Performance Evaluation of Refrigerants R-404A and R-407A in Varying Refrigeration Systems

Overview
New EPA regulations are requiring refrigeration companies to phase out of refrigerants with higher Global Warming Potentials in favor of safer options. TAFCO will be replacing their R-404A refrigerant with R-407A, which is within the required GWP level. However, this is expected to decrease the efficiency of the system.

Objectives
Our objective was to analyze the data of 4 coolers and 5 freezers to determine the efficiency trade off and provide design recommendations for increasing the efficiency of the system in order to compensate for the switch to the R-407A.

Approach
• Customer needs were gathered based on EPA regulations and communication with the sponsor.
• Extensive research was performed on the background information for refrigeration systems.
• We reviewed patents and existing components to determine optimum system designs.
• The test data, following the sponsor’s schedule, was extracted remotely via XWEB EVO software.
• The data was analyzed and manipulated in MS Excel.
• Results were compared to literature and the sponsor’s previous data for confirmation.
• The Coefficient of Performance was measured and used to determine real-time system efficiency.

Outcomes
• R-404A was more efficient at most times, as expected.
• We found that, during the highest point of stress, R-407A coolers are more efficient.
• Adding sub-cooling units, increasing coil size, and decreasing condenser temperatures will maximize the efficiency.
• Adding electronic system monitoring components would also greatly increases efficiency.
• Many of these additions and components can be implemented at low capital cost, allowing for the efficiency lost by switching to R-407A to be regained.