# Frozen To The Core

Controlling key design and operation variables can help you avoid some of the most common problems encountered in freezing food products.

By J.D. Wasir, P.E., KoolJet Inc.

When freezing food products — especially meat and seafood — there is little room for error. Food safety and appearance demand an efficient, effective and reliable process.

Three critical factors can influence the ability of freezer equipment to perform effectively:

- The air movement across the food.
- The evaporator coil design.
- The overall equipment hygiene.

By controlling these variables, you can avoid some of the most common problems.

## Air Movement

An appropriate air pattern within a freezer is one of the most important parameters for achieving efficient freezing (figure 1). The evaporator fans must be designed to provide the high air velocities needed to penetrate the food thoroughly and freeze the product to the core quickly. To ensure sufficient airflow across the evaporator coils, an optimum face velocity must be maintained on the finned surface of the evaporator coil.

In some cases, increasing the air volume within a freezer can speed the freezing process. However, it also substantially increases the horsepower requirements of the fan motors. While installing a larger motor will increase the amount of available horsepower, it also will generate a sizable amount of heat in the cold room, which can strain the system capacity and lead to equipment failure. When making adjustments to the airflow, make sure all of the equipment components can handle the increased load.

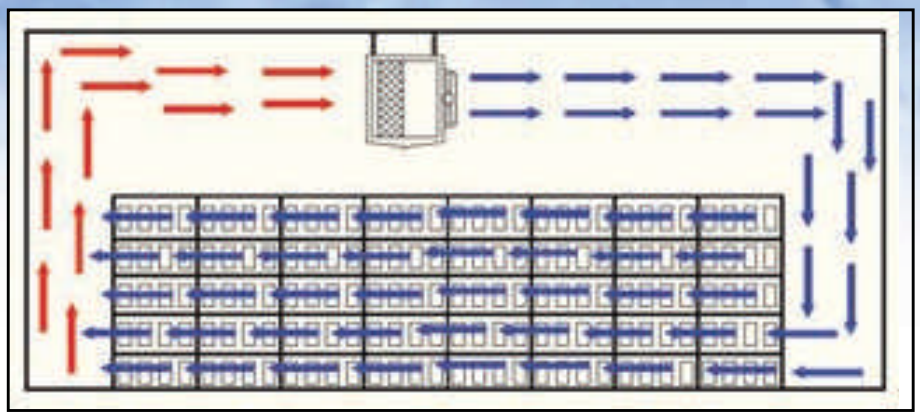

***Figure 1.*** *An appropriate air pattern within a freezer is one of the most important parameters for achieving effective freezing. In the illustration above, the blue arrows represent cold air flowing over the product and the red arrows represent warm air returning to the evaporating unit in an efficient and effective airflow pattern.*

## Evaporator Coils

Evaporator coils operate at extremely cold temperatures and often experience a buildup of frost or ice. This buildup reduces the heat transfer rate in the evaporator and also restricts the airflow. Periodically defrosting the coils with hot-gas, water-spray, electric or other defrosting methods can help prevent these problems. However, frequent defrosts can decrease the system's cooling time, which can increase the freezer room temperatures above the acceptable tolerance.

A better approach is to minimize frost and

## Web Exclusive

**Read more at www.process-cooling.com**

- **Ultra-Low Temperature Tuna Storage**
  A seafood distribution center in Toronto needed an storage facility capable of maintaining a constant temperature of -76°F (-60°C).

ice buildup with the right evaporator coil design. For example, coils with approximately three to four fins per inch optimize the air bypass factor and therefore reduce frost buildup. Using coils with a lower fin density also will reduce the amount of defrosting time required. Similar results can be achieved by using flat fins over the V-waffle or sine wave fins in the evaporator coil.

Another way to reduce frost buildup is to make sure that the temperature difference between the evaporator coil and the room air temperature does not exceed 10°F (6°C) by using "right-sized" coils. Coils that are too small often are overworked and cause more condensation, which leads to frost and ice buildup in the freezer.

The proper selection and placement of nozzles in orifice-type distributors also play a vital role in coil performance. For systems using hot-gas defrost, a side port connector should be used in the distributor to bypass the nozzle during defrost mode. If the nozzle is not bypassed, it can restrict the hot gas flow to the coil, which can lengthen the defrost time and degrade the vapor quality.

Regardless of the coil design, keep in mind that the moisture vapor pressure of the air at the coil generally is lower than the moisture vapor pressure of the air within the food package and in the freezer room. This pressure difference results in sizeable moisture loss from the product. Make sure to use a suitable packaging material that provides adequate protection to avoid food shrinkage.

## Equipment Hygiene

Improperly designed freezers can contribute to food contamination and bacterial growth. For this reason, freezer cleanliness is an equally important part of freezer design.

All freezer components must be made of food-grade, rust-proof materials, and air from raw product storage rooms should not mix with air from the finished or cooked product storage rooms. The refrigeration piping in the cold room as well as all drain pans should be sufficiently insulated to prevent condensation from forming and dripping on the food products. The freezer system also should be designed for rapid disassembly and reassembly to facilitate cleaning.

Whether you design or retrofit your own freezer system or work with a supplier, following these guidelines can help you ensure that your food processing operation remains efficient and problem-free. **PC**

*J.D. Wasir, P.E., is vice president of KoolJet Inc., Tillsonburg, Ontario, Canada, a manufacturer of freezers, hydrocoolers, chillers and other refrigeration systems. For more information, call (866) 748-7786; e-mail jdwasir@kooljet.com; or visit www.kooljet.com.*