Upgrading Cold Storage Doors

Decreasing energy costs and increasing safety

by Jon Schumacher

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THERE IS A COMMON MISPERCEPTION THAT CHOOSING FREEZER DOORS MEANS MAKING COMPROMISES BETWEEN AIR TEMPERATURE CONTROL, PRODUCTIVITY, AND UTILITY BILLS. THANKS TO RECENT ADVANCES IN DOOR TECHNOLOGY, THIS IS NO LONGER THE CASE—COLD STORAGE FACILITY MANAGERS CAN HAVE THEIR ICE CREAM CAKE AND EAT IT TOO.

Pros and cons of traditional freezer doors

Refrigerated spaces are designed to trap cold inside and keep heat and humidity out. The traditional way to approach this was to install heavy, insulated, rigid doors with a high R-value. These side-acting doors are suitable for low-traffic openings, but they are typically slow-moving—resulting in longer door cycle times and higher rates of air infiltration.

While it is true higher R-values mean less energy loss through door panels (*i.e.* conduction), there is also a downside. Having a slow-moving door makes maintaining temperature control inside the freezer difficult and hampers productivity. Further, traditional hard-core doors are susceptible to forklift damage. Unless the damaged door is quickly fixed, there can be substantial energy loss as a result of poor sealing. Thus, for high-traffic openings, energy loss due to the door being open or improperly sealed (*i.e.* infiltration) can represent a significantly larger cost component than energy losses due to conduction.

As an alternative to hard-core doors, high-speed roll-up doors and folding doors are sometimes chosen. These doors move quickly and work to minimize air infiltration via a short open/close cycle time. However, some models have poor sealing characteristics or an R-value too low to prevent frost from building on the door panel surface itself. To alleviate this problem, it is common for defrost systems to be added to these doors at an operating cost of $7000 to $10,000 or more annually.

Other traditional approaches include strip curtains and air curtains. Like all options, these designs have their own pros and cons. Strip curtains, which are comparatively inexpensive,

consist of clear plastic strips suspended in the opening. Although the low upfront cost is appealing, they are not particularly good at sealing most freezer applications—this ultimately makes them an expensive choice in the long run.

Additionally, their R-value is very low, making frost buildup a potential problem. This can lead to hazardous working conditions as scratches in the plastic and frost on the strips can obscure a forklift driver's vision, and the poor seal allows for frost and ice to build up on the floor.

Air curtains can be either standalone or housed in multiple units integrated into a vestibule assembly. Often, these systems do not seal the opening well, and proper alignment is critical for best performance. Vestibules can also require a large footprint, eating up valuable floor space.

Air units generally consist of heaters that reduce the relative humidity (RH) of the infiltrating air. Unfortunately, a tremendous amount of energy is needed for them to operate at a level that keeps the opening free of ice and frost.

Advanced bi-parting doors can operate up to 2.5 m (8 ft) per second—a speed three times faster than traditional, rigid, side-acting doors.

These doors move quickly and work to minimize air infiltration through short open/close cycle time.

Recent improvements in industrial door technology have increased safety, improved efficiency, and lowered energy costs.

No matter how one looks at it, traditional doors incur high energy costs. Significant air leakage at the opening makes it difficult to maintain proper freezer temperatures. Additionally, frost and ice buildup can often lead to serious issues unless an expensive door panel defrost system is included. Overall, these high costs have driven demand for better options.

New freezer door technologies

Recent improvements in door technology combine fast cycling with high-efficiency insulation and sealing. These innovations contribute to low long-term energy costs, and improved efficiency, as well as increased safety. In short, high R-value is no longer the main driver in door selection.

Major advances in door design have focused on improved bi-parting doors and insulated upward-acting doors. Advanced bi-parting door designs include high speeds to minimize door open time. Some doors can operate up to 2 m (7 ft) per second, which is up to four times faster than old-style, rigid, side-acting doors.

Additionally, new technically advanced freezer doors have the ability to withstand forklift impact, which minimizes maintenance and downtime while maintaining a tight seal over the door's life. Some impact-resistant doors offer higher R-values, reducing the need for heated panel defrost systems. Other models even offer torque-sensing reversing capability, which eliminates safety and maintenance concerns with doors that use pneumatic or electrical reversing edges for the same purpose.

Significant improvements in the roll-up design category include reduced cycle times and the use of insulated door panels. These insulated panels provide a high enough R-value to avoid needing expensive panel defrost systems.

The fastest roll-up doors can operate at 2.5 m (8.3 ft) per second—a rate which minimizes air infiltration and ensures optimal productivity. As with bi-parting doors, newer upward-acting doors also incorporate a perimeter thermal air seal for added energy savings through a tighter seal.

Quantifying the benefits for Arctic Cold Storage

One company that made the move to high-tech, high-speed doors was Arctic Cold Storage (ACS) in St. Cloud, Minnesota. With more than 155,743 m^3 (5.5 million cu ft) of temperature-controlled warehouse space, energy consumption was a significant issue. Previously, the company's 7432-m^2 (80,000-sf) facility had used numerous different methods to keep its refrigeration systems running at peak performance, including an 'air curtain' for its forklift service passages. However, when additional service doors needed updating inside the warehouse, the organization began looking at more technically advanced alternatives.

