

A Code of Practice for
HANDLING
Northern Demersal Scalefish

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Developed by

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and the
Kimberley Professional Fishermen's Association



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Preface

Western Australia is recognised for its high quality fisheries and pristine marine environment.

There are 1400 licensed commercial fishing units catching a wide range of finfish species in Western Australia with a commercial value of over \$50 million. Most of the State's 26,900 tonne finfish production (1996/97) is sold on the domestic market with some tropical species marketed overseas.

Over the years, a number of previously under-utilised species have been successfully launched on Australian and overseas markets, and are now in considerable demand. It is in response to this demand that the Kimberley Professional Fishermen's Association decided to develop a Code of Practice for on-board handling of fish.

The Code has been developed to address a number of quality issues on board the vessels to ensure that the highest degree of freshness and quality of the catch is maintained.

Development of the Code

The Code was developed after some work at sea and in consultation with fishermen and fish merchants from the Kimberley Line and Trap fishery at a specially convened workshop in Broome on 31st August 1999.

The Fisheries WA's Seafood Quality Management Initiative provided the funds for the field work, the workshop in Broome and the preparation of this Code to improve the quality (principally freshness and shelf life) and value of the catch from this fishery.

1. INTRODUCTION

This Code describes *general procedures and principles* to be followed for consistently achieving good practice standards on board Kimberley fishing vessels. It is intended to guide fishermen in fish harvesting (by line and trap), chilling, packing and road transport of chilled fish so that they can consistently deliver safe, prime quality product which meet the requirements of discriminating buyers and consumers.

Adoption of the Code is not mandatory but it is recommended by the Western Australian Fishing Industry Council (WAFIC), the Kimberley Professional Fishermen's Association, Fisheries Western Australia (the State Government agency responsible for managing commercial fisheries) and its Seafood Quality Management Initiative (SQMI).

This Code of Practice is not a detailed prescriptive manual setting out exactly how each task should be carried out at sea because there is often more than one way to safely and efficiently undertake any particular activity. Each vessel has different facilities and crew and needs to select the most appropriate way to undertake each individual task and maintain good practices.

Additional information is given *in italics* in the text itself, or in shaded boxes, to explain several key points in detail and the basis or principles behind some of the recommended good practices.

The Handbook provides a checklist for the typical operational practices of the vessels commonly seen in the fleet at this time.

The information in this Code can be applied to the handling of crustaceans and molluscs in the catch from this fishery. Much of this Code can also be useful to fishermen in other fisheries .

1.1 Food safety and fish quality

Governments prescribe standards for food safety to prevent or minimise public health problems while industry usually sets the standards on fish quality, size grading and other marketing or non-health issues.

The target species in the Kimberley trawl fishery represent few known hazards to human health and are not inherently dangerous to eat when cooked. This Code deals mainly with issues relating to maximising the pristine appearance, eating quality, shelf life and value of the fish.

Food safety and hygiene are best assured by providing trained crew with a hygienic and safe working environment and this Code deals with the vessel's construction and equipment requirements for achieving and maintaining good practices and maximising the quality and returns on the catch.

Although the Code is not primarily designed as a training manual it nevertheless contains useful information that can be used as reference material for induction training of new crew and a refresher for "old hands".

Guidelines on typical operating procedures are given in the ' Handbook for on-board handling of fresh fish' accompanying this Code as a succinct checklist and reminder for everyone on board.

1.2 A Code of Practice

A Code of Practice is a “living document” meaning that the standards and recommended good practices may be upgraded as vessel construction, refrigeration equipment, fishing gear, fishing and handling or distribution practices, regulatory standards or technology evolve in the industry. This document is the industry’s first edition.

There are currently five, full time, demersal fin fish trap vessels and one full time dropline vessel operating from Broome. The vessels have an average turn around fishing time of 8 days. The amount of fish being unloaded from each vessel ranges from around 2 to 10 tonnes. The catches are predominantly tropical species that include red emperor, goldband snapper and cod. The majority of fish are trucked to Perth markets while a few were sold in Broome and the surrounding areas.

