

IAFMM

**TECHNICAL
REPORT**

Hoval House, Orchard Parade, Mutton Lane, Potters Bar, Hertfordshire EN6 3AR, U.K. Tel. (Potters Bar) 0707 42343



No. 4 September 1985

**RECOMMENDED
IAFMM GUIDELINES
FOR HANDLING
INDUSTRIAL FISH
FOR HUMAN CONSUMPTION**

RECOMMENDED IAFMM GUIDELINES
FOR HANDLING INDUSTRIAL FISH FOR HUMAN CONSUMPTION

Contents

	Page
SUMMARY	2
ZUSAMMENFASSUNG	3
RESUMEN	4
1.0 SCOPE	5
2.0 DEFINITIONS	5
3.0 RAW MATERIAL REQUIREMENTS	7
3.1 General Considerations	7
4.0 FISHING VESSEL FACILITIES AND OPERATING REQUIREMENTS	8
4.1 General Conditions	8
4.2 Fishing vessel construction and sanitary design	8
4.3 Sanitary facilities	14
4.4 Equipment and utensils	18
4.5 Hygienic operating requirements	20
4.6 Handling the catch on board	25
4.7 Unloading the catch	30
4.8 Sanitary control programme	33

SUMMARY

These guidelines apply to industrial fish (that is, fish or parts thereof which are usually processed into fish meal and oil) intended for human consumption. They contain the technological details and the essential requirements of hygiene for the handling of fish at sea and unloading the catch.

Fish quality and freshness is of utmost importance. The fisherman should discard any fish that is diseased or is known to contain harmful substances. The fishing vessel should be designed for rapid handling of fish, and ease of cleaning and disinfection. With the least possible delay the fish should be thoroughly iced or immersed in chilled or refrigerated water to bring its temperature down to 0°C as quickly as possible. Chilling of fish in bulk by cold air or by top icing only should be avoided. Except for tank stowage in chilled or refrigerated sea water/brine, the stowage of fish for human consumption in holds that are not divided into pounds is not recommended. Where chilled clean sea water or brine are used for cooling and storing the catch, there should be adequate circulation of the liquid. Fish should be at 0°C when landed.

Emphasis is placed on use of corrosion resistant equipment in order to reduce the risk of harbouring harmful micro-organisms. Detailed sanitary guidelines are documented.

ZUSAMMENFASSUNG

Diese Richtlinien beziehen sich auf Industriefisch (also Fische oder Teile von Fischen, die üblicherweise zu Fischmehl und Fischöl verarbeitet werden), der für den menschlichen Verzehr bestimmt ist. Sie enthalten technische Einzelheiten und beschreiben die erforderlichen Hygiene-Massnahmen bei der Behandlung des Fisches auf See und beim Entladen des Fanges.

Qualität und Frische des Fisches sind von äußerster Wichtigkeit. Beim Fang muß jeder Fisch entfernt werden, der krank ist oder bekanntermaßen schädliche Bestandteile enthält. Das Fangschiff muß für eine schnelle Behandlung der Fische eingerichtet sowie leicht zu reinigen und zu desinfizieren sein. Mit geringstmöglicher Verzögerung muß der Fisch vollständig geeist oder in gekühltes bzw. Eiswasser getaucht werden, um die Körpertemperatur so schnell wie möglich auf 0°C zu senken. Abkühlen im Haufen durch Kaltluft oder eine Eisschicht auf der Oberfläche sind nicht geeignet. Mit Ausnahme der Tanklagerung in kaltem bzw. gekühltem Seewasser oder Salzsole ist die Lagerung von Fischen für die menschliche Ernährung in Behältern, die nicht weitgehend unterteilt sind, nicht zulässig. Wenn gekühltes klares Seewasser oder Salzsole für die Abkühlung und Lagerung benutzt werden, muß für eine angemessene Umwälzung der Flüssigkeit gesorgt werden. Die Temperatur des Fisches muß bei Anlandung 0°C betragen.

Auf die Verwendung von korrosionsbeständigem Material ist Wert zu legen, um das Risiko des Einnistens von schädlichen Bakterien zu vermindern. Genaue sanitäre Richtlinien werden beschrieben.

RESUMEN

Estas directrices se aplican al pescado industrial (esto es al pescado o partes de pescado que usualmente se procesa para la obtención de harina y aceites de pescado) y que se pretende utilizar para consumo humano.

Ellas contienen detalles tecnológicos y los requisitos esenciales de higiene, para la manipulación del pescado en el mar y en la descarga de la captura.

La calidad y frescura del pescado es de la mayor importancia. Los pescadores deben descartar cualquier pescado dañada o que se sepa que pueda contener sustancias dañinas.

Los barcos pesqueros deberían ser diseñados para manipulación rápida del pescado, así también como contar con facilidades para la limpieza y desinfección.

Con el menor retardo posible el pescado debería ser cuidadosamente helado o sumergido en agua helada o refrigerada, para llevar la temperatura bajo 0°C lo más rápido que sea posible.

El enfriamiento del pescado en volumen, por aire frío o por hielo en cabeza debe ser evitado. Excepto para almacenamiento en estanques con agua salada o agua de mar enfriada o refrigerada, el almacenamiento de pescado para consumo humano en pozos que no estén divididos en secciones no es recomendado. Donde se utilice agua de mar enfriada limpia o salmuera para enfriar y almacenar la captura, debería existir una adecuada circulación de líquido. El pescado debería estar a 0°C cuando se desembarque.

Se debe poner énfasis en el uso de equipo resistente a la corrosión en orden a reducir el riesgo de embarcar microorganismos resistentes. Guías sanitarias detalladas se han documentado.

RECOMMENDED IAFMM CODE OF PRACTICE FOR
INDUSTRIAL FISH
FOR HUMAN CONSUMPTION

1.0

SCOPE

These guidelines apply to industrial and other similar fish intended for human consumption. They contain technological details and the essential requirements of hygiene for the handling of fish at sea and unloading the catch.

