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ESTABLISHMENT OF KILKA FISH PROCESSING AND TRAINING PILOT FACILITIES

DG/IRA/93/002

ISLAMIC REPUBLIC OF IRAN

Technical report: Identification of kilka fish processing and quality control equipment requirements*

Prepared for the Government of the Islamic Republic of Iran
by the United Nations Industrial Development Organization

Based on the work of D. Chatterton, Fish processing consultant
and B. Andreassen, Quality control expert

Backstopping Officer: A. Ouaouich
Agro-based Industries Branch

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* This document has not been edited.

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EXPLANATORY NOTES

The study tour will be undertaken by;

Mr M.Beheshti, Managing Director of Kilka Industries CO
The National Director of the Project.

Mr R.. Arshad, Deputy Director of the Iranian Fisheries
Research and Training Organisation
The Deputy National Director of the Project.

The candidates for the fellowships had not been decided and we were therefore unable to meet them. The National Project Director assured us that the c.v.'s of the six candidates would be forwarded within 30 days or at the absolute latest 45 days.

The official exchange rate at the time of the visit was US$1.00 = RS1435

Electrical supply is 220v 50Hz.

Water supply is plentiful and is supplied from bore holes.

Waste disposal of solids is readily available due to the proximity of fish meal factories.

Petrol and diesel costs are minimal approx. 2.5 cents per litre.

Block Ice production at Anzali is a maximum of 10M/T per hour.
The price of ice varies at the time of the visit it was approx. Rs 30/40 p/kg

Labour costs Rs. 300.000/month, 44 hours per week

Raw Kilka price for Fish Meal is approx.	Rs 120 p/kg
Raw Kilka price for Human use is approx.	Rs 180 p/kg

Some factories said they pay more than this, up to Rs 210 p/kg in an attempt to get quality.

The main human food produced from Kilka is a variety of canned products Smoked Kilka in oil; Cooked Kilka in oil; Ground Kilka in oil; Ground Kilka in Tomato and oil

Current catches are of the order of 35.000 M/T p.a.

Projected catch at the end of current five year plan just started 110,000 M/T p.a.

ABSTRACT

A project for the Government of the Islamic Republic of Iran. DP/IRA/93/002. The establishment of a Kilka fish processing and packaging demonstration pilot plant.

The object of the first split mission was to identify the processing equipment needed and to identify the quality control equipment needed, to draft the specifications for international bidding and to identify the candidates for the fellowships and study tour.

The main conclusions were that it would be possible, very beneficial and is essential to the Kilka fishing and processing industry to establish a model demonstration fish plant which would meet the objectives of the project.

The need for such a plant was demonstrated at each and every visit to factories, ships and the landing docks where poor practices and lack of knowledge of basic fish handling techniques was acknowledged by all those connected with the industry whom we met some of these just did not know the basics of time/temperature and the irreversible spoilage of fish .

The proposed plant would be available to demonstrate and teach present factory owners and management the very basic knowledge of a minimum requirement of fish handling, the COLD CHAIN, it would be available to develop Kilka products and also versatile enough to utilise some other fish which are available when Kilka is not. It would demonstrate the absolute requirement for the catch to be treated as food for human consumption by quality control in the cold chain from catch to cold store.

The processing line as proposed is basic and once it is running correctly in the planned manner it would be possible, subject to finance, to make additions to enable the introduction of further high technology processing machinery .

The quality control laboratory will demonstrate the latest equipment able to test and give results within a very short time and show the benefits of proper processing and handling of the raw material.

Surimi production was considered at this stage but was rejected because of:

1. The uncertainty of the marked for Surimi products made from Kilka fish and the high level of investment required.

2. The lack of a basic level expertise needed for production of Surimi.

3. A basic production of ready to cook and eat foods is the first requirement and Surimi production can be added at a later stage.

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INTRODUCTION

This report has been written jointly by Mr Bent S Andreassen the Quality Control Expert and Mr David Chatterton the Fish Processing Expert The UNIDO Experts of the mission whose job descriptions are to be found in Annexe I.

The experts arrived in the Islamic Republic of Iran on the second of July 1994 and the field work of the study lasted until the fourteenth of July 1994 desk research and collation of results together with writing continued until the twenty ninth of July 1994.

The National Project Counterpart and his deputy co-operated fully and a verbal status report was presented to Mr R Lahidjanaian, the Vice Minister of Jihad-e-Sazanegi, of the Islamic Republic of Iran, jointly by the parties concerned.

The original project aims were to introduce new modern fish processing technology to the Caspian Sea area of the Islamic Republic of Iran for this purpose a fish processing plant with packaging facilities is to be established at Bandar-e-anzali in the Gilan province.

It is envisaged that this plant will demonstrate modern technology for processing and packing Kilka fish this will include quality control techniques and give training to entrepreneurs. It is expected that the facilities will provide a focal point for training in modern fish processing in the Caspian Sea area.

These original objectives required systems to meet the quality and standards of both domestic and overseas markets.

The objectives were modified by extension because it was seen that the current situation of the handling of the raw material was unsatisfactory for fish for human food, therefore the objectives were extended to give indications of the way in which the raw material handling from arriving as a catch on the vessel to delivery to the factory and then through the processing and packing stages must be improved in order to achieve the original objects and later to extend to more highly processed surimi based products.

It was also seen that in even the latest facilities built in the area there were some basic faults which could be avoided at the building stage in this new project so it was extended to include some basic requirements for the new facility buildings.

FISHING SITUATION ON ARRIVAL

We were told by Shilat that there are some 35 fishing vessels, 19 of which are owned by Shilat including 5 steel hulled boats of approximately 118 GRT, these each have a crew of approximately 17 men. The boats visited were equipped with fish locating equipment.

The boats leave harbour at Anzali at about 18.00 hr and spend some 12 hours at sea. Such vessels are unable to fish in poor weather and do not leave harbour if poor weather is forecast, we were told that fishing is possible for between 120 and 130 days each year.

The fishing method is a conical lift net with lighting attached to the centre of the top open end of the cone. Once the fish shoal has been located the net is lowered by winch to the depth determined by the fish finding equipment upon reaching this point the net is correctly orientated and the lighting equipment is switched on. This depth is between 30 to 80 meters the variation in depth is due to the season and water temperature.

Within a short time the haul will be made and the fish net raised out of the water hoisted over the receiving box on deck where the net is opened and the fish dropped into the receiving box which is a box of approx. 3 cubic metres equipped with drain holes and is fixed at working height to the deck of the vessel.

This whole cycle of shooting and hauling of the net operation from lowering the net to fish being on the deck takes only some 5 minutes. Each haul is estimated to bring a weight between 60 and 120 kilogram's of fish to the deck box.

When a suitable volume usually from a few hauls is in the receiving box the chute will be opened and the fish placed either in baskets for human consumption or into sacks for the manufacture of fish meal.

The filled baskets and sacks are then stored on the open deck until arrival in harbour. The fish for human consumption had little or in most cases no ice and the fish for fish meal had none. The ships seen do not place the fish below deck and the open slotted sides of the boxes allow the warm winds to get to the fish.

The ambient temperature estimated at 20 to 23C put the catch at risk of spoilage immediately.
When ice is used it is only used during the hotter three months and not during the "colder months" when temperatures are normally in the range of 12-15C.

