



Creators of Bubble Slurry™ Ice

About our Bubble Slurry™ Ice

About solid and flake ice

There are various forms and shapes of solid ice:

- I. **Block ice** (or cake ice) is made by freezing water in a mould to form a block typically weighing about 50 kg (110 lb), which is stored whole and normally has to be crushed before use to give small irregularly shaped pieces known as crushed ice.
- II. **Flake ice** (also known as scale or slice ice) is produced by freezing a thin layer of water on a refrigerated cylinder, and scraping it off in fragments or flakes. Flake ice crystals are usually not smaller than 1 mm (1000 μ or 0.04 in), and have sharp edges; when used in chilling or cooling of products, flake ice can damage the product, and also loses 20-50% of its cooling efficiency as cooling surface area is lost due to air pockets and irregular shapes.
- III. **Tube ice** (or pipe ice) is made by freezing water inside vertical tubes, cut into short lengths on release, and sometimes crushed before use.
- IV. **Small ice** refers to the many kinds of ice made in small pieces in addition to those described above, such as snow or powder ice, plate ice, ribbon ice, cubic ice, etc.

About slurry ice

Slurry Ice is a mix of ice crystals and a water solution, often seawater, salted or sweetened water. Slurry Ice is also known as liquid ice, slush ice, flow ice, fluid ice, or by a wide range of trade or brand names.

There are **three** ways to produce Slurry Ice, each with different characteristics and capabilities:

- I. Slurry ice can be made by crushing or grinding solid ice, and mixing the created sludge with salted or sweetened water. The resultant mix, however, still contains 500 to 15,000 μ (0.5 to 15 mm or 0.02 to 0.6 in) large ice crystals with sharp edges.
A lot of energy is needed to produce this kind of slurry ice:
 - first to make the pure ice cubes, produced at low refrigerant evaporating temperatures of -25°C to -35°C (-13°F to -31°F);
 - then to crush or grind the solid ice;
 - finally to mix the ice with water, until it has become a sludge or “slurry”.
- II. Slurry ice can be produced using a tube-in-tube evaporator or crystallizer, based on a technology that is 25 years old:
 - salted or sweetened water is pumped into the inner tube;
 - a refrigerant is circulated in between the inner and outer tube;
 - on the wall of the inner tube ice crystals are formed at temperatures that range from -15°C to -25°C ($+5^{\circ}\text{F}$ to -13°F);
 - the formed crystals are then cut from the wall by rotating knives or scrapers;
 - a mix of water and ice is subsequently collected;
 - the slurry ice mix contains 20 to 200 μ (0.02 to 0.2 mm, or 0.0008 to 0.008 in) small ice crystals.
- III. **Bubble Slurry™ Ice**, which contains ice crystals of 5 μ (0.005 mm, or 0.0002 in) in size and are formed at a moderate refrigerant evaporating temperature of -12°C to -17°C ($+10^{\circ}\text{F}$ to $+1^{\circ}\text{F}$), is produced by Crytec's second generation tube-in-tube evaporator, in which ice crystals are formed inside the entire space of the inner tube. No knives or scrapers are required.

About cooling capacity

All ice is equal. The cooling capacity or refrigeration effect of ice is 80 kcal/kg (144 Btu/lb). One kg (2.2 lb) of ice at -5°C (+23°F) has only about 3% more cooling power than 1 kg (2.2 lb) of ice at 0°C (32°F). The quantity of ice (P) required initially to cool a unit weight (G) of a product from a given temperature (t) to 0°C (32°F) is: t multiplied by the specific heat (C) of the product, multiplied by G, and divided by 80: $(t.C.G)/80$.

Bubble Slurry™ Ice is used in varying concentrations, from 5% up to 50%, depending on:

- a) the initial temperature of the cooling medium, e.g. seawater,
- b) the initial and desired final temperature of the to-be-cooled product, and
- c) the amount (weight) of the to-be-cooled product.

Because of its characteristics (typically the fact that 100% of its cooling surface is utilized due to its fluidity), the heat flux from Bubble Slurry™ Ice has a superior value, resulting in the fastest and most efficient cooling capacity.

Note: "cooling medium" (e.g. seawater) is the liquid that will transform from liquid to solid state (ice); when that transformation is taking or has taken place, the medium is referred to as "cooled medium". This should not be confused with "refrigerant".

In practice only a 1 : 1 ratio or {Bubble Slurry™ Ice mix with a 15% ice concentration} : {the product's weight} is needed to cool (e.g. a sea bream of 0.5 kg or 1 lb) down from 16°C (61°F) to 0°C (32°F) within 15 minutes.



About melting

First of all, the phenomenon "melting ice" means that the ice is extracting heat from its surroundings (a product to-be-cooled, ambient air, or water). Melting ice means that the ice is "working", and this is what the ice is supposed to do.

Secondly, seeing flake ice or ice chips on a product does not mean that the product it is cooling has reached the desired temperature. In fact it could mean the opposite, with ice crystals visible it could mean that the product has not been cooled down sufficiently, which is due to the fact that the heat transfer surface of flake ice is inadequate.

Bubble Slurry™ Ice cools down a product faster and to a lower temperature (-1°C to +1°C or 30°F to 34°F) than any other type of ice, ranging from +4°C to +12°C (or 25°F to 54°F). If Bubble Slurry™ Ice is used on products during refrigerated transport or in cold storage, the product remains at the ideal temperature and the Bubble Slurry™ Ice remains visible. If, however, the product has not been cooled sufficiently or if the ambient temperature is higher than 1°C (34°F), then the Bubble Slurry™ Ice will start "working", keeping the product's temperature down, which is visible by seeing the Bubble Slurry™ Ice melt.

The melting of ice fully depends on the circumstances during transport or storage.

The main advantages of Bubble Slurry™ Ice

- I. Bubble Slurry™ Ice can be pumped through regular hoses or pipes, so no more shoveling and hauling bins or tubs with ice cubes or flakes;
- II. Bubble Slurry™ Ice surrounds the to-be-cooled products completely, leaving no air pockets, and therefore capable to extract heat better, faster and more efficiently;
- III. Bubble Slurry™ Ice is soft and has no jagged or sharp edges, thus preventing injuries or damages to the product-to-be-cooled;
- IV. Bubble Slurry™ Ice requires less energy, space, and money to produce;
- V. Because of its optimal cooling efficiency as a result of 100% use of its cooling surface area, a Bubble Slurry™ Ice mix requires less (usually 30-50% less) pure ice crystals than a flake Ice and water mix.

Specifications and prices are subject to change without notice.

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