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Different types of ice and their manufacture

Block ice

- The traditional block ice maker forms the ice in cans which are submerged in a tank containing circulating sodium or calcium chloride brine.
- The dimensions of the can and the temperature of the brine are usually selected to give a freezing period of between 8 and 24 hours.
- Too rapid freezing results in brittle ice.

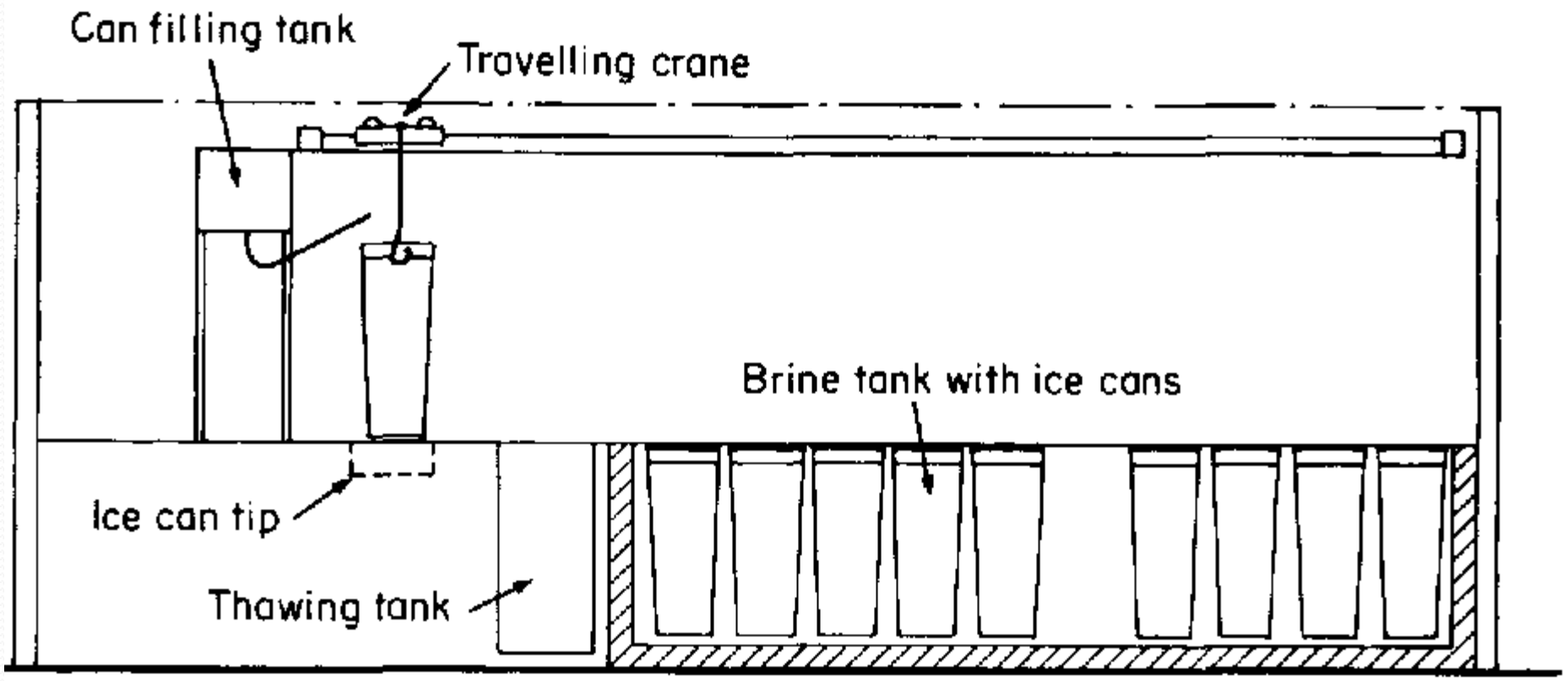
- The block weight can vary from 12 to 150 kg, depending on requirements.
- A travelling crane lifts a row of cans and transports them to a thawing tank at the end of the freezing tank, where they are submerged in water to release the ice from the moulds.
- The cans are tipped to remove the blocks, refilled with fresh water and replaced in the brine tank for a further cycle

- Storage, handling and transport can all be simplified if the ice is in the form of large blocks
- With an appropriate ice crushing machine block ice can be reduced to any particle size but the uniformity of size will not be as good as that achieved with some other forms of ice.
- manual crushing method

Rapid block ice

- produce blocks in only a few hours
- space requirements are considerably reduced compared with a conventional block ice plant.
- Block sizes vary with 25, 50 and 150 kg each being typical.
- An advantage is that it can be stopped and started in a relatively short time, since there is no large tank of brine to be cooled initially as in the conventional block ice machine in which the refrigeration system is often kept in continuous operation even when ice production has ceased.