Such ice as is used is delivered to the ships as large block ice and must be broken up manually by the fishermen before being used to ice the fish the lack of proper crushing facilities leaves large lumps of ice which causes damage to the fish by the size and weight. Ice for this purpose must be reduced to approximately 2.5cm cubes maximum size when applied to the fish.

The boats arrive in the early morning and the human consumption fish is collected to be transported to the factories for canning this is mostly done on open trucks we found only one factory which provided refrigerated transport and this truck took over two hours to load, the whole movement to the factories can take up to four hours from arrival of the boat.

The sacks of Kilka for fish meal lay on the decks and on the landing stage for a considerable time and there is much blood and waste liquid leaking around the dock. The ships, boxes and dock landing stage were being washed down by hosed water.

There is no inspection of the fish by either the port authorities or a sanitary inspector, quality and health standards are the responsibility of each factory who must nominate a sanitary manager who usually also buys the fish for his factory.

Mr Bent Andreassen the QCE of the project took a trip out to see the catching and handling of the fish on board the vessels fishing off shore near Anzali, he noted that ice was not being used and hygienic conditions were poor for fish intended for human food.

FACTORY SITUATION ON ARRIVAL

We visited seven factories all involved in canning Kilka and we had discussions with the owner of one new factory at the late planning stage. These meetings were organised by the counterparts who acted as interpreters and we met with Shilat Executive Directors and Kilka Industries Directors and with subsidiary and associated organisations. In all cases we found the discussions were frank, carried out with the utmost open co-operation with an eagerness to help achieve the objectives of the project. Most persons involved were aware of the quality problem and some were trying their own methods to solve the problems.

The situation we found at the port and on the vessels was not satisfactory for the handling of fish for human consumption and this was seen in the quality of fish presented at the factories for processing.

The boxes are unsuitable for fish. they are of open vertical slot construction which means that any ice placed on top of the fish when melting will flow out of the side of the basket and the ice is unable do the job intended which should be to melt and flow through the fish as ice water thereby lowering the temperature of the fish rapidly.

Better boxes specifically designed for such delicate fish are required, one factory had recognised the problem and was using shallow boxes which retained the ice better and they were considering use of the type of boxes used in Europe.

Visits to factories on the same day as we watched landings showed poor quality Kilka being processed both by hand and by machine giving low quality and low yield results.

Machine processing and in particular grading and automatic feed machines require at the very least a reasonable quality of fresh fish otherwise they will continually jam and be unable to produce a quality product, the Kilka, as with other delicate small pelagic fish, if not handled at low temperatures rapidly develops belly burst and in all cases must be handled gently and cut with urgency.

Examples of the problems were witnessed as attempts to nob fish on new machinery by use of an elevator with a fish orientation device. These machines should have required only one operator who can correct the odd fish which may miss the feed pockets of the cutting machine, we saw on one machine four operators were struggling and trying to get some kind of cutting through the machine which was continually jamming at the automatic feed. In spite of their efforts they were unable to cope with the problem and their efforts were a failure with at least half the fish being wasted, this was mainly due to the poor quality of the fish.

A further and disturbing point was that due to the need to clear the many jams in the cutting section of the machine the safety cover of the machine had been left in the open position, the safety switch had been over ridden and the nearest operator was in a potentially dangerous situation. This is one of the dangers and is done so that the clearing of jammed machines can be carried out while the machine continues to operate, it is a dangerous practise and should be strongly discouraged. With good quality raw material it should be unnecessary as jams would be very infrequent.

In every factory we visited we saw problems of cutting caused by attempts to work poor quality fish which in Europe would have been sent to the fish meal factories and account of this was taken in our recommendations.

Some factories visited, even new ones, where much thought has been applied to the design and construction have design faults which would have to be corrected before exports to the EC would be accepted and in every factory there was seen at least one basic design fault, but also in each factory we saw intelligent efforts to overcome the problems mainly of poor fish quality and the irreversibility of fish spoilage was being learned the hard way.

One factory owner supplies boxes and ice to a contracted ship and collects fish from this ship between 3am and 5am in order to have his production running by 7am in addition to this he takes the precaution of employing his own member of staff who at times sails on board the ship checking quality and handling methods as the fish is caught.

The efforts at this factory were nullified by the temperature in the factory which used hand cutting and though being done efficiently was in a factory temperature estimated at 25C with cut fish lying on stainless steel tables for what he estimated would be 2 to 3 hours.

CONCLUSIONS

We conclude that the chemical composition of the Kilka fish will be suitable for processing into ready to cook products for human consumption.

The tradition of catching fish for fish meal with no real tradition of producing Kilka products for human consumption will be difficult to change without the example and a teaching facility such as the planned project.

The first changes must be in the handling of the fish for human consumption and the introduction of an effective cold chain.

The price differential between fish used for fish meal (Rs120 p/kg) and the price of fish for human consumption (Rs180 p/kg) is very low by most standards. An improvement in the financial reward for well handled good quality fish for human consumption could give the fishermen an incentive to handle this item correctly.

The importance of the quality control laboratories and the teaching capability they offer in maintaining constant high standards can not be over emphasised.

To follow up on the project we highly recommend that the two consultants should go to Iran for approx. one week, February 1995, to make sure that the progress of the project is according to the time schedule and to assist in any questions that may arise.

The progress chart shows the layout of machinery. The length and dimensions of the factory depend on the length of the production machinery actually chosen and the overall length of the processing area will have to be calculated from the combined length of the machinery chosen plus approx. 50% to allow for planned expansion,

RECOMMENDATIONS FOR PROCESSING LINE

To be of real value the processing line needs to be innovative, flexible and potentially profitable and demonstrate that it is worth while learning to handle the Kilka fish as a human food, producing food items of readily marketable quality.

We have after discussion with Mr Iraj Banafshe,of UNDP, Tehran about the constraints of the finance of the project, taken his advice and produced a plan for a production line ideal for the production of formed products without regard for the cost but capable of being implemented in stages and expanded as finance becomes available. Though we most strongly advise that finding finance and implementing the project as a whole would be most beneficial to the whole Kilka fish industry.

We have concentrated our expertise on the expected end-of-project situation as listed in Paragraph B2 page 4 of the project document and as planned the recommendations will meet those specifications.

We have noted that hand produced Kilkaburgers and Kilkakebabs have been found to be acceptable and to some extent we consider that this is due to the cooked appearance of Kilka products which are a brownish colour and resemble cooked red meat. The taste is excellent.

We propose battered, breaded, cooked and frozen ready to heat and eat Kilka products of shapes which can be varied at the whim of the market.

Parts of the line will be usable without Kilka, for example it will be possible to use other fish by starting at the meat extractor with portions of white fish or sturgeon. The freezer will be able to freeze small packs of minced uncooked fish or whole kilka and there are other possibilities for variation and addition to the line.

The chosen site is currently a green field site and modern fish factory design should be taken into account before any building is started and to make it a model factory the following includes some facilities which would be essential to the success of this prototype model production factory.

LABORATORY TESTS

Laboratory tests for quality assessment of seafood are numerous, and may be categorised as mandatory or voluntary.

Many consumer countries have legal requirements for quality standards, including defined analytic methods which the industry must comply with. However, some of the other indices not included in the legal requirements are also used in quality assessment.

