

Packaging, Hardening, Storage and Shipping of ice-cream

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When ice cream is drawn from the freezer, it is put into containers that give it the desired form and size for convenient handling during the hardening, shipping and marketing processes.

The Factors that Need to be Considered In Selection of Ice Cream Container

- ⌘ Cost
- ⌘ Protection against moisture loss, temperature loss and contamination.
- ⌘ Ease of handling and disposal (i.e. ease of opening and reclosure, if required)
- ⌘ Effect upon the quality of ice cream
- ⌘ Neatness of appearance
- ⌘ Advertising that package may carry.
- ⌘ Storage problem.
- ⌘ Point of consumption in relation to the location of the factory.
- ⌘ Size of unit desired.

1.1 Bulk containers:

The three types of packaging materials used for Bulk containers for ice cream include:

- i) Fiber board containers
- ii) Metals containers
- iii) Plastic (Polyethylene) containers



The type of package can be cups, tubs, cones etc.

1.2 Wrappers

These may be composed of vegetable parchment or foil laminate.

Containers can be made up of fiber board, either paper or card board which has been treated to make it impervious to moisture.

The ice cream bars may be wrapped with wrapper made of BOPP laminates. Ice cream cone sleeves are made specifically for packaging of cone ice cream. The ice lolly packs maybe packaged in double-sided Polyethylene card board squeezers.



1.3 Plastic (polystyrene) or wax-coated paperboard cartons may also be used.



1.4 Steel cans

Tin cans with reusable containers.

It can be cylindrical or square section cans with radiused corners and with 'slip-on-lids'.



Ice Cream Hardening

In hardening process, the aim is to reduce the temperature of the product to at least 0°F in the centre of the package as quickly as possible. After the ice cream reaches this point, it is only necessary to store it at a uniformly low temperature to prevent ice melting and recrystallization.

1. Objectives of hardening ice cream

- ⌘ The physical nature of ice cream when drawn from the freezer is such that it is seldom practicable to market it in this form.
- ⌘ To freeze more water in the ice cream that has been drawn from the freezer and filled in the container to obtain better consistency.
- ⌘ To make ice cream stiff enough to hold its shape.

2. Hardening time:

The time necessary for the temperature at the centre of the package to drop to -18°C is known as 'hardening time'. A hardening time of 24 h for 19 litres (5 gal). package is considered as 'excellent' operation when performed in hardening rooms. When hardening tunnels are used, the rate of hardening is several times faster.

Factors affecting hardening time in same hardening unit

Type of hardening	Package size	Hardening time
Still- air hardening room	118 ml	30 min
Still- air hardening room	19 liters	24 h

Hardening process:

After ice cream is drawn from the freezer, it is put into containers to be placed in hardening room. Here the temperature of ice cream reaches -18°C or lower, preferably -26.1°C (-15°F). Quick hardening is desirable, since slow hardening favours formation of large ice crystals and a corresponding coarseness of texture.

Factors that affect the rate of hardening

- Temperature of ice cream when drawn from the freezer
- Composition of the mix
- Percent overrun taken in ice cream
- Size of the containers
- Whether several containers are bundled together
- Nature of the wrapping material (paper or plastic)
- The manner of stacking of the containers
- The temperature and velocity of the circulating air
- Obstructed versus unobstructed exposure of the containers to the cooling medium.

- ⌘ Very small containers harden quickly, also warm up quickly when removed from the freezing temperatures.
- ⌘ This results body and texture damage.
- ⌘ This also applies to novelties (stick bars, small cups, etc.).
- ⌘ Large containers (i.e. 11.34 liters) harden much slower in the interior (cooling is largely by conduction) and must be given ample time to reach -18°C in the interior.
- ⌘ If containers are stacked before they are adequately hardened, deformation may occur and some overrun may be squeezed out causing surface discoloration.

ICE CREAM-HARDENING METHODS, STORAGE AND SHIPMENT OF ICE CREAM

There are several hardening methods available. However, the rapid ones are desirable from the stand point of quality of ice cream. To avoid temperature fluctuations during hardening and storage, frequent opening and closing of the door should be avoided. Use of air lock systems / ante-room before the main hardening room is required.

1.Type of Hardening Methods

1.1 Hardening rooms

i) **Still air type hardening room:** This is obsolete these days.

Advantages

- a. It makes the stacking of ice cream easy and systematic.
- b. There is less loss of refrigeration when the door is open.

Disadvantages

- a. The defrosting of the coils is not very convenient.
- b. It is not so adaptive where conveyor systems exist for conveying frozen ice cream in the hardening room.



ii) **Gravity air type hardening room:** The expansion coils are arranged in tiers near the ceiling with sloping baffles below them. A definite circulation of heavy cold air and lighter warm air is set up.