2.0

DEFINITIONS

- 2.1 "boxed stowage" is the storage of fish on board the vessel in boxes;
- 2.2 "bulk stowage" is the mass storage of fish in pounds on board the vessel;
- 2.3 "chilling" is the process of cooling fish to a temperature approaching that of melting ice;
- 2.4 "chilled brine" is a solution of food grade salt (sodium chloride) in potable water of about the same salinity as sea water which is cooled in the manner as chilled sea water;
- 2.5 "chilled sea water" is clean sea water cooled by the addition of ice prepared from potable water or clean sea water and whose temperature is 0°C(32°F) or slightly below;
- 2.6 "clean sea water" is sea water which meets the same microbiological standards as potable water and is free from objectionable substances;
- 2.7 "cleaning" means the removal of objectionable matter from surfaces;
- 2.8 "contamination" means direct or indirect transmission of objectionable matter to the fish;
- 2.9 "disinfection" means the application of hygienically satisfactory chemical or physical agents and processes to clean surfaces with the intention of eliminating micro-organisms;
- 2.10 "fillet" is a slice of fish irregular in size and shape removed from the carcass by cuts made parallel to the backbone;

- 2.11 "fish" means any of the cold-blooded aquatic vertebrate animals commonly known as such. This includes Pisces, Elasmobranchs and Cyclostomes. Aquatic mammals, invertebrate animals and amphibians are not included.
- 2.12 "fresh fish" are freshly caught fish which have received no preserving treatment or which have been preserved only by chilling;
- 2.13 "gutted fish" are fish from which the guts have been removed;
- 2.14 "keeping time" refers to the length of time that fish will remain wholesome and acceptable as human food;
- 2.15 "packaging materials" are all those materials such as foils, films, waxpaper, cartons and boxes, used for covering and protecting the fresh fish or fresh fish products, and which are approved by the official agency having jurisdiction;
- 2.16 "plant or establishment" means the building or buildings, or part thereof, used for, or in connection with, the manufacture or holding of food for human consumption;
- 2.17 "potable water" is fresh water fit for human consumption. Bacterial and chemical standards of potability should not be lower than those contained in the latest edition of the "International Standards for Drinking Water," World Health Organization;
- 2.18 "pounds or pens" are areas in the fish hold and on deck, divided-off by stanchions and portable or fixed board structures for the storage of fish;
- 2.19 "refrigerated brine" is a solution of food grade salt (sodium chloride) in potable water of about the same salinity as sea water which is cooled in the same manner as refrigerated sea water;
- 2.20 "refrigerated sea water" is clean sea water cooled by a suitable refrigeration system to 0°C (32°F) or slightly below. Ice may be added initially to increase the cooling rate. Its salt content is normally about 3 percent.
- 2.21 "rigor mortis" means the stiffening of the muscles of an animal which results from a series of complex changes that takes place in the tissues shortly after death. Immediately after death, the muscles are soft and limp and can be easily flexed. At this time, the flesh is said to be in pre-rigor condition. Soon the muscles begin to stiffen and harden and no longer contract by stimulation. The animal then is in rigor. After some hours or days, the muscles gradually begin to soften and become limp again. This is called the post-rigor condition;
- 2.22 "suitable corrosion-resistant material" means impervious material, which is free from pits, crevices and scale, is non-toxic and unaffected by sea water, ice, fish slime

or any other corrosive substances with which it is likely to come in contact. Its surface must be smooth and it must be capable of withstanding exposure to repeated cleaning, including the use of detergents;

2.23 "whole fish" are fish captured ungutted.

3.0

RAW MATERIAL REQUIREMENTS

3.1 General Considerations

3.1.1 FISH ARE AN EXTREMELY PERISHABLE FOOD, AND SHOULD BE HANDLED AT ALL TIMES WITH GREAT CARE AND IN SUCH A WAY AS TO LIMIT THE MULTIPLICATION OF MICRO-ORGANISMS.

Fish quality deteriorates rapidly, and the potential keeping time is shortened if they are not handled and stored properly. Much of the fish landed for human consumption is unfortunately subjected to fairly rough handling treatment which should be avoided. Fish should not be exposed to direct sunlight or to the drying effect of winds, or any other harmful effects of the elements, and should be cooled down to the temperature of (melting ice, 0°C, 32°F), as quickly as possible. Any careless treatment or delay in reducing the temperature of the fish will have a marked effect on their potential keeping time.

3.1.2. INDUSTRIAL FISH INTENDED FOR MARKETING AS HUMAN FOOD SHOULD BE OF THE HIGHEST POSSIBLE QUALITY.

Although there are many aspects that might be taken into account when defining what is meant by the highest possible quality fish, there are two major ones that should concern the fisherman as a primary producer:

1. quality of fish when caught, and
2. quality of fish on delivery.

The first one is determined by the physical condition of the fish, and includes appearance, size, percentage of fat, amount of feed, damage to skin, presence of disease or parasites and of harmful substances. The second one will result from the methods and techniques employed in fishing, practices in handling and conditions of storage while on board the fishing vessel.

The fisherman should discard any fish that is diseased or is known to contain harmful substances or has undergone deterioration or any process of decomposition or which has been contaminated with foreign matter to an extent which has made it unfit for human consumption.

4.0 FISHING VESSEL FACILITIES AND OPERATING REQUIREMENTS

4.1 General Conditions

- 4.1.1 THE FISHING VESSEL SHOULD BE DESIGNED FOR RAPID AND EFFICIENT HANDLING OF FISH, EASE OF CLEANING AND DISINFECTION, AND SHOULD BE OF SUCH MATERIAL AND CONSTRUCTION AS NOT TO CAUSE ANY DAMAGE OR CONTAMINATION OF THE CATCH.

