C A S E S T U D Y

Conversion from R-22 to RS-45:

An Environmentally Friendly Retrofit for Two 8,000 lb. Flooded Chillers

We are proud to announce that the collaborative efforts between Ineos' Alvin, TX plant, ComStar International, Advanced Refrigeration Technologies, and Star Service have successfully completed another successful R-22 to RS-45 environmentally friendly retrofit.

A.

Two 8,000 lb R22 refrigeration units, installed for butadiene cooling for storage tanks and spheres at INEOS Olefins & Polymers in Alvin, TX, were evaluated to determine the feasibility of converting the units to operation on Refrigerant R-434A (trade name RS 45) from present operation on R-22. The units are used to cool butadiene for storage in Day Tanks and Storage Spheres.

The evaluation was done to identify any performance differences (capacity gain or loss and power increase or loss) for the system, to determine any capacity deficiencies for the components and piping, and to determine the need for modification or changing system components. The evaluation was done for AM-1908 (the largest design heat load) with the results applicable to AM-3908, except minus the heat load for one sphere.

The refrigeration systems are packaged (skidded) industrial refrigeration systems, each with two Carrier 5H80 reciprocating compressors, a water-cooled refrigerant condenser, a high pressure refrigerant receiver, a suction accumulator, suction/liquid heat exchangers, valves and control valves, and interconnecting piping. Six refrigerant flooded heat exchangers are installed near each refrigeration skid for cooling butadiene.

Compressor capacities for the Carrier 5H80s for R-434A were estimated by comparison of displacements with compressors that have published ratings for R434A. Published ratings for R-434A are not available for the 5AH80s. R-22 ratings were taken from Carrier rating tables.

The results of the evaluation show that the R-22 refrigeration systems are good candidates for conversion to R-434A (RS 45). The evaluation also showed that other components: BD heat exchangers, condenser, receiver, and suction accumulator, should be adequate (the suction accumulator is significantly oversized for R-22 and will be adequate for R-434A).

B.

Below we will discuss the findings and show the results of the retrofit: Our preliminary findings also concluded that some significant issues were discovered with the ability to maintain proper refrigerant levels (imperative to proper oil recovery) in the exchangers.

Comparison between R-22 and RS-45 environmentally friendly retrofit		
	RS-22	RS-45
Suction Pressure	55 psi	60 psi
Discharge Pressure	190 psi	210 psi
Condenser In	140° f	140° f
Condenser Out	81° f	81° f
Heat Exchanger In	60° f	60° f
Heat Exchanger Out	100° f	100° f
Suction Temp	65° f	60° f
Discharge Temp	175° f	175° f
Oil Pressure	45 dp	55 dp

As you can see from the side-by-side comparison, the same operating parameters were easily achieved. EPA compliance has been simplified with this environmentally friendly zero ODP economical option RS-45.

After the retrofit having proper refrigerant charge and minor adjustments, critical skimming level of 70% to 75% was easily achievable.

Our preliminary findings also concluded that some significant issues were discovered with the ability to properly return oil through the suction accumulator without assistance of a steam false heat load. Utilization of a false heat load causes both a safety risk, as well as severe acceleration of deterioration to the shell of the suction accumulator. The in-house refrigeration team also stated at this time that if the skimming lines were to be left in service the system would have a high level trip in the accumulator. After the retrofit, having skimming lines in operation as designed is imperative to maintaining both proper oil return and the level in the accumulator. It is not necessary to add a steam false heat load to operate this unit. Doing so will cause premature failure to both the suction accumulator vessel and also potentially lead to excessive suction superheat, which will detrimentally effect the longevity of the compressor. Proper monitoring and execution of oil return will eliminate the need for the previous practices.

RECOMMENDATIONS

Moving forward the following suggestions would greatly increase reliability and operation of the equipment:

- **Adjust the PLC Lead/Lag logic to operate at designed operational parameters to satisfy your process design parameters. At this time, your Lead/Lag parameters appear to be calling for the lag system at the 65psi range+/- 2 psi. The new refrigerant should run 65psi to maintain the same process temperature, whereas the old refrigerant had to be at 60psi. Our recommendation is that the suction pressure unloaders should be adjusted to maintain 65psi and the lag compressor should now be called at 70 psi.**
- **Proper skimming and level monitoring will be imperative.**
- **Ensure proper operation and temperature set point and sizing of immersion heater is being utilized in the suction accumulator.**
- **Please keep in mind the utilization of a steam false heat source is not system design.**
- **Perform periodic refrigerant and oil analysis.**