Commercial Refrigeration

A science of vague assumptions
based upon debatable figures
taken from inconclusive experiments
performed with instruments of problematical accuracy by
persons of doubtful reliability and questionable mentality
Is Training Really Necessary?
Secondary Coolant 101

Objectives

• Explain the importance of refrigerant management
• List the steps in the secondary coolant refrigeration process
• Identify the major components of a secondary coolant system
• Describe how the system components operate
• Describe the Pump Control strategy for a secondary coolant system
Why Is Refrigerant Management Important?

Current Regulatory Conditions

- Regulatory agencies stepping up enforcement against HCFC violations and compliance failures – CONTINUING
- No new HCFC (R-22) equipment – 2010 – OLD NEWS
- Complete HCFC (R-22) phase-out by 2020 – OLD NEWS
- Most likely increasing HFC restrictions – YET TO BE DETERMINED
- Overall impact of new refrigerants developed and announced by major manufacturers - YET TO BE DETERMINED
## Refrigerants and Environmental Impact

<table>
<thead>
<tr>
<th>Refrigerant</th>
<th>Other Names</th>
<th>ODP Ozone Depletion Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-22</td>
<td>Freon-22 (HCFC)</td>
<td>0.055</td>
</tr>
<tr>
<td>R-404A</td>
<td>HP-62 (HFC)</td>
<td>0</td>
</tr>
<tr>
<td>R-507</td>
<td>AZ-50 (HFC)</td>
<td>0</td>
</tr>
<tr>
<td>R-410A</td>
<td>AZ-20, Puron (HFC)</td>
<td>0</td>
</tr>
<tr>
<td>R-717</td>
<td>NH₃, Ammonia</td>
<td>0</td>
</tr>
<tr>
<td>R-744</td>
<td>CO₂, Carbon Dioxide</td>
<td>0</td>
</tr>
</tbody>
</table>
Useful Definitions

**Primary Refrigerant** – The heat transfer fluid used to lower the temperature of a secondary coolant (i.e. R-22, R-404a, R-507, R-410A, R-744, etc…)

**Secondary Coolant** (a.k.a. secondary refrigerant, secondary fluid) – A fluid used to transfer heat from a heat source (i.e. refrigerated space, case, or walk-in) to a primary refrigerant
Current Direct Expansion

LEAK POTENTIAL ALERT

REFRIGERANT REDUCTION
# System Comparison

## Traditional Direct Expansion (DX)

- Familiar, low-cost, reliable technology
- Centralized, serviceable, system
- Long pipe runs
- Numerous joints/welds
- Large refrigerant volumes

## Secondary Coolant System

- Significantly less refrigerant volumes
- Lower maintenance
- Leak potential isolated to machine room
- Improved temperature control
  - reduced product shrink
- Industry-accepted technology
- Learning Curve

+ **We’re here**
Nomenclature (?)
Nomenclature (?)
Secondary Coolant 101 Review

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System Comparisons

Direct Expansion System

- Condenser
- Direct Expansion Loop
- Receiver
- Compressor
- Evaporator

Second Nature® System

- Condenser
- Primary Refrigerant Loop
- Compressor
- Chiller
- Secondary Coolant Loop
- Pump
- Heat Exchanger
Secondary Main Components

- Brazed-plate heat exchanger (chiller)
- Pumps
- Finned tube-type heat exchanger (at the case)
- Expansion tank
- Fill tank
- Air separator
- Balance valves
- Valve stations
Chiller Operation

- Chiller Size = Case and cooler loads/Store size
- Chiller Approach = Supply fluid temp - SST
- What is SST = Suction converted to temperature
Centrifugal Pumps
Duplex Pumping Station
Triplex Pump System
Finned-Tube Heat Exchanger

- Coils designed for DX application are in general, not appropriate for secondary systems
- Secondary coils must be designed to:
  - Eliminate air traps and remove air from coil
  - Drain from bottom of coil for service
  - Transfer heat in counterflow manner
  - Operate with high coolant $\Delta T$ (to minimize flow rate) and low pressure drop (to minimize pumping power)
Balance Valve or Circuit Setter
Inhibited Propylene Glycol

- Specific gravity (at 70°F) of 1.033
- Boiling point of 216°F
- Freezing point of +2°F
- pH of 8.0 to 10.0
- **Never** mix manufacturers
Insulation Considerations

- The application (coolant) temperature
- Ambient conditions such as:
  - Dry-bulb temperature
  - Relative humidity
  - Surrounding air velocity
- Insulation material
- Desired performance
**Ambient Conditions**

- **Mild Conditions** – maximum severity of 80°F dry bulb temperature, 50% relative humidity, and 0 ft/min air velocity

- **Normal Conditions** – maximum severity of 85°F dry bulb temperature, 70% relative humidity, and 0 ft/min air velocity

- **Severe Conditions** – maximum severity of 90°F dry bulb temperature, 80% relative humidity, and 0 ft/min air velocity
Mechanical Expansion Valves
Electronic Expansion Valves

R-507
64 PSIG
23° SST
31 Degrees F
Electronic Expansion Valves
Secondary Pump Control

- Constant speed control
- Variable speed control
Variable Speed Pumps

One drive for each pump

PLC control with touch screen
Differential Pressure Control
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Questions