In designing a fishing vessel many other factors, apart from the vessel's performance as a harvesting unit, should be considered.

Fishing vessels should be designed and constructed so as not to cause contamination of fish with bilge water, sewage, smoke, fuel, oil, grease or other objectionable substances. Fish should be protected against physical damage, exposure to high temperatures and drying effects of sun and wind.

All surfaces with which the fish might come into contact should be of suitable corrosion-resistant material which is smooth and easily cleanable.

If a vessel is engaged in the processing of fish, then its design, layout, construction and equipment should meet the requirements for shore establishments and the processing should be carried out under similarly hygienic conditions.

4.2 Fishing Vessel Construction and Sanitary Design

- 4.2.1 DECK POUND OR PEN STANCHIONS AND DIVIDING BOARDS SHOULD BE CONSTRUCTED OF SUITABLE CORROSION-RESISTANT MATERIAL, THEY SHOULD BE ADEQUATE IN NUMBER AND HEIGHT TO PREVENT MOVEMENT OF THE FISH, DUE TO THE VESSEL'S MOTION.

In practice, wood is still used in many fisheries for deck pound boards and steel for stanchions and other fixtures. Where this is the case, the wood should be treated to prevent the entry of moisture and should be coated with a durable non-toxic paint or other non-toxic surface coating that is smooth and readily cleanable. Steelwork should be coated with anti-corrosion and non toxic paint. Whenever possible-suitable corrosion resistant materials should be used.

- 4.2.2 DECK POUND OR PEN DIVIDING BOARDS SHOULD BE FITTED TO ALLOW FOR EASY REMOVAL, AND SHOULD HAVE HAND GRIPS, BOARDS SHOULD HAVE GATES FITTED AS REQUIRED, AND DRAIN NOTCHES CUT IN THE LOWER EDGES.

Gates should be so designed that offal can be easily disposed of. Drain notches allow water, slime and blood to flow away from fish lying in the pounds.

- 4.2.3 FISH HOLDS OR TANKS SHOULD BE ADEQUATELY INSULATED WITH A SUITABLE MATERIAL. ANY PIPES, CHAINS OR CONDUITS PASSING THROUGH THE HOLD SHOULD, IF POSSIBLE, BE SUNK FLUSH OR NEATLY BOXED IN.

Adequate insulation will reduce the amount of heat entering the fish hold and consequently the rate of ice meltage which will take place near bulkheads and shipside. This may cause excessive leaching of the fish and if the amount of ice is not sufficient, this will allow fish temperatures to rise, and any fish which come in contact with the ship's structure may develop a particularly offensive smell.

- 4.2.4 FISH HOLD OR TANK LININGS SHOULD BE COMPLETELY WATER-TIGHT. THE INSULATION LAYER SHOULD BE PROTECTED BY A LINING MADE OF CORROSION RESISTANT METAL SHEETS OR ANY OTHER EQUALLY SUITABLE MATERIAL HAVING WATER-TIGHT JOINTS.

It is most important to prevent water from carrying fish slime, blood, scales and offal to parts of the vessel where effective cleaning is impossible. The melt water seeping through the fish hold lining will also reduce the efficiency of the insulation and this will, in turn, lead to an increase in the temperature of the fish. The insulation should be covered with corrosion-resistant metal sheets or any other equally suitable material having water-tight joints to ensure

protection from such contamination. An effective drainage system should be able to remove the melt water into a sump as fast as it accumulates.

4.2.5 WOODEN FISH HOLDS OR WOODEN HOLDING TANKS SHOULD BE LINED WITH A SUITABLE MATERIAL.

The lining of wooden fish holds should be similar to that described above. They should be sealed and coated with a suitable impervious and non-toxic material which is easy to keep clean and not difficult to repair.

4.2.6 PORTABLE BOARDS OF SUITABLE CORROSION-RESISTANT MATERIAL OR IMPREGNATED AND PAINTED WOOD SHOULD BE USED FOR MAKING SHELVES AND VERTICAL DIVISIONS IN THE FISHROOM.

The use of portable boards, which are a good fit in the stanchions, allows the shelf and dividing structure to be dismantled and removed for cleaning. Wooden boards should be treated to prevent the entry of moisture and should be coated with a durable non-toxic paint or other equally suitable surface coating that is smooth, readily cleanable and repairable. Whenever possible, the shelving and the partitioning boards should be interchangeable in size.

4.2.7 WHERE BOXING AT SEA IS CARRIED OUT THE STANCHIONS AND DIVIDING STRUCTURE SHOULD BE DESIGNED TO ACCOMMODATE BOXES OF FISH WITHOUT LEAVING LARGE AIR GAPS.

If the structure is not designed to suit box dimensions, large gaps will be left where air can circulate, causing excessive ice meltage. Unless these spaces are filled with extra ice the fish temperature will rise.

4.2.8 IF COOLING GRIDS ARE FITTED IN THE FISH HOLD THEY SHOULD BE PROPERLY INSTALLED AND OPERATED.

Cooling grids, fitted in the fish hold, can be used to prevent excessive ice meltage during the voyage to the fishing grounds. They are valuable in cooling the fish hold and absorbing heat leak, especially in tropical waters. To be effective they should be fitted under the deckhead and on the ship side, and once fish have been stowed in the hold, control must be such that the hold temperature does not fall below 0°C (32°F). If it does, the top layer of ice

may freeze into a solid crust, resulting in the top layer of fish being frozen slowly, on a long voyage, thus affecting their quality.

When the ice stops melting because of low temperature, its effectiveness as a cooling agent diminishes considerably. The frozen crust of ice and fish will act as an insulating blanket preventing the fish below from being adequately chilled. Only when the ice is melting and the resulting ice-cold melt water percolates downwards through the layers of fish, the removal of heat (chilling) takes place. The cooling grids alone, fitted into the well insulated fish hold, will not cool the fish or maintain them in a chilled condition.