The methods for assessing quality can generally be categorised as:

a) Physical and sensory.
b) Microbiological
c) Chemical

None of these categories can satisfactorily stand alone as a quality test because each test and normally data from all three categories is used in assessing the quality of fish products.

a, Physical and sensory tests.

This method is essential and is used for determination of commercial value of the seafood products, from landing the fish proceeds through changes in colour, texture and smell soon after death. Careless handling further causes bruising and physical damage. If the result of physical and sensory test shows a poor quality, even though microbiological and chemical tests show better results, the commercial value of seafood products is reduced to the value of almost nothing.

Numerous testing schemes of physical and sensory tests have been developed in the consumer markets. These are specific to the fish species, form of packaging and also consumer markets, therefore, its necessary to have product specifications for each species, product forms and consumer markets.

No specialised equipment is needed for physical and sensory evaluation since the technologist uses his five senses to arrive at a conclusion.

b, Bacteriological analyses.

1) Total Plate Count (TPC)

2) Thermotolerant, coliform bacteria

3) Faecal streptococci

4) Staphylococcus aureus

5) Psychophillic bacteria

1, TPC

The total plate count is the number of organisms which develop into clearly visible colonies on plate count agar (PCA) within a period of 3 days incubation at 30+/- 0.2 C. The test shows the general condition of the fish.

Reference: NMKL method number 86, 1972

2 , Thermotolerant, coliform bacteria means bacteria which ferment lactose with gas production in lauryl sulphate broth within a period of 48 +/- 2 hours when incubated at 37 +/-0.2 C and in addition produce indole in tryphone broth within 24+/- 2 hours incubated at 44+/-0.2 C. Thermotolerant, coliform bacteria shows if the fish has been contaminated after catching.
Reference: NMKL method nr. 96, 1980

3, Fecal streptococci means gram positive oblong oval cocci accruing in short chains and which develop wholly or partially pink or dark red colonies on sodium azide-tetrazolium Slanetz and Bartleys enterococci medium within a period of 48+/-2 hours incubated at 37+/-0.2 C.Fecal Streptococci shows if the production hygiene is bad that the fish has been contaminated because of bad cleaning of production areas and poor hygiene of the people working with the raw material.
Reference: NMKL method number 68, 1978.

4, Staphylococcus aureus is an anaerobic or facultative anaerobic gram positive micro organism. The organism is coagulase positive and glucose is fermented. Some strains can produce enterotoxins. Staph. aureus is found on the skin of human beings and is a direct indication of the lack personal hygiene of the people working in the production.
Reference: NMKL method number 66, 1980.

5, Psychrotrophic micro-organism determined in foods shows the quality of foods kept during cold storage.
Reference: NMKL methods number 74, 1989.

C, Chemical tests/analysis

1) TVN (Total Volatile Nitrogen)
2) pH
3) Fat/oil (Soxhlet)
4) Dry matter content
5) f.f.a. (free fatty acid)
6) Peroxide
7) Protein (Kjeldal)
8) Histamine

1, TVN shows the development of bases in the fish. The test is done automatically using a Struers water vapour distillation unit. The result is available within 15. min. The test is very useful for quick control of the quality of the fish,

4, Dry matter content & ashes should be made 105 c for 20-24 hours and to be continued at 600 C for 20-24 hours for ashes.

5, f.f.a. should be made according to AOAC No. 28.029, 1975.

6, Peroxide should be made according to J.Dairy Science, 37, p. 202-208, 1954.

RECOMMENDATIONS FOR PROCESSING MACHINERY AND FACTORY FACILITIES

1, The factory intake Chill Room should be positioned to accept fish directly from the road transport and should be able to hold intake fish at 0c to +3C in ice.

The whole purpose of icing fish is to cool the fish by allowing melting ice water to run down through and in contact with each fish thus lowering individual fish temperatures, it will not do this if it is held in the frozen state therefore care must be taken that the temperature is correct and lower temperatures are not used to preserve ice when the object is to preserve the fish.

1,a, If fish is to be held for any length of time in the chiller it should be re iced periodically and for this purpose a small capacity tube ice or flake ice machine and hopper would be of great advantage with the machinery outside the chiller and the hopper inside.

2, Washer elevator with hopper capable of washing batches of fish and raising the fish to the height of the feed table of the nobbing machine. This washer/elevator machine must be able to discharge contaminated water rapidly and refill between batches of input fish to make sure that fresh fish is not being contaminated by being washed with contaminated water, blood and stick water.
The outlet for contaminated water must be connected directly by closed pipe to an outside holding tank for offal and stick water and must not be permitted to flow over the floor causing more contamination.

3, Nobbing machines, machines with extended feed belt should be specified able to accommodate 4/5 operators hand feeding the belt. Hand feeding has been selected over automatic feed for use with this fish for a number of reasons.

a, Fish of this delicate nature should be taken though as few handling machines as is possible, grading machines can be damaging to such fish.

b, Sorting is unreliable as fish become softer and considerable waste occurs.

c, Trained operators should be given responsibility for the initial quality control, they can be quickly trained to know by sight and touch which fish are acceptable and at the same time can discard fish of the wrong species, damaged fish, burst belly fish and any ice which may pass the elevator/washer. They will place the fish in the pockets correctly orientated in the belt feeding the cutters of the nobbing machine with great accuracy and speed.

These operators can be the key to successful production and special training emphasis should be placed on increasing their skills. They should have training and instruction in the reasons for spoilage of fish and the ways of preventing or delaying spoilage. They should be in no doubt that they are very important to the quality of the end product.

4, A small elevator washer will receive the nobbed fish and will give gentle spray wash with clean water to the nobbed fish before it is presented to the meat extraction machine.
This elevator can have continuous spray washing along the lift but the overflow type outlet must be connected to the offal/waste water holding tank outside the factory.
Fish will drop into the elevator with enough water to make the fall gentle then will be picked up and gently spray washed before being presented to the meat extractor, the lifting action will be long enough to provide drainage for surplus washing water and will place the nobbed washed fish to the input side of the meat extractor where further drainage can be arranged if required.

5, Meat extractors of many makes are available, they are fitted with various sizes of perforation from 1.3mm to 8mm and before purchase of this machine it is essential that the manufacturer should have whole Kilka fish samples to test in order to determine the exact size of perforations which will give best results with Kilka fish and to give some indication of the required drum/belt pressure for best results. We expect perforation size of 2mm will be correct.

We have seen a locally made meat extractor working and would strongly recommend the purchase of a foreign make.

The operator of this machine should also have special hygiene and fish preservation instructions as this is also a critical hazard point requiring recognition of the problems of deterioration which can occur at this point by the mincing process warming the product to an unacceptable temperature.

6, 2 x 200 litre trolley/mobile lift to enable the minced fish to be moved quickly from the meat extractor to the product former. If the product is not to be formed immediately it must be placed where its temperature can be reduced.

7, The Product former, conveyers, battering and breading machines should ideally be supplied by one manufacturer as they will be inter dependant and a co-ordinated conveyer system is best designed at the manufacturing stage of these lines.