Block ice maker



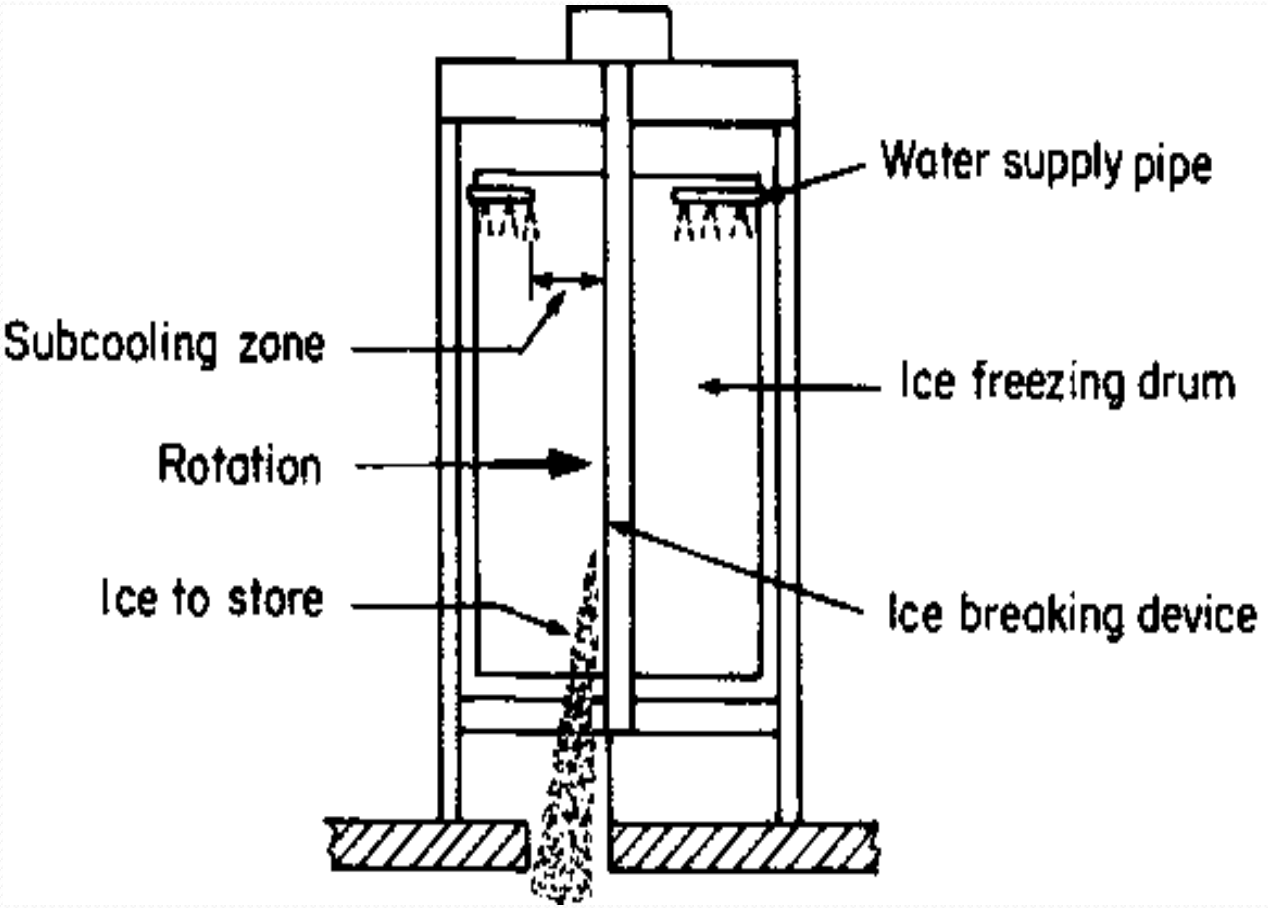
Flake ice

- This type of machine forms ice 2 to 3 mm thick on the surface of a cooled cylinder and the ice is harvested as dry subcooled flakes usually 100 to 1,000 mm^2 in area.
- In some models, the cylinder or drum rotates and the scraper on the outer surface remains stationary
- In others, the scraper rotates and removes the ice from the surface of a stationary drum
- It is usual for the drum to rotate in a vertical plane but in some models the drum rotates in a horizontal plane.

