codex alimentarius commission

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RECOMMENDED INTERNATIONAL CODE OF PRACTICE FOR SMOKED FISH

(Step 8)

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INTRODUCTION

This code of practice has been written for the use of those engaged in the fish smoking industry. It contains technological and essential hygiene requirements for the preparation of high-quality smoked fishery products, and is based on long-established and widely recognized good commercial practices.

This code is intended also as background information or as a guideline for the elaboration of national quality standards, quality control and fish inspection programmes in countries where these have not yet been developed.

However, it must be acknowledged that most of the practical information pertaining to the hygiene and technology of smoked fish processing has been gained from the industrial experience of very few countries. With this limitation in mind, this code should therefore not be regarded as a set of rules to be followed explicitly without any concern for local conditions.

The information provided is not intended to replace the advice or guidance of trained and experienced technologists regarding the complex technical problems which might be unique to a specific geographical area.

The practical application of this "international" code with regard to "national" fish smoking industries will probably require some modifications according to local conditions and specific (traditional) consumer preferences. In other words, a "national" code of practice could be developed from the information contained in this code.

The smoking process is as old as early man, who found that drying meat or fish over a fire provided him with the possibility of preserving his food. Originally, smoking was strictly a drying process. With time the accompanying smoke flavour and colour were found to be pleasant side effects, so that, today, they are the most important reasons for smoking the fish.

With the development of alternative means of food preservation, such as salting, marinating, freezing and canning, the smoking and drying processes have lost their previous importance as preservation methods. With a few exceptions, the present trend is for lightly salted and smoked products of which the keeping quality at ambient temperatures, is only slightly better than that of the raw fish. Most smoked fishery products nowadays have to be kept under refrigeration or have to be frozen if not consumed within a short time.

The equipment used in the smoking industry has undergone considerable development in the last decade. The traditional kiln is being replaced with a mechanical one offering better possibilities for process and quality control of the final product. The electronic industry provided the processer with means to measure and control automatically the temperature, relative humidity and smoke density during the smoking operation. It became possible to impart taste, odour and colour of smoke to the fish without any loss of moisture (weight) and without the necessity of subjecting them to the normal smoking procedure. Dipping of fish in "liquid smoke" solution or the use of an approved artificial dye for the purpose of obtaining the taste and the colour of smoked fish, have been introduced into processing technology and have been accepted by some countries. An introduction of mechanical smoke generators and of electrostatic methods of smoking add further to the long list of advances made in this field of fish processing for human consumption.

This code will require periodical revision, as research and experience bring new techniques and facilities into commercial practice.

RECOMMENDED INTERNATIONAL CODE OF PRACTICE FOR SMOKED FISH

1. SECTION I - SCOPE

This code of practice applies to smoked fish and fishery products as defined in sub-paragraph 2.11 of this code which are intended for human consumption.

It contains the technological guidelines and the essential requirements of hygiene for processing, handling, storage and distribution of smoked fish and smoked fish products.

It does not provide specific information on particular smoking procedures with regard to a specific species of fish. The variations in this field of food technology are too numerous to justify such an attempt.

2. SECTION II - DEFINITIONS

For the purpose of this code:

2.1 "brining" means the process of placing fish in a solution of food grade salt (sodium chloride) in water for a period of sufficient length for the fish tissue to absorb a significant quantity of salt;

2.2 "candling" means passing fish over a translucent table illuminated from below to detect parasites and other defects.

2.3 "case hardening" is the result of too fast drying, whereby the outer layer of the product becomes leather-like;

2.4 "chilling" is the process of cooling fish thoroughly to a temperature approaching that of melting ice;

2.5 "clean sea water" is sea water which meets the same micro-biological standards as potable water and is free from objectionable substances;

2.6 "cleaning" means the removal of objectionable matter from surfaces;

2.7 "cold smoking" means smoking of fish at temperatures where the product does not show any signs of heat coagulation of the protein;

2.8 "contamination" means direct or indirect transmission of objectionable matters 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 "dyeing" means the treatment of fish, prior to smoking, with a natural or artificial dye, approved by the official agency having jurisdiction, for the purpose of obtaining the colour of smoked fish;

2.11 "dry-salting" or "kench curing" is the process of mixing fish with dry food grade salt (sodium chloride) in such a manner that the resulting brine drains away;

2.12 "fish" means any of the cold-blooded aquatic vertebrate animals commonly known as such. This includes Pisces, Elasmobranchs and Cyclostomes. For the purpose of this code, and unless specifically excluded, the term also includes molluscs and crustaceans. Aquatic mammals, amphibians and reptiles are not include`

2.13 "food additive" means any substance not normally consumed as a food by itself and not normally used as a typical ingredient of the food, whether or not it has nutritive value, the intentional addition of which to food for a technological (including organoleptic) purpose in the manufacture, processing, preparation, treatment, packing, packaging, transport or holding of such food results, or may be reasonably expected to result, (directly or indirectly) in it or its by-products becoming a component of or otherwise affecting the characteristics of such foods. The term does not include "contaminants" or substances added to food for maintaining or improving nutritional qualities.

2.14 "fresh fish" are freshly caught fish which have received no preservative treatment or which have been preserved only by chilling;

2.15 "hot smoking" means smoking of fish at temperatures and for a sufficient period of time to obtain heat coagulation of the protein throughout;

2.16 "keeping time" refers to the length of time that fish will remain wholesome and acceptable as human food;

2.17 "liquid smoke" is a solution of wood smoke which, when suitably diluted, can be used to impart a smoky flavour to fishery products;

2.18 "mechanical smoking kiln or smoking tunnel" means the type of equipment in which forced flow of smoke and air passes around the fish to be smoked. The required smoke is generated outside the smoking chamber;

2.19 "pickling" or "pickle curing" is the process whereby fish is mixed with food grade salt (sodium chloride) and is stored under the resultant brine which forms by solution of salt in the water extracted from the fish tissue.

2.20 "plant or establishment" means the building or buildings, or parts thereof, used for, or in connection with, the manufacture or holding of food for human consumption;

2.21 "potable water" is fresh water fit for human consumption. Standards of potability should not be lower than those contained in the latest edition of the "International Standards for Drinking Water", World Health Organization;

2.22 "salt" means salt (sodium chloride) of an appropriate quality and otherwise suitable for the purpose.

2.23 "smoke" means volatile products derived from combustion (or from smouldering or burning) of wood, sawdust or similar products or obtained by any other process for the generation of fresh smoke from wood. This term shall include derivatives obtained by condensation or absorption of smoke in a suitable food grade liquid. A dip, which will impart a smoky flavour to fishery products, can be prepared by diluting an appropriate quantity in potable water;

2.24 "smoke powder" is a preparation containing natural wood smoke absorbed to a water soluble powder of food grade. A dip, which will impart a smoky flavour to fishery products, can be prepared by dissolving an appropriate quantity of this powder in water;

2.25 "suitable corrosion-resistant material" means impervious material which is free from pits, crevices and scales, is non-toxic and unaffected by sea water, ice, fish slime or any other corrosive substance 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;

2.26 "traditional smoking kiln" means an enclosed space, essentially a large chimney, in which fish can be subjected to the action of smoke that flows around the product by natural draught.

3. SECTION III - RAW MATERIAL REQUIREMENTS

3.1 General Considerations

3.1.1 NO FISH OR INGREDIENTS WHICH HAVE DETERIORATED OR DECOMPOSED, OR ARE CONTAMINATED TO AN EXTENT WHICH RENDERS THEM UNFIT FOR HUMAN CONSUMPTION, SHOULD BE USED FOR THE PROCESSING OF SMOKED PRODUCTS

Raw material should be rejected if it contains harmful, decomposed or extraneous substances which will not be removed to acceptable levels by normal procedures of sorting or preparation.

Fish in a diseased condition should be discarded or the diseased portion removed. Only clean, sound fish, which are suitable for human consumption, should be used for smoking.

3.1.2 FISH INTENDED FOR SMOKING SHOULD RECEIVE THE SAME CARE AND ATTENTION FROM THE TIME OF CAPTURE UNTIL THEY ARE SMOKED AS THOSE INTENDED FOR MARKETING FRESH

The processes and the principles involved in the preparation of fish for smoking are for the most part similar to those that would be involved in preparing them for marketing as fresh. Therefore, the recommendations of the "Recommended International Code of Practice for Fresh Fish" and, where applicable, the "Recommended International Code of Practice for Frozen Fish" should be used as a guide for the handling and preparation of fish for smoking.

4. SECTION IV - PLANT FACILITIES AND OPERATING REQUIREMENTS

4.1 Plant Construction and Layout

4.1.1 General Considerations

4.1.1.1 FISH SMOKING PLANTS SHOULD BE DESIGNED AND EQUIPPED SO THAT ALL HANDLING AND PROCESSING OPERATIONS CAN BE CARRIED OUT EFFICIENTLY, AND ALL MATERIALS AND PRODUCTS CAN PASS FROM ONE STAGE OF PROCESSING TO THE NEXT IN AN ORDERLY MANNER AND WITH MINIMUM DELAY

A great deal of care should be taken in planning the layout and equipment of a smoked fish processing plant to ensure that there is sufficient space and suitable facilities to carry out each operation efficiently with due concern for hygiene and quality of the final product and to move fish and materials through the various stages in an orderly manner.

In order to prevent cross-contamination between different processing activities and safeguard the wholesomeness and quality of smoked fish and fish products, the following operations should be conducted in separate rooms or in well defined areas of adequate size (see Appendix I, "Flow Diagram for Smoked Fish Processing Operation"):

(a) receiving and storage of raw materials;
(b) processing (dressing, brining, smoking);
(c) cooling, packaging; and
(d) storage of final products.

The fish handling and storage areas should be entirely divorced from:

(e) storage of waste materials;
(f) storage of packaging materials;
(g) storage of cleaning and disinfecting compounds; and
(h) storage of wood and wood products used in the smoking process.

Rooms or areas where dripping and drying of fish prior to smoking or cooling of products after the smoking are carried out should comply with all building and sanitary requirements stated for other fish handling and processing areas. Adequate chill room facilities should be provided for brining, pickling or dry-salting of fish prior to smoking if the ambient temperature necessitate it.

4.1.2 Construction

4.1.2.1 THE PLANT AND SURROUNDING AREA SHOULD BE SUCH AS CAN BE KEPT REASONABLY FREE FROM OBJECTIONABLE ODOURS, SMOKE, DUST OR OTHER CONTAMINATION. THE BUILDINGS SHOULD BE SUFFICIENT IN SIZE WITHOUT CROWDING OF EQUIPMENT OR PERSONNEL, WELL CONSTRUCTED AND KEPT IN GOOD REPAIR. THEY SHOULD BE DESIGNED AND CONSTRUCTED TO PROTECT AGAINST THE ENTRANCE AND HARBOURING OF INSECTS, BIRDS OR OTHER VERMIN AND TO PERMIT READY AND ADEQUATE CLEANING

The location of a smoked fish processing plant, its design, layout, construction and equipment should be planned in detail with considerable emphasis on the hygienic aspect, sanitary facilities and quality control.

Where new premises are constructed, or when existing buildings are modified, national or local authorities should always be consulted with regard to building codes, hygienic requirements of the operation and sanitary disposal of sewage and plant waste.

Prior to construction of a new plant or modification of the existing one, a proper flow pattern of operation should be considered (see Appendix I, "Flow Diagram for Smoked Fish Processing Operation"). Only a well organized work flow could ensure the maximum efficiency of the operation and the better quality product.

