REFRIGERATION REVIEW

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MATERIALS HANDLING

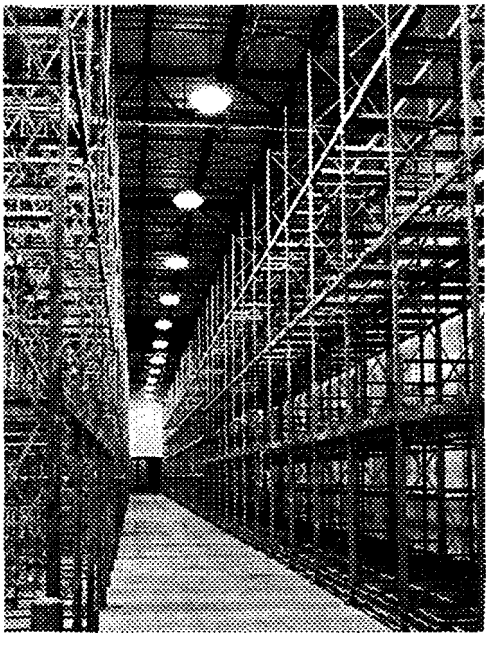
Public refrigerated warehousing was the genesis of perishable food distribution. Prior to then, fresh or fresh frozen products were only available on a local basis. Because of the complexity of early refrigerated facilities, central major installations provided public needs with large efficient installations.

Although today perishable space is shared (nearly) equally between private and public operators, the application of material handling systems has differed substantially, depending on whether the space is made for production or distribution purposes. Distribution facilities' racks and/or fork trucks vary widely as a function of many parameters: size of lots, pallets, cost of pallet position, number of line items (sku's), and cost of labor, to name a few. Generally, compromises are made between optimum retrieval times, cost of construction, operating cost, and maintenance of the refrigerated facility.

Obviously, larger lot sizes and a slower turnover lend themselves to deeper and higher rack slotting. Public warehouse facilities' material handling configurations are quite often dictated by the needs of the customers, whether it be cranberries in bulk, peas in Wisconsin, cherries in Michigan, distribution in the New York area, staging for export ships, or poultry freezing in Georgia. Seasonal turnover is also a big factor in fruit and vegetables.

Distribution facilities also vary depending on specific needs. Generally, because of the nature of distribution, higher turnovers are anticipated. With a variety of distribution needs (variable shelf life), flexibility becomes paramount in rack and material handling systems. Available inventory and location control becomes increasingly complicated when compounded with such things as two deep or more product storage. Picking of second pallets (in two-deep) can be time consuming and counter-productive in maintaining pallet positions. Attempts have been made at using a narrow and high stacking pallet storage system. Unless "real-estate" (pallet slot costs) become excessive, generally retrieval cost and time will favor the typical 10' aisle and 1-deep picking to maintain service levels for small and large lot customers. We have seen some sad attempts with use of narrow aisle systems and limited access to pallet slots. Computer programs can be used to analyze product flow with help through associations such as retail grocery associations.

We can give you our opinions, or for further assistance, you can contact Gary Lester in Jacksonville, Florida at (904) 389-6700.



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"SUPERBLAST"

Over the years, we have helped develop a number of blast freezing systems. Most of these, known as "superblasts" (as in supercharge), originated from developments at Cassco, Harrisonburg, Virginia, in the early 1980's. They were refined later at Wiscold (to then-CEO George Sayres' credit), and have "evolved" substantially in many other facilities since. Traditional blast freezers had used air unit evaporator fans as the vehicle for "moving" air through **palletized boxed** product.

This method had two major disadvantages:

- The **first** was the lack of definitive air flow and direction.
- The **second** was the air unit evaporator gradually collects moisture (ice) and eventually "blocks off" the air passing through the evaporator unit, substantially decreasing air quantities that are needed for good heat transfer.

The **superblast** overcame these two deficiencies in providing auxiliary fans for *uniform* and *continuous* air flow through the product (even though the air unit evaporators go through their cyclic process of collecting moisture and defrosting). Another primary advantage has been the ability to freeze bulk product (60 to 70 lbs. boxes) in a two-day rotation, where before three-day rotations had been required. This means a substantial reduction in "real estate," as well as "quicker" (typically 30 hours) turn around of products.

