Formax Liquid Ice System
Case study
Location: SIF-France, Boulogne France

General

The liquid ice system designed and manufactured by Formax Ltd. uses blender to mix conventional ice, sodium chloride brine and pure water to create liquid ice with specific characteristics. The parameters that specify the liquid ice are temperature and thickness.

The liquid ice system at SIF-France is a combination of 6 units designed and manufactured by Formax. For detailed description of each unit see Formax products. The appliance is:

Table 1: Liquid ice system appliance

No.	Name	Type
1.	Ice container	IB-2000
2.	Ice conveyor	IBC-2000
3.	Blender	FB-300
4.	Brine generator	BG-1000
5.	Liquid ice storage tank	ST-6000
6.	Delivery network	DS-4

These units are linked together as shown schematically on Figure 1. The ice container is loaded manually with any kind of conventional ice. But ice may also be loaded automatically with an extra conveyer linked directly to any ice machine.

The system as a whole is, in this case, located inside a refrigeration room that keeps ambient temperature between +1°C and +5°C for cooling and storing fish products. The product is submerged in liquid ice and stored for days in the refrigeration room.

Resulting from low ambient temperature in the refrigeration room the ice (the ice phase in the liquid ice and the conventional ice) melts at a very low rate. The liquid ice storage tank is extremely well isolated and the only ice melted inside it is due to the agitator that runs constantly to keep the liquid ice homogeneous.

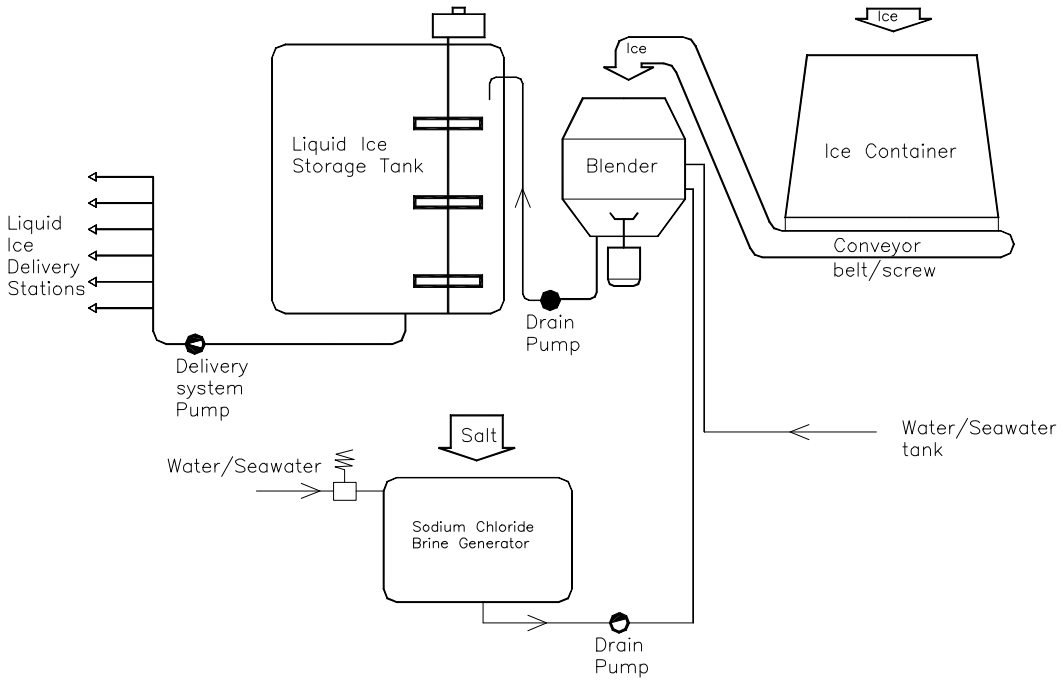

Figure 1: Liquid Ice System schematic

Mechanical appliances

Ice container (with conveyor)

The ice container serves as a temporary storage unit for any kind of conventional ice (flake ice, shell ice etc.). It keeps a suitable amount of ice for blender to run constantly for reasonable period. When the blender demands ice, it sends start signal to the ice container, and the ice is loaded into the blender at a suitable constant rate. If the ice load rate is too high the blender can not measure the total ice batch resulting in overflow. To low ice load rate also have some disadvantages.

The ice container is not used for storing conventional ice for long periods. If the blender is to work properly it is preferred that ice is loaded into the blender at a measurable rate, for the blender, and without delays. For these reasons the ice container is a highly recommended appliance for the system. The ice container stores sufficient amount of ice to allow it to run for acceptable periods between refills.

The ice container is in this case a standard unit specially designed to fit for the Formax Blender FB-300. But if the user can provide similar equipment with ice fill rate that fits for the blender, it would be considered an acceptable solution.

Blender

The blender is the main appliance, and brain, of the liquid ice system. The liquid ice is created inside the blender. The production process is controlled by a PLC computer that is located at the blender front. The blender is supplied with fresh water from the district supply system.

Brine generator

The sodium chloride brine makes it possible to regulated the temperature the liquid ice. The brine is produced in the brine generator that delivers brine close to saturation if enough salt is at hand in the brine generator. The blender orders brine batch by sending signal to the brine generator and the brine pumps starts. Coincidentally a valve on the blender brine inlet pipe opens. At salt shortage the brine strength is lowered. If that happen the blender demands increased brine batch to keep up with the changes. But in the end the liquid ice production stops if the brine strength gets to low. The salt container holds 2 ton of salt. It is refilled according to operator's estimation. The liquid level is automatically controlled.