The food handling area should be completely separate from any part of the premises used as living quarters.

4.1.2.2 FLOORS SHOULD BE HARD SURFACED, NON-ABSORBENT AND ADEQUATELY DRAINED

Floors should be constructed of durable, waterproof, non-toxic, non-absorbent material which is easy to clean and disinfect. They should be non-slip and without crevices and should slope evenly and sufficiently for liquids to drain off to trapped outlets fitted with a removable grill.

If floors are ribbed or grooved to facilitate traction, any grooving of this nature should always run toward the drainage channel.

Junctions between the floors and walls should be impervious to water and should be coved or rounded for ease of cleaning.

Concrete, if not properly finished, is porous and can be affected by animal oils, strong brines, various detergents and disinfectants. If used, it should be dense, of a good quality and with a well finished waterproof surface.

4.1.2.3 DRAINS SHOULD BE OF AN ADEQUATE SIZE, SUITABLE TYPE, EQUIPPED WITH TRAPS AND WITH REMOVABLE GRATINGS TO PERMIT CLEANING

Suitable and adequate drainage facilities are essential for removal of liquid or semi-liquid wastes from the plant. There should be no floor area where water might collect in stagnant pools. Drains should be constructed of smooth and impervious material and should be designed to cope with the maximum flow of liquid without any overflowing and flooding. Each drainage inlet should be provided with a deep seal trap which is appropriately located and easy to clean.

Drainage lines carrying waste effluent should be properly vented, have a minimum internal diameter of 10 cm (4 inches) and, if required, run to a catch basin for removal of the solid waste material. Such a basin should be located outside the processing area and should be constructed of waterproof concrete or other similar material, designed to the local specifications and approved by the local authority having jurisdiction.

4.1.2.4 INTERNAL WALLS SHOULD BE SMOOTH, WATERPROOF, RESISTANT TO FRACTURE, LIGHT COLOURED AND READILY CLEANABLE

Acceptable materials for finishing walls inside are cement render, ceramic tiles of an industrial type, various kinds of corrosion-resistant metallic sheeting, such as stainless steel or aluminium alloys and a variety of non-metallic sheetings which have adequate impact resistance, desirable surface qualities and are easily repairable.

All sheeting joints should be sealed with a mastic or other compound resistant to hot water, and cover strips should be applied where necessary.

Wall-to-wall and wall-to-floor junctions should be coved or rounded to facilitate cleaning.

Walls should be free from projections and all pipes and cables should be sunk flush with the wall surface or neatly boxed in and sealed to the wall or neatly boxed in and mounted at least 10 cm (4 inches) from the wall to allow for adequate cleaning and prevention of insect harborage.

4.1.2.5 WINDOW SILLS SHOULD BE KEPT TO A MINIMUM SIZE, BE SLOPED INWARD AT LEAST 45° AND BE AT LEAST 1 M (3 FT) FROM THE FLOOR

Window sills and frames should be made of a smooth, waterproof material and, if of wood, should be kept well painted. Internal window sills should be sloped to prevent storage of miscellaneous materials or accumulation of dust and should be constructed to facilitate cleaning.

Windows should be filled with whole panes and those which open should be screened. The screens should be constructed so as to be easily removable for cleaning and should be made from suitable corrosion-resistant material.

4.1.2.6 ALL DOORS THROUGH WHICH FISH OR THEIR PRODUCTS ARE MOVED SHOULD BE SUFFICIENTLY WIDE, WELL CONSTRUCTED OF A SUITABLE MATERIAL AND SHOULD BE OF A SELF-CLOSING TYPE

Doors through which fish or their products are moved should be either covered with or made of corrosion-resistant metal or other suitable material with adequate impact resistance and, unless provided with an effective air screen, should be of a self-closing type.

Doors and frames of the doorways should have a smooth and readily cleanable surface.

Doors through which the product is not moved, such as those providing staff access, should be appropriately surfaced, at least on the processing area side, to allow for ease of cleaning.

4.1.2.7 CEILINGS SHOULD BE SO DESIGNED, CONSTRUCTED AND FINISHED AS TO PREVENT ACCUMULATION OF DIRT AND MINIMIZE CONDENSATION, MOULD DEVELOPMENT AND FLAKING, AND SHOULD BE EASY TO CLEAN

Ceilings should preferably be 3 m (10 ft) in height, free from cracks and open joints and should be of a smooth, waterproof, light coloured finish.

In buildings where beams, trusses, pipes or other structural elements are exposed, the fitting of a suspended ceiling just below is desirable.

Where the roof beams and trusses cannot be covered, the underside of the roof may constitute a satisfactory ceiling providing all joints are sealed and the supporting structures are of a smooth, well painted and light coloured surface, easily cleanable and constructed to protect the fish products from falling debris and dust.

4.1.2.8 PREMISES SHOULD BE WELL VENTILATED TO PREVENT EXCESSIVE HEAT, CONDENSATION AND CONTAMINATION WITH OBNOXIOUS ODOURS, DUST, VAPOUR OR SMOKE

Special attention should be given to the venting of areas and equipment producing excessive heat, steam, obnoxious fumes, vapours or contaminating aerosols. The air-flow in the premises should be from the more hygienic areas to the less hygienic ones. Good ventilation is important to prevent condensation and growth of moulds in overhead structures. Ventilation openings should be screened and, if required, equipped with proper air filters. Windows which open for ventilation purposes should be screened. The screens should be made easily removable for cleaning and should be made from suitable corrosion-resistant material.

4.1.2.9 A MINIMUM ILLUMINATION OF 220 LUX (20 FT CANDLES) IN GENERAL WORKING AREAS AND NOT LESS THAN 540 LUX (50 FT CANDLES) AT POINTS REQUIRING CLOSE EXAMINATION OF THE PRODUCT, SHOULD BE PROVIDED AND SHOULD NOT ALTER COLOURS

Light bulbs and fixtures suspended over the working areas where fish is handled at any stage of preparation, should be of the safety type or otherwise protected to prevent food contamination in case of breakage.

It is highly desirable to have the light fixtures either recessed flush with the ceiling or with the upper surface of the light fixtures fitting flush with the ceiling in order to prevent the accumulation of dust on them.

4.1.2.10 SEPARATE AND ADEQUATE STORAGE SHOULD BE PROVIDED FOR WOOD, SAWDUST OR SIMILAR MATERIALS USED IN SMOKING OF FISH

Wood, wood shavings or sawdust should be stored in a separate storage room or building away from the fish processing area and in such a manner that there is no contamination by dust or other foreign matter.

To prevent spontaneous heating and the growth of moulds, the wood shavings and sawdust should be sufficiently dry on delivery and should not be stored in large containers, heaps or silos. Storage in bags is advantageous as it allows better aeration, drying and more convenient handling.

4.1.3 **Hygienic Facilities**

4.1.3.1 AREAS WHERE RAW MATERIALS ARE RECEIVED, STORED OR HANDLED SHOULD BE SEPARATED FROM THE AREAS IN WHICH PRODUCT PREPARATION, PROCESSING AND PACKAGING ARE CONDUCTED

Separate rooms or well defined areas of adequate size should be provided for receiving and storing of raw materials.

Receiving and storage areas should be clean and readily capable of being maintained in a clean condition and should provide protection for the fish from deterioration and contamination.

4.1.3.2 A SEPARATE REFUSE ROOM OR OTHER EQUALLY ADEQUATE OFFAL STORAGE FACILITIES SHOULD BE PROVIDED ON THE PREMISES

If offal or other refuse is to be collected and held before removal, adequate precautions should be taken to protect it against rodents, birds, insects and exposure to warm temperatures.

A separate refuse room for storing waste in watertight containers or offal bins should be provided. The walls, floor and ceiling of such a storage room, and the area under the elevated bins, should be constructed of impervious material which can be readily cleaned.

Where waste material is held in containers outside the establishment, the containers should be lidded. A separate enclosure should be provided for their storage with easy access for vehicles loading and unloading. Stands for the containers should be of solid, hard and impervious material which can be easily cleaned and properly drained. If containers

are used in large numbers, a mechanical washing plant might be advisable to provide for routine washing. Containers should be capable of withstanding repeated exposure to normal cleaning processes.

Refuse rooms or other offal storage facilities should be cleaned and disinfected regularly.

4.1.3.3 ANY BY-PRODUCT PLANT SHOULD BE ENTIRELY SEPARATE FROM THE PLANT WHICH IS PROCESSING SMOKED FISH FOR HUMAN CONSUMPTION

The processing of by-products or non-fish products not fit for human food should be conducted in separate buildings or in areas which are physically separated in such a way that there is no possibility for contamination of fresh or smoked fish or fish products.

4.1.3.4 AN AMPLE SUPPLY OF COLD AND HOT POTABLE WATER AND/OR CLEAN SEA WATER UNDER ADEQUATE PRESSURE SHOULD BE AVAILABLE AT NUMEROUS POINTS THROUGHOUT THE PREMISES AT ALL TIMES DURING WORKING HOURS.

All water available for use in those parts of establishments where fish is received, held, processed, packaged and stored should be potable water or clean sea water and should be supplied at a pressure of no less than 1.4 kg/cm^2 (20 lb/in^2).

An adequate supply of hot water of potable quality should be available at all times during working hours.

Facilities should be provided so that at all times when required during working hours an adequate supply of hot water of potable quality at a minimum temperature of 65°C should be available. Further provisions should be made to reduce the temperature of the water supply for other purposes such as hand washing.

The cold water supply used for cleaning purposes should be fitted with an in-line chlorination system allowing the residual chlorine content of the water to be varied at will in order to reduce the number of micro-organisms and prevent the build-up of fish odours.

Water used for washing or conveying raw materials should not be recirculated unless it is restored to a level of potable quality.

4.1.3.5 WHEN INPLANT CHLORINATION OF WATER IS USED, THE RESIDUAL CONTENT OF FREE CHLORINE SHOULD BE MAINTAINED AT NO MORE THAN THE MINIMUM EFFECTIVE LEVEL FOR THE USE INTENDED.

Chlorination systems should not be relied on to solve all hygienic problems. The indiscriminate use of chlorine cannot compensate for an unhygienic condition in a processing plant.

4.1.3.6 ICE SHOULD BE MADE FROM POTABLE WATER OR CLEAN SEA WATER AND SHOULD BE MANUFACTURED, HANDLED AND STORED SO AS TO PROTECT IT FROM CONTAMINATION.

Ice used in the operation of the smoked fish processing establishment should be made from potable water or clean sea water.

A special room, or other suitable storage facilities, should be provided to protect the ice from contamination and excessive melting. Dust, flakes of paint, bits of wood or sawdust, straw and rust, are the most frequent contaminants transferable by ice into the final product. Foot traffic should be kept to a minimum.

Care must be taken to ensure that ice used to chill the fish or fish products does not contaminate them.

4.1.3.7 WHERE A NON-POTABLE AUXILIARY WATER SUPPLY IS USED, IT SHOULD BE STORED IN SEPARATE TANKS, CARRIED IN SEPARATE LINES, IDENTIFIED BY CONTRASTING COLOURS, LABELLED AND HAVE NO CROSS-CONNECTIONS OR BACK-SIPHONAGE WITH THE LINES CARRYING POTABLE WATER OR CLEAN SEA WATER.

Non-potable water may be used for such purposes as producing steam, cooling heat exchangers and fire protection.