The Product former will have interchangeable formers to make Fishburger; Fishkebab possibly with stick inserted; Fish-ball; and other formed shapes, which work with a air knock out system. It should be equipped with a bridgebreaker to avoid the minced fish sticking to the side of the hopper. To produce fishkebab it should be possible to put a stick inserter on the forming machine.

The forming machine should be able to work with a capacity of 30 strokes a minute.
A water supply with standard tap water pressure and a compressor to provide air pressure of 6 bar will be required.

The forming machine should be made of stainless steel and equipped with lockable wheels which make it easy for movement for hygienic cleaning.

Because of the danger of bacteriological contamination no additives such as greens or vegetables should be made at this stage, if flavouring is required it can easily be added to the breading or battering stages.

8, Continuous batter application and breading machine. The batter application machine should be equipped with 4 curtains to ensure enough batter is put on the product, and a blower is needed to take off the excess to avoid batter entering the breading machine.

A batter mixer will make sure that the batter is mixed homogeneously and to fill up the batter machine when needed.

The breading machine should be equipped with a vibrator to make sure that the breading will stick properly to the product and have a blower to take away excess in such a way that the breading will not enter into the deep fat oilfryer.

9, Continuous deep fat oilfryer with hold down conveyer to lead the product through the fryer. The fryer should be equipped with sediment removal system and with app. 50 kW of heating elements. The fryer will need a CO2 system installed for security in case of open fire. The fryer is equipped with a manual hoist to make it easy for cleaning purposes.

10, Continuous freezer,(spiral or tunnel) with conveyer to freeze the product to a centre temperature of -18 C as fast as possible. The freezer should feed the frozen product through a hatch with a plastic curtain into a colder room of with a temperature of approx. 10C where it will arrive on the rotating circular packing table.

11, Circular rotating packing table where the product will be manually placed in plastic bags the number per bag determined by market needs.

The frozen product must be rapidly packed.

12, Double chamber manually operated vacuum packing/sealing machine then into master carton and quickly into cold storage at -20C.

13, The cold store should have an air lock on the loading out side in order to maintain temperature during door openings so that the refrigerated vehicles can be quickly loaded without loss of temperature in the product.
The cold store should be capable of accepting product at –18C and holding at -20C the air lock should have an input opening from the packing area.

Note, variations of temperature are as damaging to frozen products as too high a temperature is and the store should be fitted with plastic curtains to reduce the air changes on opening the doors.

RECOMMENDATIONS FOR THE COLD CHAIN

Starting the cold chain
We set out below some very basic suggestions for the flow of the cold chain from catch to factory under ideal conditions in order to have top quality raw material arriving at the factory and include suggestions for the factory basics. To have the best possible raw material arriving at the factory an effective cold chain must be established. See annexe 4

The start has to be on the fishing vessel. One such method would be by the use of insulated containers equipped with lifting eyes to match the lifting device mentioned later. Similar but larger containers are described in annexe 3.

The size has to be such that the containers are easily handled and would be in the region of 200L and would contain 50kg of crushed ice on delivery to the ships. The containers with ice could be delivered by the factory to make sure that there will be enough ice available.

On fishing approx. 75 kg or an agreed measure by volume of fish would be added to each container then 25 litres of sea water, the movement of the ship will mix the water and ice into chilled sea water and the fish will be cooled down as quick as is possible.

For each 3 tons of raw material 40 containers will be needed,
if required they can be divided between a number of boats.

The fish should be put in the containers immediately when the fish still is alive to make sure that the raw material is in the cold chain as quickly as possible and in good condition on arrival at the factory. Having the best possible raw material gives the best yield, is easier to handle, and makes the cutting machines work easier.

Off loading from the ship would quickly done by mechanical means probably by crane or suitably equipped fork lift, these will be equipped with suitable hooks to match the eyes on the containers.

The transfer time to the factory should be kept very short and immediately on arrival the fish should be put into the chill room and only taken to the production area just in time for processing. There must be urgency about this movement to a protective environment.
The containers can be moved around the factory by use of hand jack pallet trolleys.

Factory essentials
The factory should be constructed according to EEC-standards which mean among other things that the floor has to be made in one piece without joints. With coving rounding to the walls, the interior ceiling should be easy to clean and should not be higher than 3.5 m.

Ceilings should be in a continuous, smooth , unbroken surface, painted with a white high gloss, non-toxic paint. Flush light fittings and ventilation fittings are required.

Single storey buildings are preferable to multi storey buildings this avoids having a load bearing floor and makes the movement of raw material and products easier.

Buildings must be big enough to avoid crowding of people and equipment, any fish factory should be designed and built specifically for its intended purpose.

The construction must prevent the entry of birds , vermin and insects entering.

Doors should be wide and self closing, they must be smooth surfaced for easy cleaning, fly screen, metal mesh or air curtain should be provided to prevent the entry of flying insects.

The walls in the processing area must be waterproof, smooth surfaced and washable.
ceramic tiles are best. This should be carried to the highest practical height.

Windows are best if large and simple and easy to clean, where glass is used it should be in a few large panes not a large number of small ones. Any opening glass windows must be fitted with fly screens.

Non-porous material should be used for all construction, wood is not suitable for walls or floors.

All floors should be hard wearing non-porous material. They should be washable and slope evenly towards the drains, Granolithic cement is very suitable and the floor material should be carried up the walls for approx. 15cm and the joints coved(rounded).

The floor should fall to the drains, a 1 in 90 or 1 in 100 slope is suitable. Slopes of more than 1 in 40 are dangerous. If there are joints in the floors these must be smooth and close fitting.
Drains can be either embedded, underfloor, drains with gratings at suitable points or can be of the covered type with full length removable metal gratings. For this project we recommend round embedded underfloor drains provided that they be made so that rodding to clean is easy.

All drains should be of an adequate size, at least 20cm diameter, covered with removable metal gratings which should be level and flush with the floor. They should have a even fall so that water can not remain in them.

Outlets should have a catch basin outside the building made of water proof concrete and where a drain goes through the walls it must be fitted with a vermin proof seal.
All drains should be designed to provide for essential cleaning.

All areas where the product will be handled should be kept separate from any part such as living quarters, offices, or engineering facilities. Fish should not be processed in the same place as meat, chickens, frogs etc.

The temperature in the production area must be less than 15 C by the use of air conditioning.

Ice should be available at all times in case of any break in production when ice must be added quickly to hold down the temperature of the product at any of the different stages.

Toilet facilities should have easy clean walls and floors of non-porous material. These rooms must not open directly onto the working areas.

Handwashing facilities must be provided in each entrance so that they are used each and every time anyone enters, there should be running hot and cold water with pedal operated taps.

Towels should be single use throw away type and a bin should be provided.

FELLOWSHIPS SUBJECTS

Subjects for fellowships, Two in Quality Control and two in Fish Processing. The candidates will be selected from Iran and will go for fellowships of one month each. The personnel who are selected should preferably be University graduates in food technology and processing they should have a direct connection to the implementation of the project and should be competent in both spoken and written English. For quality control one should be specialised in microbiology and the other in chemistry for Fish Processing both should have some technical experience and knowledge of food processing machinery.