- 4.2.9 EXCEPT FOR TANK STOWAGE IN CHILLED OR REFRIGERATED SEA WATER OR REFRIGERATED BRINE, THE STOWAGE OF FISH FOR HUMAN CONSUMPTION IN HOLDS THAT ARE NOT DIVIDED INTO POUNDS IS NOT RECOMMENDED. THE HOLDS OF SMALL VESSELS CARRYING SUCH FISH AS HERRING SHOULD BE FITTED WITH AT LEAST ONE LONGITUDINAL AND ONE ATHWARTSHIP BULKHEAD, WHICH CAN BE REMOVED IF THE VESSEL CONVERTS TO OTHER TYPES OF FISHING SUCH BULKHEADS SHOULD BE CONSTRUCTED OF SMOOTH, NON-ABSORBENT, EASILY CLEANABLE MATERIAL.

The fitting of removable type bulkheads increases the versatility of fishing vessels and prevents movement of the stowed fish. They also permit rapid conversion to other types of fish stowage.

- 4.2.10 HOLDS THAT ARE NOT DIVIDED INTO POUNDS OR PENS SHOULD HAVE AN ADEQUATE NUMBER OF DRAIN LINES LOCATED AT INTERVALS ALONG THE HOLD, DISCHARGING TO A CENTRAL DRAIN OR BILGE. VERTICAL DRAIN SLOTS SHOULD BE LOCATED ALONG BOTH THE FORWARD AND AFT BULKHEADS, RUNNING FROM DECKHEAD TO BILGE.

As has already been stated, holds which are not divided into pounds, are not to be recommended. Those which do exist in very small vessels also require adequate drainage facilities.

In a hold containing tanks, floor troughs should be installed, draining from all areas of the hold to a bilge sump. Fish hold bilge sumps should have separate piping and valves so that fish juices and slime do not flow into other bilge lines.

- 4.2.11 THERE SHOULD BE NO SHARP CORNERS OR PROJECTIONS IN THE HOLD OR TANK AS THESE WILL MAKE CLEANING DIFFICULT AND MAY DAMAGE THE FISH.

Contamination with fish slime, blood, scales and guts will build up rapidly on surfaces, in corners or around projections which are not smooth and impervious.

Any ledges or projections resulting from the encasement of pipes, wires, chains and conduits, that are passing through the fish hold, should be so constructed as to allow free drainage, ease of cleaning and not to cause any physical damage to the fish.

- 4.2.12 CHILLED OR REFRIGERATED CLEAN SEA WATER OR CHILLED OR REFRIGERATED BRINE MAY ALSO BE CONSIDERED FOR SOME FISHERIES.

The storage temperature achieved by refrigerated clean sea water or refrigerated brine makes it possible to chill large quantities of fish quickly in tanks and maintain the fish in a chilled condition. Fish are chilled more rapidly by this immersion process than when iced, and if stowed at the correct density are in close contact with the cooling medium at all times.

This type of stowage has been found successful where very large quantities of small fish are caught in each haul and where it would be difficult to stow the catch quickly in ice. It has so far proved successful only for very short voyages. A storage time of more than a few days can affect the appearance of certain species, result in excessive salt uptake, and the scouring effect of fish rubbing together in a tank of water can also remove the scales from some species.

- 4.2.13 REFRIGERATED SEA WATER OR REFRIGERATED BRINE SYSTEMS SHOULD BE PROPERLY DESIGNED TO GIVE ADEQUATE COOLING CAPACITY.

If the use of a refrigerated brine system is considered, the system should be the subject of much research before an investment of money is made. The system should be designed by refrigeration experts having a knowledge of the fishery, including catching and stowage rates and of fish, water and ambient temperatures. The cooling capacity must be related to catching

rates in the fishery involved. The system must be capable of rapidly chilling large quantities of fish.

- 4.2.14 IN ALL SHIPS USING REFRIGERATED SEA WATER OR REFRIGERATED BRINE SYSTEMS FOR PRESERVATION OF THE CATCH, TANKS, HEAT EXCHANGERS, PUMPS AND ASSOCIATED PIPING SHOULD BE MADE OF, OR COATED WITH SUITABLE CORROSION-RESISTANT MATERIAL. THEY SHOULD BE DESIGNED SO THAT THEY CAN EASILY BE CLEANED AND DISINFECTED.

With hard, non-porous surfaces such as stainless steel, aluminum alloys or plastics, spoilage micro-organisms together with all the debris deposited during storage of the fish can be easily removed, thus reducing the risk of contaminating later catches. It is important to avoid corners and edges in which filth can lodge.

The whole system should be designed as to allow an easy introduction and effective circulation of the cleaning and disinfecting solutions. There should be no place where a proper cleaning cannot be carried out.

It is important to remember that with ice storage only part of a load may spoil but with refrigerated sea water or brine, any malfunctioning of the system or neglect on the part of operators, can result in the whole catch being rejected because of spoilage.

- 4.2.15 WHERE CHILLED CLEAN SEA WATER OR BRINE ARE USED FOR COOLING AND STORING THE CATCH, THERE SHOULD BE ADEQUATE CIRCULATION OF THE LIQUID.

Effective means of circulating the cold liquid round the mass of fish should be provided. If pumping facilities are inadequate some of the load may not be cooled properly, resulting in fish with unpleasant odours and flavours.

The fish hold-tanks should be equipped with suction screen arrangements which are strong enough to withstand the pressure exerted by the brine and fish mixture as well as negative pressure (suction) created by the circulating pump. Such screens should be so designed and located as to allow a constant and unobstructed flow of cold brine or sea water. Heat transfer and water circulation may also be affected

by pumping air through the mixture via a suitable distribution system e.g. perforated floor coils.

- 4.2.16 CHILLED OR REFRIGERATED SEA WATER OF REFRIGERATED BRINE TANKS SHOULD BE INSULATED TO MINIMIZE HEAT LEAKAGE FROM THEIR SURROUNDINGS.