It is very important that the systems of storage and distribution of potable and non-potable water are entirely separate and there is no possibility for cross-connection or for inadvertent usage of non-potable water in the fish processing areas. Only potable quality water should be used for the supply of hot water.

4.1.3.8 ALL PLUMBING AND WASTE DISPOSAL LINES, INCLUDING THE SEWER SYSTEM, SHOULD BE LARGE ENOUGH TO CARRY PEAK LOADS AND SHOULD BE PROPERLY CONSTRUCTED

All lines should be watertight and have adequate deep seal traps and vents. Waste must not be disposed of in a way that may contaminate potable water or clean sea water supplies.

Sumps or solid matter traps of the drainage system should be located outside the processing area and so designed as to allow them to be emptied and thoroughly cleaned at the end of each working day or more often as needed.

When waste systems are installed overhead in processing rooms to service upper floors, the installation and location of these systems should be such as to preclude any chance of contaminating processing lines.

The plumbing and manner of waste disposal should be approved by the official agency having jurisdiction.

4.1.3.9 PROPER FACILITIES FOR WASHING AND DISINFECTION OF EQUIPMENT SHOULD BE PROVIDED

Facilities should be present in every smoked fish processing establishment for cleaning and disinfection of trays, removable cutting or filleting boards, containers and other similar equipment and working implements. Such facilities should be located in a separate room or in a designated area in the work rooms where there is an adequate supply of hot and cold potable water or clean sea water, under good pressure, and where there is proper drainage.

Containers and equipment used for offal or contaminated materials should be washed in a separate area than that used for products intended for human consumption,

4.1.3.10 ADEQUATE AND CONVENIENTLY LOCATED TOILET FACILITIES SHOULD BE PROVIDED.

Adequate, suitable, and conveniently located changing facilities and toilets should be provided in all establishments. Toilets should be so designed as to ensure hygienic removal of waste matter. These areas should be well lit, ventilated and where appropriate heated and should not open directly on to food handling areas. Hand washing facilities with warm or hot and cold potable water, or clean sea water, a suitable hand-cleaning preparation, and with suitable hygienic means of drying hands, should be provided adjacent to toilets and in such a position that the employee must pass them when returning to the processing area. Where hot

and cold water are available mixing taps should be provided. Where paper towels are used, a sufficient number of dispensers and receptacles should be provided near to each washing facility. Taps of a non-hand operable type are desirable. Notices should be posted directing personnel to wash their hands after using the toilet.

Toilet rooms should have walls and ceilings of a smooth washable, light-coloured surface and floors constructed of impervious and readily cleanable material. The doors leading to the facilities should be of a self-closing type and should not open directly into the fish processing areas.

The following formula could be used as a guideline in assessing the adequacy of toilet facilities in relation to the number of employees:

1 to 9 employees	=	1 toilet
10 to 24 employees	=	2 toilets
25 to 49 employees	=	3 toilets
50 to 100 employees	=	5 toilets
for every 30 employees over 100	=	1 toilet

Note: Urinals may be substituted for toilets, but only to the extent of one-third of total toilets required.

4.1.3.11 FACILITIES SHOULD BE AVAILABLE IN THE PROCESSING AREAS FOR EMPLOYEES TO WASH AND DRY THEIR HANDS AND FOR DISINFECTION OF PROTECTIVE HAND COVERINGS

Adequate and conveniently located facilities for hand washing and drying should be provided wherever the process demands. Where appropriate, facilities for hand disinfection should also be provided. Warm or hot and cold potable water or clean sea water and a suitable hand-cleaning preparation should be provided. Where hot and cold water are available mixing taps should be provided. There should be suitable hygienic means of drying hands. Where paper towels are used, a sufficient number of dispensers and receptacles should be provided adjacent to each washing facility. Taps of a non-hand operable type are desirable. The facilities should be furnished with properly trapped waste pipes leading to drains.

4.1.3.12 STAFF AMENITIES CONSISTING OF LUNCHROOMS AND CHANGING ROOMS OR ROOMS CONTAINING SHOWER OR WASHING FACILITIES SHOULD BE PROVIDED

Where workers of both sexes are employed, separate facilities should be present for each except that the lunchrooms may be shared. As a general guide, the lunchrooms should provide seating accommodation for all employees and the changing rooms should provide enough space for lockers for each employee without causing undue congestion. Clothing and footwear, not worn during working hours, must not be kept in any processing area.

4.1.3.13 SALT AND OTHER INGREDIENTS USED IN CURING OF FISH SHOULD BE STORED DRY AND IN A MANNER TO PREVENT THEIR CONTAMINATION

Salt and other ingredients used in the processing of smoked fish should be of food grade.

4.1.3.14 STORAGE FACILITIES SHOULD BE AVAILABLE FOR THE PROPER DRY STORAGE OF PACKAGING MATERIALS

Separate facilities for the storage of cartons, wrappings or other packaging materials should be provided in order to protect them against moisture, dust or other contamination.

4.1.3.15 IF POISONOUS OR HARMFUL MATERIALS, INCLUDING CLEANING COMPOUNDS, DISINFECTANTS, AND PESTICIDES ARE STORED, THEY SHOULD BE KEPT IN A SEPARATE ROOM DESIGNED AND MARKED SPECIFICALLY FOR THIS PURPOSE

All such materials must be prominently and distinctly labelled so that they can be easily identified. The room should be kept locked and the materials contained in it should be handled only by personnel trained in their use.

4.2 Equipment, Utensils and Working Surfaces

4.2.1 General Considerations

ALL WORKING SURFACES, EQUIPMENT AND UTENSILS USED IN FOOD HANDLING AREAS AND WHICH MAY CONTACT FOOD SHOULD BE MADE OF MATERIAL WHICH WHICH DOES NOT TRANSMIT TOXIC SUBSTANCES, ODOURS OR TASTES, IS NON-ABSORBENT, IS RESISTANT TO CORROSION AND IS CAPABLE OF WITHSTANDING REPEATED CLEANING AND DISINFECTION. SURFACES SHOULD BE SMOOTH AND FREE FROM PITS AND CREVICES. THE USE OF WOOD AND OTHER MATERIALS WHICH CANNOT BE ADEQUATELY CLEANED AND DISINFECTED SHOULD BE AVOIDED EXCEPT WHEN THEIR USE WOULD CLEARLY NOT BE A SOURCE OF CONTAMINATION. THE USE OF DIFFERENT MATERIALS IN SUCH A WAY THAT CONTACT CORROSION CAN OCCUR SHOULD BE AVOIDED.

Contamination of fish during processing can be caused by contact with unsatisfactory surfaces. All food contact surfaces should be smooth, free from pits, crevices and loose scale, substances harmful to man, unaffected by salt, fish juices or other ingredients used, and capable of withstanding repeated cleaning and disinfection. Wood should be used for cutting surfaces only when no other suitable material is available. Machines and equipment should be so designed that they can be easily dismantled to facilitate thorough cleaning and disinfection.

Containers, vats and barrels used for holding fish should preferably be constructed of washable plastic or corrosion-resistant metal and, if of wood, they should be treated to prevent the entry of moisture and coated with a durable non-toxic paint or other surface coating that is smooth and readily washable. Any container, the surface of which is pitted, corroded, scaled, or has peeling paint should not be used for holding fishery products. Wicker baskets should not be used.

Stationary equipment should be installed to permit easy access and thorough cleaning and disinfection.

Fish washing tanks should be designed to provide a constant change of water with good circulation, and to have provisions for drainage and to be easily cleaned.

Equipment and utensils used for inedible or contaminated materials should be identified as such and should not be used for handling of fish and products intended for human consumption.

4.2.1.2 BOARDS AND OTHER SURFACES ON WHICH FISH ARE CUT SHOULD BE MADE OF IMPERVIOUS MATERIALS WHICH MEET THE PHYSICAL REQUIREMENTS FOR CUTTING SURFACES

Considerable microbial contamination of fish is caused by contact with the filleting and cutting boards. Wooden cutting surfaces are porous and quickly become waterlogged and are practically impossible to clean thoroughly. They are not recommended as suitable for this type of work.

If in the absence of other materials, wood has to be used, a single board of a well finished and smooth surface is recommended. Once the surface becomes badly worn or pitted then the board should be reconditioned or discarded.

The use of plywood or other boards of laminated structure should be discouraged.

4.2.1.3 THE USE OF PROPERLY DESIGNED MACHINES FOR GUTTING, WASHING, SPLITTING, SKINNING, STEAKING, BRINING AND TENTERING AND OTHER SIMILAR OPERATIONS IS TO BE ENCOURAGED

Where large quantities of fish are processed, properly designed machines will simplify the production of smoked fish products in quantity with consistently low bacterial counts. This is mainly because well designed machines have impervious and corrosion-resistant working surfaces, are easy to dismantle, clean, disinfect and are capable of handling the fish with a minimum of delay.

It is essential that the installation of new machinery should be well researched and economically justified. The units should be rigorously tested before being put into commercial use; otherwise costly failures may arise.

4.2.1.4 BRINING AND SALTING VATS SHOULD BE MADE OF SUITABLE CORROSION-RESISTANT MATERIAL AND SHOULD BE SO CONSTRUCTED AS TO PERMIT EASY CLEANING AND COMPLETE DRAINAGE

Such vats or containers could become a serious source of contamination by micro-organisms, rust, dirt and miscellaneous detritus if not made of suitable material or if not kept clean.

4.2.1.5 FISH TRANSPORT VEHICLES SHOULD BE DESIGNED TO PROTECT FISH FROM WARMING UP DURING TRANSPORTATION, AND SHOULD BE OF SUCH MATERIAL AND CONSTRUCTION AS TO PERMIT EASY AND THOROUGH CLEANING

Vehicles used for transporting fish and fish products should be designed to provide some means of refrigeration and constructed to ensure constant protection to the fish against contamination by dust and the drying effect of sun or wind. Even where ice is very cheap and journey times or distances are relatively short, the use of an insulated vehicle provides an additional insurance against inadequate icing or unforeseen delays. The walls, roof and the floor of the vehicle should be insulated. The thickness of insulation employed will depend on the outside temperatures normally encountered. It should be remembered that insulation cannot help to cool the fish but helps to keep it at the temperature at which it was put into the vehicle.

Vehicles used for transporting frozen fish should be capable of maintaining the product at or below a temperature of $-18^{\circ}C$ ($0^{\circ}F$).

For the purpose of cleaning, the vehicles transporting fish should have the wall, floor and roof linings made of suitable corrosion-resistant material with smooth and non-absorbent surface. Floors should be adequately drained.

4.2.2 Smoking Equipment

4.2.2.1 PROCESSING PLANTS SHOULD BE EQUIPPED WITH EITHER TRADITIONAL OR MECHANICAL SMOKING KILNS

Both types of kilns, traditional and mechanical, should be preferably designed and constructed by specialists to ensure safe and efficient operation and to facilitate easy cleaning.

Both types of kilns could be used for either cold or hot smoking. However, the mechanical kiln gives better prospects for controlling the operation and the quality of the final product. The traditional kiln is essentially a large chimney with means to suspend fish strung on tenters, (sticks or rods on which fish is hung; smoke stick) over a fire of smouldering wood. It is easy and cheap to construct. In this type of kiln, the hot air generated by the smouldering wood in the kiln creates a vertical current of smoke

which passes the fish to be smoked. The speed of this current is usually slow and uneven. Some improvement and a limited amount of process control can be obtained by installing a suction fan and dampers in the chimney at the top of the kiln. Recirculation of smoke is not practised.

