DuPont™ ISCEON® MO99™ refrigerant

CASE HISTORY

HCFC-22 to DuPont™ ISCEON® MO99™ Refrigerant Conversion in a York YCAS Chiller - Stine Haskell Research Center – Newark, DE

Introduction

As Operations and Engineering Manager for the Stine Haskell Research Center in Newark, Delaware, Bill Pew has responsibility for maintaining the site's entire infrastructure, ensuring the facilities are up and running to support this world class research and development site. A critical part of the site utilities includes the HVAC systems serving office space, conference rooms, and research laboratories. So when Bill became aware of the scheduled phase-out of R-22 refrigerant, he knew he needed to take action. Bill charged his operations team, lead by Christine Lynn, to develop a refrigerant management plan that would allow the site to cost effectively transition out of dependence on R-22 in an environmentally sustainable way, without impacting business operations, while at the same time balancing the site's HVAC needs against numerous other important projects upgrading site infrastructure.

Stine Haskell has a number of small DX air conditioning and refrigeration systems in addition to numerous larger water chillers operating on R-22. Since a lot of the systems are relatively new, replacing them, even over a timeframe of several years, would not be a cost-effective solution. As part of her refrigerant management plan, Christine conducted a survey of chillers and identified many that were potentially good candidates for retrofit of the refrigerant gas since they still had a significant operating lifetime ahead.

The site facilities engineering team consulted with their chiller service contractor, the chiller OEM, as well as technical consultants from DuPont's engineering group and refrigerants business, who together selected one of the sites chillers (Bldg#190 – York YCAS) on which to perform an initial trial retrofit project. The team then developed a data monitoring and retrofit plan for converting that chiller. ISCEON® MO99™ refrigerant was selected as the preferred non-ozone depleting refrigerant candidate to replace the R-22.

Equipment Description

York YCAS Type Chiller - Building #190 - Office and Research Areas

- Model # - YCAS0230EC46YGADB (April 2005)
- 2 Independent Circuits w/ 2 Screw Compressors
- Single Evaporator w/ 2 Independent Circuits
- Oil Separator/Reservoir System on each Circuit
- Air Cooled Condenser
- 2 Thermal Expansion Valves (TXV's) – 1 per Circuit thru Evaporator
- Chiller Nominal Capacity 230 Tons
- R-22 nameplate charge 418 lbs w/ JCI "L" Oil (POE)
- Shell (30 wt% Propylene Glycol) and Tube (Refrigerant)
- New Refrigerant – ISCEON® MO99™ (R438A)

Retrofit Procedures Summary

Energy monitors and data loggers were installed on the chiller several weeks prior to the conversion to collect baseline data while the system was still using R-22. In addition, operational data was manually recorded from system control panel periodically. This data included suction/discharge temperatures and pressures, oil temperatures/pressures, superheat values, motor current, chilled water temperatures and ambient temperature.

Each independent circuit was converted from R-22 to ISCEON® MO99™ refrigerant individually over two subsequent days, including an extended leak check test. In the first step of the retrofit, the R-22 was recovered and weighed; after which filter driers were changed out. Next, a thorough leak test, using both N2 positive pressures as well as leak checking under vacuum conditions was performed for each circuit.

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Once each of the circuits was verified leak free, they were charged with ISCEON® MO99™ refrigerant by removing liquid refrigerant from the cylinders. After charging approximately 170# of MO99™ refrigerant (the weight of R-22 recovered from each circuit) the systems were started up and quickly pulled down and began operating at conditions very similar to that when using R-22. Operating parameters such as superheat and oil return were monitored for several hours after start-up with no problems or issues observed. The recovered R-22 was stored on-site in recovery cylinders to be used as needed in the future for servicing of other R-22 equipment.

Overall, the conversions were quick and problem free. No changes were made to any hardware piping, valves etc. In addition, no changes to any control set points were needed and the system has performed nearly identically before and after the retrofit from day one. A detailed guide for R-22 to ISCEON® MO99™ refrigeration retrofits can be found at www.isceon.com.

