

Ice Makers and Refrigeration for the Fishing Industry

ERIK BUSCHARDT
Turbo Refrigerating Company
Denton, Texas

When we speak about the fish processing industry, we are really speaking about a complete chain of processes which have to be linked together from the very instant when you have the catch at sea until the very moment that the product is served on the dinner table somewhere in the world. As in any chain, the maximum strength of the chain depends on the weakest link. Once the weakest link is broken the whole chain is broken. It is our task to look after every little part and piece in our process chain to make sure that everything works properly, to guarantee that the product reaches its destination maintaining its good quality.

One of the very important factors which we must control carefully is the temperature. It all starts at sea, on board the fishing vessel the moment that fish or shrimp leaves the water. As soon as that fish dies, the decomposition process starts and only the proper handling can delay that process so we can get the product to the consumer and feed a hungry world. The key word is temperature, we can control the decomposition process and handle our catch.

Now, how can we do that? There are basically two different ways, both require keeping the product at a low temperature, one way is putting our catch into a refrigerated room on board, freeze it on board or we can put ice on the product and in that way keep it fresh until its arrival at the processing plant on shore. Let us take a closer look at the icing of the product. Ice is placed in between and on top of the product and during the melting the ice absorbs the heat from the surroundings which is the product itself, and keeps it at a temperature around 0°C or 32°F. What is ice? Ice is frozen water, yes, nothing else, but as it appears in a solid form you cannot use any shape of ice, you need an ice cut into the proper size pieces, an ice which is dry and cold to assure easy handling and a slow melting ice to give long term, efficient heat-absorbance all over the product.

Now how can such an ice be manufactured? One answer is to use a Turbo Ice-maker which gives you a trouble free design after the most simple principles. The ice machine I am going to talk to you about has been designed to work on shore and can handle both fresh and sea water. However, when making ice using sea water you will normally get a softer and cloudy ice because of the mineral content of the water. You can get the complete package unit ready to start up and you can obtain the lowside, only if you prefer to have the highside connected to your existing system provided that you have sufficient capacity or in other cases where you might prefer a remote highside.

The heart of the Turbo Ice-maker is the ice making cycle on stainless-steel ice-freezing plates. The ice is formed on the outside of each ice making plate. Once the cycle is complete, thick, clear ice is released by fresh water defrost

flowing on the back side of the plates. We call this cycle "The Harvesting." The ice stays hard and dry and once released from the plate it drops by gravity and it cracks into perfect chunks or ice blocks. All of this is one operation. After the overflow flush, the now prechilled harvest water is recirculated and becomes your next batch of ice. The whole process and the shift from cycle one, the *ice making*, to cycle two, *the harvest* as well as the ice cutting bar action, are all operated by a timer system which is all factory wired and assures the simplest and safest operation. As you will find, there is only the compressor, the water circulation pump and the crusher bar motor as moving parts in the machining. You do not need special engineering or any specialized operators or tools to run the plant, the maintenance required to keep these ice makers will fit into almost any plant's ordinary maintenance program. The ice, as mentioned before, is formed on a plate of stainless steel, it is a high heat transfer surface which resists the constant flow of water and ice. Also the tray and even the crusher bar are made out of stainless steel which make the operation almost dairy clean.

When ice is made out of sea water and sea water is also used for cooling purposes at the condenser, a few modifications have to be made in material selected for water piping and the condenser to make them resistant to the sea water. Around the heart of the ice maker you have a polyurethane insulated panel box made of stainless steel which in coastal regions with high salt concentrations in the air provides better protection and less maintenance and will give the opportunity of placing the ice maker in the open air wherever you want, even on a roof top letting the ice drop by gravity down to a holding room or wherever else you may need it for your process. What I am saying is, that by using these units you do not need any housing and it also is not necessary to have a special machine room.

The ice is delivered from the machine as a hard, dry, fragmentary ice which does not fuse together. You can adjust the machine to make pieces from $\frac{1}{4}$ " to $\frac{3}{4}$ " average thickness. It is ready to be used immediately and it is also good for storage. You will realize that ice is a funny thing and though everything may look simple you have to be very careful once you are handling it. If you use the produced ice directly you will probably have no problems at all. If you store your ice for later use, you must have an insulated store room, it is recommended to keep the temperature of the room at 15°-20° F (-9° to -7° C) to keep the ice from fusing together. By doing so you can store your ice over longer periods without problems. Depending on amount stored, you can choose from a totally manual handling up to a totally automized loading and unloading of your ice holding room using an ice rake system, which as the word says is a rake moving on the top surface of the ice bin, raking the top ice towards a screw conveyor which brings the ice out from the storing space. Ice transportation can be achieved either by screw conveying or by air conveying depending on the distance and other lay out characteristics of your plant.

Once your iced product has arrived at the processing plant and has been processed, there are three different ways of further handling: (1) To ship the fish or shrimp, fresh or iced out of our plant directly to the customer, (2) To can the product, in such case normally no further refrigeration is needed, and

(3) To freeze the product and keep it in a holding store until needed. In the last method you would use blast-freezing or contact freezers to freeze the product and then a holding room for storing the product for the necessary time until shipment.

The refrigeration systems for blast-freezing and storage are basically identical and to explain how it works we can consider a very simple system. As a liquid evaporates, heat is needed, and that heat is taken from the surroundings. The evaporation process takes place in the evaporator situated inside an insulated room. The necessary heat is absorbed from the room and the products therein, as a result, we therefore have a cold ambient which can be controlled according to the temperature and the capacity needed. The evaporation in the coil is caused by the compressor outside in the insulated room by a suction from the evaporator. The compressor discharges a compressed gas which we transfer into a liquid in the water or air cooled condenser and then collects in receiver. From the receiver the liquid or refrigerant will go back to the coil regulated by the expansion valve and will be ready to begin evaporating again. The liquid or refrigerant, can be ammonia or freon and the size and selection of equipment depends completely on the purpose of the system. It is important that the freezing of a product is done as quickly as possible to obtain the best possible quality of the frozen product.

During the freezing of fish or shrimp the water in each cell of product is frozen. Ice crystals will form inside the cell and if freezing goes too slowly the ice crystal may increase to such an extent that the cell wall is perforated. However, quick freezing will produce more, but smaller ice crystals assuring that the cell walls stay intact. After thawing the product with perforated cell walls will change characteristics, but a product with intact cell walls will practically stay in the same condition as before freezing. After freezing the product will go to a storage room and now it will be important to watch your holding temperature and another important factor to consider when selecting holding equipment is the temperature difference on which the holding system balances compared to the room temperature, the bigger the difference is the more the tendency there is to dry out the product. It is recommendable that you should not go above 10°-12°F (6°-8°C) of temperature difference between your suction temperature in your evaporator and the room temperature. Sometimes it pays to select a little more expensive equipment obtaining a reasonable temperature difference and saving weight loss on your product.

The last part of the process chain is the distribution, you will be interested in making sure that your product is well presented and that it keeps its quality during the display in the store from where your product is distributed. It is to your best interest that the store have display cases which can guarantee your product in the distribution link of our chain. Through our organization in Miami we can assist you the whole way. We can supply you with the necessary ice-makers and ice storage equipment, blast freezers, holding room equipment, cold storage and freezer doors, panels, small holding and freezing systems and display cases for supermarkets and distribution centers. We are one of the most complete groups you can address yourself to, and we will be happy to assist you in your project.