- Advantage of the rotating drum method is that the ice-forming surfaces and the ice release mechanism are exposed and the operator can observe whether the plant is operating satisfactorily
- The ice is subcooled when harvested, the degree of sub-cooling depending on a number of factors but mainly the temperature of the refrigerant and the time allowed for the ice to reach this subcooled temperature.
- The subcooling region of the drum is immediately before the scraper where the ice is reduced in temperature.

- This ensures that only dry subcooled ice falls into the storage space immediately below the scraper.
- The refrigerant temperature, degree of subcooling and speed of rotation of the drum are all variable with this type of machine and they affect both the capacity of the machine and the thickness of the ice produced.

Flake ice maker



Tube ice

- Tube ice is formed on the inner surface of vertical tubes and is produced in the form of small hollow cylinders of about 50 x 50 mm with a wall thickness of 10 to 12 mm.
- water on the inside of the tubes and the refrigerant filling the space between the tubes.
- The machine is operated automatically on a time cycle and the tubes of ice are released by a hot gas defrost process.
- As the ice drops from the tubes a cutter chops the ice into suitable lengths, nominally 50 mm, but this is adjustable

- Transport of the ice to the storage area is usually automatic, thus, as in the flake ice plant, the harvesting and storage operations require no manual effort or operator attendance.
- The usual operating temperature of this type of plant is -8°C to -10°C. The ice will not always be subcooled on entering the store but it is usually possible to maintain the store at -5°C since the particle size and shape allow the ice to be readily broken up for discharge, especially with a rake system.