Kimberley trap and line fish make up Perth’s second largest source of fresh fish, after Pilbara trawl fish. The long distances to some fishing grounds, the size of the boat restricting the number of traps, inadequate cold storage capacity and out dated handling practices all make it difficult to consistently achieve good prices for large loads of fish.

The recommended good practices outlined in this initial Code, for the existing fleet, will need to be replaced if new vessels and equipment are introduced into the fishery.

1.3 General aims and principles behind this Code

The information in this Code can best be applied when the vessel management (owner or skipper) provides or arranges for:

- a vessel with all the necessary gear and equipment to produce a clean and safe working environment;
- introductory training on personal hygiene and the handling of seafoods for all crew before they commence duty;
- sufficient crew, clean water and ice, chilling facilities and containers to handle the anticipated catch in a safe manner;
- fish temperatures to be monitored, utilising a calibrated thermometer that measures to within 0.1 °C, to ensure that the required temperatures are maintained and records are kept in an orderly manner; and
- the maintenance of adequate records on the catching and subsequent distribution of product from the vessel to customers for effective and efficient product traceback and recall.

Fish quality and deterioration

The eating quality of a fish will begin to deteriorate once it is caught and subjected to stress. After the fish is landed, the action of bacteria, biochemical (enzymes) changes and chemical actions will lead to an inevitable deterioration which cannot be stopped, but can be slowed down. Deterioration and loss of quality can be minimised by:

- **Controlling temperatures.** Temperatures should be kept at a steady low level to minimise bacterial, biochemical and chemical activity. Keep fish as cold as possible without freezing, if intended for sale as fresh.
- **Preventing physical damage** (e.g. bruising, cuts to the skin) to the fish.
- **Preventing contamination** through good vessel design and construction, providing a hygienic working environment and good handling practices.

2. GOOD HYGIENE & SANITATION PRACTICES

2.1 Water and ice

Clean water is essential for food and public health safety. Therefore:

- all ice should be made from **potable water**, when using fresh water, or clean seawater and stored in hygienic containers at all times;
- seawater should not be used on fish or fish-holding containers while the vessel is in harbour, nor in areas where there is danger of it being polluted;
- all equipment used for handling and storage of ice should be maintained in a clean manner to minimise contamination; and
- any ice that falls to the deck or comes into contact with unclean surfaces should not be used.

Definition of potable water

Potable water will:

- (a) not contain any *Escherichia coli* per 100 millilitres;
- (b) not contain more than 10 coliform organisms per 100 millilitres;
- (c) not contain 1 to 10 coliform organisms in 100 millilitres in any two consecutive samples; and
- (d) not contain 1 to 10 coliform organisms in 100 millilitres in any three samples, for any consecutive 12-month period.

(from AQIS Processed Food Orders)

2.2 Fish handling

Fish should be handled by trained crew members under conditions which ensure that contamination is minimised or eliminated. This can best be achieved by:

- conducting a pre-operational check of facilities and equipment and cleaning any soiled areas or equipment as necessary, before start-up;
- keeping facilities and equipment as clean as possible during fishing, chilling, packing and storage of seafood (“clean as you go”);
- ensuring that all cleaning or sanitising chemicals are food safe, used in accordance with the manufacturer’s instructions and comply with government regulations;
- storing all poisonous or harmful materials such as oil, insecticides and cleaning compounds in secure and appropriately marked locations where they cannot leak into fish handling areas; and
- storing packaging material such as plastic bags, cartons or styrene boxes in a clean dry area away from fish product or contaminants.

2.3 Hygiene & health of crew

All crew must maintain a high standard of personal hygiene whilst handling seafood or containers used in holding seafood. This is achieved by:

- ensuring that crew are fully trained in the hygienic handling of food product;
- crew thoroughly washing their hands with soap and rinsing and drying hands before handling seafood or entering the holding rooms especially after using the toilet.;
- prohibiting smoking, drinking and eating in the packing area, holding rooms or wherever fish are handled;
- having crew with hepatitis or gastroenteritis, infectious skin conditions or other illnesses that may be transmitted to the product excluded from processing areas; and
- ensuring that bandages (on minor injuries) are clean and waterproof and of an easily detectable type or colour.