Advantages

- a. The main part of hardening room is free from all obstructions and this is convenient where ice cream is conveyed into hardening room on a conveyor.
- b. Defrosting of coils is convenient

Disadvantages

- Ice cream cannot be stacked as conveniently and systematically as in Still air type
- a. Ice cream containers if not properly placed, interferes with the air circulation.
 - b. Due to freedom from obstructions, the loss of refrigeration with the opening of the door is greater.



iii) Forced air type hardening room: The expansion coils are in the form of a compact unit utilizing fins to assist in the conductance of heat from the air to the coils. A fan placed directly behind the expansion coil unit, draws the air from the hardening room and blows it over the expansion coils and back into the room.

⌘ Advantages

⌘ Defrosting requires only a matter of minutes and is so simple that it can be done daily

⌘ 1.2 Unit hardening systems

- a. Plate / Contact hardeners
- b. Blast tunnel hardeners
- c. Hardening cabinet

⌘ 1.3 Hardening rooms

⌘ Bundled units of 4 containers requires about 7 h to reach -18°C at core as opposed to about 3 h for unbundled 2 litres containers (convection hardening; air temperature -34.4°C).

1.4 Hardening tunnels

Some manufacturers of larger volumes use hardening tunnels that produce an air blast at -34.4 to -45.5°C for fast hardening. This may or may not contain a conveyor belt and the advantage comes when hardening smaller packages, which can be hardened in about 1 h. Blast tunnel hardeners have been used for several years. The conveying systems have been expanded more recently to include the wide flat belt, fixed tray, suspended free tray, and multi-shelf carrier types of conveyors. The zone hardening tunnel and the ceiling conveyor systems are other types of hardeners.





Hardening Tunnel

1.5 Hardening cabinet

They resemble the retail ice cream cabinet and are refrigerated by mechanical refrigerant. The ice cream package is placed in the dry, water tight compartments, each of which will hold one or two 19 liters containers. These are usually operated at temperatures of -23.3 and -26.1°C and are most economical for limited volume of business.



Contact Plate Hardeners

Direct refrigerated contact plate hardening provides very effective heat transfer, but requires that all containers are of same size and geometry. Hardening of 2 liters containers to a temperature of -17.8°C at the core may be accomplished within a period of 1-2 h.

& Cryogenic Hardening

When individual 500ml packages of vanilla ice cream were immersed in liquid nitrogen at -195.6°C for 1 min, bagged together in groups of 8 packages and placed in hardening cabinet at -12.8°C , the product had good body and texture.

A center temperature of -22.7°C in 500 ml package could be reached in less than 5 min. with outer temperature of the product at -157.9°C or lower. One minute immersion per 500 ml of ice cream was considered the maximum treatment to which ice cream could be subjected without adversely affecting its body and texture.



Liquid nitrogen requirement is 0.56 kg per kg of ice cream to be hardened. However, after 2 weeks storage pronounced shrinkage was evident. In few countries (viz., Sweden) ice cream cones are hardened at the rate of 11,000-16,000 per h with the help of sprayed liquid nitrogen. The cones are pre-cooled by exhaust nitrogen in the first section and final freezing takes place in the second section.

Nitrogen Refrigerated Hardening Tunnels

In Sweden, there is an ice cream factory where ice cream cones at the rate of 14,000 – 16,000/h is sprayed with liquid nitrogen for hardening. The cones are pre-cooled by exhaust nitrogen in the first section and finally frozen in the second section.



Storage and Distribution of Ice Cream

- ⌘ After the ice cream has been hardened, subsequent steps are dictated by local requirements.
- ⌘ The fully hardened ice cream may be loaded directly onto trucks for transfer to distribution points.
- ⌘ Whether during warehousing or the transportation and transfer phase, a constant and low temperature (-26.1 to -31.7°C) should be maintained to minimize heat shock.
- ⌘ Maintaining a frost-free environment is also important.
- ⌘ After ice cream is hardened, it may be immediately marketed, or it may be stored for a week or two at the most.
- ⌘ Manufacturers plan on a maximum of 5 days between freezing and marketing.

- Since hardened ice cream can be stored satisfactorily at slightly higher temperature than is required for hardening, it is sometimes more economical to use special storage room.
- The retailers use one cabinet for storage in addition to the dispensing cabinets.
- The operation is same as in Hardening room, except the following:
 - i) The temperature should be maintained uniformly at a point between -23.3 and -18°C
 - ii) The packages should be piled up very closely to delay changes in the temperature of the ice cream.

& Insulated Trucks

Timbers are used for frame; inside glass wool or cork insulation may be used. The outside material is aluminium metal, which reflects light and shines. Ice cream is loaded directly from hardening room into refrigerated trucks for shipment to distribution stations near the point of consumption.

Sometimes dry ice, sawed in to pieces are wrapped in paper and then placed around the package of ice cream inside an insulated pack or in single service type packer. The freezing point of dry ice is about -78.3°C .

