

Preformed containers in a carton and paperboard setup containers for microwaveable food packaging

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ABSTRACT: *Frozen food companies utilize different packaging as well as different systems to prepare and present the package for filling. Choosing a packaging medium is therefore more complex than merely determining the lowest priced or most consumer appealing package. This is a discussion of the performance of two popular types of microwaveable packaging containers on the equipment required in the frozen food plant with the advantages and concerns for each variation.*

KEYWORDS: *Economics, equipment, food boards, frozen food, microwaves, packaging, processes, products.*

Most major frozen food companies produce similar end products from a consumer's perspective. Therefore the packaging processes are generally similar. The road taken by an individual company to arrive at the destination of a quality, packaged product can often be quite different, however, because each organization has unique engineering and operations philosophies.

The type of package selected by any frozen food packager is dependent upon the particular product as well as the niche in the marketplace, packaging philosophy, existing equipment, and economical constraints. Before addressing two general types of frozen food packaging and the processes and equipment necessary to utilize each, it is first necessary to examine briefly each of these considerations.

Parameters affecting packaging decisions

Product

Obviously the most important criterion in selecting a package for a frozen food is matching the package to the food product. Just as an automobile manufacturer would not consider putting a five-speed stick shift in its premier luxury model, most food companies would not consider packaging a multi-component frozen dinner in a boil-in-bag package. A package not only has a drastic impact on the quality of reconstitution but also determines consumer acceptance. In addition, the product itself will often dictate the method of reconstitution and therefore the packaging materials required.

Niche in marketplace

Many products in past years have failed as a result of being incorrectly packaged for the intended market. Most recently, many frozen food companies have lost market share as a result of not employing microwave friendly materials in their packaging. Today's plethora of new frozen food categories such as health foods, children's meals, club store items, etc., mandates that packaging professionals understand more about their customers' markets than ever before.

Packaging philosophy

No more than 10 years ago the majority of frozen food companies viewed packaging simply as a technique to distribute their product. Today, however, more and more companies are recognizing that packaging can actually sell their products. Therefore it is important to understand the attitude of customers. Do they prefer value added packaging, or do they view the packaging as a commodity?

Existing equipment

Every frozen food package experiences at least six steps in the packaging process:

- Dispensing
- Conveying
- Filling
- Sealing

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- Freezing
- Case packing.

Depending upon the type of packaging selected by the company, this list might even expand to include several additional steps.

When choosing a new package, whether for a new product or simply updating to new packaging technology, every frozen food company considers the ramifications of such a decision on the factory. If marketing recommends a specific type of package for a product and the factory cannot process that type of package without major equipment replacement, the project will be in jeopardy. For example, certain types of packages require special conveyors or freezers to process the product after it has been packaged. If all the conveyors and freezers on the line required replacement to process a new package, the company would consider all of its options very carefully.

Economical constraints

Closely related to the above item regarding existing equipment is the subject of economical constraints. Such concerns relate both to a capital expenditure for new or modified equipment and to the continuing expense of the package itself. Although capital and expense budgets are separate, they can relate closely if the lower cost of one type of package over another provides substantial enough savings to justify additional capital expenditure.

Equipment requirements

As mentioned above, different types of packaging require different processes and equipment for use in a frozen food packaging plant. This paper will examine the equipment required in a frozen food plant to utilize two general types of frozen food packages.

Preformed container in a carton

Preformed containers are a semi-rigid paperboard, pulp, or molded plastic. Although these utilize one of three drastically different materials with varying functional or end-use characteristics, a frozen food plant can generally use the equipment required to handle the three packages interchangeably with only minor modifications.

Figure 1 depicts the eight sections of a typical frozen food line for a preformed container in a carton: denester, conveyor (including filling area), film sealer, cartoner, conveyor, freezer, conveyor, and case packer. If the product being packaged happens to be a baked product, there will be an oven section after filling and before freezing. In addition there are two items not shown on the diagram generally placed immediately following the filling area of the conveyor which will not be discussed here: check weighers and metal detectors.

Most companies today utilize rotary vacuum denesting equipment supplied by one of several manufacturers. Dimensional consistency and stability of the package are imperative for the denester to operate at peak efficiency. With a line operating at over 100 packages per min per lane, small inconsistencies in the packaging product can cause many misses in the denester thereby causing high percentages of food waste as food product is automatically dispensed onto a conveyor containing no packages.