2.4 Pest and animal control

Pests such as rats, mice, birds, insects and domestic animals such as dogs and cats, should be kept off the vessel at all times. Food should be kept in sealed containers or in tightly closing compartments.

All insecticides and fumigants should be used:

- in accordance with the manufacturer's recommendations;
- in a manner that does not risk contamination of product. All product shall be removed from the brine tanks or holding rooms before pesticides are used; and
- in accordance with government regulations.

3. VESSEL & GEAR DESIGN, CONSTRUCTION AND OPERATION

3.1 Vessel design and construction

Fishing vessels should be designed and constructed so as to prevent contamination of fish with bilge water, sewage, fuel, oil or other objectionable substances. The vessel's toilet facilities, plumbing and waste-disposal lines should be designed so as to not contaminate fish. The intake for sea water for the deck hose should be well forward of, and on the opposite side of the vessel from the toilet waste and engine-cooling discharge. Each vessel should have a foot or elbow operated tap with soap dispenser.

Consideration should be given to protection of fish against physical damage, exposure to the drying effects of sun and wind, and exposure to high temperatures.

Surfaces which come into contact with fish should be made of smooth, corrosion-resistant material which can be easily cleaned.

Any wooden boards used that come into contact with fish on deck should be coated with durable non-toxic paint or other smooth coating that can be easily cleaned.

The fish hold and brine-tank walls should be completely water-tight to prevent water from carrying fish slime, blood and scales into the walls where cleaning is impossible.

(Leakages are also a problem in that dirty water, blood, etc. may later re-enter and contaminate the brine tank or hold).

3.2 Brine tanks (refrigerated/chilled sea water)

The refrigerated brine system should be designed to rapidly chill fish. Each tank should be fitted with an easy to read temperature gauge. There should be ample insulation in the walls of the tank to minimise heat leakage and operating costs.

There should be sufficient compressor capacity to:

- maintain the temperature of the fish at about -1°C ;
- prevent a significant rise in temperature of the water when the tank is being loaded with freshly-caught fish; and
- ensure that the core temperature of the fish can quickly come down to -1°C .

Fish are more rapidly chilled by immersion in refrigerated sea water (RSW) or chilled sea water or (CSW - ice added to sea water) than by packing in ice, therefore RSW or CSW tanks are commonly used on Australian vessels.

3.3 Fishing gear design

Fishing gear should be designed, constructed and regularly maintained to minimise damage to fish and maximise the physical condition of catch.

Sharp wires or corners in bait boxes or pots should be covered or removed.

Wires should run in the same direction that the fish travel to avoid scale loss.

Bait boxes should be made of plastic with tight lids and either lined or made of fine mesh to reduce the amount of bait that fish are able to access.

3.4 Trip planning and logistics

The duration of each trip and the crew's fish handling capacity should be assessed prior to leaving port in order that the fish can be handled, chilled and packed to satisfy customers.

The amount of fish caught needs to be controlled. Increased catches could mean reduced shelf life if this means that there are difficulties in chilling fish in limited capacity in brine tanks.

Once the fish is caught, death and spoilage may commence and there is a continual and irreversible deterioration in quality. This deterioration is determined mainly by the time and the temperature the fish are held; therefore fishing trip length should be controlled and governed by fish condition, not just by a prearranged schedule or traditional practices.

4. OPERATIONAL PROCEDURES

4.1 Before leaving port

- Ensure that all crew have read the 'Handbook for on board handling of fresh fish'.
- Assign a crew member as the quality assurance supervisor who is responsible for ensuring that the vessel's quality control program is properly carried out during the trip. This should include the responsibility for sanitation of vessel and equipment, product quality and maintenance of log sheets.
- Ensure that there are at least two probe thermometers on board in good working order.
- Make sure any fish boxes being returned from the market are clean (pressure blast if required). Do not place the boxes on the vessel until just prior to departure unless they are stored in an enclosed area that is clean.