Tube ice maker

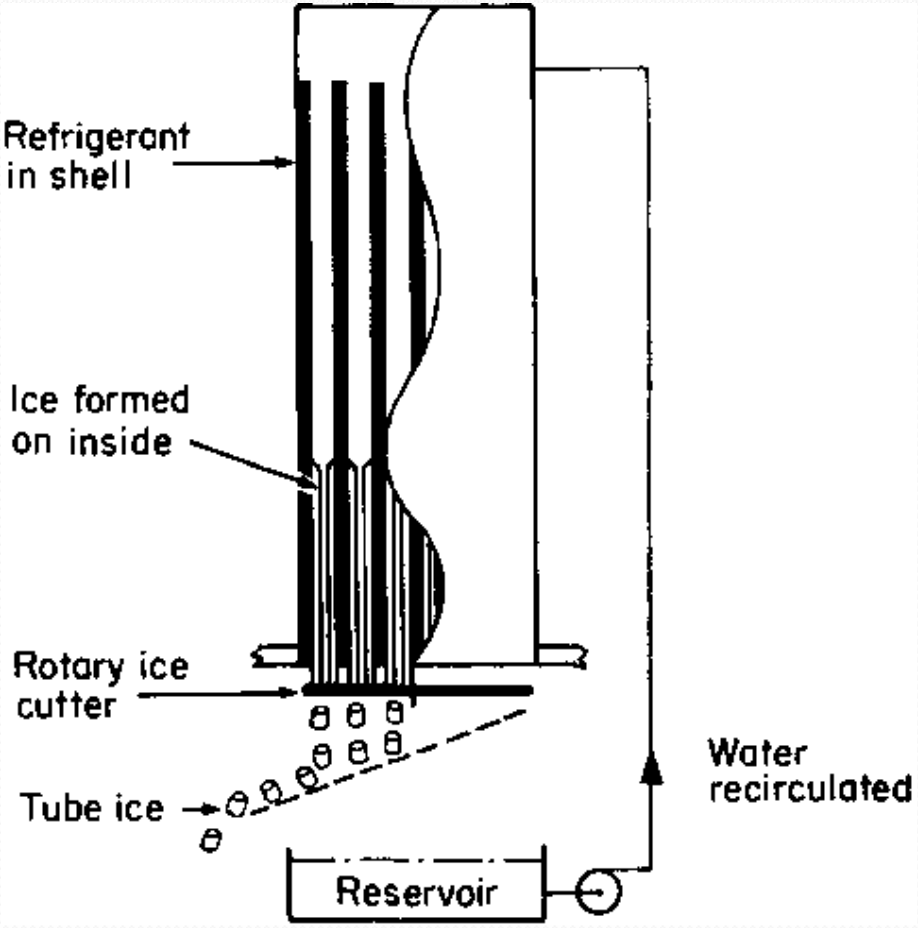
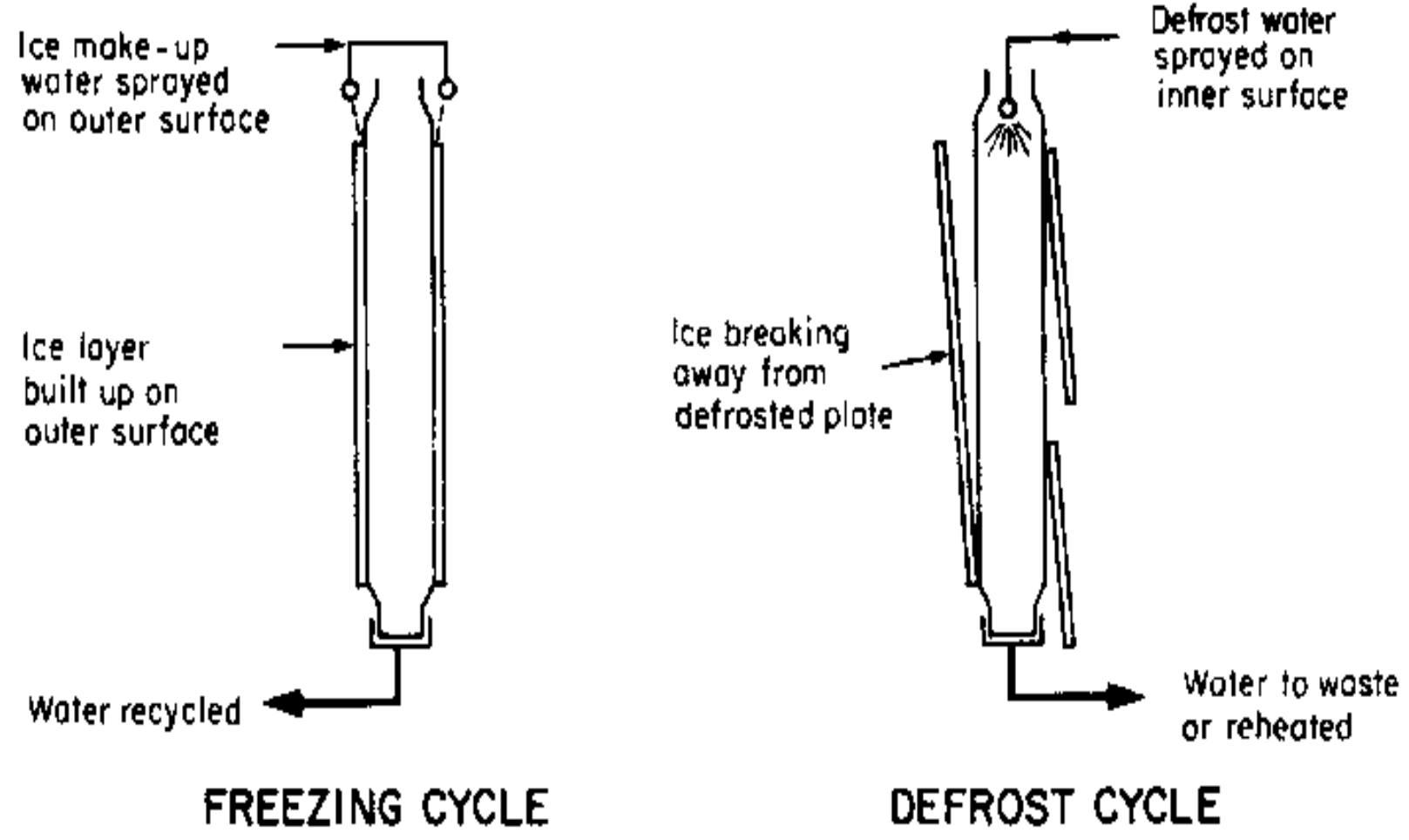


Plate ice

- Plate ice is formed on one face of a refrigerated vertical plate and released by running water on the other face to defrost it.
- Multiple plate units are arranged to form the ice-making machine
- The optimum ice thickness is usually 10 to 12 mm and the particle size is variable.
- An ice breaker is required to break the ice into a suitable size for storage and use .

