>ROI in Years</td>
<td>$</td>
<td></td>
<td>$</td>
</tr>
</tbody>
</table>
Impact on CO$_2$ technology in a small format

100 stores operating in U.S. with CO$_2$ booster technology
60+ stores operating in a warm climate with CO$_2$ booster
55 stores EPA GreenChill Platinum certified stores
Impact of Natural Refrigerants on the Environment

- Estimated environmental impact of operating small format stores
- Equivalencies for: 100 stores, 200 lb. charge, 15% leak rate, over 10 years
- 52,475 tons (104,950,000 lbs.) CO₂/ 10 years/ 100 stores

### Equivalent Impact

<table>
<thead>
<tr>
<th>Impact Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cars driven for 1 year</td>
<td>8,711</td>
</tr>
<tr>
<td>Gallons of gas</td>
<td>5,403,876</td>
</tr>
<tr>
<td>Train cars of coal</td>
<td>252</td>
</tr>
<tr>
<td>Tons of recycled waste</td>
<td>16,372</td>
</tr>
<tr>
<td>Average household energy use</td>
<td>4,303</td>
</tr>
<tr>
<td>Tree growth for 10 years</td>
<td>1,220,569</td>
</tr>
</tbody>
</table>
Contacts and Additional Information

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Upcoming Webinars

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<td>February 13</td>
<td>Tips for Servicing Carbon Dioxide-based Refrigeration Systems</td>
</tr>
<tr>
<td>March 6</td>
<td>Experience working with the North American Sustainable Refrigeration Council</td>
</tr>
<tr>
<td>April 10</td>
<td>Small, Independent Grocers Participating in GreenChill</td>
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