FDE 447
COLD PRESERVATION TECHNOLOGY

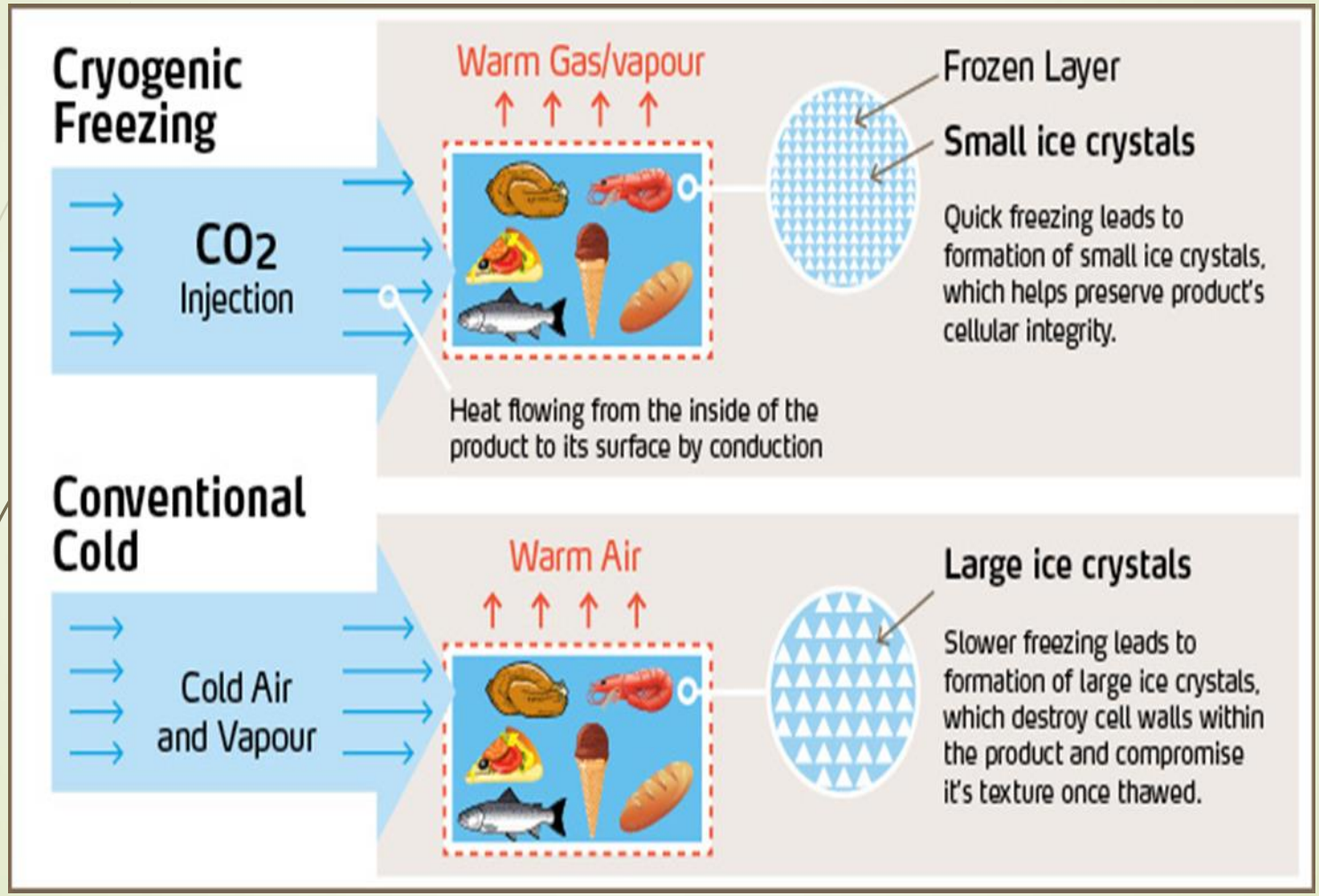
Content:

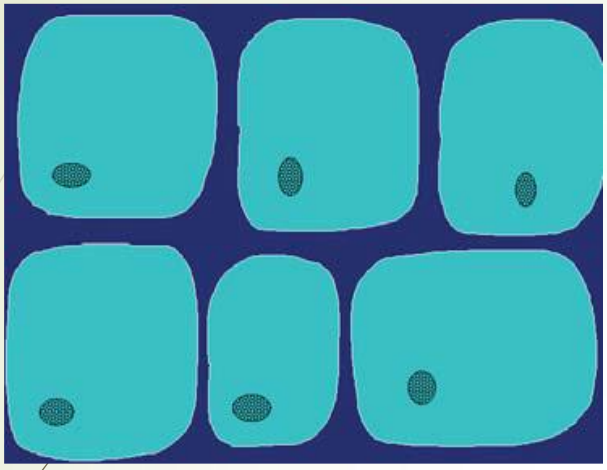
Food freezing methods

*Freezing in air

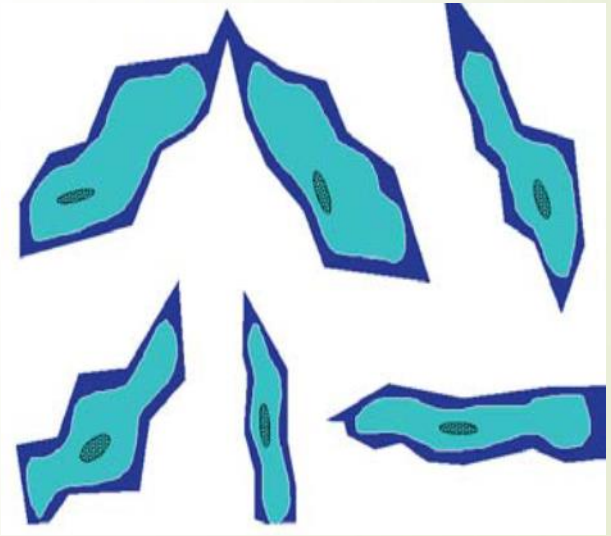
*Indirect contact freezing

Freezing methods of foods





Cells before freezing



Cells after freezing

Methods of food freezing

- Freezing in air (blast freezing)
- Indirect contact freezing
- Immersion freezing
- Cryogenic freezing

Freezing in air (blast freezing)

- Cabinet Freezing
- Air-Blast Freezing
  - tunnel freezing,
  - belt freezing,
  - fluidized bed freezing.

Freezing in air (Blast freezing)

Cabinet Freezing

- In this method, cold air is circulated in a cabinet where product is placed in a tray. The moisture pick-up from the product surface may deposit on the cooling coils as frost, which acts as an insulation.
- A cabinet freezer with air velocity at least 5 m/s generates high heat-transfer rates.

Air-Blast Freezing

- In this method, the temperature of food is reduced with cold air flowing at a relatively high speed.
- Air velocities between 2.5 and 5 m/s give the most economical freezing.
- Lower air velocities result in slow product freezing, and higher velocities increase unit-freezing costs considerably.
- This method can be further divided into *tunnel freezing*, *belt freezing*, and *fluidized bed freezing*, depending on how air interacts with the product .

Air-blast freezers

- Temperatures -30°C and -40°C at a velocity of 1.5 -6.00 m/s

Many configurations are possible.