- Water for defrost requires heating if its temperature is less than about 25°C; below this value the defrost period is too long, resulting in a loss in capacity and an increase in cost.
- This machine operates on an automatic timed cycle and the ice is conveyed to the storage area or if the machine can be located directly above the storage space, harvesting can be achieved using gravity flow.

Plate ice maker



Slush ice

- The cooling unit for making "slush" ice is called a scraped-surface heat exchanger.
- It consists of concentric tubes with refrigerant flowing between them and water in the inner tube.
- The inner surface of the inner tube is scraped using a rotary screw.
- The small ice crystals formed on the tube surface are scraped off and mixed with unfrozen water.

- This results in a slurry of ice and water, which may contain up to 30% water by weight.
- This mixture may be pumped or, after removing most of the water in a mechanical separator, used as a 'dry' form of ice.

Storage of ice

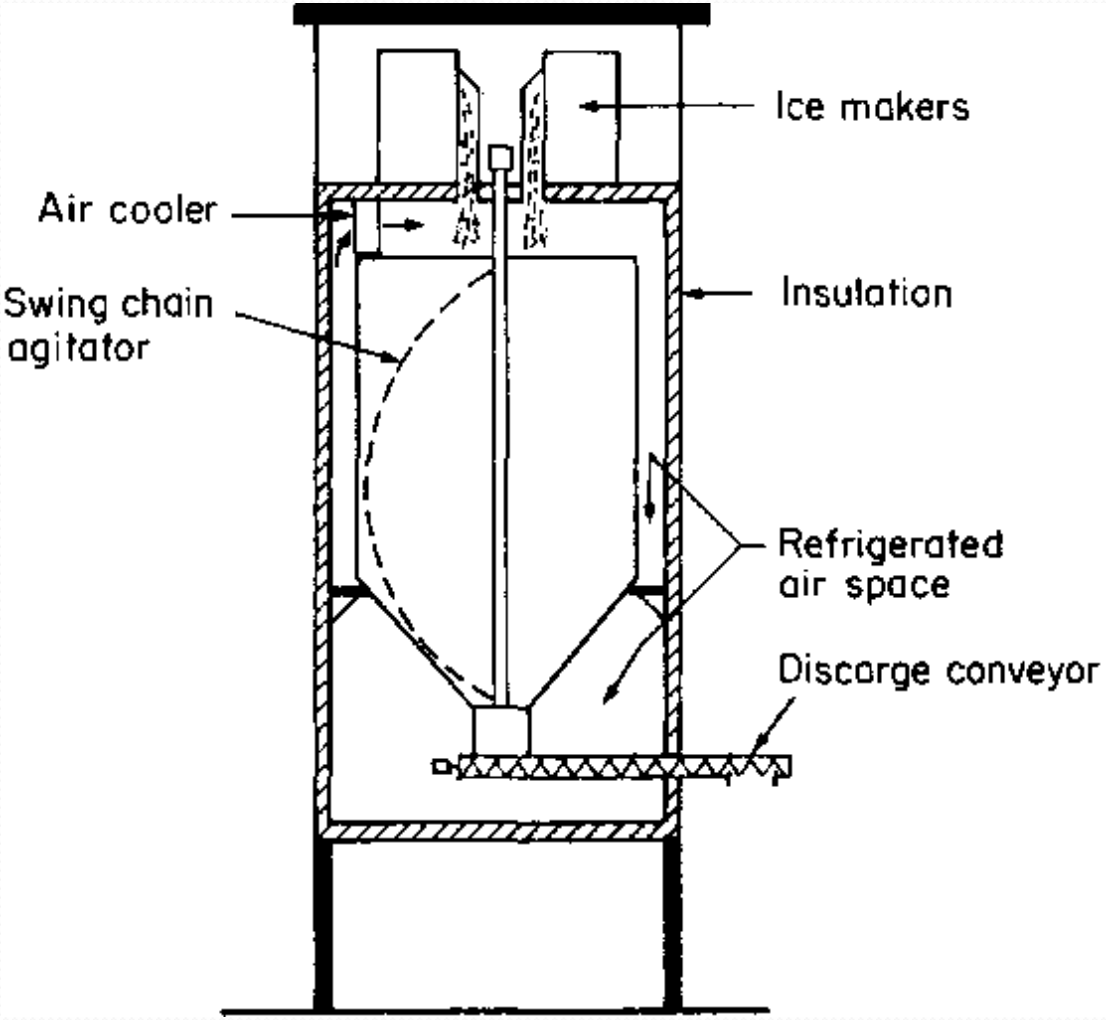
- Ice manufacture and demand rates are seldom in phase, therefore storage is necessary to ensure that the plant caters for peak demand.
- storage allows the ice maker to be operated 24 hours per day.
- It also acts as a buffer against any interruption to the ice supply due to minor breakdowns and routine maintenance procedures.
- Usually this is done by plotting the likely pattern of ice production and ice usage over a period of time, and selecting a storage capacity which will ensure that ice will be available at all times.