The traditional type of kiln should preferably be constructed of material with good insulation properties such as bricks. This results in smaller heat losses, in more uniform temperature distribution, and prevents the condensation of moisture on the inner surfaces during cold weather.

The inner surface of the kiln should preferably be finished smoothly with a lining such as stainless steel or other suitable material to facilitate cleaning of the walls with steam and hot water.

In a traditional kiln the fire must be looked after constantly as it could flare up suddenly and cook, or even burn, the lowest hanging fish. For this reason, therefore, it is advisable to equip the kiln with a high temperature alarm device which is relatively inexpensive and simple to install. The fire in the traditional kiln is usually built up of a layer of wood shavings covered by a layer of moist sawdust and should be attended by an experienced operator.

The mechanical kiln offers many more possibilities for process control. The movement of the air-smoke mixture in this type of kiln is done by ventilators (electric fans). The speed of the air-smoke current can be controlled as well as its relative humidity. If fitted with cooling coils, the temperature can be more precisely controlled and this facility will be of particular value in cold smoking.

Smoke required for the mechanical kiln is always produced outside the chamber in which fish is smoked, either in a simple fire box or a more sophisticated smoke generator. The positive movement of the air-smoke mixture through the kiln allows for its recirculation which, in turn, will result in better fuel utilization.

In large and long mechanical kilns, in order to create more uniform processing conditions, it is advisable to shift the product's position with respect to the point of entry of the smoke or to provide for reheating of the air-smoke mixture during its passage.

4.2.2.2 THE USE OF AUTOMATED SMOKE GENERATORS IS STRONGLY RECOMMENDED

In order to provide a consistently uniform volume and quality of smoke throughout the smoking process the installation of an automated smoke generator should be considered.

Numerous types of smoke generators are presently available on the market. Most of these devices use sawdust fed to a combustion chamber where an electric heating element effects ignition. Other types of smoke generators use superheated steam or hot air to combust the wood. In case of the friction smoke generator, a piece of solid wood is pressed against a fast rotating disc or cylinder. The heat of friction causes the wood to smoulder and smoke.

The use of smoke scrubbers for the removal of fly-ash, soot and tare, is recommended. It may be necessary to recirculate the scrubbing water which rapidly becomes saturated with the lighter fractions which impart the desired smoke flavour. Colour development of the fish product might be affected.

4.2.2.3 INSTRUMENTATION TO MONITOR AND CONTROL THE SMOKING PROCESS SHOULD BE APPLIED WHEREVER POSSIBLE

Plants using traditional kilns frequently regulate the process entirely by "feel" based on long experience. Although it is possible to produce a good quality product in this way the results are frequently not uniform.

Such factors as temperature, humidity, smoke density and time of processing can be controlled. A simple dial thermometer, placed strategically and coupled with a high temperature alarm system is the least that should be present in a smoking kiln.

Relative humidity which affects the rate of smoke absorption, surface evaporation (case hardening), and the final loss of weight can be regulated by adjusting the proportions of recirculation and ventilation in the kiln or by injection of steam into the smoke trajectory.

Installation of a suction fan and a damper on the chimney of the kiln will control the speed of air and smoke current which passes the fish.

4.2.2.4 EQUIPMENT USED FOR HANGING OR LAYING OUT OF FISH DURING SMOKING SHOULD BE CONSTRUCTED OF SUITABLE CORROSION-RESISTANT MATERIAL AND SHOULD BE DESIGNED SO AS TO BE READILY CLEANABLE

Trolleys, racks and other equipment which do not come in direct contact with fish, should be constructed to permit easy and thorough cleaning.

4.2.2.5 EQUIPMENT USED IN "ELECTROSTATIC" SMOKING SHOULD BE MANAGED BY SKILLED OPERATORS AND SHOULD BE CONTROLLED BY AUTOMATIC REGULATORS OF TEMPERATURE, HUMIDITY AND SMOKE DENSITY

In this process, the smoke particles are given an electric charge in a very high voltage electric field. After this, the smoke passes the fish that is held at an opposite charge. The smoke particles ionized in this way are deposited more quickly on the fish than in the traditional process and the processing time is cut down appreciably. Deposited smoke, however, must be "fixed" to the product by a heating process, usually with infra-red lamps.

4.3 Hygienic Operating Requirements

4.3.1 FISH INTENDED FOR SMOKING SHOULD ALWAYS BE TREATED IN A HYGIENIC MANNER

All the handling, processing and packaging of fish should be carried out in a clean manner.

Precautions should be taken at all times to protect the fish from contamination by animals, insects, birds, chemical or microbiological contaminants or other objectionable substances.

Preparatory operations leading to the finished product and the packaging operations should be so timed as to permit expeditious handling of consecutive batches in production within the time and temperature range that will prevent deterioration, spoilage or the multiplication of micro-organisms of public health significance. Special precautions should be taken to avoid the conditions under which the outgrowth of Clostridium botulinum spores may occur.

It is considered good practice to develop a schedule of permitted times in which each operation will be allocated a definite portion of the total time permitted for each fish to remain on the premises of the processing plant.

4.3.2 STRICT HYGIENIC PROCEDURES SHOULD BE OBSERVED DURING HANDLING, PROCESSING AND STORAGE OF SMOKED FISH AND FISHERY PRODUCTS TO PREVENT PRODUCTION OF TOXIN BY Clostridium botulinum

The micro-organism Clostridium botulinum sometimes occurs in water and bottom sediments and hence may occasionally be found on fish. Given the right conditions, the organism may produce toxin which can cause fatal food poisoning.

Some processes employed in hot smoking are insufficient to inhibit outgrowth and toxin production of Clostridium botulinum type E, and in lightly salted products (less than 5% salt) the outgrowth of this organism will not be prevented. Where this is the case, effective methods of avoiding the dangers of botulinum poisoning from lightly salted smoked fish are, firstly, the strict observance of hygienic and good manufacturing practices

during the handling and processing and, secondly, to keep final product temperature at all times below 3°C (37°F) at which temperature the organism does not grow. It is therefore advisable that the recommended storage temperature should be clearly stated on the label.

Outgrowth and toxin formation from Clostridium botulinum during hot smoking can be prevented by control of the combination of time and temperature, and the water phase salt concentration of the fish flesh. For example, during hot smoking of chub (Coregonus spp.) the internal temperature should reach at least 65°C (150°F) for at least 30 minutes, and 5% of the water phase salt concentration as measured in the thickest segment of the muscle. If the water phase salt concentration is between 3.5 - 5% the internal temperature should reach at least 82°C (180°F) for at least 30 minutes.

Other processes according to the type of fish and shown to have equivalent effects in preventing outgrowth and toxin formation of Clostridium botulinum may be used.

No risk is attached to frozen smoked fish provided it remains frozen from the time of production to cooking and/or consumption. Freezing does not destroy the micro-organisms and therefore any mishandling after thawing could result in outgrowth of and toxin production by Clostridium botulinum.

4.3.3 THE BUILDING, EQUIPMENT, UTENSILS AND OTHER PHYSICAL FACILITIES OF THE PLANT SHOULD BE KEPT CLEAN, IN GOOD REPAIR AND SHOULD BE MAINTAINED IN AN ORDERLY AND HYGIENIC CONDITION

All surfaces which come in contact with fresh fish should be hosed down with hot water of potable quality or clean sea water as frequently as necessary to ensure cleanliness. It is important that the cleaning method used will remove all residues and the disinfecting method will reduce the microbial population of the surface being cleaned. A preliminary rinse in potable cold water or clean sea water, followed by a wash in water of a sufficient temperature providing for effective cleaning is recommended. An ample supply of potable water or clean sea water at adequate pressure is the first requirement and cleaning will be much easier if done immediately and the surfaces are not allowed to dry.

The use of cold or hot potable water or clean sea water alone is generally not sufficient to accomplish the required result. It is desirable, if not essential, that aids such as suitable cleaning and disinfecting agents together with manual or mechanical scrubbing, wherever appropriate, be used to assist in achieving the desired objective. Such surfaces after disinfection should be sprayed with cool potable water or cool clean sea water before coming into contact with fish again.

Cleaning agents and disinfectants used should be approved by the official agency having jurisdiction, should be appropriate for the purpose, and should be so used as to present no hazard to public health.

4.3.4 SPLITTING AND CUTTING BOARDS SHOULD BE FREQUENTLY AND THOROUGHLY SCRUBBED AND TREATED WITH DISINFECTANT. WHEREVER PRACTICABLE, THE BOARDS SHOULD BE CONTINUOUSLY FLUSHED WITH RUNNING POTABLE WATER OR CLEAN SEA WATER DURING USE

It is recognized that the degree of microbial contamination found on fish and fish products is related to microbial contamination of the working surfaces on which they are processed. All such surfaces should, therefore, be cleaned, scrubbed and disinfected, at least at the end of each working day.

4.3.5 ALL MACHINES USED FOR GUTTING, SCALING, WASHING, FILLETING, SPLITTING, TENTERING OR OTHER PROCESSING EQUIPMENT USED IN SIMILAR OPERATIONS, SHOULD BE THOROUGHLY CLEANED, DISINFECTED AND RINSED DURING REST OR MEAL BREAKS AND BEFORE RESUMPTION OF PRODUCTION FOLLOWING OTHER WORK STOPPAGES

The use of machinery reduces the risk of contamination from human sources. If, however, these machines are not properly maintained and cleaned regularly they can become a serious source of contamination.

4.3.6 UTENSILS AND FOOD-CONTACT SURFACES OF EQUIPMENT SHOULD BE PROTECTED FROM CONTAMINATION

Cleaned and disinfected portable equipment and utensils should be stored above the floor in a clean, dry location. Suitable space and facilities should be provided for such storage so that food-contact surfaces are protected from splash, dust, and other contamination.

The same requirement should also apply to the exposed food-contact surfaces of the fixed equipment.

Utensils should be air dried before being stored or should be stored in a self-draining position on hooks or racks constructed of corrosion-resistant material. When the storage in protective liquids or other solutions is practised, the equipment and utensils so stored should subsequently be washed, disinfected and rinsed prior to re-use. Wherever practicable, stored containers and utensils should be covered or inverted.

4.3.7 CLEANING OF SMOKING EQUIPMENT SHOULD BE MADE INTO A REGULAR ROUTINE

The periodical removal of tarry deposits on walls, ceilings, fans, tenters, racks, trolleys, etc., is necessary not only for hygienic reasons but also to reduce the risk of fire.

Both the traditional and the mechanical kilns used for smoking present a potential fire hazard if large amounts of tar are allowed to accumulate.

Centrifugal fans are likely to collect an appreciable amount of tar in the fan housing. A special drain hole should be provided on the bottom of the fan's enclosure.

Cleaning methods usually involve the application of alkaline solutions. This can be done manually with a brush or can be sprayed on the walls and ceilings by means of a spray gun which is connected to a hot water or steam supply. The detergent and the dissolved deposits should be rinsed off thoroughly with a copious amount of clean water. For better and more uniform contact of the detergent with the soiled surfaces the use of a foam solution of detergent is recommended.

Easy day-to-day maintenance can be achieved by installing permanent rotating spray nozzles inside the smoking kiln.

Whenever new kilns are being designed, consideration should be given to the accessibility of all parts for easy cleaning; necessary drainage points must be provided.