Liquid ice storage tank

Storing liquid ice demands specially designed tank. It is of vital importance to understand that liquid ice has the natural tendency to liquid phase separation from the ice phase. To prevent this from evolving the storage tank is fitted with agitator that runs constantly to maintain the liquid ice homogeneous.

Delivery network

One of the main advantages of the liquid ice is the manoeuvrability. It is easy to pump with any conventional liquid pump. In the SIF-case a standard stainless steel centrifugal pump was selected. The delivery network is made of PVC plastic piping. The SIF delivery pump is switched on and off manually, no automation is installed. The delivery system selected for SIF-France is very simple. It is a manually controlled system called DS-4.

Production process

The ice container is loaded with any kind of conventional ice. The ice is transported to the blender via conveyor and mixed with water and sodium chloride brine according to the pre-calculated recipe. The recipe it then updated for each liquid ice batch produced. The outcome is a liquid ice specified with the temperature and thickness that was requested by the operator.

As the mixing process for one batch is finished the liquid ice is pumped to the storage tank. In that tank it is constantly agitated to hinder liquid phase separation.

Finally the liquid ice is distributed through piping network to the delivery stations.

Control system

The blender is, as already stated, the centre of the liquid ice system. The PLC computer in the blender calculates the recipe that gives the quantity of each phase that makes up the liquid ice: water, brine and ice. The recipe results in the liquid ice that was requested by typing in temperature and thickness (ice ratio).

As the storage tank indicates low level the liquid ice production starts. First the liquid phases flow into the blender. Then the ice container starts (screws and conveyor simultaneously) to load ice into the blender. As the batch is fully loaded (according to blender's estimation) the ice container stops loading and the mixing starts in the blender. After adjustable period the mixing process is finished and the liquid ice is pumped to the ice storage tank.

Installation

The SIF liquid ice system was located inside a refrigeration room in the factory, as previously noted. The appliance was located and bolted onto the floor. It was linked together and connected to the district water- and electrical supply.

The system layout was designed to keep the distance between each unit to a minimum and make it accessible for repair. It's necessary to keep space around the ice container and the blender at the front side to make it easy to operate the system.

Piping installation is according to Figure 1. Water piping from the district supply was connected to the blender and brine generator. The internal piping is between blender and liquid ice storage tank, and brine generator and blender respectively.

The electrical system is connected according to normal procedures. First the power cables were connected and then the signal cables.

Figures 2 show the system installation on site. Furthest away is the ice container, then comes the blender with conveyor (note the conveyor between ice container and blender), next to the blender is the brine generator and then comes the 6000 liter liquid ice storage tank.


Figure 2: Liquid Ice System SIF-France

The liquid ice is normally produced with temperature slightly below freezing point of pure water. For this reason the piping system collects ice on the outside. However this effect is not considered a problem.

Conventional ice vs. liquid ice

There are two options to choose between, at the present, to keep fresh fish cold for periods, measured in days or even few weeks. The conventional ice is the best known method. But the other is the, later invented, liquid ice solution.

In the case at SIF-France the liquid ice system was selected to take over the old conventional ice. The quality of the stored fish was increased considerably. The fish is cooled down faster and kept at lower temperature during the storage period, by using the liquid ice. It's also important to note that less ice mass is needed by using the liquid ice instead of conventional ice.

On Figure 3 it is obvious that the ice is not effectively cooling the fish. The ice only partly touches the fish.

On Figure 4 it is shown that the fish is submerged in the liquid ice. This results in faster cooling and lower storage temperature. The look of the fish is also protected better.


Figure 3: Fish stored in conventional ice (flake ice)

Figure 4: Fish stored in liquid ice

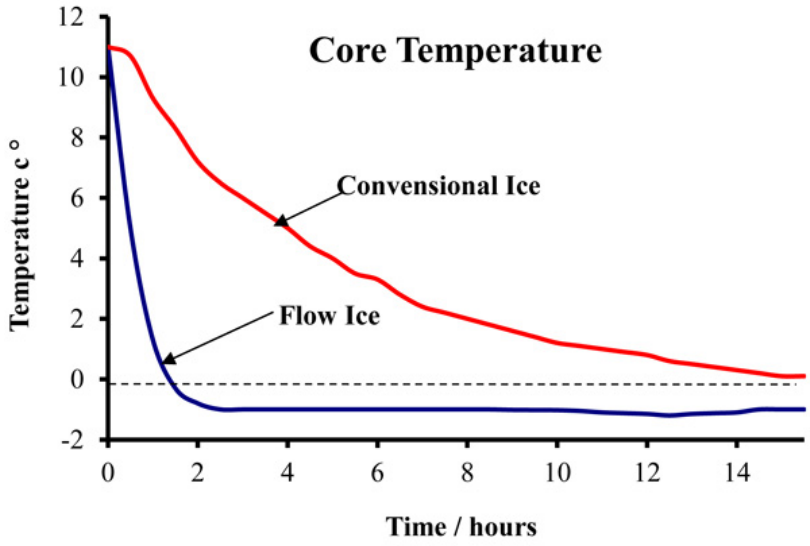

Figure 5: Core temperature graph

Discussion

This document describes the liquid ice system at SIF-France. But this is only a case. The Formax liquid ice modules make various setups possible, both for liquid ice production and many more applications where blender processes are needed.