Advanced Refrigeration Systems

Maintaining CO$_2$ Secondary & Cascade Systems

Wayne Rosa
Energy & Maintenance Manager
Food Lion, LLC
Food Lion, LLC

Legend

<table>
<thead>
<tr>
<th>Store</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Lion</td>
<td>1,149</td>
</tr>
<tr>
<td>Bloom</td>
<td>64</td>
</tr>
<tr>
<td>Bottom Dollar</td>
<td>28</td>
</tr>
<tr>
<td>Harveys</td>
<td>69</td>
</tr>
<tr>
<td>Reid's</td>
<td>9</td>
</tr>
</tbody>
</table>

Hilton
Minneapolis, MN
September 19-22, 2010

E+sd²010
Energy & Store Development Conference
Advanced Refrigeration Systems

2118 Dinwiddie, VA: MT Glycol Secondary Loop System (R507)

2663 Montpelier, VA: LT CO₂ Secondary System (R507)

2659 Portsmouth, VA: MT Glycol Secondary Loop System (R507)
 LT CO₂ Secondary System (R507)

2161 College Park, GA: CO₂ Cascade System (R507)

2157 Columbia, SC: CO₂ Cascade System (R407A)

2191 Conyers, GA: CO₂ Cascade System (R407A)
 Opened July 28, 2010
# Refrigerant Reductions

<table>
<thead>
<tr>
<th>Refrigerant/CO₂ Charge (lbs)</th>
<th>Refrigerant</th>
</tr>
</thead>
<tbody>
<tr>
<td>500/???</td>
<td>R507/Glycol</td>
</tr>
<tr>
<td>350/900</td>
<td>R507/CO₂</td>
</tr>
<tr>
<td>800/???</td>
<td>MT R507/Glycol</td>
</tr>
<tr>
<td>300/900</td>
<td>LT R507/CO₂</td>
</tr>
<tr>
<td>1800/2248</td>
<td>R507/CO₂</td>
</tr>
<tr>
<td>900/1450</td>
<td>R407A/CO₂</td>
</tr>
<tr>
<td>1000/1800</td>
<td>R407A/CO₂</td>
</tr>
</tbody>
</table>
## Refrigerant Reductions

<table>
<thead>
<tr>
<th>Refrigerant</th>
<th>ARS (lbs)</th>
<th>DX System (lbs)</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>R507</td>
<td>500</td>
<td>1150</td>
<td>650 (57%)</td>
</tr>
<tr>
<td>R507</td>
<td>350</td>
<td>885</td>
<td>535 (60%)</td>
</tr>
<tr>
<td>MT R507</td>
<td>800</td>
<td>1753</td>
<td>953 (54%)</td>
</tr>
<tr>
<td>LT R507</td>
<td>300</td>
<td>1367</td>
<td>1067 (78%)</td>
</tr>
<tr>
<td>R507</td>
<td>1800</td>
<td>3100</td>
<td>1300 (42%)</td>
</tr>
<tr>
<td>R407A</td>
<td>900</td>
<td>3100</td>
<td>2200 (71%)</td>
</tr>
<tr>
<td>R407A</td>
<td>1000</td>
<td>3100</td>
<td>2100 (68%)</td>
</tr>
</tbody>
</table>
## Refrigerant Reductions - Savings

<table>
<thead>
<tr>
<th>Refrigerant</th>
<th>ARS (lbs)</th>
<th>DX System (lbs)</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>R507</td>
<td>500</td>
<td>1150</td>
<td>$4,388</td>
</tr>
<tr>
<td>R507</td>
<td>350</td>
<td>885</td>
<td>$3,612</td>
</tr>
<tr>
<td>MT R507</td>
<td>800</td>
<td>1753</td>
<td>$6,433</td>
</tr>
<tr>
<td>LT R507</td>
<td>300</td>
<td>1367</td>
<td>$7,202</td>
</tr>
<tr>
<td>R507</td>
<td>1800*</td>
<td>3100</td>
<td>$8,775</td>
</tr>
<tr>
<td>R407A</td>
<td>900**</td>
<td>3100</td>
<td>$13,860</td>
</tr>
<tr>
<td>R407A</td>
<td>1000</td>
<td>3100</td>
<td>$13,230</td>
</tr>
</tbody>
</table>

*Refrigerant reclaim  **Glycol Loop reclaim
Leak Rates

• Primary Refrigerant Leak Rate: 0%
  • Total refrigerant use (rolling 1 year - August 2010)
  • Last refrigerant add was July 30, 2009
    – 1.79% rolling 1 year (60 lbs.)

• CO₂ operating leak rate: 42.7%
  • CO₂ loss thru actual system failure (Leak – 2350 lbs)
  • 2010 (rolling 1 year thru August): 11,609 lbs CO₂ used
    – Power Failure
    – Water Cooled Condenser (Freezing)
    – Volumetric expansion in system (PRV)
  • Component failures (Pressure Relief Valves)
Refrigeration Costs

Advanced Refrigeration Systems:
- Average Refrigeration Cost is 49% of chain average.*
- Refrigeration CPSW calculation (Metric)
- Low Leak Rates and Low Refrigerant use

Refrigeration Costs include (CPSW):
- Refrigerant (includes CO$_2$)
- Refrigeration Parts
- Refrigeration Labor

* Year to date 2010
Key to Successful Implementation

Manufacturer Sponsored Training

– Factory visit
  • Training by Engineering Department (Theory)
  • Equipment Assembly (Chillers, pumps, heat exchangers)
  • Promote equipment familiarity

– On-site during installation
  • Pipe routing
  • Control wiring
Key to Successful Implementation

Who to include:

- Installing Refrigeration Contractor
- Refrigeration Technician (In-House)
- Back-up/Service Contractor
- Energy Specialist (Refrig. Commissioning)

Require Factory Start-up
Installation

• Construction - Cost Neutral
  – Electric Defrost – Added Cost
  – EEV – Added Cost
  – Generator/Condensing Unit
Challenges

• **CO₂ Availability**
  – Lead Times at Supply House (Week Delivery)
  – Not Common stocking item at Supply House
  – Build Relationship with Supply House
  – Maintain Rack Capacity on Site

• **Proper Service Tools**
  – CO₂ Leak Detectors
  – Heavy Duty Hoses for charging system
  – Adaptors for CO₂ cylinders for system charging
Thank You

Questions?