Generally, plastic and molded fiber trays are inherently more dimensionally consistent than pressed paperboard trays. The flexibility of the pressed paperboard tray, however, allows for a greater range of denester adjustments. With the correct adjustments, it is nevertheless possible to make each of these types of packaging function equally well.

The vacuum denester deposits the package onto a timed, lugged conveyor that moves the empty package to the filling areas. Automatic timing of the

conveyor unit, manual labor, or a combination of both for complicated products accomplishes the filling. Because filling equipment relies upon the specific product being packaged, this paper will not discuss this aspect of the operation. The same type of filling equipment works equally well for semi-rigid containers as well as setup containers.

Following the filling of the container, the product moves to the film sealer where it is transferred from the lugged conveyor to cavities in a platen matching the top inside dimension of the tray. Here again the dimensional consistency and stability of the packaging product are very important to prevent the filled container from falling through the cavity in the platen with resultant food spill on the conveying line and heat sealer. Once the product has been transferred to the heat sealing platen, it passes under a roll of film which is compressed onto the flange of the container with heat and pressure using either a heated roller or a heated, reciprocating platen on a walking beam. There are advantages to both systems. The heated roller system provides very high point-contact forces, while the walking beam type of sealer provides longer dwell times for the sealing operation. In both cases, the heat and pressure activate a heat-sensitive adhesive on the film causing it to seal to the flange of the container. This flange is either plastic or contains a plastic laminate. After the lidding film has been adhered to the container, a cutoff device (either a knife or hot wire) severs the film material to separate the container from adjacent packages.

As the package exits the heat sealer, it transfers to another conveyor which carries the product to a cartoning machine. Here it receives an automatic push into a carton that has been erected by the cartoner. Then the carton is sealed shut.

After the cartoning operation the product moves to the freezing area.

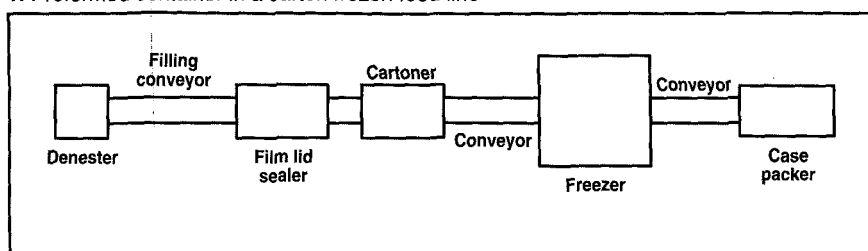
Packaging

One advantage of products that are packaged in primary packages and then enclosed in six-sided cartons is the ability to convey and handle the product easily. Such packages offer four flat sides from which to guide or push without concern of "shingling," i.e., the back package riding up on the package in front. Therefore jamming of conveyors, freezers, and case packers is minimized. In addition, changing from one size or shape package to another generally requires only a few adjustments. These observations hold true for any package that utilizes a primary package inside a carton.

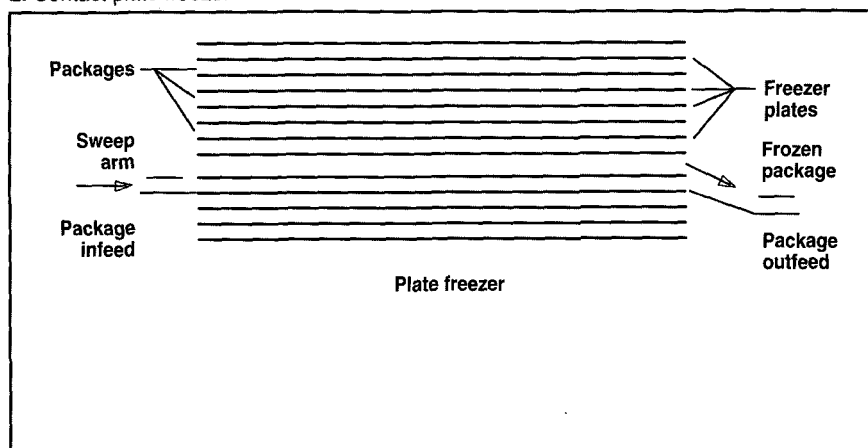
Freezers in frozen food plants fall into one of two general categories: contact freezers or blast freezers. A contact plate freezer sandwiches the package between two plates filled with ammonia as shown in Fig. 2. Packages are automatically arranged by rows on a bottom plate until it is full of unfrozen packages. Then the bottom plate moves upward clamping the packages between the bottom plate and an identical plate on top to provide direct contact between the freezing plates with the top and bottom of the packages. After these packages are frozen, unfrozen packages move onto the plate, row by row from the back, as frozen packages exit from the freezer in the front. Due to the direct contact of the plates on the top and bottom of the packages, this type of freezer is probably the most efficient operation. For the same reasons noted earlier in the discussion regarding conveying, products packaged in an outer carton perform very well in contact plate freezers from a handling perspective due to the flat sides from which to push the preceding package.