- Fast freezing -
- Continuous vs. batch -
- Potential concerns -freezer burn and dehydration (counter current flow helps)

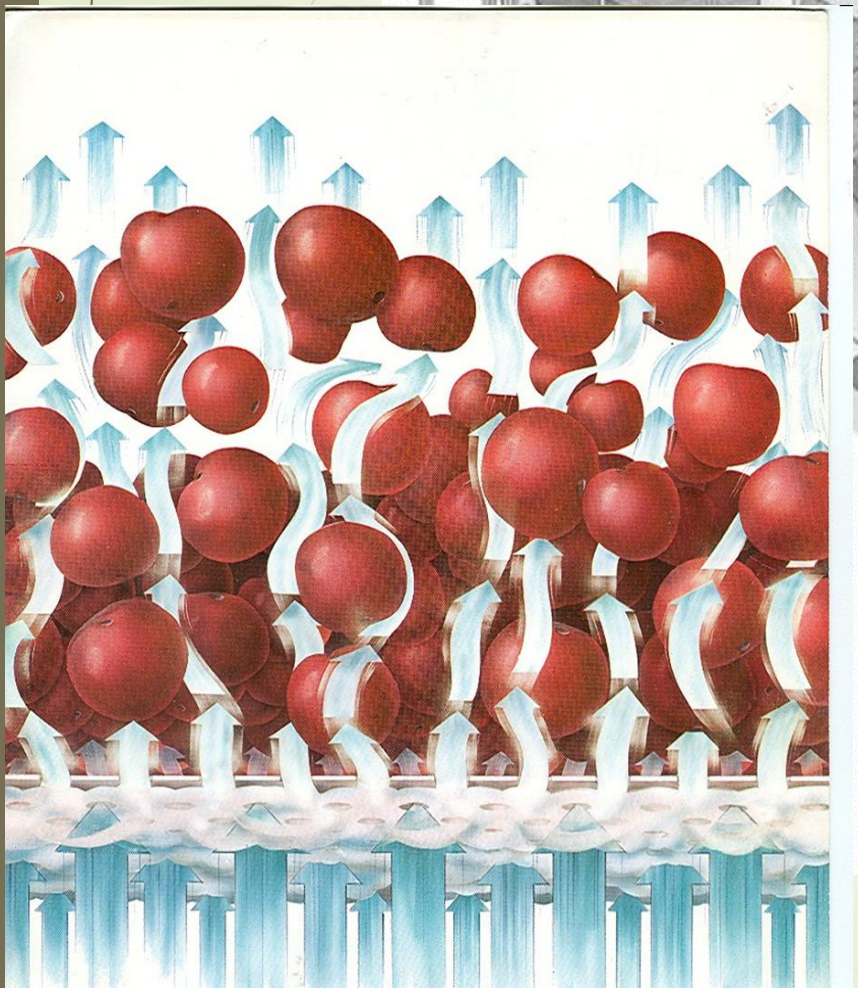
Air-Blast Freezing

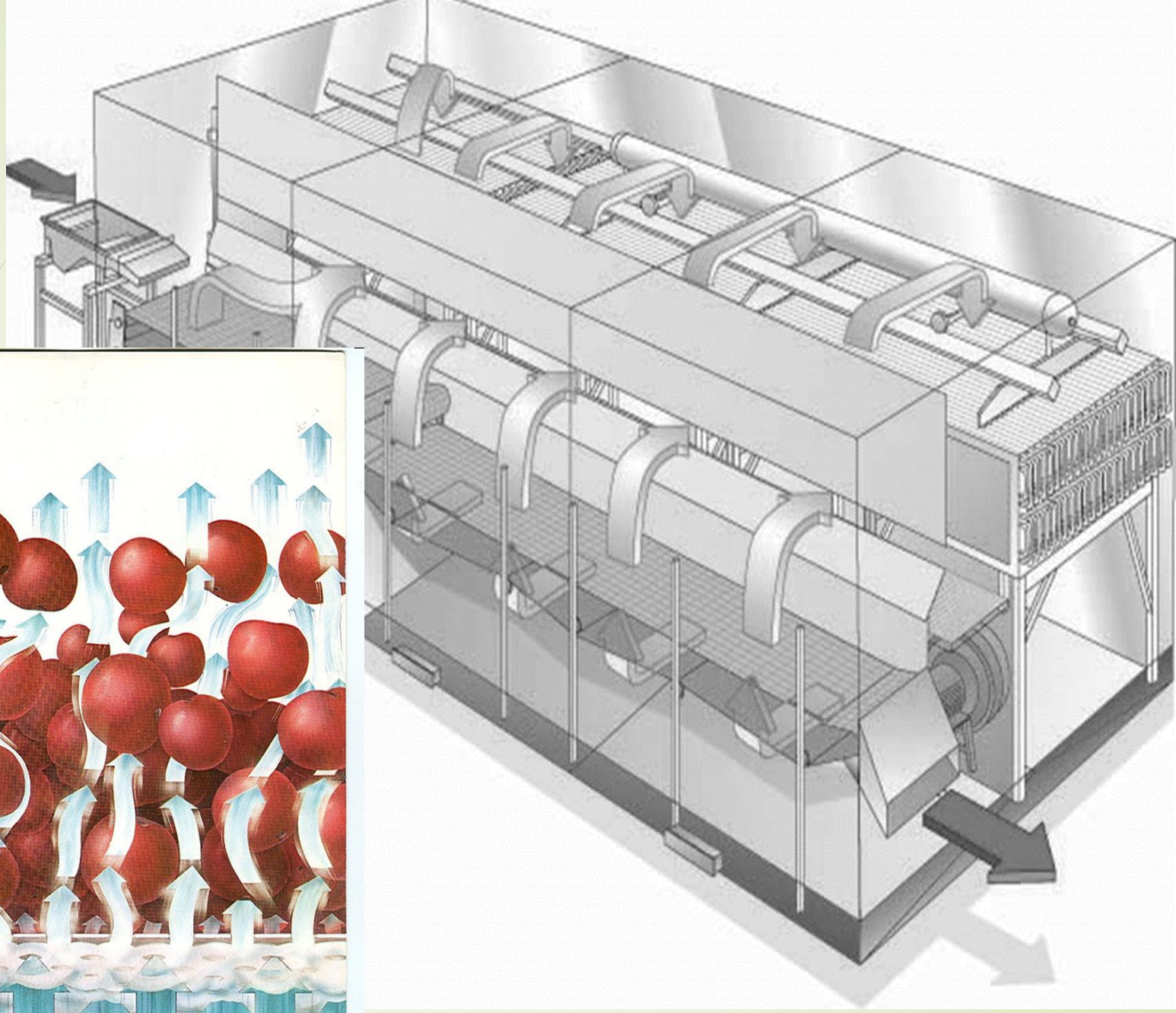
Fluidized Bed Freezing

- A fluidized bed freezer consists of a bed with perforated bottom through which refrigerated air is blown vertically upward.
- The air velocity must be greater than the fluidization velocity.
- This freezing method is suitable for small particulate food bodies of fairly uniform size,
- e.g., peas, diced carrots and potatoes, corns, and berry fruits.
- The high degree of fluidization improves the heat-transfer rate and results in good use of floor space.

Fluidized Bed Freezing

- This type of freezer is bedded in 2-13 cm depth according to food size and shape.
- Higher heat transfer coefficients, shorter freezing times, higher production rates (10.000 kg/h) and less dehydration of unpackaged food than blast freezing.
- The freezing time varies between 3-15 minutes depending on the particle size.
- E.g: peas freeze in 3-6 minutes, diced carrots in 5-6 minutes, strawberries in 9-13 minutes.
- High air flow velocities: 2-5 m/s.