4.3.8 BRINE USED IN BRINING OF FISH SHOULD BE CHANGED AS FREQUENTLY AS NECESSARY TO PREVENT ACCUMULATION OF FATTY SCUM AND DEPOSITION OF SLUDGE OF SOLID SALT MIXED WITH FISH RESIDUE AND OTHER FOREIGN MATTER

There are always some impurities left in the brine after fish have been removed. These impurities derive mainly from salt or fish and may consist of undissolved salts, particles of dirt, fish scales, slime and other remnants of fish including fish fat, blood and proteins.

Such impurities should be removed either by changing the brine or recirculating it through a filtering device.

With every batch, the strength of the brine should be checked with a salinometer (brinometer) and adjusted to the required concentration (see Appendix II).

4.3.9 ONLY NEW AND CLEAN BOXES, CARTONS AND WRAPPING MATERIAL SHOULD BE USED FOR THE TRANSPORT AND DISTRIBUTION OF SMOKED FISH AND SIMILAR PRODUCTS. WHERE RETURNABLE BOXES ARE USED, THEY SHOULD BE CORROSION-RESISTANT MATERIAL AND SHOULD BE THOROUGHLY CLEANED AND DISINFECTED AFTER EACH USE

The practice of using returnable boxes for the transport and distribution of smoked fish and similar products should be discouraged unless the box is constructed of a light inner non-returnable container protected by a stronger returnable outer case.

All too often, returnable boxes lie around processing plant yards or warehouses in an unwashed, filthy condition.

As it is very important to protect smoked fish or smoked fish products from all sources of contamination, only clean new or non-returnable containers should be used.

4.3.10 WATER USED FOR WASHING OR CONVEYING RAW MATERIALS, INCLUDING SEA WATER FOR CONVEYANCE OF FISH AND OTHER MARINE PRODUCTS INTO THE PLANT, SHOULD BE FROM SUCH A SOURCE, OR SUITABLY TREATED, AS NOT TO CONSTITUTE A PUBLIC HEALTH HAZARD

During gutting and scaling, or for washing fish, equipment and utensils, water of potable quality or clean sea water should be used. It should not be recirculated unless suitably treated to meet the required standards of potability.

4.3.11 REMOVAL OF SOLID, SEMI-SOLID OR LIQUID WASTES FROM FISH UNLOADING, HOLDING AND PROCESSING AREAS SHOULD BE ON A CONTINUOUS OR NEAR CONTINUOUS BASIS USING WATER AND/OR APPROPRIATE EQUIPMENT SO THAT THESE AREAS ARE KEPT CLEAN AND THERE IS NO DANGER OF CONTAMINATING THE PRODUCT

All waste materials resulting from the operation of a smoked fish processing plant should be disposed of as soon as possible in a way that they cannot be used for human food and in a manner that they cannot contaminate food and water supplies and offer harbourage or breeding places for rodents, insects, or other vermin.

Containers, flumes, conveyors, bins or storage bays used for removal, collection or storage of fish offal and other waste should be cleaned frequently with potable water or clean sea water containing an appropriate amount of free chlorine or other suitable disinfectant.

All waste material from containers and vehicles should be removed in such a way as not to cause any contamination and not to create a nuisance.

Arrangements for the frequent removal and disposal of waste material should be approved by the appropriate official agency having jurisdiction.

4.3.12 EFFECTIVE MEASURES SHOULD BE TAKEN TO PROTECT AGAINST THE ENTRANCE INTO THE PREMISES AND THE HARBOURAGE ON THE PREMISES OF INSECTS, RODENTS, BIRDS OR OTHER VERMIN

An effective and continuous programme for the control of insects, rodents, birds, or other vermin within the establishment should be maintained. The plant and surrounding area should be regularly examined for evidence of infestation. Where control measures are necessary, treatment should be under the direct supervision of personnel with a thorough understanding of the hazards involved, including the possibility of harmful residues being retained by the fish or their products, and the chemical, biological or physical agents used should meet the requirements of the official agency having jurisdiction.

The use of insecticides, during the plant operation, without any provision for collection of dead insects, should be discouraged. Instead, the use of adhesive insect traps or very efficient "black light insecticutor" lamps with the attached collecting trays, are recommended. Insect traps should not be located directly over the processing areas and should be away from windows and doors.

All rodenticides, fumigants, insecticides or other harmful substances should be of a type approved by the official agency having jurisdiction and should be stored in separate locked rooms or cabinets used only for that purpose and handled only by properly trained personnel.

4.3.13 DOGS, CATS, AND OTHER ANIMALS SHOULD BE EXCLUDED FROM AREAS WHERE FISH IS RECEIVED, HANDLED, PROCESSED OR STORED

Dogs, cats, and other animals are potential carriers of diseases and should not be allowed to enter or to live in rooms or areas where fish or their products are handled, prepared, processed or stored.

4.3.14 ALL PERSONS WORKING IN A SMOKED FISH PLANT SHOULD MAINTAIN A HIGH DEGREE OF PERSONAL CLEANLINESS WHILE ON DUTY AND SHOULD TAKE ALL NECESSARY PRECAUTIONS TO PREVENT THE CONTAMINATION OF THE FISH OR FISH PRODUCTS OR INGREDIENTS WITH ANY FOREIGN SUBSTANCE

All employees should wear, appropriate to the nature of their work, clean light-coloured protective clothing including a head covering and footwear all of which articles are either washable or disposable. The use of waterproof aprons, where appropriate, is recommended. Light colours are required to assess visually the cleanliness of the garment. It is desirable that, except for workers operating in freezers or cold rooms, the sleeves of clothing should not extend below the elbows unless waterproof protective sleevelets are used to cover the arms.

Gloves used in the handling of fish should be maintained in a sound, clean and hygienic condition and should be made of an impermeable material except where their usage would be incompatible with the work involved. Hands should be washed thoroughly with soap or another cleansing agent and warm water before commencing work, on every occasion after visiting the toilet, before resuming work, and whenever otherwise necessary. The wearing of gloves does not exempt the operator from having thoroughly washed hands.

Any behaviour which can potentially contaminate the fish such as eating, smoking, chewing of tobacco or other materials and spitting should be prohibited in any part of the fish handling areas.

4.3.15 NO PERSON WHO IS KNOWN OR SUSPECTED TO BE SUFFERING FROM, OR WHO IS A CARRIER OF A DISEASE LIKELY TO BE TRANSMITTED THROUGH FOOD, OR HAS AN INFECTED WOUND OR OPEN LESION, SHOULD BE ENGAGED IN THE PREPARATION, HANDLING OR TRANSPORTING OF FISH OR FISH PRODUCTS

The management should take care to ensure that no person, while known or suspected to be suffering from, or to be a carrier of a disease likely to be transmitted through food or while afflicted with infected wounds, skin infections, sores or with diarrhoea, is permitted to work in any food handling area in any capacity in which there is any likelihood of such a person directly or indirectly contaminating food with pathogenic microorganisms. Any person so affected should immediately report to the management that he is ill.

Any person who has a cut or wound should not continue to handle food or food contact surfaces until the injury is completely protected by a waterproof covering which is firmly secured, and which is conspicuous in colour. Adequate first-aid facilities should be provided for this purpose.

4.3.16 CONVEYANCES USED FOR TRANSPORTING FISH SHOULD BE CLEANED AND DISINFECTED IMMEDIATELY AFTER EACH USE AND SHOULD BE SO MAINTAINED AS NOT TO CONSTITUTE A SOURCE OF CONTAMINATION FOR THE PRODUCT

The cleaning of vehicles, together with receptacles and equipment thereon, should be a regular planned routine. Hosing, scrubbing and cleaning with potable water or clean sea water to which a suitable detergent and disinfectant have been added is usually necessary.

Forklift trucks should not be used outside the plant unless they can be adequately cleaned upon re-entry.

4.4 Operating Practices and Production Requirements

4.4.1 General Considerations

4.4.1.1 SMOKED FISH OR FISH PRODUCTS SHOULD BE OF A GOOD QUALITY, WELL PREPARED AND PACKAGED SO THAT THEY WILL REMAIN ATTRACTIVE AND SAFE TO EAT

Only fish which are suitable for sale as fresh or frozen fish should be used for processing into smoked fish. Some spoiled or spoiling fish, particularly scombroids, have caused food poisoning incidents. These incidents have been associated with high levels of histamine. Processing such fish by smoking will not render the product safe for human consumption. Smoking cannot correct faults that are due to the poor physiological condition of the fish, improper handling practices or prolonged storage. Despite the masking effect of smoke on taste, odour and colour of fish, poor quality raw materials will produce poor quality smoked products.

4.4.2 Handling of Raw Material

4.4.2.1 ALL FISH, FISH PRODUCTS, AND INGREDIENTS USED IN FISH-SMOKING ESTABLISHMENTS SHOULD BE FREE FROM SPOILAGE AND CONTAMINATION AND SHOULD BE SAFE FOR HUMAN CONSUMPTION

Raw materials should not be accepted by the fish smoking establishment if they are spoiled, rancid, or if they are known to contain harmful or foreign substances which under normal plant procedures of sorting or preparation would not be reduced to an acceptable level. Salt used in the processing of fish should be of an appropriate quality and otherwise suitable for the purpose.

4.4.2.2 FRESH FISH WHICH CANNOT BE PROCESSED IMMEDIATELY ON ARRIVAL SHOULD BE CHILLED IN CLEAN CONTAINERS AND STORED IN SPECIALLY DESIGNATED AREAS WITHIN THE PLANT WHERE THEY WILL BE PROTECTED FROM HEAT AND WEATHER CONDITIONS AND WILL NOT BE CONTAMINATED BY DUST, INSECTS, OR VERMIN. WHERE POSSIBLE, THE ICED FISH SHOULD BE STORED IN A CHILL ROOM, THE TEMPERATURE OF WHICH IS JUST ABOVE THAT OF MELTING ICE

Fresh fish, prior to processing, should be kept chilled. Containers when filled or partially filled with iced fish should not be stacked in a manner which permits contamination from other containers. Intimate contact of ice and fish by proper mixing or layering is essential to obtain rapid cooling and maintain temperatures near $0^{\circ}C$ ($32^{\circ}F$). Flaked or crushed ice will speed cooling and prevent bruising which may occur from large lumps of ice.

Some species of fish, such as herring, are more susceptible to spoilage than others and require special care.

Fish which is salted in wooden barrels, should be stored under refrigeration and in a humid atmosphere.

Where larger quantities of fish than the daily requirements are stored, the plant should have adequate chilled storage available to keep the stock of raw material at temperatures near 0°C (32°F). Stocks should be limited to the amount that can be processed while the fish are still in good condition.

It must be stressed that placing quantities of fresh fish in a chill room does not remove the need for adequate icing. Chill rooms are designed to maintain a low temperature and to keep already cool fish from warming up. The refrigeration machinery used in chill room operation is not adequate to lower the temperature of a mass of fish in a short time. The initial cooling should be done by icing the fish thoroughly.

4.4.2.3 ALL FISH SHOULD BE CAREFULLY INSPECTED, SORTED, OR CULLED BEFORE THEY ARE PROCESSED. ANY DAMAGED, CONTAMINATED OR OTHERWISE UNACCEPTABLE FISH SHOULD BE DISCARDED

As has already been stated, the quality and keeping time of the final product is largely dependent on the quality of the fish from which it is produced.

Fish which are damaged (bruised, crushed, mutilated) will produce a very poor or unacceptable product and, if contaminated in any way, can spread this contamination to working surfaces and other fish.