The temperature of the refrigerated sea water will be more uniform throughout the tank and more easily controlled if the heat leak from other sources is reduced by effective insulation.

- 4.2.17 REFRIGERATION PLANT AND SEA WATER OR BRINE CIRCULATING EQUIPMENT SHOULD BE ADEQUATE TO MAINTAIN THE TEMPERATURE OF THE FISH AT- 1°C (30°F).

In fresh fish maximum delay of spoilage is obtained at this temperature. If the temperature is reduced below - 1°C (30°F) the fish may be damaged because of partial freezing. In practice it is extremely difficult to control the temperature so precisely , but a range of - 1°C to +2°C (30° to 34°F) is achievable.

There should also be a sufficient compressor to prevent a significant rise in temperature of the pre-chilled sea water or brine solution when the holding tanks are being loaded with the freshly caught fish.

Rapid cooling of fish is the primary task of the system. Once the initial cooling of fish is accomplished, the subsequent maintenance of a constant low temperature requires only a fraction of the compressor's load. Thermal inertia of a large body of chilled fish and brine should prevent sudden and significant fluctuations in temperatures.

4.3 Sanitary Facilities

- 4.3.1 AREAS OF THE DECK WHERE FISH ARE UNLOADED AND HANDLED, OR THE FISH HOLD WHERE FISH ARE STOWED, SHOULD BE USED EXCLUSIVELY FOR THESE PURPOSES.

All such areas should be well defined, be readily capable of being maintained in a clean condition and should be kept clean.

Storage of fuel and other petroleum products or cleaning and sanitizing agents should be so arranged that there is no possibility of contamination of surfaces with which fish can come into contact. Any exposure, even for a short time, of fish to petroleum products, very often results in rejection or eventual destruction of the whole load.

- 4.3.2 AN AMPLE SUPPLY OF COLD POTABLE WATER OR CLEAN SEA WATER UNDER ADEQUATE PRESSURE SHOULD BE AVAILABLE AT A SUFFICIENT NUMBER OF POINTS THROUGHOUT THE FISHING VESSEL.

Only potable water or clean sea water should be used on fish and on surfaces with which fish might come in contact. Even if the fish is caught in polluted waters, as occasionally happens, that water should not be used for washing fish or for the preparation of refrigerated sea water, or refrigerated brine.

Fish when alive are relatively resistant to a polluted environment but loses its natural defence when it dies.

- 4.3.3 A SYSTEM FOR INJECTING CHLORINE INTO THE LINES OF SEA WATER WHICH ARE USED IN THE PROCESSING OF FISH OR FOR THE CLEAN-UP OF THE VESSEL SHOULD BE PROVIDED WHERE PRACTICABLE.

It has been established in the fish processing industry that the injection of chlorine into a supply of cold water, used for general wash-up, helps to control microbial contamination.

The fishing vessels involved in handling or processing large quantities of fish might gain considerably in sanitation by having chlorine introduced into the water lines. Chlorine dosage should be around 10 ppm during the normal use and 100 ppm of residual concentration during the clean-up.

As a word of caution, the use of strongly chlorinated water in confined spaces such as a vessel's hold could prove objectionable to the operator. For that reason, a system for injecting chlorine should be capable of varying the amount of chlorine delivered.

There are a number of relatively inexpensive and easily operable instruments on the market that will perform this task with the minimum of cost and maintenance.

The installation of a chlorine injection system might not be practical for small boats.

4.3.4 DECK HOSES SHOULD BE SUPPLIED WITH CLEAN SEA WATER, AT ADEQUATE PRESSURE, BY A PUMP USED ONLY FOR CLEAN SEA WATER.

A good supply of clean sea water, at adequate pressure, with an addition of chlorine, if possible, should be available for washing fish and for flushing and rinsing of decks, holds, gear and other equipment which comes in contact with the fish.

The intake for sea water should be well forward of and on the opposite side of the vessel from the toilet waste and engine cooling discharge. Sea water should not be used while the vessel is in harbour, nor in the areas where there is danger of it being polluted. Clean sea water should be taken in while the vessel is in forward motion. The piping for the clean sea water supply should have no cross-connections with the engine or condenser cooling system. It should be so constructed as to prevent any possibility of back-siphonage from the kitchen sink or toilets.

4.3.5 ICE USED IN EVERY FISHERY SHOULD BE MADE FROM POTABLE WATER OR CLEAN SEA WATER AND SHOULD NOT BE CONTAMINATED WHEN MANUFACTURED, HANDLED OR STORED.

Ice made from water which is neither potable nor clean sea water may contaminate the fish with water-borne microorganisms or other objectionable or even harmful substances. Such contamination will result in a loss of quality, in reduced keeping time or it might create a health hazard.

Some of the larger fishing, collecting or fish processing vessels might have their own ice making machines. The water used in ice manufacture should be potable or clean sea water. The sea water intake for the pump should be located on the opposite side away from the waste discharge and engine cooling water outlet of the boat. Chlorine injection into the lines or water storage tanks, or the use of UV lights for continual

flow purification should be provided. Both systems are easy and inexpensive to operate. The sea water for ice manufacture should be taken only from areas known to be relatively unpolluted and without any visible discoloration or suspension.

The ice making plant should be cleaned regularly and maintained in a clean hygienic condition at all times.

When vessels are taking ice to sea, only fresh clean ice should be taken on board at the beginning of each voyage. Ice left from the previous voyage should be discarded and removed from the vessel.