4.2 Travelling to the fishing grounds

- Wait until the vessel is clear of the harbour and associated bays before using the deck hose to clean.
- Release water from brine. Rinse brine and lug boxes with clean sea water.
- Clean fish bins, deck, mats and any other potential fish contact surfaces with an approved detergent / sanitiser (*it is essential that the boat is thoroughly cleaned on the way out, so as to get rid of any contaminants from the wharf*). Equipment and utensils should be hosed down, cleared of rubbish and scrubbed regularly throughout the fishing trip.
- Allow bins to dry before packing / storing. The bins should be kept as sterile as possible.
- Fill the brine with clean sea water and turn on (*add a little extra water as it maybe needed to top up a small ice slurry deck box*).
- Add required amounts of anti bacterial agents to the brine and water used to make ice.

Skippers may choose to use a detergent **and then** a sanitising ("disinfecting") solution instead of a combined detergent-sanitiser to scrub facilities and utensils.

Use of sanitisers

Alkaline detergents are recommended for removal of fat and protein materials found on fish. Sanitisers containing phenols (such as 'Pine-o-cleen') may impart undesirable odours to seafood, which may affect their taste. They are not recommended. The key point is to select compounds that will work well with seawater of a pH of 8.5 at ambient temperatures of about 25-30°C.

A sanitising agent containing chlorine, such as swimming pool hypochlorite powders, are used on many fishing vessels. However, the optimum pH for swimming pool powders is 7.2-7.6 and they are not effective in the high pH waters found off the northern WA coast (pH about 8.5). They should not be used.

Scrubbing surfaces with a brush is a critical part of cleaning. If organic material such as blood and slime is not removed, it rapidly combines with and neutralises the disinfecting ability of the sanitiser solution. Simply soaking lug boxes in a sanitiser is ineffective and almost a waste of time; this is particularly so for chlorine solutions, for the reasons outlined above.

*The **Pseudomonas** group of spoilage bacteria are found naturally in the warm waters of the Kimberley region. They are also able to live in the low temperatures found in brine tanks and grow well in an iron rich environment (such as a steel deck or stanchions). They produce volatile sulphur compounds as they reproduce and increase in numbers which accelerates rusting.*

***Thorough cleaning of lug boxes and the deck is essential** to minimise contamination of brine tank water and to control rust on deck. The clean boxes should be stored in a clean, preferably dry, area so that they are not contaminated. Short term storage in the sun may be beneficial as the ultraviolet rays, heat and drying of the sun destroys many of the bacteria.*

*Fish can be weighed accurately at sea with modern electronic scales and then packed with ice below deck. Packing fish in ice keeps the fish moist, which prevents drying out and reduces the loss of pristine appearance and weight. Packing fish with ice **is therefore recommended for financial and quality reasons.***

Iced fish are best held at a room temperature of about 0-4°C where ice is able to melt a little and the resulting melt water percolates down through the pack thereby washing the fish. With ice storage, boxes with drain holes are required to allow the dirty melt water to run away to waste; if poly bags are used to minimise soiling and work in cleaning of boxes then bags with holes in the bottom would need to be ordered.

4.3 Handling of gear and fish catch

- After baiting and setting lines, rinse the deck with clean sea water. Rotten bait should not be used in fish traps.
- Keep the deck wet and as cool as possible while fishing.
- The landing of the catch onto the deck should be done with care to minimise physical damage to fish and exposure to the warming and drying effects of sun and wind. Haul lines slowly (about 5 minutes from 70 fathoms) and remove fish as quickly and gently as possible so as to minimise damage to fish.
- Don't throw fish. When sorting the catch, fish should be handled and transferred carefully to a nearby box to minimise the distance fish fall and consequent damage.

Loss of scales or breaks in the skin when fish are thrown exposes fish to early and more severe attack by bacteria. This leads to more rapid spoilage, loss of freshness and shelf life. Place lug boxes as close as possible to the fish.

- Traps should be cleared of enmeshed fish or trash after each haul.

Consideration should be given to the size of particular fish and to species variability in handling, because some are more delicate than others; and smaller fish are more easily damaged and warm up more quickly than larger individuals of the same species.