If the fish is suspected to be infested with parasites, a representative sample should be filleted and examined to determine whether to proceed with the processing.

Although most types of parasites found in fish are harmless to humans, nevertheless the presence of parasites in fish or fish products is highly objectionable to the majority of the consuming public.

Proper and careful candling will not only detect parasites but also blood spots, pieces of skin, guts, scales, and any other defects which otherwise might reduce the overall quality of the final product.

4.4.2.4 ALL FISH SHOULD BE THOROUGHLY WASHED BEFORE PROCESSING OR IMMEDIATELY AFTER OPERATIONS LIKE SCALING OR GUTTING

Spoilage micro-organisms come mainly from the surface of the fish and their intestines. Experience has shown that a large part of the surface micro-organisms can be removed by proper washing.

During the dressing, eviscerating (gutting), or trimming operations, each fish should be washed by a flow or spray of potable water or clean sea water which is sufficient in quantity and pressure and is applied in such a manner as to clean the fish thoroughly. If the fish are to be scaled before smoking, a thorough washing should follow immediately after the scaling (removal of scales) otherwise loose scales adhering to the surfaces of the fish will detract from the appearance of the final product.

Water used for washing, rinsing or conveying, should not be recirculated unless suitably treated to maintain a potable level of quality.

4.4.2.5 WHERE FISH ARE BEING GUTTED, HEADED, SKINNED, BONED OR PORTIONED, THESE OPERATIONS SHOULD BE CARRIED OUT IN A CLEAN AND HYGIENIC MANNER

All waste material resulting from these operations should be collected immediately into suitable containers which are removed and emptied regularly or be removed continuously by mechanical means or flumes.

Small fatty fish, such as herring, sardine and sprat, are usually smoked without having been gutted.

4.4.2.6 THAWING OF FROZEN FISH PRIOR TO PROCESSING SHOULD BE DONE IN THE MANNER RECOMMENDED IN THE "RECOMMENDED INTERNATIONAL CODE OF PRACTICE FOR FROZEN FISH"

The thawing method chosen should suit the volume and type of product that is to be processed and should be economically practical. Exposure of fish to elevated temperatures during the thawing should be carefully controlled.

Where fish are thawed in still air, the ambient temperature should not exceed 18°C (65°F).

With air blast thawing, the air should be humidified and the temperature should not exceed 21°C (70°F).

Water used for thawing should be either clean sea water or potable water and its temperature should not exceed 21°C (70°F).

All thawing operations should be carried out under strict hygienic conditions. Surface drying should be avoided.

4.4.2.7 WHEN FROZEN FISH IS USED THE TEMPERATURE IN ANY PART OF THE THAWED PRODUCT SHOULD NOT RISE ABOVE 7°C (45°F) BEFORE BEING PROCESSED. IF PROCESSING CANNOT COMMENCE IMMEDIATELY THE THAWED MATERIAL SHOULD BE KEPT CHILLED

4.4.3 Brining, Pickling and Dry-Salting

4.4.3.1 BRINING SHOULD BE CARRIED OUT WITH THE FULL UNDERSTANDING OF THE EFFECT ON THE QUALITY OF THE FINAL PRODUCT AND SHOULD BE DONE UNDER STRICT HYGIENIC CONDITIONS

Brining gives the smoked fish its taste, appearance (attractive gloss), texture and affects its shelflife.

As there is usually a loss of moisture from the fish, strict control of the process should be maintained in order to keep the resulting loss of weight within the profit margin of the operation.

There are many factors that should be carefully considered by the processor when establishing proper brining procedures for his plant. Brining time depends on the species of fish (amount of fat) as well as on their size and thickness. Proper brining methodology should, above all, reflect the requirements of the final products, such as taste, salt content, texture, appearance, and the product's shelflife.

To assure the uniform salt content of the final product, the fish in the brining batch should be uniform in size and weight.

It is advisable to stir the brine during the process to obtain an even salt content in the product. Stirring can either be done by hand with a paddle or by a brine agitator such as a slow revolving electric stirrer or a pump. High speed stirrers cause foaming of the proteins dissolved in the brine and are, therefore, not recommended.

An excessive amount of salt present in the outer layers of the fish may result in the appearance of solid salt crystals on the surface of the product after drying and smoking processes have been completed or eventually during the subsequent storage.

Brine strength should be checked regularly with a salinometer (brinometer) and should be maintained at the required level by the addition of solid salt. Brine strength decreases with use as water extracted from the fish tissue dilutes it and salt is absorbed by the fish.

The salinometer (brinometer) consists of a float with stem attached, marked in degrees. In a saturated brine, the stem will be almost entirely above the level of the salt solution and read 100° (approximately 23 percent salt solution). In weaker brines more of the stem will become submerged.

Salinometer readings should be taken at the standard temperature stated for the given instrument, otherwise temperature correction should be applied (see Appendix II "Preparation of Brine of Required Strength").

All fish should be brined under cool conditions preferably at a temperature not exceeding 10°C (50°F).

4.4.3.2 THE SALT USED IN THE BRINING OR SALTING OF FISH SHOULD POSSESS AN APPROPRIATE COMPOSITION FOR THE PRODUCT

Calcium and magnesium salts are the main impurities but limited amounts of iron and copper salts do occur. The presence of excessive amounts of calcium and magnesium salts in common salt used for brining or dry salting may impart a bitter flavour and unattractive chalky appearance to the fish. When only impure salt is available, most of the calcium and magnesium impurities can be washed away by using rainwater or potable water and draining off the wash water.

4.4.3.3 LARGE FISH SHOULD BE SPLIT OR CUT OR SCARIFIED BEFORE BRINING OR DRY-SALTING TO ALLOW FOR MORE EFFECTIVE AND UNIFORM SALT PENETRATION

The incisions should be made through the skin at regular intervals of a few centimetres. Care should be taken not to cut too deep so that the meat will not tear during subsequent handling and processing.

4.4.3.4 BRINING MAY BE COMBINED WITH A COLOURING PROCESS; DYES USED IN COLOURING FISH SHOULD BE APPROVED BY THE OFFICIAL AGENCY HAVING JURISDICTION

In some countries, it is customary to improve on the colour of the product by the addition to the brine of a permitted natural or artificial dye. Fish coloured in such a manner can then be very lightly smoked to obtain the desirable smoke flavour.

This method is frequently applied to cold or lightly smoked products that require heating (cooking, frying) before consumption. Otherwise, the colour and flavour of normally smoked products when subjected to heat become very intense.

4.4.3.5 FRESH BRINE SHOULD BE PREPARED AT LEAST EACH DAY BEFORE THE START OF OPERATIONS

As has been mentioned before, the brine used in brining of fish should be changed as frequently as necessary to prevent accumulation of fatty scum and deposition of sludge of solid salt mixed with fish residues and other foreign matter.

Such impurities, if not removed, will contaminate the subsequent loads of fish and will, in turn, affect the quality of the final product. Fresh brine of required strength can be easily prepared either by dilution of the saturated brine with water or preferably by dissolving the required amount of salt in a given amount of water (see Appendix II "Preparation of Brine of Required Strength"). A saturated brine can be produced by forcing upward a flow of clean water through a column of salt. The resulting overflow of saturated brine is then collected into a storage tank. With a large volume production and with the use of a continuous mechanical briner, the brine can be re-circulated and its concentration readjusted after passing it through the filtering device and through a bed of solid salt.

In some countries where salt is an expensive commodity, it may be worthwhile to recover it from the used brine but trouble may be encountered with such a brine due to the presence of halophylic bacteria which might cause red discoloration of the final product. Salt may be recovered from the used brine by heating the brine to coagulate dissolved proteins and filtering it. After cooling and recrystallization the resulting salt should be washed with clean water and spread out to dry. The controlled flocculation and clarification of brine with lime and aluminium sulphate could be considered as an alternative. This process enables brine to be circulated continuously.

4.4.3.6 DURING PICKLING FISH SHOULD BE KEPT AT A TEMPERATURE BELOW 3°C (37.4°F)

This can be achieved in the chill room by the addition of small quantities of ice and required amount of saturated brine to make up for the dilution of the brine. In a mechanical brining system, the brine can be passed through a water chiller or similar cooling device.

Pickling should always be done in a chill-room temperature. Pickled fish should be thoroughly covered by the brine to prevent rancidity and discoloration.

4.4.3.7 THE RATIO OF BRINE TO FISH SHOULD BE AT LEAST 1:1 BY WEIGHT WHEN USING A SATURATED BRINE

When saturated brine is used, a certain amount of solid salt should always be present on the bottom of the brining vat.

When weak (very light) brining is practised then the quantity of brine in relation to fish should be increased.

In either case, during the brining process, the brine should be stirred as often as possible either by hand or mechanically.

4.4.3.8 BEFORE SMOKING, THE SALT CONTENT OF HEAVILY SALTED FISH MUST BE REDUCED BY PROLONGED IMMERSION IN CLEAN WATER

Desalting in running water, although preferable, is not practical or economical because of the large quantities of water involved. Salted fish is usually immersed in tanks with an equal amount of water. The process should be carried out at temperatures not higher than 10°C (50°F).

To secure uniform results, the fish should be regularly stirred. The salty water, being heavier than the fresh water, will sink to the bottom of the tank resulting in an uneven distribution of salt content in the final product.

4.4.3.9 IMMEDIATELY AFTER BRINING, FISH SHOULD BE SUSPENDED ON RODS (TENTERS) OR HOOKS, OR LAID OUT ON TRAYS FOR DRYING AND SMOKING

After brining, fish should be subjected to drying which could be carried out in an open area or in a mechanical dryer under controlled conditions. For this reason and for the purpose of subsequent smoking, the fish or fish products should be suspended on rods, hooks or laid out on trays. Care should be taken to ensure that the suspended fish do not touch each other otherwise they will be unevenly smoked and damaged physically during the separation.

4.4.3.10 "DRIPPING" AND DRYING OF FISH PRIOR TO SMOKING SHOULD BE CARRIED OUT UNDER CONTROLLED CONDITIONS AND IN A HYGIENIC MANNER

Dripping or drip-drying and drying of fish after the brining or desalting, refer to the removal of the adhering surface water and evaporation of the surface moisture. If it is done properly, the formation of a glossy pellicle will result. The pellicle is important because it helps to seal in the natural juices and flavours of the fish flesh and forms a smooth and attractive surface upon which the smoke can be evenly deposited.

The flesh of some fish, if smoked before a pellicle is formed, will exude the fish juice which will coagulate into a white curd when exposed to higher temperature or in case of cold smoking will support the growth of micro-organisms resulting in off-odours, sour taste and mushy texture.

Drying of fish may be done outdoors providing there is no chance for contamination by insects, birds and dust, or in the smokehouse. An ideal system is in the chill room with the aid of a blower where a steady current of cool, clean air could be provided.

4.4.3.11 IF FOOD ADDITIVES ARE TO BE USED, THE ADVICE OF A FOOD TECHNOLOGIST SHOULD BE SOUGHT AND THE APPROVAL OF THE OFFICIAL AGENCY HAVING JURISDICTION SHOULD BE OBTAINED

Food additives cannot be used indiscriminately. Some are effective only with certain types of food, and in all cases the concentration and the time of contact of the additive must be rigidly controlled in accordance with specialist advice and the official agency having jurisdiction. Food laws differ from one country to another and it is essential to seek specialist advice before using a particular additive, whether the product is for domestic use or for export.