4.3.6 THE USE OF CLEAN SEA WATER ICE CANNOT BE GIVEN UNQUALIFIED RECOMMENDATION

The use of clean sea water ice may be necessary in some areas, where there is a shortage of potable water, and there may also be some advantage in using clean sea water to manufacture ice at sea. The initial melting temperature of clean sea water ice may be as low as -5° to -6°C (23° to 21°F), but due to the leaching away of salt in the melt water, the melting temperature may rise again to nearly 0°C (32°F). Temperature, therefore, is variable. There is a risk that some of the fish stored in clean sea water ice will become partly frozen or too salty. Some experimentation prior to deciding on the kind of water for ice production is recommended.

4.3.7 THE VESSEL'S TOILET FACILITIES, ALL PLUMBING AND WASTE DISPOSAL LINES SHOULD BE SO CONSTRUCTED AS NOT TO CONTAMINATE THE FISH.

All the plumbing and waste disposal lines servicing the vessel's toilets, hand wash basins or kitchen sinks should be large enough to carry peak loads, be watertight and preferably should not go through the fish holds where fish is being handled or stored.

4.3.8 SUITABLE WASHING FACILITIES SHOULD BE PROVIDED ON LARGE FISHING VESSELS.

Such facilities should be located in toilets and close to the fish handling or processing areas. They should be supplied with clean water, soap and towels (preferably disposable).

- 4.3.9 THE FISHING VESSEL SHOULD BE EQUIPPED WITH BRUSHES, SCRAPERS, WATER HOSES, SPRAY NOZZLES AND OTHER SUITABLE WASHING AND SANITIZING EQUIPMENT.

Although there is a variety of cleaning and sanitizing equipment available on the market, good quality hand brushes of several sizes and shapes are still the most inexpensive and versatile tools for cleaning operations. Brushes should be kept in a clean and sound condition, disinfected after each use (dipping in 50 ppm chlorine solution is recommended) and when not used should be stored in a dry state. Brushes could spread dirt and micro-organisms.

Micro-organisms will proliferate in a dirty brush when stored in a wet condition. The use of steel-wool for scouring should be avoided as there is a constant danger of introducing small, sometimes hardly visible, bits of wire into the final product. If for some reason cleaning cannot be done effectively with a good brush, then plastic scouring pads might be used.

High pressure and high frequency oscillating water or detergent spraying equipment has been found to be quite effective in cleaning, but it usually requires an experienced operator to prevent damage to painted surfaces

- 4.3.10 IF POISONOUS AND HARMFUL MATERIALS, INCLUDING CLEANING COMPOUNDS, DISINFECTING MATERIALS, AND PESTICIDES ARE STORED ON BOARD THE VESSEL, THEY SHOULD BE KEPT IN A SEPARATE COMPARTMENT, RESERVED AND MARKED SPECIFICALLY FOR THIS PURPOSE.

Extreme caution must be exercised to prevent poisonous or harmful materials from contaminating the fish. All such materials should be prominently and distinctly labelled so that there can be no confusion between these and edible materials used aboard the vessel. Such compartments should be kept locked and the materials contained in them should be handled only by personnel trained in their use.

4.4. Equipment and Utensils

- 4.4.1 ALL FISH HANDLING, CONVEYING AND STORAGE EQUIPMENT, USED ON BOARD FISHING VESSELS, SHOULD BE DESIGNED FOR THE RAPID AND EFFICIENT HANDLING OF FISH, AND BE SUITABLE FOR EASY AND THOROUGH CLEANING OR SHOULD BE CONSTRUCTED SO AS NOT TO CAUSE CONTAMINATION OF THE CATCH.

Some of the equipment currently used in the fishing industry is quite unsuitable for the purpose in which it is employed. More thought should be given to the design and layout of fixtures and plant used for the handling, conveying and storage of fresh fish. When obtaining equipment, only that which can readily be cleaned should be considered.

- 4.4.2 FISH WASHING AND CONVEYING EQUIPMENT SHOULD BE CONSTRUCTED OF SUITABLE CORROSION-RESISTANT MATERIAL AND SHOULD BE EASY TO CLEAN AND BE FITTED WITH CHUTES OR SIMILAR MEANS OF CONVEYING FISH INTO THE HOLD. CHUTES SHOULD BE OF SUFFICIENT LENGTH AND FITTED IN SUCH A MANNER THAT FISH DO NOT HAVE TO DROP FREELY MORE THAN 1 METRE (3 FT) INTO THE HOLD.

Washers should, where possible, be fitted with chutes or conveyors for efficient handling purposes and to prevent bruising or other damage to the fish, which often occurs when rough manual methods are used. Washers should be designed to give an adequate washing period, and should have a copious and continuous supply of cold clean sea water. The water should enter the washer through a number of jets, placed so that a water swirl is formed in the washer, allowing dirty water and scum to spill off and drain away. Water used in fish washing should not be recirculated.

- 4.4.3 CONVEYORS USED IN THE FISH HOLD SHOULD BE MADE OF CORROSION-RESISTANT MATERIAL AND SHOULD BE SO CONSTRUCTED TO PROVIDE FOR EASY CLEANING.

Fish holds are difficult to clean thoroughly and any board structures or any conveying equipment should be capable of easy removal so that access can be gained to all areas of the fish hold.

- 4.4.4 ALL TUBS, TANKS, BARRELS AND OTHER CONTAINERS USED FOR HANDLING AND CONVEYING FISH SHOULD BE OF CORROSION-RESISTANT MATERIAL AND EASY TO CLEAN.

Containers with smooth, waterproof surfaces which are easy to clean and disinfect are recommended for handling quantities of fish on deck.

- 4.4.5 ALL CONTAINERS USED FOR ICE STOWING OF FISH SHOULD BE OF UNIFORM AND SUITABLE SIZE, EASY TO HANDLE WHEN LOADED, AND SHOULD BE CONSTRUCTED OF SUITABLE CORROSION-RESISTANT MATERIAL.

Such containers should be capable of accommodating the larger fish without bending and, when fully loaded, should be easy to handle by one or two men without tilting, tipping or jerking.

If wooden boxes are used, they should be of a smooth construction and of durable, non-toxic and waterproof finish.

