Field Study of CO_2 Refrigeration System Efficiency Options



This three-year field project investigated the grocery store CO_2 refrigeration system market and potential efficiency upgrades. Three installations tested the most currently relevant CO_2 system upgrade options for grocery stores in Minnesota.

Overall CO_2 Market Findings

1. It's very common to use CO_2 refrigerant when new grocery stores are built or a wholesale refrigeration system is replaced. In Minnesota's climate, CO_2 systems tend to have higher demand and lower annual energy use than traditional systems.
2. Technicians and operators are still becoming familiar with CO_2 systems, so as of today the market strongly favors simple efficiency upgrades.

Market Findings for Efficiency Measures

3. Adiabatic gas coolers already dominate the Minnesota market in larger grocery store CO_2 systems, although many smaller stores do not have them. The most common water on setpoint for adiabatic gas coolers is 75°F, which provides demand savings but limited annual energy savings.
4. There is strong local interest in two upgrades that have seen little use so far: mechanical subcooling and a flooded evaporator option called FTE that is available from one manufacturer.
5. Two other available technologies that have received national attention but limited local interest are ejectors and parallel compression. Local interest is limited due to the complexity of both and controller compatibility issues for ejectors.

Field Findings

1. Energy and demand savings were field verified for an adiabatic gas cooler, FTE, and a mechanical subcooler. FTE/flooded evaporators had about double the annual energy savings of the other two measures. On the other hand, FTE/flooded evaporators had about half the summer demand savings of mechanical subcooling and adiabatic gas coolers.
2. Lowering an adiabatic gas cooler's wet-dry switchover point from 75°F to 55°F tripled the annual energy savings achieved.

Recommendations

1. Promote optimization of the wet-dry switchover setpoint for new and existing adiabatic gas cooler installations.
2. Provide incentives for FTE/flooded evaporators and small system adiabatic gas coolers at the time of store construction and refrigeration system replacement.
3. Provide incentives for retrofitting existing systems with mechanical subcoolers or adiabatic gas coolers.
4. Track developments of emerging options. The most promising opportunities are the expected release of one or more expander options (e.g., Epta's ZTE system) and the potential resolution of controller compatibility issues for ejectors.

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This project was supported by a grant from the Minnesota Department of Commerce, Division of Energy Resources through the Conservation Applied Research and Development (CARD) program.