Module 7. Packaging, hardening, storage and shipping of ice cream

Lesson 20
HARDENING OF ICE CREAM-HARDENING METHODS, STORAGE AND SHIPMENT OF ICE CREAM

20.1 Introduction

Hardening of ice cream facilitates stacking of ice cream packages during storage and transportation. There are several hardening methods are 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.

20.2 Type of Hardening Methods

20.2.1 Hardening rooms

1. Still air type hardening room: This is obsolete these days.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.

2. 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.

3. 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

20.2.2 Unit hardening systems

a. Plate / Contact hardeners

b. Blast tunnel hardeners

c. Hardening cabinet

20.2.3 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 liters containers (convection hardening; air temperature – 34.4°C).

20.2.4 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.

Fig. 20.1 Ice cream packaging in the hardening room

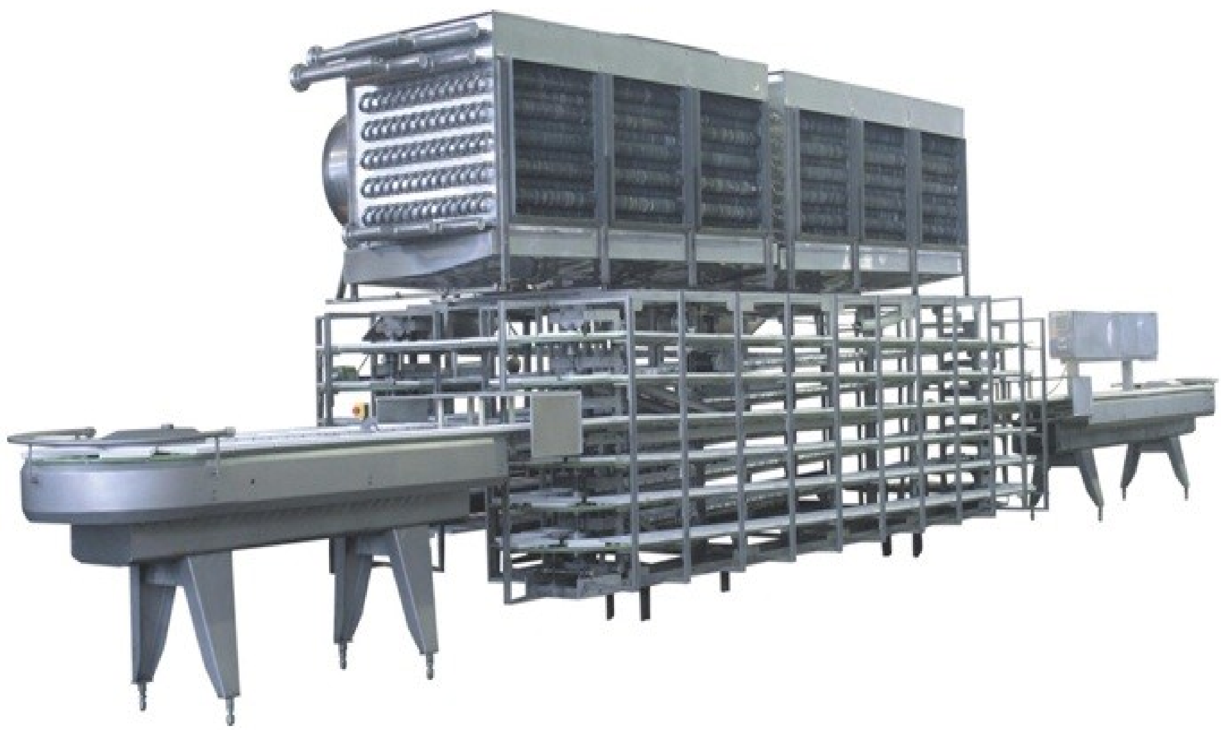

Fig. 20.2 Hardening tunnel for ice cream

20.2.5 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°Cand are most economical for limited volume of business.

20.3 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°Cat the core may be accomplished within a period of 1-2 h.

20.4 Cryogenic Hardening

When individual 500ml packages of vanilla ice cream were immersed in liquid nitrogen at -195.6°Cfor1 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 was 0.56 kg per kg of ice cream to be hardened. The ice cream hardened in such manner was decidedly whiter in appearance compared to the one that was hardened slowly. 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.

20.5 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.

20.6 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.

20.7 Shipping of Ice Cream

During marketing, the manufacturer ships it to the retailer under refrigeration at the same temperature as it was maintained in the retailer's cabinet.

20.8 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.

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