Baskets should not be used for handling fish on board the vessel or on shore, as they are difficult to clean and disinfect.

- 4.4.6 SHOVELS AND RAKES USED IN THE HANDLING OF FISH SHOULD ALSO BE MADE OF A SUITABLE CORROSION-RESISTANT MATERIAL AND SHOULD BE KEPT CLEAN

These implements are used frequently in many stages of fish handling and therefore should meet the same hygienic specifications as other equipment and utensils.

4.5 Hygienic Operating Requirements

- 4.5.1 BEFORE ANY FISH COMES ABOARD, AND BETWEEN EACH HAUL OF THE GEAR, DECKS, BOARDS, STANCHIONS AND ALL OTHER DECK EQUIPMENT WHICH WILL COME INTO CONTACT WITH FISH FOR CONTACT HUMAN CONSUMPTION SHOULD BE HOSED DOWN WITH CLEAN SEA WATER TO REMOVE ALL VISIBLE SLIME AND BLOOD.

The purpose of this washing is to remove all traces of contaminating matter, such as slime, blood, tar, oil, etc., which may cause discoloration and offensive odours in the fish. In most fisheries this cleaning can be carried out while the net is in the water.

It is also important to have the surface of the deck and deck pounds well precooled by hosing them down with cold clean water before the fish is unloaded. During warm weather, the surface temperature of the deck could be very high. It would be bad practice, therefore, to dump the catch on such a deck without any concern for the quality of the fish, especially

those from the bottom layer which, in all probability, will remain for a longer time in direct contact with the hot surface of the vessel's deck.

- 4.5.2 ALL TUBS, TANKS, BARRELS AND OTHER EQUIPMENT USED IN HANDLING, WASHING AND CONVEYING OPERATIONS SHOULD BE THOROUGHLY CLEANED, DISINFECTED AND RINSED AFTER EACH CYCLE OF OPERATIONS.

Any filth, slime, blood or scales if allowed to dry and accumulate on surfaces with which fish comes into contact will be very difficult to remove later and will thus, contaminate the subsequent loads of fish.

- 4.5.3 DURING FISHING TRIPS THE FISH HOLD BILGE SUMP SHOULD BE DRAINED REGULARLY. THE SUMP SHOULD BE ACCESSIBLE AT ALL TIMES.

Bilge water containing blood and slime, if not regularly pumped out, will provide a perfect medium for the multiplication of micro-organisms and give rise to offensive odours in the fish hold.

- 4.5.4 SEA WATER WHICH HAS BEEN USED FOR COOLING ENGINES, CONDENSERS OR SIMILAR EQUIPMENT SHOULD NOT BE USED FOR WASHING FISH, DECK, HOLD OR ANY EQUIPMENT WHICH MIGHT COME IN CONTACT WITH FISH.

The water used for cooling engines is usually at a temperature higher than that of fresh sea water and might be contaminated with oil or other petroleum products or contain rust and other by-products or metal corrosion.

Such water, therefore, will accelerate the spoilage of fish by raising their temperature and might impart objectionable taste, odour or undesirable discolouration.

- 4.5.5 WHEN CLEANING AND HOSING OPERATIONS ARE CARRIED OUT WHILE THE VESSEL IS IN PORT, POTABLE WATER OR CLEAN SEA WATER SHOULD BE USED.

The water should always be free from objectionable contamination. The total number of micro-organisms in it should be low, and it ought not to contain any micro-organisms of public health significance. Contamination of fish by water-borne micro-organisms or other undesirable substances will result in the loss of the quality and might become a health hazard.

Harbour water is usually heavily polluted, and should never be used for cleaning purposes. This is also true for water in the close vicinity of towns, villages and industrial plants.

- 4.5.6 IMMEDIATELY AFTER THE CATCH IS UNLOADED, THE DECK AND ALL DECK EQUIPMENT SHOULD BE HOSED DOWN, BRUSHED AND THOROUGHLY CLEANED WITH A SUITABLE CLEANSING AGENT, DISINFECTED AND RINSED.

Fish blood, guts, slime and dead fish left on the deck will support multiplication of micro-organisms which may contaminate future catches. If allowed to dry, slime, blood and scales are very difficult to remove.

It is important to realize that thorough cleaning should always precede disinfection especially when chlorine is used as the disinfecting agent. Any organic matter, which if not removed from the surfaces that are to be disinfected, will rapidly combine with and neutralize the micro-organism killing ability of chlorine and many other disinfectants.

- 4.5.7 IMMEDIATELY AFTER THE CATCH IS LANDED THE FISH HOLD AND BILGE SUMP SHOULD BE THOROUGHLY CLEANED WITH A SUITABLE CLEANING AGENT, DISINFECTED AND RINSED.

This is necessary to remove all fish slime, blood and other residue as soon as the catch is landed, in order to avoid multiplication of micro-organisms, offensive odours and the drying of residues on the hold or other surfaces. Cleaning should be completed before the fresh ice is taken on board for the next trip.

- 4.5.8 IN SHIPS USING CHILLED OR REFRIGERATED SEA WATER OR CHILLED OR REFRIGERATED BRINE SYSTEMS FOR THE PRESERVATION OF THE CATCH, ALL TANKS, PUMPS, HEAT EXCHANGERS AND OTHER ASSOCIATED EQUIPMENT SHOULD BE CLEANED IMMEDIATELY AFTER DISCHARGING THE CATCH. POTABLE WATER OR CLEAN SEA WATER CONTAINING A SUITABLE CLEANING AGENT SHOULD BE CIRCULATED THROUGH ALL PARTS OF THE SYSTEM. TANKS SHOULD BE INSPECTED CAREFULLY AND CLEANED OUT BY BRUSHING IF NECESSARY.

Since anaerobic micro-organisms are particularly active under tank storage conditions, a very high standard of sanitation is required to avoid their build-up and the spread of infection

from one tank to another.