The quality controllers overseas programme should contain;

a, International standards and codes of practice for the handling of fish and fish products.

b, Buyers specification of seafoods, sampling and analytical procedures to comply with buyers specifications.

c, Quality assessments, organoleptic methodology.

d, Final random inspection

e, Batch identification

f, Sampling methods

g, Samples examination

h, New sanitary regulations in major importing companies

i, Plant sanitation and hygiene organisation of plant and quality control unit

j, Physical, chemical and microbiological testing methods for fish and fishery products.

k, Design and operational features of instruments used for physical, chemical and microbiological analysers, interpretation of the results.

The fish processing overseas programme should include,

a, Factory studies of the machinery to be used including the mechanical knowledge of all the processing machinery, automatic processing lines for forming, battering, breading and freezing equipment, the factory services and ability to recognise and rectify faults.

b, International standards and code of practise for fish and fish products .

c, Fish processing machinery safety codes and practise

d, Hygiene and maintenance standards for fish processing machinery and fish containers.

e, Batch identification methods

f, Quality assessment by organoleptic methods.

g, Communication skills in passing on their knowledge.

h, Clear understanding of the cold chain requirements of fish processing

i, Freezing machinery and temperature control

j, Cold storage temperatures

k, Rotation of fresh input stock

l, Rotation of frozen stocks

m, The separation of offal, stick water and wastes from products for human consumption.

n, Treatment of wastes.

PROGRAMME FOR FELLOWSHIP STUDY

The training programme for two quality control fellows and the two processing fellows is suggested to be held in Denmark. There are other countries which could offer similar facilities but we consider Denmark is most compact and suitable.

Much of the training is applicable to both processing and quality control aspects. and because they will all be working together at the same facility in Iran we suggest that their training be interlinked as far as is possible in order to promote useful interchange of studies between the two groups and good co-operation when they return to Iran.

The overseas training should be started not earlier than 3 month before the scheduled start day of the factory in Iran. After completing overseas training the QC trainees will be able to carry out all necessary chemical and bacteriological tests needed at factory level using modern test equipment and methods. They will be closely acquainted with products standard requirements and hygiene production practices and will be furnished with necessary documentation for products standard and method of analysis.

The trainees will also be able to manage day to day operation of QC laboratories and practises to act as trainees at factory level.

The Processing fellows will after overseas training have a clear understanding of the urgency of fish processing and will be able to progress production from input to cold store. They will be able to train and manage staff, quickly recognise potential production problems and deal with them.

Before departure and again on returning from overseas they should all spend as much time as is available in study and practical experience they should learn by practical experience the current situation in the Kilka Industry the problems which face the fishermen and the factories. They should learn by practical experience and actually working with the fish getting to know their raw material intimately.

They should go to sea and work with the fishermen, they should be attached to and work in the local factories and work in the QC laboratories and before taking up their duties at the new facility should have a thorough understanding of the way in which they can affect in a beneficial way the Kilka industry and its development as a good human food source.

They must learn about the fish the practical way by handling it themselves and become adept at organoleptic quality control knowing what the fish is like before being faced with a factory needing their expertise and other trainees wanting to learn from them.

Quality Control Programme outline:

The programme is composed of three major activities.

1. Formal training at the Esbjerg Technical School and at the Højmark laboratory, 70 km from Esbjerg

The QC fellows would have the following subjects included in the formal training:

Microbiology, TPC, coliform bac., e. Coli, staphylococcus, streptococcus, salmonella, and clostridium botulinum

Chemical analysis, TVN test, fat according to soxhlet method, histamine, and salt contents.

Import standards of Denmark and the EEC.

General routine work and behaviour in laboratory following Danish practise.

Quality control aspects, raw material control, organoleptic, in process control, hygiene control, certification.

Sanitary procedures, daily, weekly, monthly planning.

The processing trainees would also attend the Esbjerg Technical School and would have the following subjects included in formal training.

Understanding the cold chain.

Handling and preservation of fresh fish.

Fish containers, their use and cleaning.

The importance of ice.

Basic quality assessment by organoleptic methods.

Batch identification.

Processing machinery, nobbing machines, meat extractors, forming, battering, breading, automatic lines, freezing methods by spiral and tunnel, packing and vacuum packing.

2. Both groups would then go and visit a number of Danish processing plants to follow up the actual exercise of both QC and Processing practices.

The proposed plants are:

Esbjerg Seafood (shrimp production)

Rahbek fisk (ready to cook dishes)

Marina, Nørre Sundby (canned products)

Royal Greenland (formed /fried products)

3. Important public agencies involved in different aspect of quality control will be visited by both groups.

Fiskeriministeriets Forsøgslaboratorium, Lyngby

Industritilsynet, Fiskeriministeriet, København.

The North Sea centre, Hirtshals.

There is likely to be considerable variations in the planned outside visits of the programme due to variations in availability of fish being processed and other factors which can not be established this far ahead. However situated in Esbjerg the programme can without great difficulty travel to visit plants in Germany, Holland, Sweden, The United Kingdom Norway and others therefore final planning should be left until as late as possible but within the time needed to obtain the required visas.

RECOMMENDATION FOR STUDY TOUR

The following outline for a study tour for two persons for a period of 4 weeks.

1. week: Morocco to see catching, processing canned small pelagic fish. Surimi production located in Agadir .

2. week. Spain to se catching, processing of Sardine according to European standard.

3. -4 week. One day visit at KOPPENS factory, Bakel Holland, to see forming, batter/breading, frying and freezing of small pelagic fish.

Fishing ports in Denmark to see modern hygienic facilities, landings facilities, modern CSW-equipped boats for small pelagic fish.

Visit different types of fish processing factories such as white fish processing, forming, batter/breading, canned products etc.

Visits to either Cabinplant, Denmark or VMK, Sweden, factories to see nobbing machinery.

If there is any relevant fishing/fish processing exhibition during period of the study tour, it would be a very useful addition to add this to the program.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

April 1994

Project for the Government of the
Islamic Republic of Iran

Establishment of a Kilka fish processing and packaging demonstration pilot plant

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Job Description

DG/IRA/93/002/11-51/07-2000

Post title:	Fish Processing Consultant
Duration:	8 weeks (2 missions of 4 weeks each)
Date required:	As soon as possible
Duty station:	Bandar-e-anzali, Gilan province, Islamic Republic of Iran
Purpose of project:	The project aims at introducing new, modern fish processing technology in the Caspian Sea area of Iran. For this purpose a fish processing demonstration pilot plant with packaging facilities is to be established at Bandar-e-anzali in the Gilan province. It is envisaged to demonstrate at that plant in particular technology for processing and packaging of Kilka fish, including quality control techniques and to give training to entrepreneurs. It is expected that the facilities will provide a focal point for training in fish processing in the Caspian Sea area.
Duties:	The Fish Processing Consultant, working in close cooperation with the National Project Director (NPD) and with the other consultant of the project, will be expected to carry out the following duties:

- Identify the processing equipment needed, draft its specifications for international bidding;
- Identify the candidates for the fellowships and the study tour;
- Elaborate and conduct the in-plant training programme for the pilot plant staff.
- Carry out the test run of the plant and the plant commissioning;
- Put the plant into operation for experimental, demonstration and on-the-job training purposes.

Elaborate a short status report on the duties undertaken during the first split mission and a final report setting out his findings and recommendations to the Government for further action which might be taken.

Qualifications: University degree in food processing technology with long experience in fish processing.

Language: English.