4.4 Washing the catch

A small bin of ice slurry positioned near the tipper can be used for washing of the fish prior to immersion in the brine tank and would greatly assist to:

- take the initial heat out of the fish which would make it easier for the brine to chill the fish;
- allow the fish to cough up most of the food in their mouths and stomachs thus help to keep the brine clean;
- reduce scale damage by not having to carry flapping fish to the brine tank;
- help circulation in the brine tank by reducing the scale blockages in the pump and PVC pipe; and
- remove bacteria from the fish prior to going into the brine.

The small slurry should be replaced regularly and an anti-bacterial agent added

- every four or five good lines or when the wash tub is nearly full remove fish from tub and place in brine (use clean gloves or ensure bare hands are clean); and
- if the water in the wash tub is polluted or above 3C replace it with clean water from the brine tank and/or a combination of ice and salt water.

(It is important to ensure that gloves are clean and no slime or old bait gets into the brine via gloves. Gloves should be rinsed after baiting and setting pots and stored in a hygienic position when not in use).

4.5 Chilling fish in brine tanks

- The temperature and cleanliness of the brine should be monitored and recorded regularly to ensure that each new lot of fish is rapidly cooled without substantially raising the temperature of the brine (ie 'overloading' the system). Try to maintain brine temperatures around -1.5C.
- The brine water should be replaced with clean sea water, and ice if needed, when it is noticeably discoloured (indicating contamination from earlier loads of fish).
- Clean fish should be immersed in the brine tank to rapidly lower the temperature of the fish to about zero to -1.0°C.
- Fish should be removed once core temperature of fish has been lowered to about -1°C using clean hands or fresh gloves.

Ideally the fish in the brine should be removed every couple of hours and no longer than six hours. . At about -1.0 to -1.5°C some fish eyes may be white and the flesh very firm but the eyes revert to normal colour after they are removed to refrigerated storage; the core temperature of fish must not be below -1°C for fish to be sold as fresh (not frozen).

- Only remove and pack a few fish at a time. The fish should be held in clean lug boxes to drain and not exposed to the air for more than 15 mins.
- Any ice build up on the refrigeration plates/coils in the brine tank should be physically removed or the power to the refrigeration system switched off. Take care to not allow temperature to rise substantially above zero.
- *The build-up of ice on the refrigeration plates/coils in brine tanks without circulating brine increases chilling times and operating costs. These tanks are inferior to the circulating brine tanks.*

4.6 Transfer to refrigerated storage

- After chilling in the brine tank, fish should be quickly and carefully transferred to the holding room for packing and storage. Take care to prevent warm up or contamination during the move below deck.
- When removing fish from the brine and packing, crew should use clean gloves that are non-porous (or clean hands) that are as sterile as possible.
- Air temperature in the holding room should be regularly monitored and controlled at a steady low temperature of 0 to -1°C. Fish should remain thoroughly chilled but not frozen. The core temperature of the fish should be monitored, and recorded, to ensure that it is about 0 to -1.0°C.

Below -1.5°C, the fish will freeze slowly and freezing should be avoided because fish colder than -1°C do not meet Australian Food Standards for fresh fish.

4.7 Packing of fish

- Each vessel should consider developing a grading system, especially if intending to export the product.
- Fish should be packed neatly with belly down on the bottom layer and belly up thereafter, parallel to each other (soldier packed) and in boxes ideally lined with a new polyethylene bag, to a limit of about 15 or 25 kg per case (depending on case size) to avoid squashing.
- Reject any severely damaged fish (ie: 50% scale loss, bruised, etc)
- Fish which are still bent stiff in *rigour mortis* should not be straightened out. *Straightening bent fish still in rigour will later lead to a gaping (separation of the muscle bands in the flesh) when the fish is cut into a fillet or cutlet.*
- A polyethylene bag should be folded over the top of the fish to enclose them and control drying out and a plastic lid is then fitted to the case.
- If packing fish in ice, ensure each layer of fish is covered with ice.
- Use a temperature probe to ensure the fish are being held at between
- -1°C. and 1°C.
- Place a thin plastic streamer over each days catch when it is packed in the ice so that fish capture dates can be known during unloading.
- Remove gloves, rinse and soak in anti-bacterial solution.
- Report any irregularities to the skipper immediately.