Immediately after unloading, when surfaces are still wet, the holding tanks should be washed with cold potable water or clean sea water under adequate pressure then scrubbed with a brush using alkaline detergent solution, then followed by a rinse with warm and cold water.

All pumps, pipes and heat exchangers should be thoroughly flushed with clean cold potable water or clean sea water, followed by circulating through the system either with a hot alkaline solution or cold water to which a strong cleaning agent has been added. After rinsing with potable water or clean sea water, a suitable disinfectant should be circulated through the system. It has been regarded by many fishermen as good practice to leave a weak solution of a non-corrosive disinfectant in the system. This of course must be drained and rinsed out thoroughly with potable water or clean sea water before filling the tanks.

- 4.5.9 WHERE CHILLED OR REFRIGERATED SEA WATER IS USED FOR THE PRESERVATION OF FISH, ONLY CLEAN SEA WATER SHOULD BE USED AND SHOULD BE CHANGED AS OFTEN AS POSSIBLE TO PREVENT THE ACCUMULATION OF CONTAMINATING MATERIALS.

Use of sea water contaminated with sewage or industrial discharges will affect the quality of the catch or render it unfit for human consumption. It is advisable for fishermen to check with the local authorities which areas are likely to be free of pollution. The intake for the vessel's sea water pump should be located on the opposite side away from sewage, waste discharge and engine cooling water outlets of the boat. Clean sea water should be taken in while the vessel is in forward motion.

- 4.5.10 ADEQUATE PRECAUTIONS SHOULD BE TAKEN TO ENSURE THAT HUMAN AND OTHER WASTES FROM THE FISHING VESSEL ARE DISPOSED OF IN SUCH A MANNER AS NOT TO CONSTITUTE A PUBLIC HEALTH OR HYGIENE HAZARD.

With man's increased concern for the protection of his environment, in some countries the disposal of any waste from any boat into the surrounding water is restricted by law. Fishermen should be fully aware of their responsibilities

in this regard. Discharge of animal, human or any other wastes from the fishing vessel into the sheltered waters close to inhabited areas, or over shellfish growing areas should not be practiced.

4.5.11 EFFECTIVE MEASURES SHOULD BE TAKEN TO PROTECT THE FISHING VESSEL AGAINST INSECTS, RODENTS, BIRDS OR OTHER VERMIN.

Rodents, birds and insects are potential carriers of many diseases which could be transmitted to man by contamination of fish. Fishing vessels should be regularly examined for evidence of infestation and, when required, effective control measures should be taken.

All rodenticides, fumigants, insecticides and other harmful substances should be used only in accordance with the recommendations of the appropriate official agency having jurisdiction.

4.5.12 DOGS, CATS AND OTHER ANIMALS SHOULD BE EXCLUDED FROM AREAS OF THE VESSEL WHERE THE FISH IS RECEIVED, HANDLED, PROCESS AND STORED.

Because of public health hazards and for aesthetic reasons, no surface of the fishing vessel and of the equipment thereon which comes into contact with fish should be exposed to contamination with animal hair or excreta, etc.

4.5.13 WHEN A VESSEL CONVERTS TO STORING FISH IN ICE FOR HUMAN CONSUMPTION, AFTER CATCHING SPECIES FOR REDUCTION PURPOSES, THE HOLD AND BILGE MUST BE THOROUGHLY CLEANED, DISINFECTED AND RINSED.

Cleaning should be carried out with high pressure potable water or clean sea water containing a suitable cleaning agent, followed by a thorough rinsing. A suitable disinfectant should then be applied to all surfaces and remain in contact long enough to complete the disinfection. Always, when using commercial products, the manufacturer's recommendations as to the concentration and treatment time should be followed. Finally the hold should be thoroughly rinsed with potable water or clean sea water.

- 4.5.14 FOOD SUPPLIES FOR THE SHIP'S KITCHEN OR FOR THE CREW'S MESS SHOULD NEVER BE STORED IN ICE BINS WHERE FISH ARE KEPT.

Storage of such materials in ice intended for fish might contaminate the ice and the fish.

4.6 Handling the Catch on Board

- 4.6.1 DURATION OF THE FISHING TRIP FOR A FISHING VESSEL SHOULD BE DETERMINED BY THE FACILITIES AVAILABLE ON THE VESSEL FOR HANDLING AND KEEPING THE CATCH WELL CHILLED AND BY THE DISTANCE FROM THE PROCESSING PLANT AND BY LOCAL ENVIRONMENTAL CONDITIONS.

From the time the fish are caught there is a continual and irreversible deterioration in quality. The progress and degree of such deterioration are governed mainly by the time the fish are held and the temperature at which they are handled and stored. With short distances from the processing plant or market more time could be spent on the fishing grounds providing the boat is equipped with adequate facilities to handle, effectively chill and hold the catch at a low temperature.

- 4.6.2 WHERE IT IS REQUIRED TO KEEP SPECIES UNSUITABLE FOR HUMAN FOOD, THESE SHOULD ALWAYS BE SORTED FROM THE EDIBLE CATCH AND KEPT SEPARATE AT ALL TIMES

Fish for human consumption and fish for fish meal manufacture should be stored separately. Both categories require appropriate precautions to be taken to prevent spoilage.

- 4.6.3 FISH SHOULD NOT BE TRAMPLED OR STOOD UPON, AND SHOULD NOT BE PILED DEEPLY ON DECK.

Any physical damage, whether by crushing, bruising, rubbing or scraping assists spoilage and reduces the value of the fish for subsequent food processing purposes.

- 4.6.4 ALL FISH ON DECK SHOULD BE PROTECTED FROM SUN, FROST, AND THE DRYING EFFECTS OF WIND.

It is essential to prevent the fish temperatures from rising. Any rise in temperature increases the rate of spoilage. If the catch is to be on deck for any length of time, it should