Background information: The Islamic Republic of Iran possesses a coastline of about 1,800 km in the south along the Persian Gulf and the Oman Sea and of about 500 km in the north along the Caspian Sea. Furthermore, there are many lakes and rivers with good fish potential. A vast variety of fish is found in the waters around Iran, the most popular are Sefid, Halva, Shoorideh, Sardin, Kaviar and Azad. About 50,000 to 80,000 tons of fish are caught annually. Kilka fish is caught in the Caspian Sea, at present only about 5,000 tons per year. However, Kilka fish is abundantly available and a programme has been undertaken by the Ministry of Jihad-e-Sazandegi to increase the catch up to 40,000 tons per year. There are about 35,000 fishermen in the private sector in Iran who catch the fish in the traditional way, by using ordinary fisherboats. At present, Kilka fish is only manually processed in Iran. However, for the processing of other species five canning plants and ten fish powder plants are available in Iran, but they are mainly for processing of Sefid, Halva and Kaviar.

Kilka fish can hardly be sold locally; because of its size (8-12 cm) it is not easy to process, and it can also not be exported (proper processing, packaging and storage facilities do not exist). Nevertheless, some small artisanal manual fish processing facilities exist, involving local female labour force. The Ministry of Jihad-e-Sazandegi expects that through the establishment of a demonstration fish processing pilot plant the local fishermen/entrepreneurs could be encouraged to process the Kilka fish for local consumption by using modern industrial processing technology.

ANNEX 2

UNIDO

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

November 1993

Project for the Government of the
Islamic Republic of Iran

Establishment of a Kilka fish processing and packaging demonstration pilot plant

Job Description

DP/IRA/93/002/11-02/J 13107

Post title:	Fish technological and laboratory equipment expert
Duration:	2 months (2 split missions, 3 weeks and 5 weeks respectively)
Date required:	As soon as possible
Duty station:	Bandar-e-anzali, Gilan province, Islamic Republic of Iran
Purpose of project:	The project aims at introducing new, modern fish processing technology in the Caspian Sea area of Iran. For this purpose a fish processing demonstration pilot plant with packaging facilities is to be established at Bandar-e-anzali in the Gilan province. It is envisaged to demonstrate at that plant in particular technology for processing and packaging of Kilka fish, including quality control techniques and to give training to entrepreneurs. It is expected that the facilities will provide a focal point for training in fish processing in the Caspian Sea area.
Duties:	The Fish technological and laboratory equipment expert, working in close cooperation with the project CTA and the National Project Director (NPD), will be expected to carry out the following duties:

- Identify the laboratory equipment needed and elaborate the specifications for international bidding;

- Contribute to the identification of the candidates and elaborate the quality control training programme for the fellowships and the study tour;

- Elaborate and implement the in-plant training programme in the field of fish handling, hygienic plant keeping, laboratory tests, etc;

Define a set of regulations for the enforcement of the international and national norms and quality standards for fish products;

Prepare manuals describing the methodologies to be applied for the verification of the compliance with the norms and standards as indicated above:

Elaborate technical reports on the duties undertaken during the two first split missions setting out his findings and recommendations to the Government for further action which might be taken.

Qualifications: University degree in food processing and quality control with long experience in fish quality control (laboratory analyses, regulations and standards as well as quality assurance).

Language: English.

Background information: The Islamic Republic of Iran possesses a coastline of about 1,800 km in the south along the Persian Gulf and the Oman Sea and of about 500 km in the north along the Caspian Sea. Furthermore, there are many lakes and rivers with good fish potential. A vast variety of fish is found in the waters around Iran, the most popular are Sefid, Halva, Shoorideh, Sardin, Kaviar and Azad. About 50,000 to 80,000 tons of fish are caught annually. Kilka fish is caught in the Caspian Sea, at present only about 5,000 tons per year. However, Kilka fish is abundantly available and a programme has been undertaken by the Ministry of Jihad-e-Sazandegi to increase the catch up to 40,000 tons per year. There are about 35,000 fishermen in the private sector in Iran who catch the fish in the traditional way, by using ordinary fisherboats. At present, Kilka fish is only manually processed in Iran. However, for the processing of other species five canning plants and ten fish powder plants are available in Iran, but they are mainly for processing of Sefid, Halva and Kaviar.

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FACTORIES VISITED

ANNEX 3

We were welcomed and allowed very open visits which enabled us to view things as they really are, some problems were obvious but were not being recognised as problems by the factories.

In almost all cases we were encouraged to hear of efforts to make improvements which are being made and we were able to offer our advice to some specific questions.

There was considerable lack of knowledge of the basic reasons for the spoilage of fish and in no case was the cold chain requirements being observed.

Some Examples

Most factories were large buildings with very high roofs, making temperature control of the processing areas almost impossible. The maximum height of the controlled temperature working areas of factories should be around 3.5 metres with the roof surface made of easily cleaned material, walls should be tiled to roof level.

Some factories had ceiling fans which give the impression of a lower temperature but in fact have the worst and the opposite effect, fish dries out in warm temperature and it dries and deteriorates even quicker in moving warm air draught created by ceiling fans.

Most places had wide open doors without fly screens and we saw piles of dead flying insects, many places had no hygienic insect killers, we were told that this was due to there being no suitable equipment available in Iran. Working areas should be sealed with fly screens and have self closing doors.

We saw one instance of a factory which was totally unhygienic with maggots crawling in many areas hygiene was of the lowest standards.

Unsuitable drains of too large size were evident and with a square in cross section shape had offal and some wastes running through them, drains are only for taking away surplus water and contaminated water, offal is disposed of in a different way, in some cases we saw large amounts of offal and contaminated waste standing in the drains. Another factory we visited had a working area with an excellent jointless floor acceptable to the highest standards with a reasonable size of drain and a suitably low roof giving acceptable conditions for cleaning.

In some cold stores and factories tiles had been used as flooring material this gives many joints which will need very careful cleaning and no drains were evident in others. Some almost new stores had large girders protruding into the air space, giving areas of reduced air movement. Plastic air retaining door curtains were not seen at all.

The majority of cold stores where we were able to check the temperature were not running below -18C which is the absolute maximum for holding frozen foods of this nature.

The freezing of poor quality fish does not improve it, once deterioration has started moving quickly there is no way of reversing it.

Some fish was frozen in cold stores in shallow layers on open mesh trays at an air temperature of minus 5C, we were told this was for holding until needed for processing in a couple of days, this process actually dries out the fish if is was for later production it should be frozen when fresh at a temperature of at least -20C and glazed to protect it from dehydration.

None of the fish we saw in the cold stores had been glazed to prevent dehydration. Glazing is simply adding a thin coat of clean water to the frozen fish this then freezes and becomes a simple barrier to dehydration it can be done by dipping the block in water or by a fine water spraying of the block.

Two companies showed us equipped laboratories with serious efforts being made to enforce quality control.

Problems were noted with the automatic feed on the cutting machinery equipment and one company board had already discussed the possibility of returning this part of the machine to the makers.

One cutting line was using ladies to hand cut the fish, as the ladies are paid by the quantity produced the individual ladies had a small pile of cut fish in front of each of them on a very warm stainless table we were told that the fish would be further processed within the next 2 to 3 hours.