Only approved food preservatives should be added to the brine or applied after brining. Dissolved food preservatives should not be applied to the surface of the smoked fish as this will tend to spoil the appearance.

4.4.3.12 FISH FOR DRY-SALTING SHOULD BE PROPERLY ARRANGED TO ENSURE UNIFORM CONDITIONS AND PROPER DRAINAGE

In dry-salting (kench curing), two or three rows of fish are placed down the centre of a drainage rack, which is covered with a layer of salt, and salt is sprinkled over each fish, particularly on the thicker portions. A pile is formed gradually working out to the edges of the rack. At all times the fish at the centre of the pile is kept 7 to 10 cm higher than at the edges. For first salting piles should not be higher than 1 m but in subsequent resalting piles of a greater depth are possible. Round piles are prepared by placing the tails of the fish toward an open centre.

There should be no pockets in the pile that will cause irregular drainage. If pockets are present, the fish around the area will become tainted and dark resulting in an inferior grade product.

The edges of the pile should be checked frequently and fine salt should be sprinkled over the napes of the fish which are affected by drainage from the pile. Fish piles should never be placed directly on the floor unless it has been specifically designed for the purpose.

4.4.3.13 IN THE DRY-SALTING OF FISH THE AMOUNT OF SALT, THE TIME AND TEMPERATURE SHOULD BE CAREFULLY CONTROLLED TO ATTAIN THE DESIRED PRODUCT

The amount of salt to fish may range from 1 unit of salt to 8 of fish by weight for light salting, to 1 unit of salt to 3 of split fish (or exceptionally 1 to 1) for heavy salting. Time in the cure may range from 6-8 days for light salting to 21-30 days for heavy salting. In view of the multiplicity of the factors involved only through experimentation and experience can the proper curing conditions be ascertained. In general more salt is required for given weight of fish for dry-salting as compared to brining or pickling.

Dry-salting of fish should be carried out in a cool room with a temperature below 10°C (50°F) for the control of "pink" (halophylic bacteria) and "dun" (mould).

4.4.3.14 FISH WHICH IS DRY-SALTED IN PILES SHOULD BE RE-STACKED PERIODICALLY WITH THE ADDITION OF FRESH SALT TO ENSURE UNIFORM CURING CONDITIONS AND PRESSING

After several days in the pile, fish should be re-stacked with the top of the pile going to the bottom. Each fish during the re-stacking operation should be carefully salted using additional fresh salt to ensure that sufficient salt will be present to complete the cure.

4.4.3.15 FOR SALTING OF SMALL FATTY FISH, SUCH AS ANCHOVY OR SMALL HERRING, DRY-SALTING OR KENCH CURING MAY BE USED; UNDER CERTAIN CONDITIONS AND FOR LARGE FISH, PICKLING OR BRINING SHOULD BE USED IN PREFERENCE

Since fatty tissue absorbs salt more slowly than lean tissue, dry salt in contact with fish will dissolve in water extracted from the tissue and run off without increasing the salinity of the muscle sufficiently fast to prevent decomposition. Furthermore, the fat of the flesh unprotected by brine or pickle will turn rancid more readily.

However, if the fish is processed in such a way that the brine and most of the oil runs off, the fish will be preserved and kept in a dry state. This occurs with pressed, salted sardines.

4.4.4 Smoking

4.4.4.1 FOR SMOKE PRODUCTION, THE WOOD, WOOD SHAVINGS OR SAWDUST SHOULD BE DRY AND FREE FROM SOIL DUST AND HARMFUL SUBSTANCES SUCH AS WOOD PRESERVATIVES AND PAINT

Soft resinous woods give the product an acrid unpleasant taste.

The best combustion temperatures for the wood are in the range of 250-350°C (482-662°F). Temperatures of more than 400°C (752°F) are to be avoided because of the development of undesirable components in the smoke.

Wet or mouldy sawdust should not be used, however, depending on the type of wood and the nature of the operation, it may be desirable to use damp sawdust. It is a bad practice to use water during the smoking operation for damping the fire in an attempt to regulate the rate of sawdust burning.

4.4.4.2 ASH DERIVED FROM BURNING WOOD OR SAWDUST SHOULD BE PREVENTED FROM BEING DEPOSITED ON THE PRODUCT

It is important, therefore, that the current of air passing the burning wood or sawdust is not so fast that it carries burned particles (ash) into the kiln. Ash should not be allowed to accumulate in large amounts in the boxes where smoke is generated.

The use of smoke scrubbers for the removal of fly-ash, soot and tars is recommended. It may be necessary to re-circulate the scrubbing water which rapidly becomes saturated with the lighter fractions which impart the desired smoke flavour. Colour development of the fish product might be affected.

4.4.4.3 IF LIQUID SMOKE OR SMOKE POWDER IS USED APPROVAL SHOULD BE OBTAINED FROM THE APPROPRIATE AGENCY HAVING JURISDICTION

Such preparations have been used to impart to the fish or fish products the characteristic taste, odour and colour of the smoked fish without subjecting them to normal smoking procedure.

Fish is usually dipped into liquid smoke or a solution of smoke powder for a few seconds and then it is dried and cooked with infra-red heaters to develop and "fix" the colour and the flavour.

Care should be taken to ascertain whether or not the agents used are permitted in the countries where the product will be marketed and consumed.

4.4.4.4 IN PREPARATION FOR SMOKING, CARE SHOULD BE TAKEN TO ARRANGE THE FISH ON TENTERS, HOOKS OR ON TRAYS IN SUCH A MANNER AS TO PROVIDE FOR UNIFORM SMOKE-ABSORPTION, TEMPERATURE EXPOSURE AND DEHYDRATION

Fish should be hung or laid out on trays without overcrowding and touching each other.

Depending on weight, shape, size and species of fish, additional support may be required when fish are suspended vertically in order to prevent muscle separation or a breakage due to an excessive weight.

Trays or screens used for laying out fish will occasionally imprint a distinct design on one side of the product. In certain products, such a design might add to the appearance of the fish, otherwise screens should not be used if the fish can be hung. Trays and screens used in smoking should be clean and greased with food grade mineral or vegetable oil or should be coated with Teflon or another suitable release agent approved by the official agency having jurisdiction.

In traditional kilns, the position of fish in relation to fire should be changed frequently. The same requirement will also apply to mechanized kilns where electric fans are used and where fish are located directly in front of the air-/smoke inlet. If no remedial action is taken a distinctly darker colour, a bitter tarry taste and a tougher texture will result.

To obtain even smoking and dehydration of the fish in the same batch, the fish should be of reasonably uniform size and weight.

4.4.4.5 IT IS RECOMMENDED THAT FISH TO BE HOT SMOKED SHOULD UNDERGO ADDITIONAL DRYING BEFORE SMOKING COMMENCES

Pre-drying before smoking is a necessity if fish suspended by the head on spits is to be hot smoked. The process of pre-drying can be combined with drying for the purpose of pellicle formation or could be carried out in the kiln as an initial stage of the hot-smoking operation. It is done by a gentle rise of temperature to strengthen the skin of the head and body by drying it and toughening so that it will support the weight of the suspended body of the fish during subsequent hot smoking.

4.4.4.6 DURING COLD SMOKING THE TEMPERATURE OF THE FISH SHOULD NOT EXCEED A LEVEL AT WHICH HEAT COAGULATION OF PROTEIN TAKES PLACE

Cold smoking, by definition, means smoking of fish at temperatures where the product does not show any signs of heat coagulation of the protein. There is a possibility that if during cold smoking the temperature of the fish flesh exceeds 29°C (84°F) for longer than a few minutes that protein will be coagulated and parts of the fish will be cooked. Such fish will not have the elasticity and flexibility of the properly cold smoked product.

During cold smoking, the relative humidity should at first be maintained at about 90% to facilitate smoke absorption but subsequently dropped to about 70% to achieve the required amount of drying. If it is much higher than 70% during the drying period the drying will be too slow; if considerably lower, the fish will dry too quickly, resulting in case hardening and poor smoke absorption.

If an extended shelf life is desired, the fish should be brined or dry-salted to a minimum salt concentration of 8% of the water phase of the muscle and then cold smoked.

4.4.4.7 DURING HOT SMOKING THE TIME/TEMPERATURE COMBINATION SHOULD BE SUFFICIENT TO OBTAIN A COMPLETE COAGULATION OF THE PROTEIN

It should be stressed that hot smoking does not necessarily suppress the outgrowth of Clostridium botulinum type E and toxin production. Lightly salted fish or fish products with a high water content processed by the hot smoking method are highly perishable. If not consumed immediately, the product should be chilled as soon as possible.

4.4.4.8 AFTER COMPLETION OF SMOKING AND BEFORE PACKAGING THE WARM PRODUCTS SHOULD BE IMMEDIATELY COOLED TO THE AMBIENT TEMPERATURE OR LOWER. AFTER PACKAGING THE PRODUCT SHOULD BE COOLED FURTHER WITHOUT DELAY

When smoking is finished, the fish should be cooled rapidly and thoroughly before it is packaged; otherwise it will turn flabby, moist and sour, or mouldy. Cooling too slowly may promote the growth of micro-organisms harmful to humans.

Cooling can be conducted in an ambient temperature or in a chill room providing the humidity is not too high and there is a continual movement of clean, cool air or the kiln itself can be used for cooling at the end of the working day if it is equipped with cooling coils.

In large operations, air blast chilling tunnels, capable of accommodating full trolleys and operating at 0°C (32°F), can be used.

4.4.4.9 FISH AND FISH PRODUCTS THAT ARE TO BE CANNED AND RETORTED SHOULD BE SMOKED VERY LIGHTLY

The colour and flavour of smoked products intensify considerably when (retorted) heated.

If large quantities of fish or fish products are to be smoked for subsequent canning, it is advisable to experiment with a few fish having them smoked under different conditions and then canned and retorted. After a period of aging, at least one week, the cans should be opened and examined for taste and appearance.

4.4.4.10 IN CASE OF A FIRE IN A MECHANICAL KILN, THE FANS SHOULD BE SWITCHED OFF AND ALL DAMPERS CLOSED. ALL OTHER SUPPLIES OF ELECTRICITY TO THE KILN SHOULD ALSO BE TURNED OFF

There is a serious fire hazard if the kiln is allowed to become coated with a fatty condensate from the smoke. If a fire occurs the outside of the kiln should, as far as possible, be kept cool by spraying water. The fire inside should be fought by the injection of carbon dioxide into the closed kiln.

4.4.5 Packaging, Storage and Distribution

4.4.5.1 PACKAGING MATERIALS SHOULD BE OF A TYPE APPROVED BY THE OFFICIAL AGENCY HAVING JURISDICTION AND BE CLEAN AND STORED IN A HYGIENIC MANNER. PACKAGING SHOULD BE CARRIED OUT UNDER CONDITIONS THAT PREVENT CONTAMINATION OF THE PRODUCT.

All packaging material should be stored in a clean and hygienic manner. The material should be appropriate for the product to be packed and for the expected conditions of storage and should not transmit to the product objectionable substances beyond the limits acceptable to the official agency having jurisdiction. The packaging material should be sound and should provide appropriate protection from contamination.

4.4.5.2 LIGHLTY SALTED AND SMOKED FISH OR FISH PRODUCTS SHOULD NOT BE KEPT IN CHILLED STORAGE LONGER THAN FOR A FEW DAYS ONLY

Such products spoil extremely fast and, if not distributed immediately, should be frozen. The period of time in chilled storage, during which the product can be safely kept, will depend on the species and particular process employed.