Eventually, two tight-sealing, insulated, high-speed roll-up doors were installed to access cold storage areas. In addition to anticipated energy savings, these doors also offered numerous safety benefits. Their features included through-beam photo eyes that constantly monitor the opening and reverse

Some roll-up doors can operate as fast as 2.5 m per second—a rate which minimizes air infiltration and ensures optimal productivity.

the downward direction when obstructed, as well as motion sensors and light-emitting diode (LED) lights to alert employees to equipment or pedestrians that are moving on the opposite side of a closed door. Additionally, their tight-sealing soft-bottom edge helps protect personnel from injury in the event of accidental impact.

After experiencing the performance of the first two doors—and capturing an estimated annual energy savings of $8130—ACS installed four more high-speed freezer doors. Five were used to help ensure a temperature difference of 16.7 C (30 F) between separate areas. Specifically, one space is maintained at –21 C (–5 F) and another is held at 1.7 C (35 F). The sixth door helps ACS keep a space in one area at –21 C and another at –12 C (10 F).

The six doors (each of which activates an estimated 2500 times daily) allow ACS to save an estimated $48,780 annually in energy costs, with nearly 100 percent uptime.

"We have seen greater efficiency in our daily operation," says the company's general manager, Jay Condon. "We don't have to concern ourselves with cloudy strip curtains, and we're able to better maintain temperatures using less energy. And, given the safety features and impact-friendly design of these doors, we no longer have to worry about unnecessary energy use or downtime."

Blast freezers

Blast freezers present their own unique set of door challenges. Also known as 'shock' freezers, they are widely used in the food industry (and some commercial kitchens) to quickly freeze everything from TV dinners to fish to ice cream. Blast freezers are growing in popularity since their extremely cold temperatures induce very rapid freezing, which creates small ice crystals. (The smaller the crystals, the less damage to the food, as large crystals can rupture cells.) Once food has been frozen in a blast freezer, it can be moved to a more conventional freezer for storage, as long as it stays cold enough to keep the food frozen.

Unfortunately, the huge size of many blast freezers—combined with other issues like pressure and frost buildup—often makes their insulated panel doors very unwieldy. In some cases, these huge doors (which can be as large as 8 x 8 m [25 x 25 ft]) have become so heavy and hard to use that employees have resorted to dangerous methods to open them, such as using a forklift. In other cases, there are problems with closing them, thus wasting energy.

Fortunately, a relatively new building technology—fabric walls—has now been adapted to provide a light, safe, and affordable thermal barrier alternative for blast freezer cells. As the name implies, fabric walls are very different from traditional solid walls or rigid panelized systems because they are not considered permanent structures. As such, they can be quickly and easily installed, dismantled, and re-installed, all of which lend to a high degree of flexibility.

A fabric wall can be used in place of a conventional wall in virtually any non-load-bearing application. They are omni-functional and offer flexibility in:

- managing physical space;
- improving productivity;
- saving energy;
- recapturing needed floor space;
- controlling temperature, odor, dust, and sound; and
- improving or protecting the bottom line.

The fabrics used to form the actual walls differ in materials and properties, allowing them to be precisely matched to the application. The walls can be installed as stationary systems or sliding units. Stationary walls can be affixed to existing building structures (*e.g.* ceiling joists) or custom metal frameworks can be constructed. Sliding walls operate on a track-and-trolley system. The operating environment and a host of site-specific factors dictate the type of fabric wall and configuration best suited for a given situation. Aside from the type of fabric walls available, there are virtually no limits to how the systems can be configured.

In the past, the massive panels of blast freezer doors made them difficult to open and close. Today, new technology has helped alleviate this issue.

In the past year, customized curtain walls have been designed specifically for blast freezers—potentially eliminating the need for heavy and dangerous insulated panel doors. These flexible sliding fabric 'walls' provide a safer and simpler alternative for food processors to quickly bring products to an optimal temperature to maintain their freshness, safety, and integrity. Blast freezer curtain walls are made of insulated, sliding panels nested in a tubular steel frame. Each panel is constructed of 560-g (18-oz.) industrial vinyl fabric surrounding a layer of anti-microbial polyester batting. The panels slide open and closed on a track-and-trolley system and are available in three design options:

- between jambs;
- face-mounted single slide; or
- face-mounted bi-parting.

Engineered to be light and easy to use, blast freezer curtain walls form a safe and affordable airflow and thermal barrier and can be operated by a single person. Their tight and effective seal redirects the chamber's airflow, making it more efficient, reducing blast cycle times, and lowering energy consumption. Their seal also minimizes ice buildup on the floor at the base of the doors, reducing the chance of employee injuries from slips and falls. Additionally, blast freezer curtain walls require minimal long-term maintenance and are generally easier to install and less expensive than a traditional wall/door combination.

The bottom line

The expectations placed on cold storage doors are significant. In the food industry, product integrity is of the utmost importance and proper temperature control is essential. Given the challenges and tradeoffs posed by traditional door designs and operating environments, finding the perfect cold storage cell door or blast freezer door can be a daunting task. Fortunately, there is no need to compromise any longer. Improved technology has 'opened the door' to more options that result in low, long-term energy costs, improved efficiency, and increased safety. **CS**

ADDITIONAL **INFORMATION**

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Abstract

The traditional freezer door approach has involved heavy, insulated, rigid doors with high R-values. However, new high-speed door technologies offer intriguing alternatives. Recent improvements in door technology combine fast cycling with high-energy insulation and sealing; the result is increased safety, improved efficiency, and lower energy costs. Many of these new-generation doors can also withstand forklift impact, leading to less downtime.

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