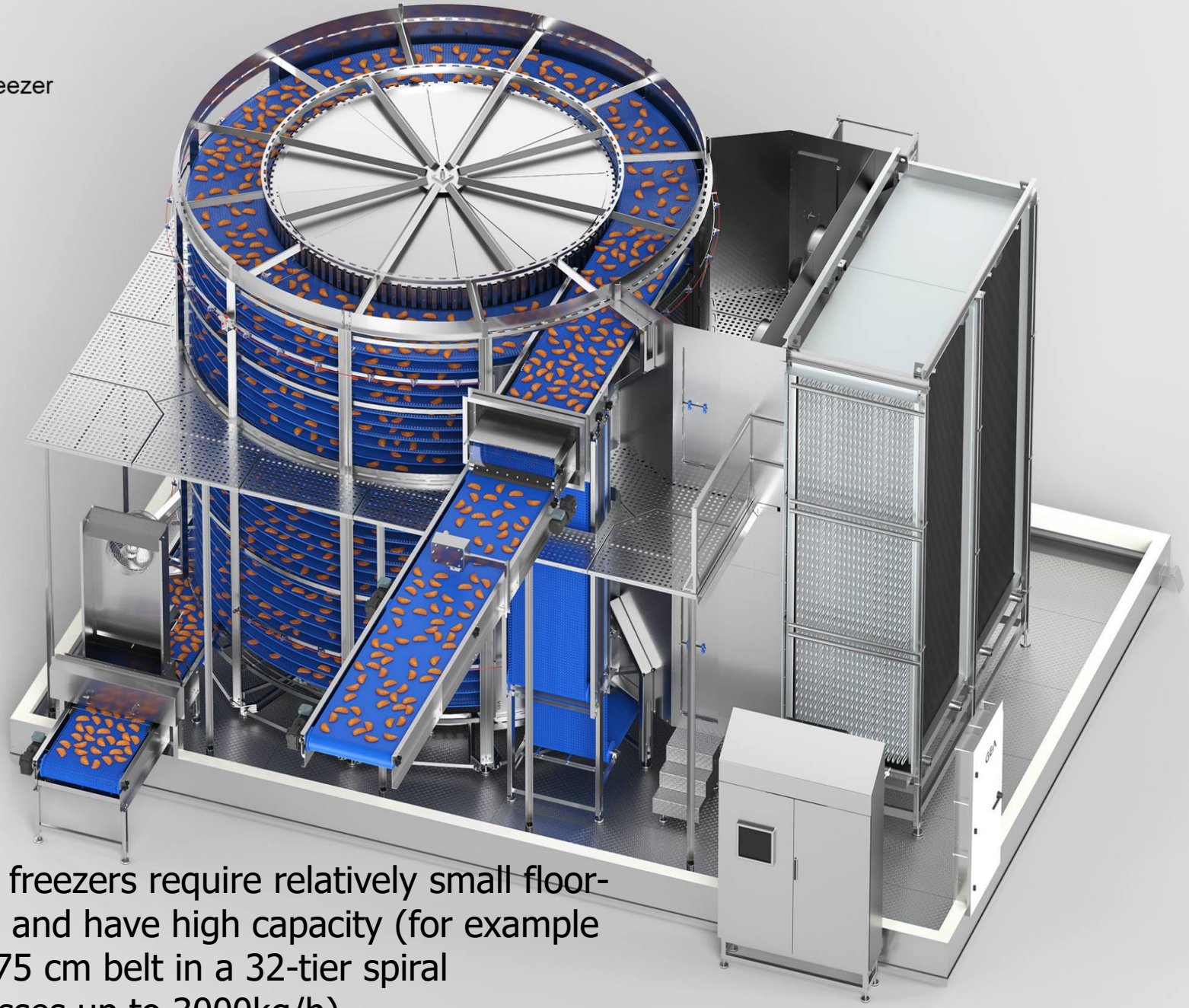
Belt freezing

- The first mechanized air-blast freezers consisted of a wire mesh belt conveyor in a blast room for continuous product flow.
- Uniform product distribution over the entire belt is required to achieve uniform product contact and effective freezing.
- Controlled vertical airflow forces cold air up through the product layer, thereby creating good contact with the product particles and increasing the efficiency.
- The principal current design is the two-stage belt freezer. Temperatures used usually are -10°C to -4°C in the precool section and -32°C to -40°C in the freezing section.