Chiller Operation Performance

Typical operational data collected just prior to and right after the conversion from R-22 to ISCEON® MO99™ refrigerant is shown in *Figure 1.* In order to make it a useful comparison, this data was recorded for both refrigerants when the outdoor temperature was approximately 40°F. As shown in the figure, all system pressures and temperatures while running on MO99™ refrigerant closely match the values for R-22. One point to note is the compressor discharge temperature, which was169°F on R-22, but only150°F with MO99™ refrigerant. This lower discharge temperature for MO99™ refrigerant was as expected based on previous laboratory calorimeter tests as well as earlier retrofits on other systems and may have a potential positive benefit on compressor and lubricant wear.

Figure 1

York YCAS Chiller Typical Operating Snapshots
Before and After Conversion to ISCEON® MO99™

R-22 – December 2009, Ambient Temp ~ 40°F
ISCEON® MO99™ - January 2010, Ambient Temp ~40°F

Chilled Water Set Point	42 ± 2.5°F	Flow Rate	~340 gal/hr
Chilled Water Leaving	41°F (42)	Chilled Water Return	43°F (44)
Oil Pressure	176 psig (181)	Oil Temp	118°F (113)
Suction Pressure	53 psig (54)	Discharge Pressure	185 psig (198)
Suction Temp	43°F (43)	Discharge Temp	169°F (150)
Motor Current	70-80 amps (79)		
Sat Suct Temp	28°F (30)	Sat Suct Superheat	14°F (13)
Sat Discharge Temp	98°F (99)	Sat Dis Superheat	65°F (61)

Additional data was periodically downloaded in the months following at higher outdoor temperatures and is plotted in *Figures 2 – 4* along with baseline R-22 data. As previously noted, the system continues to perform virtually identically to R-22 when using ISCEON® MO99™ refrigerant, as evidenced by the data shown in the figures.

Figure 2

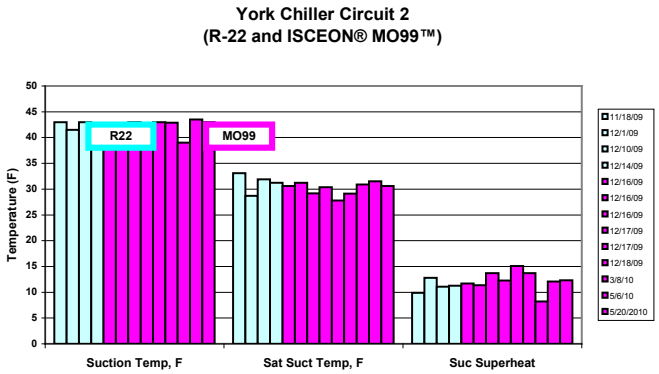


Figure 3

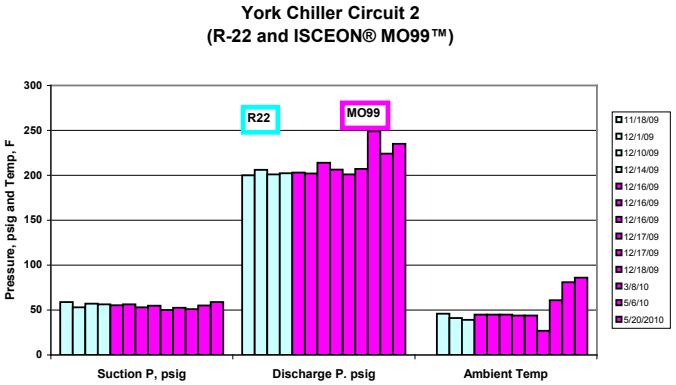
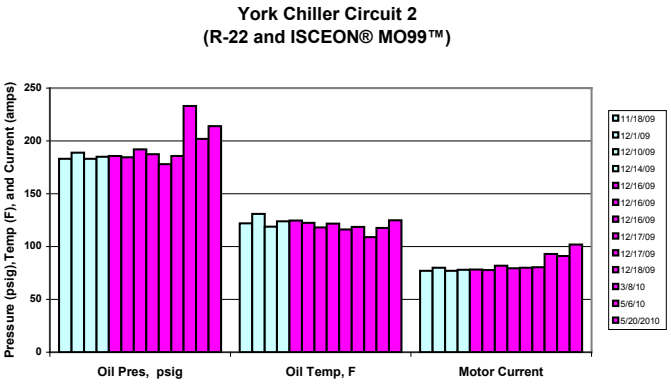


