Ice

Revised 2018

Types of Ice

The four main forms of ice being used in commercial, retail, and industrial applications are block ice, tube ice, plate ice, and flake ice. Ice applications vary widely from packaged "party ice" (retail) to produce cooling (commercial) to industrial applications, such as for curing concrete.

Block Ice: Block ice has traditionally been made in "can ice" plants, in which large, water-filled cans are dipped into tanks of refrigerated brine. After a succession of steps to produce clear ice, including air agitation and coring, heavy cranes are used to lift the cans out of the brine. The cans are then dipped into a warming tank to loosen the ice from the can wall and the cans are turned horizontally in a pivoting apparatus to allow the ice to slide out on to a conveyer.

Block ice is especially suitable for applications in which the ice must be transported before being used or processed, as the blocks melt much more slowly than fragmentary forms of ice. Block ice applications include premium ice cubes, ice sculptures, crushed ice, and snow. In the latter two applications, the blocks are processed through a crusher and slinger. The ice is used principally for refrigerating freshly caught fish or produce off the field, for curing concrete, and for recreational purposes.

Tube Ice: Tube ice, commonly called cylinder ice, is formed by freezing potable water on the inside of a series of vertical metal cylinders around which refrigerant is evaporating at a low temperature. When the cylinders are nearly full of ice, hot gas is used to loosen the ice from the cylinder walls. The ice falls downward and is broken into pieces by a spinning breaker bar or other apparatus. The ice is then usually fed up a screw conveyer or auger to a mechanical storage bin or "rake," where it is stored until it can be bagged or processed. Tube ice is recognizable from the trademark hole in the middle of each "tube." The density of tube ice in storage is approximately 32 lb/ft^3 (0.41 kg/m^3).

Because of the hot gas thawing system employed, tube ice is harvested wet. In order to deliver a superior product that does not freeze together, the ice should be refrozen, which dries the surface of the ice and prevents sticking together. This may be accomplished through the use of a drying system or by placing in a cold room immediately after bagging.

Plate Ice: Potable water flowing downward over refrigerated plates, usually stainless steel or aluminum, freezes to a desired thickness of perhaps 5/8 inch (15 mm), at which time hot gas is introduced into the plates, causing the ice to break away and fall in chunks. These plates are generally rectangular or cylindrical in shape, normally using both sides for ice production with the refrigerant in the annular space formed between the two pieces of metal. Plate ice will usually be found in chunks or nuggets. The density of plate ice in storage is approximately 40 lb/ft^3 (0.51 kg/m^3).

For industrial or produce cooling operations, the ice is made thinner and harvested more frequently. In such cases, the water may continue to flow over the plates during harvest, which has the effect of

speeding up the harvest and increasing production. In this case, a slurry results, which may be desirable for such applications.

Flake Ice: To make flake ice, the exterior or interior of a drum is refrigerated to a temperature of around -20°F (-28.9°C) usually much lower than that of other ice-making systems, and water flows over the interior side of the drum. A rotating scraper scrapes the ice off almost as quickly as it forms and it falls in flakes. Flake ice may be formed faster than ice from other systems, but will involve an energy penalty due to the low temperature used.

Retail, Commercial, and Industrial Uses

Industrial and commercial ice applications are enormous, perhaps greater than retail or consumer applications. Ice manufacturing hinges on the following factors:

Quality of Water: Usually, the lower the total dissolved solids (TDS) content of the water, the better for ice-making applications. Filters and/or treatment may be required where the concentration begins to exceed 600 ppm. The presence of TDS or other minerals in the water will affect ice quality.

The temperature at which the ice is frozen affects the quality or clarity. At temperatures below 10°F (-12.2°C) the ice may become cloudy or crack. High quality ice is clear and without fractures.

Appearance and Taste: Agitation of water will, under proper circumstances, cause alignment of ice crystals during freezing such that minerals in solution are not able to freeze into the ice. The ice produced will thus be free of most dissolved solids that were in the water used to make the ice.

Cloudy ice may be the result of air and impurities trapped within the ice. Cracked ice may be the result of trying to freeze the water too fast at subfreezing temperatures. It is important to note that cloudy ice is viewed as being “dirty” whereas clear ice is viewed as “clean”. Generally, the clear ice is very clean; however, with cloudy ice, it may be impossible to know what minerals or other materials, including organic matter, it might contain. Pure potable water will freeze at 32°F (0°C).

Potable water is usually acceptable for ice making. When the TDS exceeds 600 ppm, water treatment may be required.

Bags and Bagging: Principally, paper and polyethylene bagging materials have been used for holding ice in quantities of about 3-100 lbs (1.5 to 45 kg). Paper bags, which do not allow the customer to see the product and which are comparatively expensive and may allow odors to be absorbed by the ice, have been used less and less, though they remain in use in some heavy duty applications, such as for 100 lb (45 kg) bags. It should be noted that paper bags tend to stack better than plastic bags as the paper surface has more friction.

Plastic bags are transparent and allow the customer to view the product without having to open the bag. They are also less expensive than paper bags and may be stored in a smaller space. Recommended bag thicknesses are 1.5 mil for 5-10 lb (2.25-4.5 kg) bags and 2.25 mil for 20-40 lb (9-18 kg) bags.

There are two main types of plastic bags in use: pre-formed and site-formed. Pre-formed bags in sizes of about 3-100 lbs (1.5 to 45 kg) can be filled from simple ice bins and turreted ice bagging machines. Bags

from rolls of polyethylene are formed on site by heating and sealing the plastic in sections using automatic bagging machines. Site-formed bags usually cost less per unit than the preformed bags. The disadvantage of bags in rolls is that they require the fairly expensive automated bagging equipment.

Ice Storage and Handling

In the early 20th century in the United States, block ice was stacked and stored in massive quantities. This practice is still employed in other nations. Heat of compression must be considered and lower temperatures used. Normally about 25°F (-3.9°C) is adequate, but about 15°F (-9.4°C) may be required when stacking the ice very high.

Packaged ice is stored usually at between 10 and 25°F (-12.2 and -3.9°C) for up to 3 months with excellent integrity maintained. However, ice has been stored for a year and longer with good results by various ice companies under these conditions. After 3 months, a slight frost build-up may occur on the inside of the bag due to sublimation of the ice.

Storage temperatures below 0°F (-18°C) are acceptable for shorter periods of time, approximately 3 months, but may cause increased sublimation of the ice. The ice should be inspected periodically when stored at these lower temperatures. It should also be remembered that the bags have small holes in the sides to release air during the filling process. This means that the ice bag is not hermetically sealed and may absorb odors or sublimate to the refrigeration coils.

In stacking packaged ice, it is a general practice to go as high as 3 and in some cases 4 pallets high without racks. Quality of stacking or palletization will directly affect effectiveness of the stacking. An interesting phenomenon is that stacked packaged ice will, after a period of 4-6 weeks, begin to lean slightly towards the entrance to the room. This leaning condition has been noted by a number of ice professionals. Temperature is usually kept at 20°F (-6.7°C). Probable cause is influx of warm air from entrance door repeatedly being drawn to the lower temperature ice.

Generally, naked or purified block ice in 300 lb (136 kg) form is moved manually, one block at a time. Fragmentary ice is moved, usually in semi-automatic or automatic fashion, with bins for storage and augers moving the ice where desired.

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