On another hand processing line the ladies were heading, gutting and tailing the fish and then keeping the cut fish in small plastic boxes on their laps.

One factory was trying to hold fish quality by holding input raw material in a water and ice mixture bath the fish were in poor condition.

Workers were putting kilka whole onto spigots for smoking in a local make of smoking kiln very efficiently on one well controlled line.

A number of locally made smoking kilns were in use.

A stainless steel processing table was spoilt by having non-removable plastic cutting blocks for the workers to cut on which is very unhygienic.

Temperature in working areas at 26C much too high.

There were instances of offal and wastes being stored alongside fish for human consumption. Offal and waste water must be separated from fish for human food, and should have distinct and separate containers.

We found most places with organised daily routines for Hygiene and planned routines for major Hygiene at weekends. One in particular had a hygiene routine superior to many EC factories, correctly placed wash basins were in place and being used at this factory

PEOPLE MET

ANNEX 4:

Mr R Lahidjanaian
Vice Minister of Jihad-e-Sazanegi for Fisheries Affairs
Managing Director of The Iranian Fisheries Co.

Mr H Salehi.
General Director of the Ministry of Jihad-e-Sazandegi Fisheries Co. of IRAN,
International Affairs Dept.

Mr M Beheshti.
Managing Director, Kilka Industries Co.
National Project Director.

Mr Rassoul Arshad.
Deputy Director Mirza Koochek Khan
Higher Education Centre for Fishery Science and Technology
Deputy National Project Director.

Mr Mohammed Ali Youseefi.
Ministry of Jihad-e-Sazandegi,
General Manager of the Gilan Province.

Mr A Niazmand.
Deputy Director of the Gilan Province Fisheries Administration
responsible for administration, finance and marketing office.

Mr A R Pajrovi
General Director Gillan Industrial Fishing Co.

Mr M Amini
Managing Director Kilka Khazar Products Co.

Mr H R Fahim
Kilka Industries Natural Resources Engineer, Fishery Science.

Mr Ing Divshali
General Manager and Director Nemoone Fishing and Conserving Co.

Mr S Djam
Production Manager Nemoone Kilka Canning Factory.

Mr Reza Adeli
Technical Manager Kilka Industries Co.

Mr Hushmand
Director Mala Kilka Canning Co.

Mr Sharifi
Managing Director Mala Kilka Canning Co.

Mr Radjabi
Director Gilan Food Industry Kilka Processing Factory

Mr Ahmadour
Production manager and quality control manager
Gilan Food Industry Processing Factory

Mr Farzanfar
Director Tadbir Fish Meal Factory

Mr Shirazi
Managing Director, Pars Kadoos Kilka Canning Factory Co.

Dr Akhondi
Consultant to the MD of the Iranian Fishing Co. in Gilan Province

Mr Abdi
Khazar Tolid Kilka Canning Co.

Mr Ali Assghar Kanipour
Director, Fishery Research and Training Organisation
Mirzakouchek Khan, Higher Education Centre for Fisheries Science and Technology

Mr Akhodnd Zadeh
Director of Fish Propagation and rearing
Complex of Shahid Beheshti

Mr M Kameli,
Deputy M.D. and member of the board of directors of Kilka Industries Co.

Dr S Moini
Consultant of M.D. of the Iranian Fisheries Co.

THE RELATIONSHIP OF TIME/TEMPERATURE TO THE SPOILAGE OF FISH

ANNEX 5:

The relationship between time and temperature to the quality of fish

The quality of the fish depends a lot upon the treatment of the fish on board of the ship. That includes also the boats/ships that are only out catching fish for a few hours.

Fig 1. shows the difference between Herring caught in Denmark where No.1 has been iced immediately after catching and No.2 has been iced 4–6 hours after catching. The last mentioned is Herring which has been lying in the open with wind and sun affecting it.

These factors on the surface of the fish will dry the fish and oxidation of the fish will increase. The best quality will be maintained by keeping the surface of the fish wet and cold immediately after capture.

Fig.1.

	2	4	8	10	Days
Iced fish	0	0	4	14	Peroxide, millieqi/kg
4–6 hours before icing	8	10	12	37	Peroxide, millieqi/kg

As shown there is huge difference in the quality after only 4–6 hours.
The best way to cool down the fish is by using brine mixed with ice. 25% ice, 25% brine and 50% fish.

Fish for human consumption should be cooled down to a temperature of less than 3 C within 4 hours after catching and to a temperature of 0 C before 16 hours.

Fig.2

	1	3	5	9	12	Days
0 C	15	30	60	100	100	TVN mg/100g
6 C	15	90	200	210	270	TVN mg/100g
12 C	15	130	240	370	425	TVN mg/100g

As shown in Fig.2 TVN develop a lot faster at higher temperatures.

For that reason GET THE TEMPERATURE OF THE FISH BELOW +4 C IMMEDIATELY, KEEP IT THERE AND IT WILL GIVE YOU THE BEST POSSIBLE FINAL PRODUCT.

Histamine is another factor that occurs with these species of fish, eventhough it hasn't been proved that this problem occurs in Iran it has to be considered. Histamine does develop at higher temperatures and can give irritation.

SPECIES AND SIZES

ANNEX 6

The Kilka , clupeonella delicatula, is similar to the anchovy there are three sub-species Kilka or Common Kilka, Zalon Big Eye Kilka, and Silca or Anchovy like Kilka.

There are some efforts made to use grading machines to separate the species by thickness but we saw no evidence of success.

AVERAGE SIZES

	Length	Weight	Water	Fat	Spawning
Kilka	81mm	8.3g	72.0%	8.2%	No specific period
Zalon	108mm	7.0g	76.2%	5.6%	December to July
Silca	114mm	10.5g	75.7%	3.9%	May to August

FISHING DAYS

The annual number of days when landings take place is an average of 122.5 days, in theory it would be possible for fishing to take place at least twice as often however the boats are not suitable for difficult weather conditions and an adverse forecast before 18.00 means that they remain in dock.

