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Subcooling for Increased Compressor Capacity and Efficiency



Technical Bulletin
Product: Solstice® N13 (R-450A)
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Application: Refrigeration

Background

There will be instances when a refrigeration system will need an increase in refrigeration capacity due to additional refrigeration load or design changes while retrofitting.

Problem

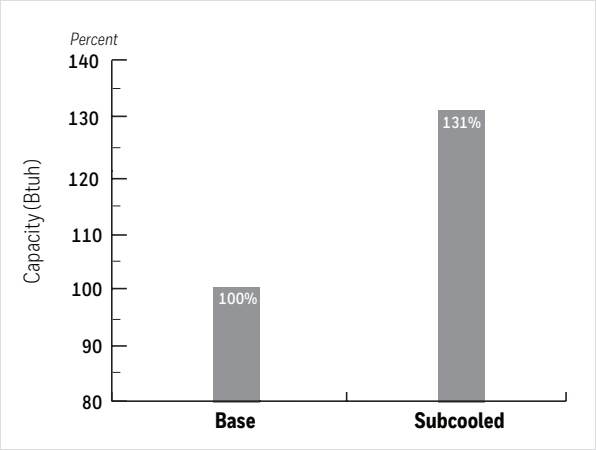
Replacing an entire system to increase capacity is time consuming and costly. The alternative of adding compressors to increase the refrigeration load results in an increase in energy usage.

Resolution

Subcooling the main liquid line will increase refrigeration capacity while improving energy efficiency. Subcooling in this document refers to the use of a separate refrigeration source to lower the temperature of the main liquid line. This separate system operates at a higher evaporator pressure and thereby increases the overall efficiency of the combined systems.

As an example, we will review the subcooling effect upon a medium-temperature parallel rack system utilizing Honeywell Solstice N13 (R-450A) refrigerant.

Chart 1
Peak Load Capacity (San Antonio, Texas)
Shows the capacity increase due to subcooling of the R-450A system.



System Description

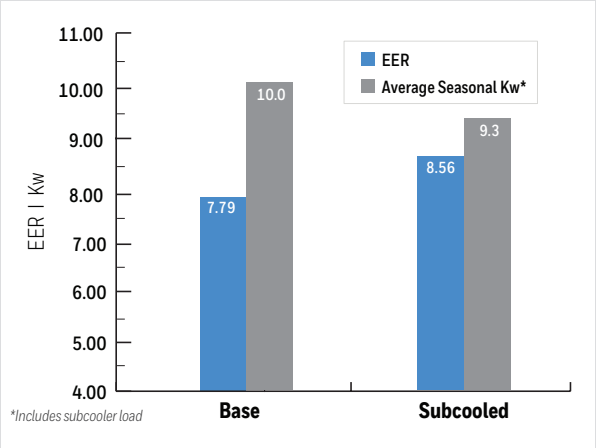
- Install a pre-packaged condensing unit to subcool the main liquid line with a plate heat exchanger[1].
- Run this condensing unit at 50°F suction temperature to subcool the main system liquid line to 70°F[2].
- Main system peak condensing temperature assumed to be 120°F with a suction temperature of 20°F[3].

Results

- Chart 1 shows the capacity increase due to subcooling of the R-450A system.
- Chart 2 indicates an increase in efficiency as well as an overall reduction in operating costs.

The addition of a small condensing unit with a plate heat exchanger to subcool the main liquid line will increase the system capacity as much as 31% at peak load conditions while reducing overall energy consumption.

Chart 2
Subcooling Performance
Efficiency for ~100,000 Btuh System (San Antonio, Texas)



Notes:

[1] Capacity control for compressor is recommended due to load fluctuations over operating range.

[2] Most areas in the United States have a 1% dewpoint lower than 70 degrees. Therefore it is recommended to limit subcooling to 70 degrees to avoid condensation on liquid lines. If liquid lines are insulated lower liquid temperatures are possible.

[3] Analysis is done using an independent condenser for subcooling compressor. If it is desired to utilize the existing main system condenser an approximate 6°F increase in condensing temp is expected. This would change the capacity increase from 31% to 25%.

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