The other major advantage is the ability to use higher-temperature air (-15° F. to -20°F.), as opposed to -30° F. to -40° air. The effect of this is a substantial reduction in compressor horsepower (as much as one-third reduction in total power consumption by the compressor).

The later generations of superblasts also are now using computers to provide multiple air flow quantities, depending on the stage of freezing which may be occurring (removal of latent versus removal of final sensible heat in the product as the product temperature moves from freezing point to 0° F.). The ability to stage fans further improves efficiency while still maintaining optimum compressor horsepower. Staging of the air velocities by choosing a combination of air unit fan speeds and multiple motors, with or without booster or assist fans, has become standard procedure on the recently designed superblast freezers.

There have been several attempts to freeze product in 24 hours, or even 12 hours. Although some product, such as whole birds or cornish hens, have been frozen in 16 hours, products in 60 to 70 lb. boxes (poly bags) would normally require a two-day rotation in superblast freezers (this also allows for loading and unloading). Some of the larger blast cells have 60 to 90 pallets, which may require several truckloads of product to load and unload. It may be noteworthy, that, when needed, superblast temperatures can be lowered (to -35°F.) and provide 30-hour rotation, i.e. poultry products.

We hope this information will be helpful to you in considering blast freezing requirements and your needs in the future. You may want to seriously question anyone who claims the ability to freeze 60 and 70 lb. boxes (in poly bags) in a 24-hour rotation, at least determine operating cost, blast temperatures, and power (from an investment viewpoint). If we can help in the design of these, please feel free to call Henry B. (Hank) Bonar, II or Robert (Bob) Bonar at (904) 389-6700.

PSM

As everyone is aware by now, Process Safety Management (PSM) has arrived. Although many industries are still clamoring to find a "generic" manual, the current efforts we have seen are falling substantially short of satisfying the OSHA 1910.119 process safety requirements (as we interpret them for refrigeration facilities with more than 10,000 lbs. of ammonia).

Many "Guides to PSM Manuals" are just that - guides. They provide general topic discussions of requirements of the Federal Register. The sixteen elements of the Register are very specific with many subparagraphs of individual requirements. Based on our observations of the fines, and compliance directives, the references are very specific.

We are recommending a specific and convenient description of each requirement for better and easier interpretation.

For information contact Carol Williams or Robert Bonar in our Jacksonville, Florida office at (904) 389-6700.

INDUSTRIAL REFRIGERATION IN THE HEART OF RUSSIA

We have had the recent opportunity to make visits to Russia and see firsthand what the refrigeration industry provides for perishable storage distribution. In addition to refrigerated facilities, refrigeration compressor manufacturing plants were visited. Having been a professional curiosity of Hank's (Henry Bonar, II), the trip was indeed a rewarding experience, and one that has provided deep appreciation of advances in a country without free enterprise incentives. In this brief article we will try to give you one descriptive "snapshot" of a major refrigerated facility.

One town we visited had a population of 700,000 people. Ten years earlier, it had a population of 30,000. The "Man-Made" town's focus was a large truck factory (largest in the world). The town has a refrigerated storage facility which also serves the needs of an ice cream manufacturing facility (ice cream cones).

The facility, approximately 2 million cubic feet, had some unusual amenities, such as a barber shop, a dentist, an obstetrician, and a small shop for employees. The loading docks were open, with multi-story refrigerated areas four stories in height, including a basement story level similar to facilites in older metropolitan areas such as those built in Jersey City, Philadelphia, and Chicago from 1910 to the 1940's.

The refrigeration equipment, particularly compressors, was very similar to those manufactured in the United States. Many of the exotic features, such as thermosyphons, were not present, but efficiency would be on a par with the United States. The absence of fan-driven air units was noteworthy, although condensers were similar (except for the use of fin coils). Generally, perishable products consisted of bulk storage of raw materials. Very little "packaging" material was available, and poultry was frozen in "open" crates similar to our plants in the 1950s. Usually one year's supply is kept on hand. Based on observation, even in metropolitan areas, 70-80 percent of the food consumption would be "fresh" or freshly processed, or "canned."