Silo storage

- Silo storage is generally used with a free-flowing subcooled ice such as flake ice and, in order to be effective, it must have an independent cooling system to maintain the ice in this subcooled condition.
- The cooling is usually by means of an air cooler in the jacket space between the silo and the outer insulated structure.
- The air cooler is normally placed at the top of the jacket space adjacent to the ice maker and the air space is cooled by gravity or fan circulation
- Ice is collected by gravity flow with the aid of a chain agitator which scrapes the ice from the walls of the silo.

- The silo allows for a first-in- first-out (FIFO) system of storage but, if the storage space is not cleared periodically, only the central core of ice is used, leaving a permanent outer wall of compacted ice.
- An access hatch should therefore be provided at the top of the silo so that a pole can be inserted to collapse the outer wall of ice into the central core at least once daily.
- Silo storage is expensive for small quantities of ice and although units are made for as little as 10 tonne, this method of storage is more suited for storing 40 to 100 tonnes of ice.

Silo storage



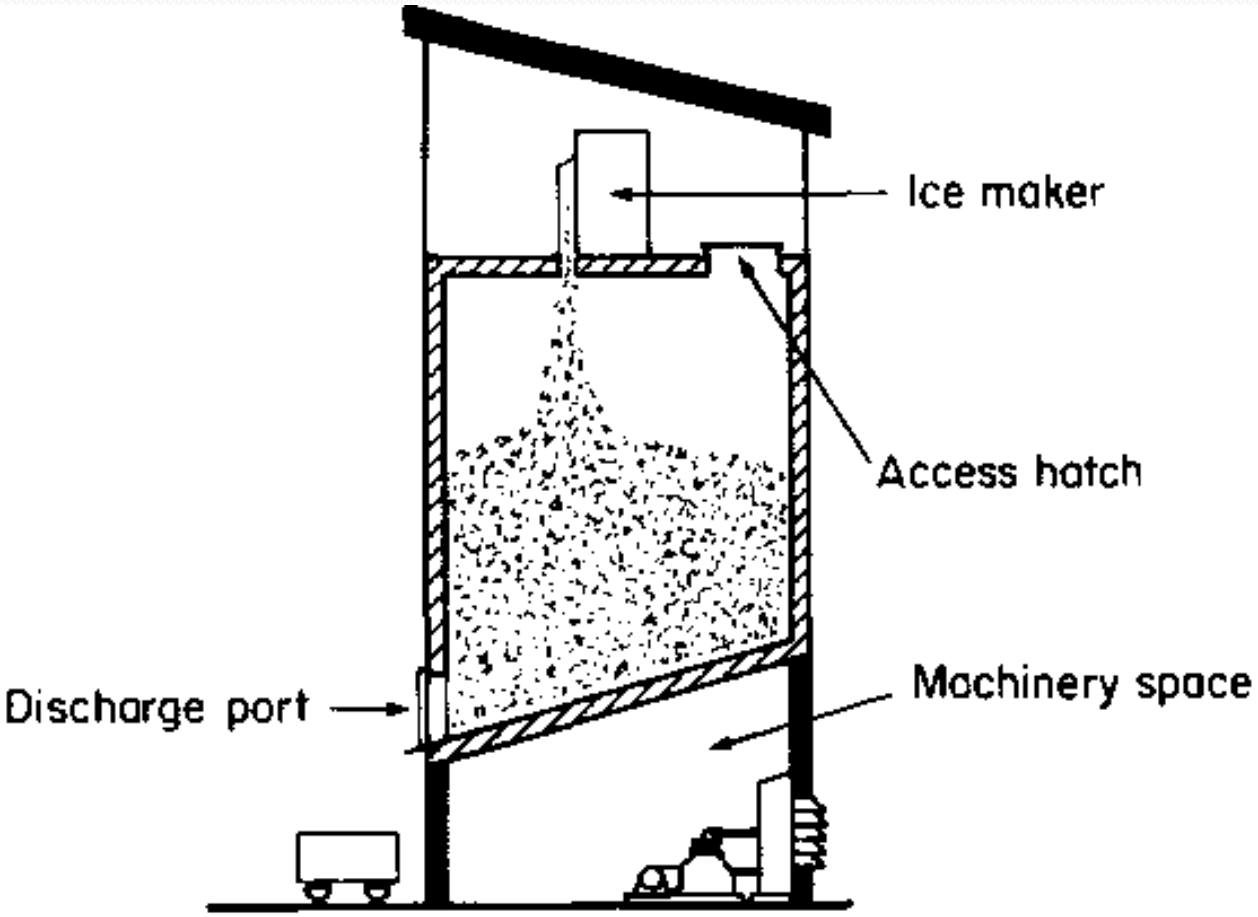
Bin storage

- Bin storage may mean anything from a box holding no more than 500 kg to a large installation of 1,000 tonnes or more.
- Bin storage can be used for any type of ice and may incorporate a separate cooling system.
- An insulation thickness of 50 to 75 mm of polystyrene or its equivalent in one of the many other suitable types of insulation, is suggested.
- Small bins may be arranged with the icemaker above the storage space; the bin is filled by gravity and a FIFO system is operated by removing the ice at a low level. This simple bin system is suitable for processors making and using their own ice.

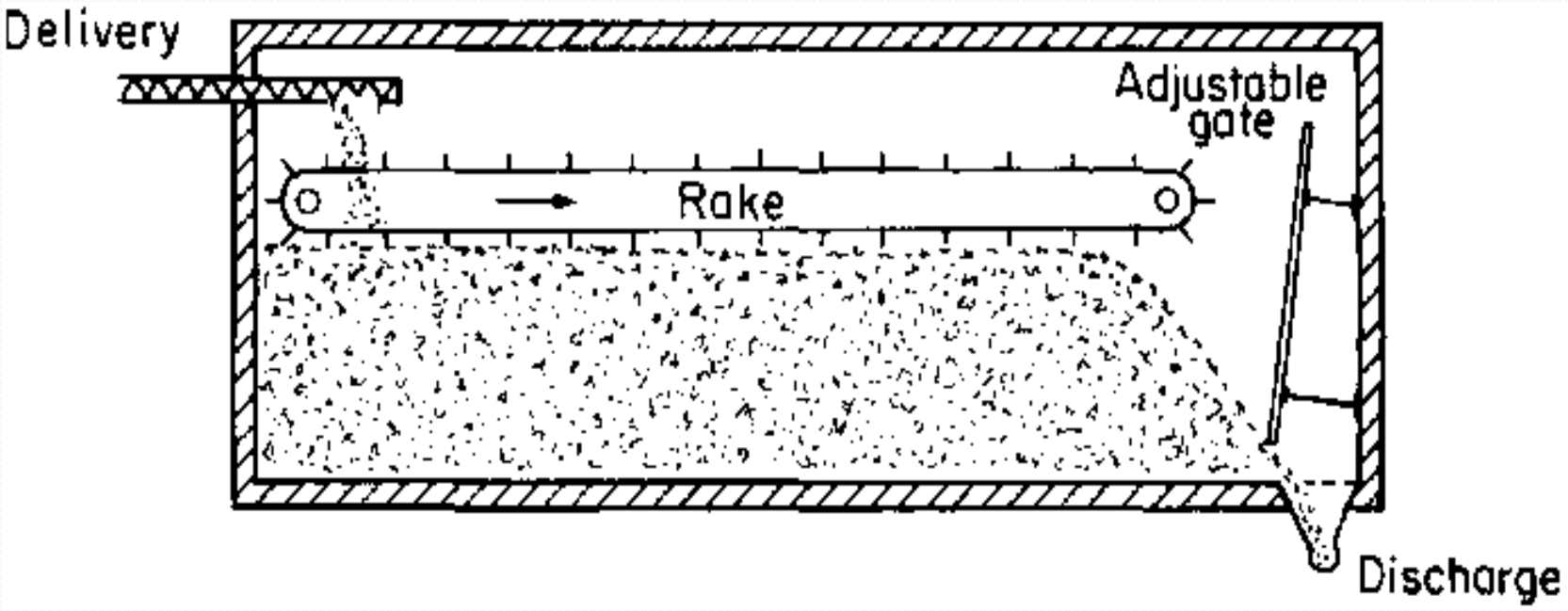
- Bins of up to about 50 tonnes capacity can be constructed without a mechanical unloading system.

