



# Cryogenic Tunnels Do More Than Just Freeze

**Cryogenic tunnels can ease the challenges associated with many food processing applications, enabling food processors to boost productivity.**

By Air Products Food Group

**M**any food manufacturing processes require heat removal. Whether it is livestock that arrives at the factory already hot, or prepared meals that undergo heating as a step in the process, some form of heat nearly always must be removed prior to shipment. For many food processors, cryogenic tunnels using either liquid nitrogen or liquid carbon dioxide are a versatile option for the final freezing of food products. Like other forms

of refrigeration, however, cryogenic tunnels also can be used effectively to remove heat in order to cool food products prior to final packaging and shipment.

Food processors choose cryogenic tunnels as a freezing and chilling solution in their food manufacturing operations for several reasons. First of all, cryogenic tunnels are relatively small due to their extremely cold operating temperatures (from -100 to -200°F [-73 to -129°C]). For any given production rate,

a cryogenic tunnel can employ a shorter belt versus other refrigeration options. A shorter belt generally goes hand-in-hand with a smaller equipment size, which equates to fewer surfaces and less belt to clean, sanitize and inspect. Also, a smaller piece of equipment frees up valuable floor space for other production activities.

Cryogenic tunnels also are chosen because they sometimes can eliminate one of the heat exchange steps within the refrigeration equipment. Mechanical



**Gas-movement fans in a liquid nitrogen tunnel freezer facilitate heat transfer within the tunnel during chilling and freezing.**

refrigeration systems using ammonia or chemical refrigerants require two heat exchange steps in order to chill or freeze food. First, the refrigerant exchanges heat with the air in the chamber. Second, the air exchanges heat with the food.

By contrast, in a typical cryogenic tunnel, the refrigerant (liquid nitrogen or liquid carbon dioxide) exchanges heat directly with the food, eliminating the refrigerant-to-air heat exchange. This is important because the refrigerant-to-air heat exchange can be cumbersome and inefficient. Also, it requires additional components, including coils and fins. Compared to cryogenic freezing, mechanical refrigeration systems are large in size and include many moving parts, greater surface area to clean, and frost buildup to contend with. In short, the heat exchange between chemical refrigerants and the air inside a chiller/freezer requires larger, more complex

and potentially more difficult-to-clean equipment than an equivalently sized cryogenic freezer.

Another benefit to cryogenic tunnels is that they provide high chilling and freezing quality. Slower freezing such as that provided by a mechanical refrigeration system, often leads to the formation of large ice crystals in the food product and higher dehydration, both of which damage the food and lead to poor quality. Freezing food quickly at cryogenic temperatures significantly limits or even prevents the formation of large ice crystals and effectively locks the moisture in place, greatly reducing dehydration.

While cryogenic tunnels commonly are chosen for their small size and the speed with which they freeze or cool food, they offer benefits in many applications up and down the processing line.

### **Crust Freezing with Cryogenic Tunnels**

Crust freezing is the first reaction that occurs when something is frozen. For example, if you place something in the freezer, the outside freezes first because it is in closest contact with the cold air in the freezer. With time, the item will continue to freeze from the outside in until it is completely frozen.

Having the ability to stop the freezing process with only a frozen crust can be beneficial in some food processing applications. Using a cryogenic tunnel to crust freeze certain food items can facilitate much cleaner downstream processing and reduce waste.

For example, crust freezing deli meats promotes clean cutting and slicing. With products such as grilled chicken breasts, calamari and bacon, crust freezing allows them to be sliced



**Crust freezing pizza in a cryogenic tunnel freezer facilitates handling and packaging while improving the aesthetics of the packaged product.**

or diced cleanly before packaging or further processing. This can help ensure better-looking products and more uniform sizing and help eliminate waste. Meat stuck to blades or protein “shrapnel” landing on the production room floor costs food processors millions of dollars each year.

Placing a high powered, small-sized cryogenic freezer upstream of the cutting, dicing, slicing or mincing operation is a way to impart a useful frozen crust to many food items.

### **Coating/Glazing with Cryogenic Freezers**

Many food products are coated in the production environment. Coating is a technique used by food processors to add value to a product as well as to deliver branded flavor to restaurateurs or consumers. Glazing is

another technique used by producers of individually quick frozen (IQF) products to keep food pieces from sticking together and to remain separated in the final package. It also prevents freezer burn and dehydration.

At the same time, coating and glazing can be challenging for food processors in terms of obtaining the required pickup of sauce or water. Achieving the proper amount of sauce can be particularly difficult with par-cooked or fully cooked products. Over the production day, the sauce can increase in temperature, the product can increase in temperature or the sauce can thin. If pickup is a challenge at the beginning of the production day, it is even more so by the end of the day.

For coating applications, quickly chilling a food item immediately before the coating system allows for improved

pickup quantity and, therefore, quality. Adding a cryogenic tunnel to the processing line allows many food processors to strike a proper balance between chilling and shake-off.

In glazing applications, having glazed foods drag excess water into the final freezer is a problem for belt performance and sanitation. A cryogenic tunnel freezer can be used to add a crust freeze to food items immediately before a glazing bath or spray, allowing for maximum pickup. Food processors can precisely dial in the percentage of pickup required with a tunnel freezer.

### **Setting/Firming with Cryogenic Tunnels**

Setting or firming of a product prior to the succeeding steps is necessary in certain food production processes

such as those for making layered items, delicate foods, appetizers and entrees. Using a small cryogenic tunnel for firming up a surface, setting a dripping sauce, fixing a loose ingredient or solidifying a layer can improve productivity, food quality and appearance. Additionally, waste of poor- or unacceptable-quality product is reduced or eliminated.

Some newer vacuum packaging methods that highlight the color and texture of the food contents use thin films that cling to the food products. Using a quick-firming surface freeze with a cryogenic tunnel freezer on these products helps prevent collapse of the food during the vacuum packaging step.

In conclusion, cryogenic tunnels traditionally have been used as the final step in the food-manufacturing process for freezing products prior to packaging and shipment. Given their small footprint and the speed with which they

chill and freeze, however, cryogenic tunnels also can be valuable up and down the production line.

Cryogenic tunnels can ease the challenges associated with food processing steps such as cutting, slicing, dicing, mincing, coating, glazing, setting and forming. Utilizing cryogenic tunnels can enable food processors to boost productivity, reduce waste and improve the quality and appearance of their products. If heat is creating a trouble spot in your food processing operation, a cryogenic tunnel may be the solution. **PC**

*Air Products, Allentown, Pa., is a manufacturer of industrial gases and related equipment and experienced in cryogenic technology applications. For more information from Air Products, call 800-654-4567 or visit [www.airproducts.com/food](http://www.airproducts.com/food).*

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## Process too hot?

We have the liquid nitrogen, equipment and knowledge, to cool things down quickly.

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