(To be continued next issue.)

EVAPORATIVE CONDENSERS

On occasion we are asked about condenser piping. There are several misconceptions by some engineers and contractors passing about in our industry.

Condensers have more "mystique" about them than any other portion of the refrigeration system. Understanding condensers necessitates understanding not only refrigeration thermodynamics, but also the psychometric relationships of water, water vapor, and water vapor and air. In a very technical sense, this gets into vapor pressures and relationships of wet bulb and relative humidities.

I will try, in layman's terms, to explain some of the "phenomenon" that may be observed. As a preface, you can be assured that the following are **true** in the operation of evaporative condensers:

1. **"Open drain"** piping systems for evaporative condensers equalized to the receiver through their condensate drain lines, is the best equalizing method. It uses the entire pipe size for equalizing. Trapped drains with **small** equalizing lines will sometimes have trouble equalizing pressures. This can be observed by feeling these lines on occasion and observing that they become warm in their efforts to equalize.

2. **Purging** of air is much simpler on condensers equalized through open drains. This is because the air can be purged directly from the receiver or drain line header going to the receiver (individually trapped condensers need to be purged at every outlet connection).

(Continued on next page.)

COMING NEXT ISSUE...

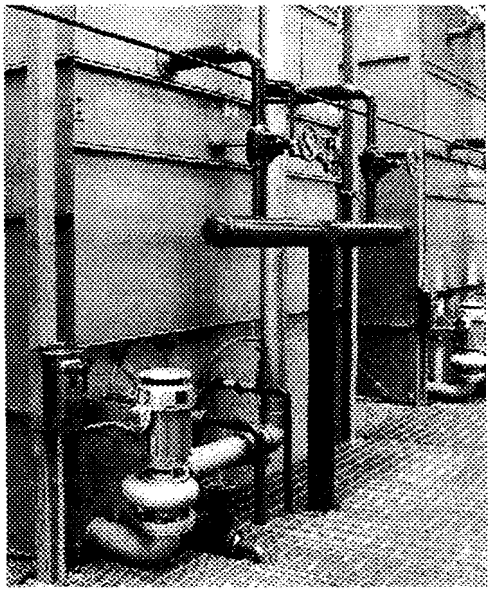
- *Industrial Refrigeration in the Heart of Russia "Continued"*
- *More on Evaporative Condensers*
- *More on Process Safety Management*

Exceptions to the "normal" operation include the following:

1. **Temperature inversion** - On occasion, condensers and condenser platforms (the same as the automobile sitting in the open) will experience lower surface temperatures because of radiation to a clear sky. The surface temperature of the metal will be lower than the air adjacent to the metal. When the surface temperature becomes lower than the dew point (the inversion on a clear night will normally reach a temperature difference of ~7° F), (water) condensation will form on these metal surfaces.

2. When there is an abundance of condensers on a refrigeration system, such as on cool days, and the relative humidity is low, the wet bulb temperature of the air can be 10° to 15° lower than the ambient air. There are occasions when this occurs that "natural convection" will produce air temperatures (and consequently, refrigerant temperatures) that are lower than the temperature of the air (if the fans were blowing). When this occurs, some unusual phenomenon can be observed in the evaporative condensers. If enough convection (or slight breeze) is available, it would be possible to operate condensers without the fans running (when the refrigeration load is low) and provide discharge pressures lower than if the fans were operated on a few of these condensers. This, of course, is not recommended as standard procedure, since you never know when the humidity will be high. Humidity is normally high in the early morning, but can be high for extended periods, depending on the "frontal" systems active at the time.

(To be continued next issue.)



Evaporative condensers at Publix Super Markets, Deerfield Beach, Florida.

REFRIGERATION REVIEW
A Publication of Bonar Engineering, Inc.
Editor - Amy S. Hartwig
Mail or Fax Inquiries to:
P. O. Box 60009
Jacksonville, FL 32236
PHONE: (904) 389-6700
FAX: (904) 389-6003

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