Blast freezers can come in a variety of styles. They all generally have some type of conveyor to move the packaged product through a large freezer. These conveyors can either be vertical stacks whereby the product moves onto indexing screens or be a spiral configuration whereby the product continuously moves around and up on a conveyor inside a freezer compartment. Although somewhat less efficient than contact freezers, blast freezers have the capa-

1. Preformed container in a carton frozen food line



2. Contact plate freezer



bility of processing irregular-shaped packages because they do not rely upon pushing each package for transfer.

Note that in any type of freezing operation less packaging results in less total freezing time.

After packages are frozen, they move to a case packer where they are stacked into a predetermined configuration and then pushed onto or into a corrugated case, depending upon the type of case utilized. Again packages that utilize a six-sided outer carton are generally very easy to case pack due to their flat sides, 90-degree angle corners, and rectangular shape. To obtain as small a case as possible, the case packaging process places the individual products end-to-end. Irregular-shaped outer cartons require special feeding and stacking sections for a case packer.

After the corrugated case is closed and palletized, the pallet of product moves from the processing area to the storage freezers to hold until shipment.

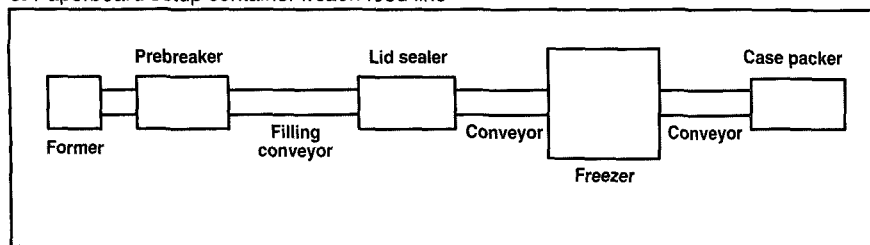
Paperboard setup containers

While semi-rigid preformed frozen food containers are delivered to the food processor in a ready-to-use state, the ovenable paperboard setup containers arrive as flat blanks. They require formation into a container on-line before filling.

The block diagram in Fig. 3 depicts a typical layout for an ovenable paperboard setup container line in a frozen food facility. There are also eight sections to this type of line: former, prebreaker, conveyor (including filling area), lid sealer, conveyor, freezer, conveyor, and case packer. The typical design utilizes a setup container with an attached, hinged lid. Many lines in existence today use a separate container and lid to eliminate the prebreaker in that case. A lid dispenser is necessary just before the lid sealer.

The former is very similar to a top load carton former employing male and female tools to form and seal the carton into a container shape. Vacuum cups pull the flat, preprinted blank from the magazine and place them in proper

3. Paperboard setup container frozen food line



I. Cost comparison

Equipment description	Preformed container 220/min	Setup container 220/min
Former	NR	US\$ 470,000
Tray dispenser	US\$ 30,000	NR
Prebreaker	NR	US\$ 250,000
Film lid sealer	US\$ 275,000	NR
Tray lid sealer	NR	US\$ 530,000
Cartoner	US\$ 125,000	NR
TOTAL	US\$ 430,000	US\$ 1,250,000
NR means not required.		