4.8 Date labelling/coding of cases

Proposed food regulations will require food businesses to be able to recall product should the need arise. This implies a traceability system that operates from catch through wholesale and distribution to the retailer.

- A label with the name of the vessel, species, date of capture, or a date/colour code, should be affixed to cases of fish to allow for stock identification and rotation, and for better distribution of the catch according to the date of landing.
- Fish temperatures and quality should be monitored and documented before transport with a copy provided to the buyer.

When the catch is labelled or date coded the fish can be processed or distributed in order of age since capture so that freshest fish goes to more distant markets or is processed last : “first in first out”.

4.9 Returning from the fishing grounds

- Monitor chill room temperatures and maintain at 0°C, plus or minus one degree.
- Clean the vessel giving particular attention to the toilet and shower.
- Drain and check brines for bacteria traps (ie: cracks, holes, fish bits stuck behind plates, etc) fix as required.
- If OK, fill brine tank with clean seawater and a detergent / sanitiser and immerse lug baskets and other bins used on deck. Close brine lid.

4.10 Unloading the catch

- The refrigeration on the truck should be operating early so that the truck is cold when the fish is actually loaded.
- Unloading of the vessel should only commence once all the necessary equipment, the catch and crew are “ready to go”, and all preparatory work is completed.

Sufficient pallets and crew, and a fork-lift truck, should be assembled in preparation for unloading the catch at the waterfront.

- The crew should ensure that all cases of fish in the hold have their lids on and are ready for quick unloading before the hatch cover is removed and warm air enters the holding room.
- Don't unload fish during the hottest part of the day.
- Fish should be checked for species and weight, quickly loaded onto pallets with labelled end facing out and overwrapped with plastic sheet to secure each lot. The pallets should then be transferred to a waiting truck or holding-room **without delay**.
- The back door of the truck should be closed in between loading each pallet load of fish, to minimise warming up of the fish.

4.11 After unload

At the end of each trip, the deck, boards, lug boxes, brine tanks, fish-holding room, bilge sump, ice bins, ice room, and other fish-handling equipment and utensils should be thoroughly cleaned, as follows:

1. Flush (hose) all surfaces with clean sea water or freshwater.
2. Scrub all surfaces with a brush, using a solution of detergent-sanitiser (a solution that both cleans and sanitises). Pressure clean the boxes & chill room and everything in them (use clean fresh water with a detergent / sanitiser mix, don't pressure blast around light fittings or the chiller units, scrub and wipe these areas by hand).
3. Rinse surfaces with clean seawater or freshwater and allow to dry in the sun (fish boxes can be stored in the sanitiser solution in the brine); and
4. Clean, and then fill the brine tank with sanitiser solution until the next trip.
5. Traps should be thoroughly cleaned at the end of each trip.
6. Check the boxes & room for damage (ie: bacteria traps such as cracks, holes, rust, broken pipes or coverings etc) and make management aware.
7. Lock the boxes and chill room until the next trip (think of them as hospital operating theatres).
8. Check the deck for any oil leaks and fix if required.

4.12 Road transport and temperature checks

Product temperature should be taken from a random sample of the consignment (at least two cases from two different days or consignments) immediately prior to loading the road carrier or lodgement at a shore depot.

These temperature measurements should be noted on the consignment papers and retained as a record of product temperature when possession was transferred to a depot or the road carrier. This may be used to resolve disputes with customers over temperature condition of product on arrival.

The carriers should be advised of their responsibility for ensuring continuous mechanical refrigeration to maintain temperature control of the consignment at all times until the consignee accepts delivery.

4.13 Fishing, temperature and fish distribution records

Detailed records should be maintained of each day's trawling and fish packing to clearly identify the fishing area and packing details to allow for efficient traceback and recall of any suspect or faulty product.

