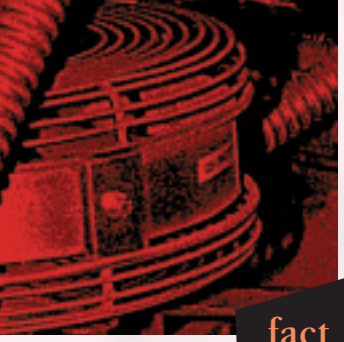


fact sheet

Cutting Energy Waste in Large Refrigeration Systems

Standard practices often aren't enough to keep costly inefficiency at bay

Hidden inefficiencies in your refrigeration system could be robbing you of thousands of dollars in energy costs and shortening the life of your equipment. At an ice arena in Madison, Wisconsin, for example, a mechanical engineering graduate student from the University of Wisconsin took a close look at a new refrigeration system. What he found added up to problems costing more than $19,000 a year.

Engineering graduate student Kyle Brownell demonstrates the effect of letting refrigeration head pressure "float"—a technique that should save an ice arena $9600 a year in energy costs.

Your refrigeration systems could be suffering from hidden equipment faults and inefficient controls. You might be surprised at how much money you can save—and how easily you can prevent costly problems—simply by installing proper monitoring equipment and adopting an efficient control strategy.

SOME COSTLY CULPRITS—A CASE STUDY

A plugged filter: $2300

Suction line filters keep the refrigerant clean and protect the compressor from ingesting damaging debris. One normally does not expect these filters to get dirty because the refrigerant system is sealed, but at the ice arena one of the suction line filters was found to be plugged. The restricted flow caused a pressure drop in the system that, according to computer models, was costing the facility $2300 a year, or about five percent of their annual operating cost.

> "We are a fourth generation butter manufacturer. We've been working with a refrigeration contractor since 1989 to cut the energy cost for our operation. We've been able to save tens of thousands of dollars by applying ideas such as floating head pressure."
>
> —*Stan Zander*
> *Zander's Creamery, Inc., Cross Plains,Wisconsin*

A low refrigerant charge: $7800

The system inspection at the ice arena also revealed a low refrigerant charge due to a hidden refrigerant leak. The leak was repaired and the system recharged, bringing about a dramatic performance boost. According to operational data taken before and after the repair, the low charge caused a 33 percent performance drop and was adding $7800 to annual operating costs.

A "standard" control strategy: $9600

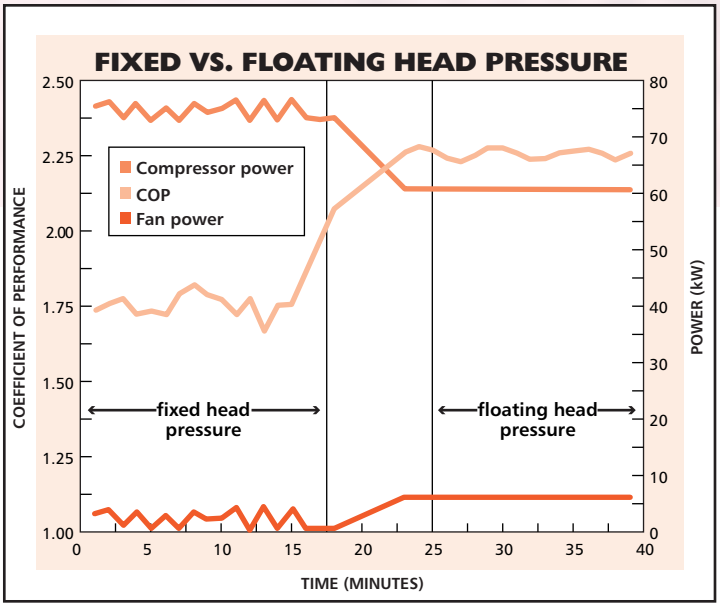
Sometimes a common, accepted practice is not the *best* practice. In many refrigeration systems, compressor discharge (head) pressure is kept at a fixed, high level to assure safe, reliable operation over a range of outdoor temperatures. Fixed high head pressure maintains adequate refrigerant flow, freeze protection for the evaporative condenser, and an adequate pressure difference across the expansion valve. But fixed head pressure isn't the only way to provide these assurances.