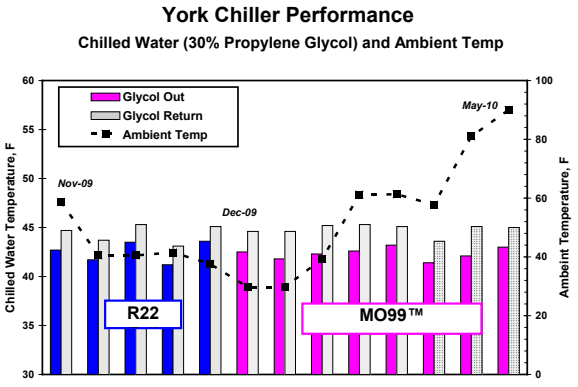
Figure 4



Capacity Performance

The ability of the ISCEON® MO99™ refrigerant chiller to meet the facility's load demand and maintain supply of chilled water (42 + 2.5°F @ ~340gpm) to the building is shown in *Figure 5*, a graph of chilled water temperatures (leaving and return) over a range of ambient temperatures (<10°F to >90°F). Although the data in this chart is only through May 2010, this time period did include some >90°F days, and the chiller continued to operate flawlessly thru the entire summer, one of hottest on record for the region.

Figure 5

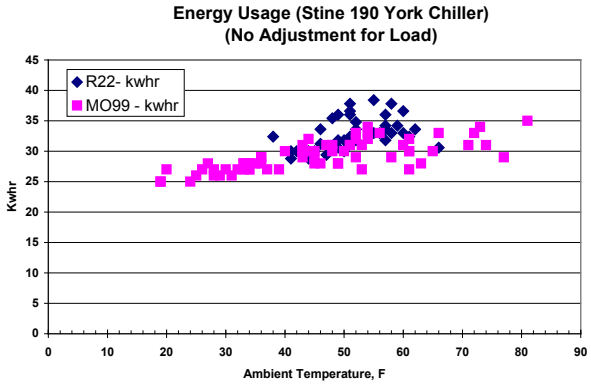


Energy Performance

As part of the conversion project, energy meters and data loggers were attached to the power supply lines on the chiller, which enabled continuous collection and storage of the system's energy consumption. Energy data was collected while operating on R-22 for several weeks, over a range of ambient temperatures prior to conversion to ISCEON® MO99™ refrigerant and is used as a baseline for comparison purposes.

Figure 6 is a plot of energy consumption for the chiller, while the compressor is operating, over a range of temperatures. As expected, energy usage increases with increasing ambient temperature for both R-22 and MO99™ refrigerant. However, what is interesting to note from these data is that at a given outdoor temperature, the chiller appears to use less energy when operating on Isceon MO99™ refrigerant than with R-22. While this analysis does not take into account differing capacity for the two refrigerants, even if one assumes the MO99™ refrigerant system had as much as 10% longer compressor run times, the energy usage, at worst, would still be equivalent for the two refrigerants on this chiller.

Figure 6



Conclusion

Overall, the conversion of the York YCAS chiller with screw compressors has proven to be a huge success for all parties involved. The actual conversions in the field were quick and problem free and required no change to any hardware, piping, valves, and lubricant or control set points. As evidenced by the operational field data, the ISCEON® MO99™ refrigerant system operated very similarly to R-22 from initial start-up with no leaks or oil return issues.

The system continued to operate through record-setting heat and maintained chilled water temperature and flow to serve the facilities cooling needs. Energy consumption was equivalent or better while operating on MO99™ refrigerant versus R-22.

"From my perspective things went flawlessly", said Bill. "The collaboration was great, the refrigerant performed as advertised, and most importantly, there was essentially no downtime and no impact on the facilities, occupants, or research operations."

Christine commented, "The ISCEON® MO99™ refrigerant continues to work well, and as an added bonus, we put the recovered R-22 to good use in servicing other systems on site, further reducing costs by avoiding purchases of new gas."

"MO99™ refrigerant will definitely have an important role in Stine Haskell's refrigerant management plan for equipment we plan to keep running as R-22 is phased out over the coming years", Bill added.

For more information on DuPont™ ISCEON®, or other DuPont Refrigerants, please contact your local representative.

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