Holding room, brine tank and fish temperature monitoring records should be maintained to provide the vessel owner and customers an assurance of good handling practices.

Any unusual or significant fishing or handling factors affecting fish quality should also be noted in the vessel's records to facilitate any traceback or follow up inquiry on a particular days catch. Such information is passed onto customers for their information and guidance on managing the quality of their consignment.

These records should be maintained for 12 months.

5. THERMAL CHARACTERISTICS AND USE OF ICE

5.1 Use of ice for chilling fish

Ice is a very efficient coolant and is widely used to cool food because it is:

- safe to use;
- does not change the food; and
- removes a lot of heat from the food when the ice melts from a solid at about 0°C to a liquid (melt water at 0°C). This is because ice has such a large reserve of cold known as the **latent heat** of melting ice.

A kilogram of ice removes about 335kJ of heat from fish or water as it melts.

How to calculate ice requirements

The amount of ice needed to cool fish depends on:

- *weight of the fish;*
- *the temperature reduction required;*
- *the specific heat of the fish (3.6 x 1,000 (J/kg °C)); and*
- *latent heat of ice.*

For example, to cool 100 kg of fish (or water) from 25°C to 0°C the amount of ice needed (in a box or tank without refrigeration) can be calculated by :

$$\frac{\text{weight of fish} \times \text{temperature change} \times \text{specific heat of fish}}{\text{latent heat of ice}}$$

ie, multiplying the weight of the fish (100 kg) by the temperature change required (25° - 0° = 25) and the specific heat of fish (3.6) and then divided by the specific heat of ice (335).

This is :

$$\frac{100 \times 25 \times 3.6}{335} = 27 \text{ kg of ice}$$

In this example, the 27 kg of ice will cool the fish from 25°C to 0°C, but there will be no ice left after the fish have reached 0 °C. This means that 27 kg of ice in a slurry fish (eg tank with seawater chilled only with ice) will melt in cooling the fish. More ice will be required to then keep the fish at a temperature of 0°C.

(The use/consumption of ice in refrigerated brine tanks will vary according to fish volumes, temperatures and the mechanical capacity of the refrigeration system).

An ice slurry is commonly used to chill fish immediately after harvesting, but the ice must be thoroughly melted in water to produce a slurry with uniform temperature of about 0 C. The formula shown above can also be used to determine how much ice needs to be melted in water to produce a slurry at 0°C.

Note: 1 litre of freshwater weighs 1 kg; 1 litre of sea water weighs about 1.035 kg.

5.2 Sea water ice

Sea water ice

The temperature of sea water ice is highly variable. The initial melting temperature of clean sea water ice may be as low as -6°C , but due to the leaching away of salt in the melt water, the melting temperature may rise again to nearly 0°C .

Another characteristic of sea water ice is that the salinity is also highly variable and the ice at the bottom of a bin is very salty while that at the top may not be noticeably salty at all.

There is also a risk that fish stored in plenty of sea water ice may become partly frozen, and any headless, gutted fish may absorb some salt.

A key point to note about sea water ice is that its cooling capacity is only marginally greater than that of freshwater ice despite its lower temperature versus freshwater ice.

This is because most of the cooling capacity of any type of ice comes from the latent heat --the heat absorbed when the ice melts from a solid to a liquid (water) -- rather than the heat absorbed in raising the temperature of the ice itself, from about -6°C say for sea water ice, to about zero.

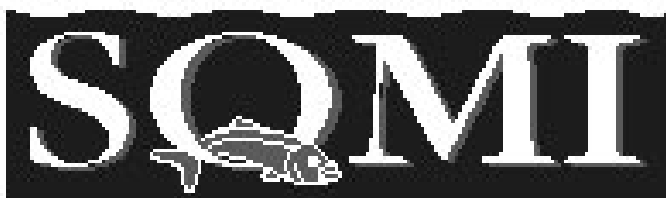
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This Code has been produced as part of the SQMI project promoting

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WA SEAFOOD QUALITY



MANAGEMENT INITIATIVE

An Initiative of the Minister for Primary Industry: Fisheries
Funded through the Development and Better Interest Fund

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