It's far more efficient to allow head pressure to "float" with ambient wet-bulb temperature, down to a minimum safe level for a given system. With floating head pressure, the system works only as hard as it needs to under all weather conditions, yet safety and reliability are maintained.

ENERGY CENTER
OF WISCONSIN
We show you how

595 Science Drive
Madison, WI 53711
Phone: (608)238-4601
Fax: (608)238-8733
email: ecw@ecw.org
www.ecw.org

10/99



As head pressure is allowed to float, the efficiency of the refrigeration system (COP) rises and total power draw (fan plus compressor) drops.

When head pressure floats, the evaporative condenser fan operates continuously instead of cycling on and off. Although this consumes more condenser fan energy, it is more than compensated by the much larger decrease in compressor energy use. In addition, eliminating fan starts and stops can prolong fan belt and motor life. And because floating head pressure reduces compressor operating pressure ratios, it greatly reduces wear on compressor parts.

At the ice arena, switching to a floating head pressure control strategy boosted their system efficiency—providing annual cost savings of $9600 based on monitored operational data taken before and after the change. This simple change in control strategy cut projected overall operating costs by 21 percent.

BETTER PRACTICES

Are there hidden inefficiencies lurking in your refrigeration system? Are you using the most efficient control strategy? Monitoring equipment costing about $840 as well as consultation with someone familiar with floating head pressure could have prevented the ice arena's costly problems. This experience led to the following general recommendations developed at the University of Wisconsin and published in the *ASHRAE Journal* by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers. You don't need to implement these recommendations all at once.

> "We use floating head pressure quite often. If you're careful not to set the minimum pressure too low, floating head pressure will save a lot of energy. We've been doing it successfully for years."
>
> —*Mark Madigan*
>
> *Madigan Refrigeration, Waunakee, Wisconsin*

Monitor your filters

Install differential pressure gauges to monitor pressures across all suction-line and liquid-line filters. These will detect any pressure drop across a filter, flagging a need for a new filter or some other problem with the system.

Monitor your refrigerant charge

Install a pressure switch connected to an alarm that indicates when a high-pressure receiver relief valve has opened. Also install level indicators and angle valves to show the level of the liquid in the receiver. This equipment can quickly alert operators to possible refrigerant loss or other costly problems with the system.

Use a floating head pressure control strategy

Consult a refrigeration expert familiar with floating head pressure. Your minimum safe head pressure depends upon the expansion valve installed and the maximum heat rejection capacity of the condenser. Head pressure need only be controlled to float above this minimum to achieve the same level of safety and reliability provided by a high, fixed head pressure.

LEARN MORE

Find out more about preventing malfunctions, using floating head pressure, and the experience at the ice arena:

Refrigeration System Malfunctions—Monitoring to Prevent Problems.
By Kyle A. Brownell, Sanford A. Klein, and Douglas T. Reindl. ASHRAE Journal, February 1999. Available on-line at www.ashrae.org.

Investigation of the Field Performance for Industrial Refrigeration Systems.
1998 Master's thesis by Kyle A. Brownell. University of Wisconsin-Madison. Energy Center of Wisconsin publication 174-1.

Fixed and Floating Head Pressure Comparison for Madison Ice Arena.
1998. By Kyle A. Brownell. Energy Center of Wisconsin publication 174-2.

Industrial Refrigeration Systems—Operation and Maintenance Tips to Reduce Energy Use.
Provided by the Pacific Gas & Electric Company at www.pge.com/pec/inftoc/facirefg.html

ABOUT US

The Energy Center of Wisconsin is a private nonprofit organization dedicated to improving energy efficiency in Wisconsin. With support from Wisconsin's energy utilities, the Center provides energy efficiency programs, research, and education to residents, businesses, and government.

ENERGY CENTER OF WISCONSIN
We show you how

Copyright© 1999 Energy Center of Wisconsin