Spiral freezing

- A spiral belt freezer consists of a long belt wrapped cylindrically in two tiers, thus requiring a minimal floor space.
- The spiral freezer uses a conveyor belt that can be bent laterally.
- It is suitable for products with a long freezing time (generally 10 min to 3 h), and for products that require gentle handling during freezing.
- It also requires a spatial air-distribution system.
- Other advantages include automatic loading and unloading,
- low maintenance costs and flexibility for different products.
- used for a wide range of foods including pizzas, cakes, pies, ice cream, whole fish and chicken portions.

Spiral freezer



Spiral freezers require relatively small floor-space and have high capacity (for example a 50-75 cm belt in a 32-tier spiral processes up to 3000kg/h).

Tunnel freezing

- In this process, products are placed in trays or racks in a long tunnel and cool air is circulated over the product.

The advantages of air flow freezing

- Suitable for irregular shaped products,
- economic,

The disadvantages of air flow freezing

- Moisture loss in unpackaged products (weight loss in the product, frost burn, discoloration)
- Excessive snow of evaporator spirals

Applications made to prevent water loss from the product;

- Pre-cooling, glazing

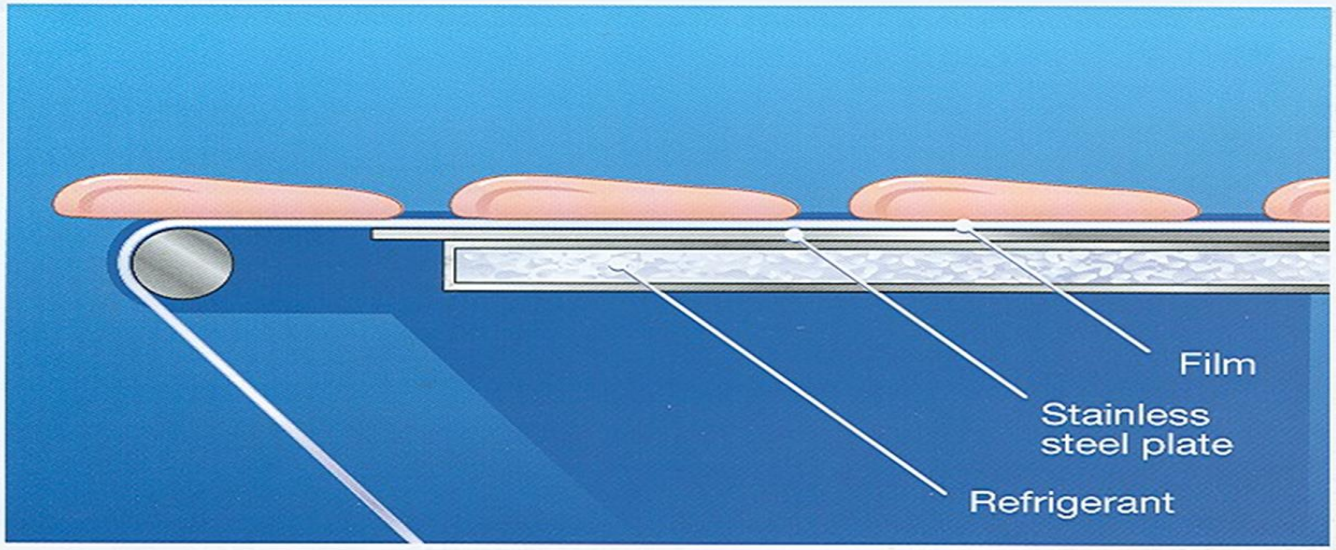
Indirect contact freezing (Freezing by Contact with a Cooled Solid: Plate Freezing)

- The product is sandwiched between metal plates and pressure is usually applied for good contact.
- Plate freezers are only suitable for regular shaped materials or blocks.
- When the product has been frozen, hot liquid is circulated to break ice seal and defrost.
- Spacers should be used between the plates during freezing to prevent crushing or bulging of the package.
- The surface film heat transfer coefficient is up to 100-200 W/m^2K.