II. Benefits comparison

<i>Preformed container in a carton</i>
Additional packaging protection for the food
Less capital intensive
Most output per square foot of factory space
Easy to handle and convey
<i>Paperboard setup container</i>
Less total packaging
Less continuing packaging cost
Less energy consumption for freezing

location. A male tool attached to the forming head then forces them through a female tool. While moving through the tool, the side panels of the unit fold up. The end flaps also fold and adhere to the sides. The container exits from the tool onto a flighted conveyor which carries it to the prebreak section.

The polyester coated sulfite bleached sheet used for ovenable materials is inherently stiff. It is therefore

necessary to fold the flanges mechanically in the horizontal mode to keep them from interfering with the filling operation and to prepare them for application of the lid. This operation takes place before exiting from the former.

While in the prebreak section of the line, the lid and front flap bend along the scored lines to make the package more machineable throughout the rest of the operation. As previously mentioned, if a separate lid is being used, the prebreak section is not necessary.

Following the prebreaker, the container continues on the flighted conveyor into the filling section which consists of a length of conveyor and different types of filling stations exactly like those used on the preformed container described above.

After the container has been filled, it enters the lid sealing section. In the case of the hinged lid style of container, the lid is "plowed down" and the front flap portion of the lid is adhered to the front panel of the package. In the case of the separate lid system, a lid is deposited onto the container. The pack-

age flanges on each side then pass through a sealing section that welds the polyester coated lid to the tray. A combination of heat supplied either conventionally, by microwaves, or ultrasonically as well as pressure from pinch rollers accomplishes this. In both cases, the package then turns 90 degrees and passes through an identical sealing section to that just described wherein the side flanges are welded to the lid.

As the package exits the lid sealer, it moves to the freezing section as described previously for the preformed container. Handling the setup container through conveying and freezing is somewhat more challenging, however, than the preformed tray inside a six-sided folding carton. This is due to the overhanging flanges either on all four sides or on at least two of the sides depending upon the style of package. These overhanging flanges can contribute to uncontrolled shingling of the packages leading to jamming of conveying lines or freezers or both. Likewise, if a sweep arm pushes a row of packages on the flanges (freezer loading devices), it is apt to cause package twisting and concomitant jamming. In addition, if the conveyors are not properly designed for this type of package, the overhanging flanges can catch on conveyor components. From the perspective of freezing efficiency, however, this type of package freezes much quicker than does the preformed container in the carton simply because there is less packaging.

After it is frozen, the package exits the freezer and moves to the case packing area. Again, as in conveying and freezing, case packing the setup container is more challenging than the preformed container in a carton. It is especially necessary to select a case packer that will not force the flanges of the packages together which would cause significant downtime. Although this system seems more difficult to handle compared to the alternate package, all of these challenges associated with it can be overcome with the correct design changes in the equipment.

Capital cost comparison of equipment

Table I describes the approximate capital costs associated with purchasing equipment to utilize either the preformed container in a carton or the paperboard setup container. Actual costs for the equipment can vary significantly depending upon package size, options selected, and equipment manufacturer. Because the conveyors, fillers and associated equipment, check weighers, metal detectors, freezer, and case packers are required for each line, the costs for these items would be redundant and therefore are excluded from the comparison.

Obviously the costs represented in the table indicate that the equipment necessary to run the setup ovenable paperboard container are substantially higher than that for the preformed

container. This is primarily because a single line of equipment for the setup container can only run approximately 110 packages per min compared to 220–240 packages per min for a single, two-up line for preformed containers. To achieve the same speeds as a single, two-up preformed line, it is necessary to purchase two separate, independent lines of equipment.

Although the capital equipment cost to a frozen food company is substantially higher for the setup ovenable container than for the preformed containers, the continuing costs of packaging, transportation, and warehousing are generally lower enough compared to the alternate preformed container to provide a reasonable payback period.

Summary

An objective summary of the advantages and disadvantages of preformed and setup containers is rather difficult, because it is dependent upon the observer's point of view. **Table II** nevertheless objectively presents a general list of benefits for each type of package ignoring such issues as consumer appeal, end use functionality, marketing factors, etc. Although the factors have a significant impact on a frozen food company's packaging decisions, each company must carefully consider any additional, subjective information it has accumulated from previous packaging experiences. **□**

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