Only heavily smoked products with high salt content and low moisture can be kept longer without freezing provided the conditions are dry, well aerated and the temperature is relatively low.

Appropriate date marking and corresponding instructions on storage conditions should appear on the label.

4.4.5.3 VACUUM OR GAS PACKED PRODUCTS SHOULD BE STORED AT AN APPROPRIATE SAFE TEMPERATURE

If storage temperatures are above 3°C (37°F) there is a risk that Clostridium botulinum may grow in some types of smoked fish and may produce toxins. The process of vacuum or gas packaging involves the removal of air and, therefore, may give rise to favourable growth conditions for this organism and may suppress the growth of moulds and other aerobic micro-organisms which indicate improper storage. Therefore the use of such packaging should be restricted to frozen products; however, in cases where a particular product does not support the growth of Clostridium botulinum, other storage temperatures can be used. Frozen products should be kept frozen until required for consumption. When the frozen product is thawed the package should be opened.

Appropriate date marking and corresponding instructions on storage conditions should appear on the label.

4.4.5.4 SMOKED FISH AND SIMILAR PRODUCTS WHICH ARE NOT FROZEN SHOULD BE PACKED FOR TRANSPORT SO THAT THERE IS NO DIRECT CONTACT WITH ICE OR MELT WATER

Intimate contact with ice or melt water will result in the leaching away of flavour and colour, softening of the texture and general deterioration of the product.

Ice packed in the same container with smoked fish, but not in direct contact with them, is still the most common method of maintaining a chilled condition during transport.

Wet-strength paper or plastic film should be used to wrap the products and separate them from ice. Dry ice or pre-chilled eutectic solutions, in plastic or metal containers, can be used in master cartons having good insulation.

4.4.5.5 BOXES CONTAINING SMOKED FISH OR SIMILAR PRODUCTS SHOULD BE HANDLED VERY CAREFULLY DURING TRANSPORT AND DISTRIBUTION. THEY SHOULD NEVER BE UP-ENDED

In some areas boxes may be handled and stacked many times during distribution. Handling practices are often very rough due to shortage of time at transfer points and use of outdated methods for handling large quantities of boxes. Boxes should never be up-ended as this can result in physical damage to the product and may also contaminate the fish or fish products with ice melt water.

4.4.5.6 CARTON WRAPPINGS AND OTHER PACKAGING MATERIALS SHOULD NOT BE STORED IN THE PROCESSING AREA

Delivery wrappings of packaging materials should be removed outside the processing area and only those packages required for immediate use at any given time should be introduced to the area.

4.5 Hygiene Control Programme

4.5.1 IT IS DESIRABLE THAT EACH SMOKED FISH PROCESSING PLANT IN ITS OWN INTEREST DESIGNATES A SINGLE INDIVIDUAL, WHOSE DUTIES ARE PREFERABLY DIVORCED FROM PRODUCTION, TO BE HELD RESPONSIBLE FOR THE CLEANLINESS OF THE ESTABLISHMENT

Such a person or his staff should be a permanent part of the organization or employed by the organization and should be well trained in the use of special cleaning tools, methods of dismantling equipment for cleaning and in the significance of contamination and the hazards involved. A permanent cleaning and disinfection schedule should be drawn up to ensure that all parts of the establishment are cleaned appropriately and that critical areas, equipment and material are designated for cleaning and/or disinfection daily or more frequently if required.

4.6 Laboratory Control

4.6.1 IN ADDITION TO ANY CONTROL BY THE OFFICIAL AGENCY HAVING JURISDICTION IT IS DESIRABLE THAT EACH SMOKED FISH PROCESSING PLANT IN ITS OWN INTEREST SHOULD HAVE ACCESS TO LABORATORY CONTROL TO ESTABLISH HYGIENE AND QUALITY OF THE PRODUCTS PROCESSED AND TO MONITOR THE HYGIENE OF PROCESSING

The extent and type of such control will vary with the food product as well as the needs of management. Such control should reject all foods that are unfit for human consumption.

Analytical procedures used should follow recognized standard methods in order that the results may be readily interpreted.

5. SECTION V - END PRODUCT SPECIFICATIONS

5.1 Appropriate methods should be used for sampling and examination to determine the compliance with the following specifications:

A. Smoked fish and smoked fish products should be free from micro-organisms in amounts harmful to humans, free from parasites harmful to humans and should not contain any substances originating from micro-organisms in amounts which may represent a hazard to health;

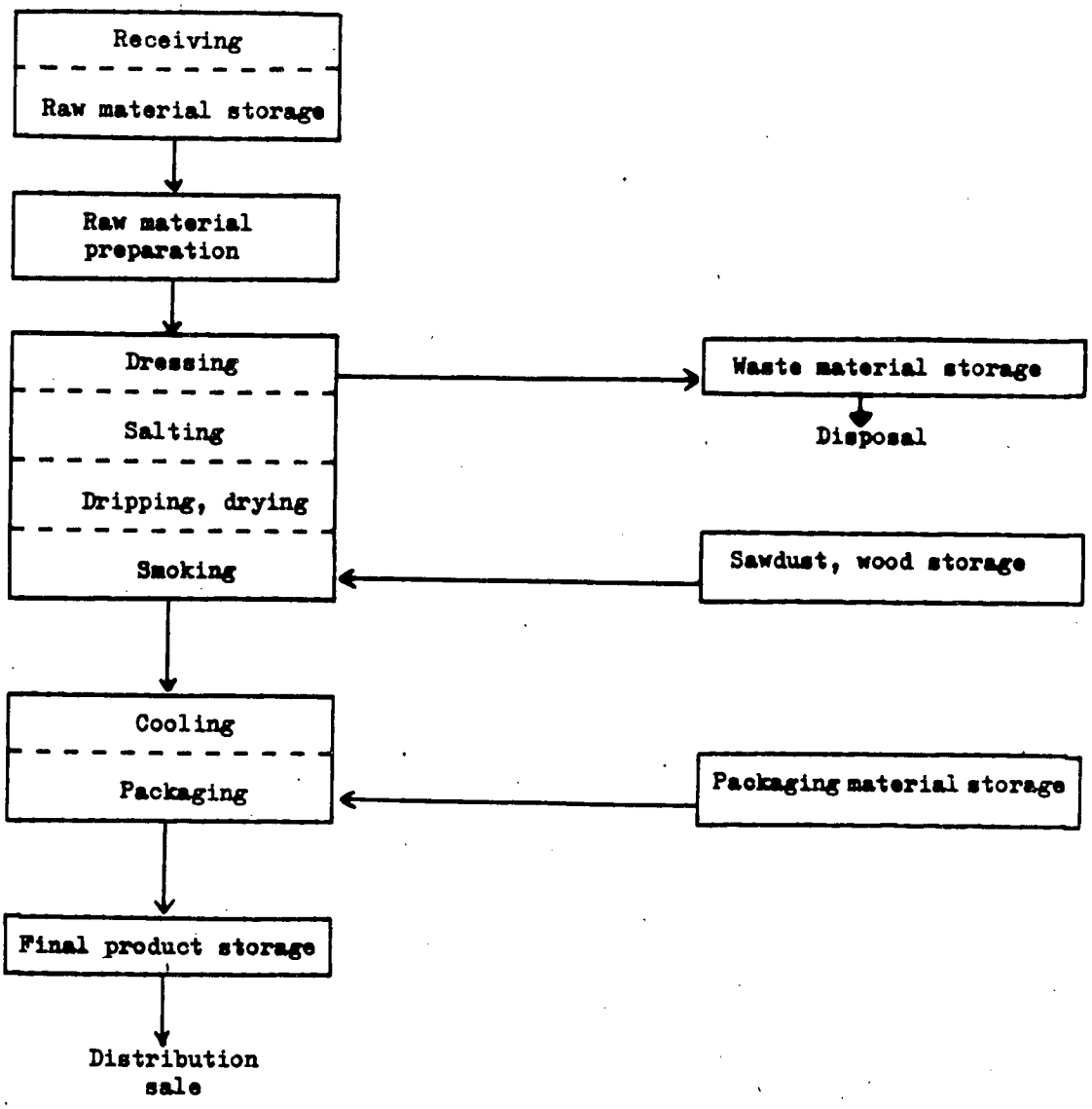
B. Smoked fish and smoked fish products should be free from chemical contaminants in amounts which may represent a hazard to health;

C. Smoked fish and smoked fish products should be, to the extent possible in good manufacturing practice, free from other objectionable matter and parasites not harmful to humans.

D. Smoked fish and smoked fish products should comply with any requirements set forth by the Codex Alimentarius Commission on pesticide residues and food additives as contained in Codex lists of maximum limits for pesticide residues or Codex commodity standards or should comply with the requirements on pesticide residues and food additives of the country in which the fish will be sold.

APPENDIX I

FLOW DIAGRAM FOR SMOKED FISH PROCESSING OPERATION



(solid lines denote physical separation)

APPENDIX II

Preparation of Brine of Required Strength
(The amount of salt to be dissolved in water to obtain required brine strengths.)

Specific gravity	% NaCl by weight	Baumé degrees U.S. standard	Salinometer degrees	Kg NaCl to be dissolved in 100 l water
1.007	1	1.0	3.8	1.0
1.014	2	2.0	7.6	2.0
1.022	3	3.1	11.4	3.1
1.029	4	4.1	15.2	4.2
1.037	5	5.2	19.0	5.3
1.044	6	6.1	22.7	6.4
1.051	7	7.0	26.5	7.5
1.058	8	7.9	30.3	8.7
1.066	9	8.9	34.1	9.9
1.073	10	9.8	37.9	11.1
1.081	11	10.9	41.7	12.4
1.089	12	11.9	45.5	13.6
1.096	13	12.7	49.3	14.9
1.104	14	13.7	53.1	16.3
1.112	15	14.6	56.8	17.6
1.119	16	15.4	60.6	19.0
1.127	17	16.3	64.6	20.5
1.135	18	17.2	68.2	22.0
1.143	19	18.1	72.0	23.5
1.151	20	19.0	75.8	25.0
1.159	21	19.9	79.6	26.6
1.168	22	20.9	83.4	28.2
1.176	23	21.7	87.2	29.9
1.184	24	22.5	91.0	31.6
1.192	25	23.4	94.8	33.3
1.201	26	24.3	98.5	35.1
1.204	26.4	24.6	100.0	35.9

(Brine strength measured at 16°C (61°F))

APPENDIX III

References to Related Codes and Standards and FAO Technical Papers

Recommended International Code of Practice for Fresh Fish	CAC/RCP 9-1976
Recommended International Code of Practice for Canned Fish	CAC/RCP 10-1976
Code of Practice for Frozen Fish	CX/FFP 77/15 (FAO Fish. Circ., No. C145 Rev.1)
Code of Practice for Shrimp or Prawns	CX/FFP 77/7 (FAO Fish. Circ., No. C322 Rev.1)
Code of Practice for Salted Fish	CX/FFP 77/5 (FAO Fish. Circ., No. C336)
Code of Practice for Lobsters and Related Species	CX/FFP 76/16 (FAO Fish. Circ., No. C330)
Recommended International Code of Practice - General Principles of Food Hygiene	CAC/RCP 1-1969 (to be revised)
International Standards for Drinking Water WHO, 3rd edition, 1971	