- This type of storage would usually be a high structure with a sloping base and access to dislodge compacted ice.
- Any ice left undisturbed for a few days will compact and fuse together.

Bin storage



Large bin ice store with rake discharge system



Block ice storage

- Block ice cannot be stored in silos or bins unless the ice is crushed beforehand.
- This type of ice is therefore stored in block form in refrigerated rooms.
- A conventional block ice plant also has a considerable amount of extra storage in the ice making unit, since it is usual to maintain the ice cans filled, even when demand has fallen below the plant's rated capacity.

Ice handling and conveying

- Some types of ice maker can be sited above the storage space and new ice is therefore added directly by gravity flow.
- This arrangement can only be used when the ice maker produces a dry subcooled ice.
- With other types of ice it is necessary to drain excess water, usually in the conveyor system, before storage.
- Silos, and the smaller size of vertical bin, require no ice distribution system within the storage space to ensure uniform loading.
- Larger bins, however, require a means of distributing the ice uniformly.

- A variety of harvesting methods can be used with bin storage and some of these are also used to distribute the ice uniformly over the store area.
- One system of unloading uses a combined rake and scraper arrangement, which breaks up the surface ice and then conveys it to the end of the bin, where an adjustable gate regulates the flow into a discharge conveyor
- Another system uses a scraper bucket to move the ice to the discharge conveyor.
- Both these systems can operate as ice distributors, but have the disadvantage of discharging the newly-made ice first. Since long-term storage of ice is undesirable, these bins should be emptied periodically.

Transport of ice

- One of the main advantages of the compact modern ice plant is that it can usually be located at the place where the ice is to be used, therefore transport distances are kept to a minimum.
- Transport to distribution points or to the consumer is usually done in bulk and, for short journeys in temperate climates, this may be in a covered uninsulated vehicles.
- However, if long journeys are made, the ice should at least be covered and, in warmer climates, insulated transport or even refrigerated transport may be economical.

Refrigerated seawater and Chilled sea water

- The terms refrigerated seawater (RSW) and chilled seawater (CSW) describe seawater which has been cooled to just below o°C. In some cases, a brine of about the same salinity as seawater is used.
- RSW is generally used when a mechanical refrigeration unit cools the water and CSW is more often used when ice is added for cooling.

Advantages:

(1) Greater speed of cooling

(2) Reduced pressure on the fish

(3) Lower holding temperature possible

(4) Quicker handling of large quantities of fish with little delay or labour involvement

(5) In some cases, an extended storage time

Disadvantages:

- excessive uptake of salt, u
- ptake of water by species with a low fat content,
- loss of protein,
- problems with anaerobic spoilage bacteria,
- modification of characteristics of fish traditionally used as quality indicators, e.g. "bleaching" of gills, dulling of skin, and leaching of soluble end products of spoilage changes.

Salt uptake

- Salt uptake is probably the most important factor which limits the application of RSW systems.
- Fish intended for normal processing and marketing can acquire a salt fish taste which would make them unacceptable.
- The salt uptake in industrial fish is also critical since it is concentrated during processing.
- The upper limit is usually equivalent to a concentration of about 0.5 percent in the raw fish.

Salt uptake depends on:

- (1) Species
  (2) Size of fish
  (3) Salt content of the RSW
  (4) Ratio of RSW to fish
  (5) Time
  (6) Temperature

Chilled sea water

- Mixing ice with seawater
- Ratio of seawater and ice, 1:1 to 1:2
- Temp -1.5°c
- Hear transfer by convection
- Agitation in tank
- Ratio of fish to seawater 3:1 to 4:1

Thank you…..