Plate freezing

Two type:

- Vertical
- Horizontal


Film
Stainless steel plate
Refrigerant

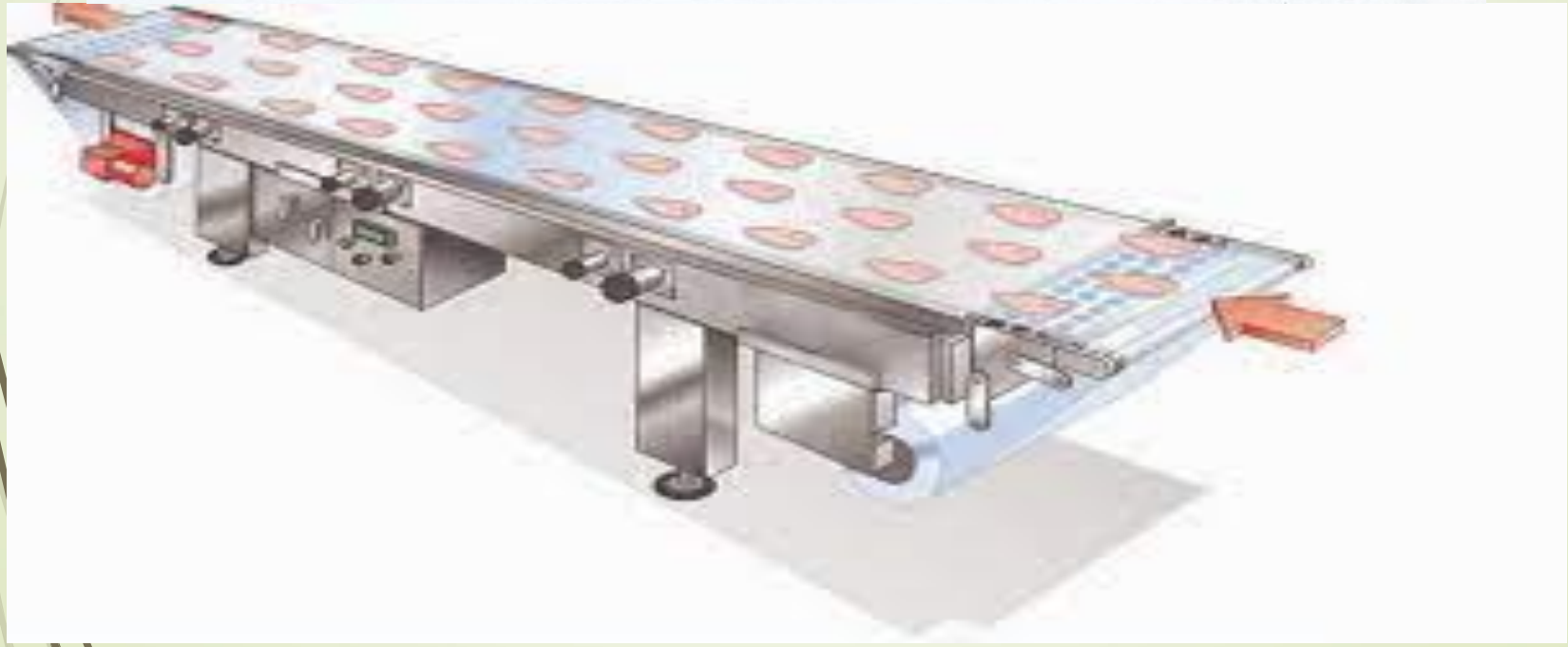


Plate freezers

Advantages

- good use of floor space
- low operating costs
- little dehydration of food
- high rates of heat transfer
- food package keeps dimensions

Disadvantages:

- high capital costs
- size limitations

Scraped surface, continuous system

- These types of freezing systems utilize a scraped surface heat exchanger as a primary component of the continuous system used to convert liquid product into a frozen slurry. In these systems, the outer wall of the heat exchanger barrel represents the barrier between the product and the low -temperature refrigerant used for product freezing.