MONTHLY CATCH

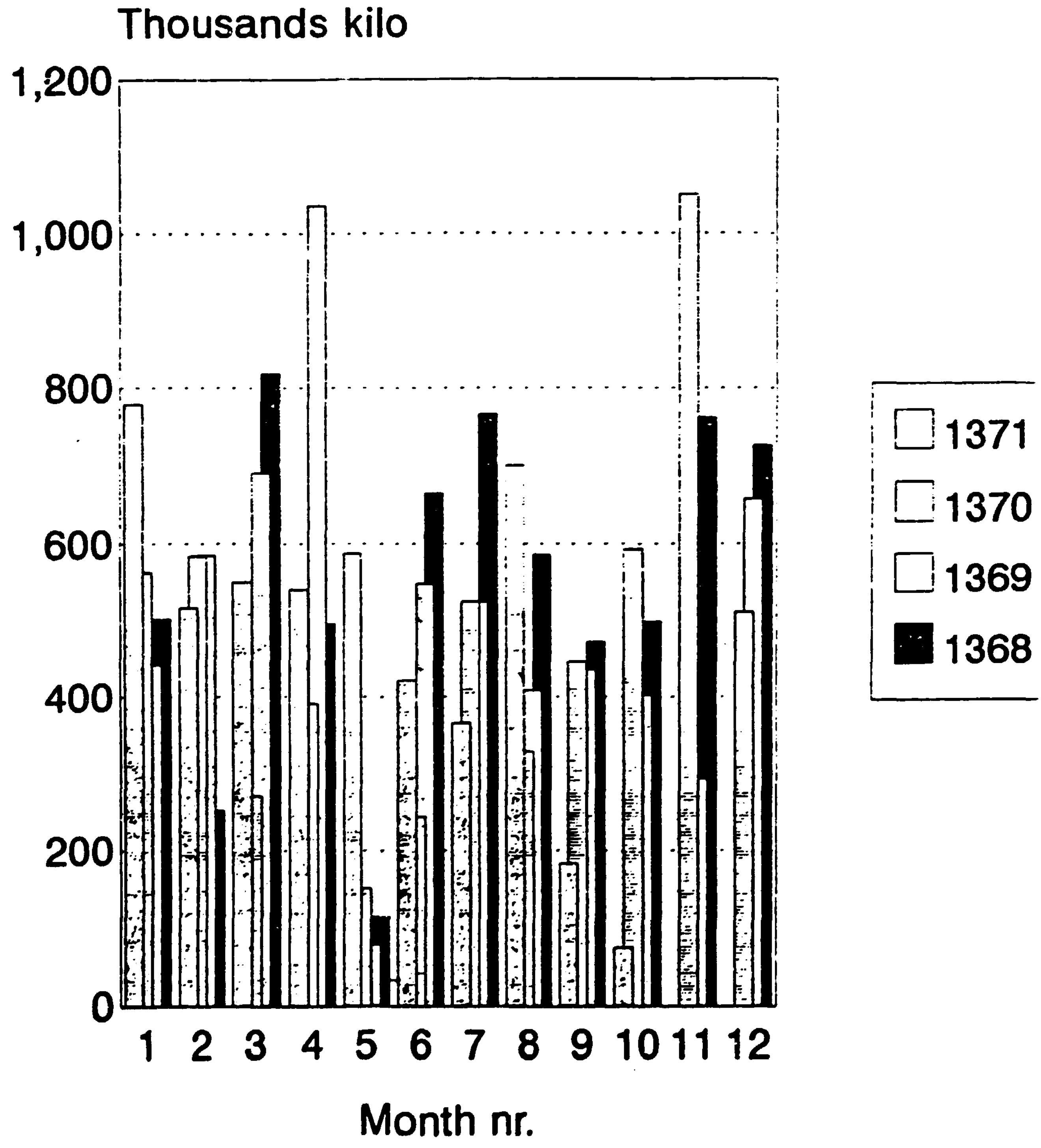
Year	Average	Worst Month	Best Month
1989/90	554,560kg	114,040kg	818,549kg
1990/91	471,615kg	78,966kg	1,036,505kg
1991/92	465,080kg	150,940kg	1,050,350kg
1992/93 (10 months)	471,752kg	75,075kg	779,000kg

STEEL FISHING VESSELS

The five steel fishing vessels average from 9,100kg to 10,900kg per day per ship.

Source SHILAT

Catch per month in kilo
Year 1368-1369-1370-1371
(1989/90 - 90/91 - 91/92 - 92/93)



Total for 5 steel vessels.

ANNEX 8

TOTAL CATCH RECORD

year 1368 - 1371

(1989/90 - 1992/93)

شماره ____________

تاریخ ____________

پیوست ____________

بسمه تعالی

شرکت فراورده‌های کیلکا خزر

مقدار صید کیلکا توسط شناورهای صید صنعتی از سال ۱۳۶۸ الی ۱۳۷۱

	١٣٧١	١٣٧٠	١٣٦٩	١٣٦٨	
AVERAGE PER MONTH (4 YEARS)	1371 1992/93	1370 1991/92	1369 1990/91	1368 1989/90	ماهها
570.596	٧٧٩٠٠٠ 779000 Kg	٥٦٢٢٩٠ 562290 Kg	٤٤٠٦٨٥ 440685 Kg	٥٠٠٤١٠ کیلو 500410 Kg	فروردین 20/3 - 20/4
424.072	٥١٥٣٢٠ 515320 Kg	٥٨٣٨٩٠ 583890 Kg	٥٨٤٣٧٥ 584375 Kg	٢٥٢٧٠٣ کیلو 252703 Kg	اردیبهشت 20/4 - 20/5
582.226	٥٤٩٢٠٥ 549205 Kg	٢٧٠٦٧٥ 270675 Kg	٦٩٠٤٧٣ 690473 Kg	٨١٨٥٤٩ کیلوگرم 818549 Kg	خرداد 20/5 - 20/6
615263	٥٣٩٥٧٩ 539579 Kg	٣٩٠٦٠٥ 390605 Kg	١٠٣٦٥٠٥ 1036505 Kg.	٤٩٤٣٦٣ کیلو 494363 Kg	تیر 20/6 - 20/7
232.860	٥٨٧٤٩٤ 587494 Kg	١٥٠٩٤٠ 150940 Kg	٧٨٩٦٦ 78966 Kg	١١٤٠٤٠ کیلو 114040 Kg	مرداد 20/7 - 20/8
469.312	٤٢١٣٧٥ 421375 Kg	٢٤٣٣٣٧ 243337 Kg	٥٤٧٢٩٠ 547290 Kg	٦٦٥٢٤٧ کیلو 665247 Kg	شهریور 20/8 - 20/9
545049	٣٦٥٧٢٠ 365720 Kg	٥٢٣٨٧٦ 523876 Kg	٥٢٤٠١٠ 524010 Kg	٧٦٦٥٩٠ کیلو 766590 Kg	مهر 20/9 - 20/10
506108	٧٠١٥٧٦ 701576 Kg	٣٢٩٠١٥ 329016 Kg	٤٠٨٣٥٠ 408350 Kg	٥٨٥٤٩٠ کیلو 585490 Kg	آبان 20/10 - 20/11
383960	١٨٣١٨٠ 183180 Kg	٤٤٥٧٨٨ 445788 Kg	٤٣٥١٤٠ 435140 Kg	٤٧١٧٣٠ کیلو 471730 Kg	آذر 20/11 - 20/12
391668	٧٥٠٧٥ 75075 Kg	٥٩١٧٥٢ 591752 Kg	٤٠٢٢٧٠ 402270 Kg	٤٩٧٥٧٥ کیلو 497575 Kg	دی 20/12 - 20/1
3 YEARS 702074	——	١٠٥٠٣٥٠ 1,050,350 Kg	٢٩٣٧٧٢ 293772 Kg	٧٦٢١٠١ کیلو 762101 Kg	بهمن 20/1 - 20/2
3 YEARS 631.197	——	٥٠٩٤٤١ 509441 Kg	٦٥٨٢٢٥ 658225 Kg	٧٢٥٩٢٥ کیلو 725925 Kg	اسفند 20/2 - 20/3
509.532	4,717,520	٥٥٨٠٩٥٩ 5,580,959 Kg	٥٦٥٩٣٧٦ 5,659,376 Kg	٦٦٥٤٧٢٣ کیلو 6,654,723 Kg	جمع TOTAL

METEOROLOGICAL INFORMATION

for Bandar Anzali

Temperature.

Maximum average temperature	19.5°C
Minimum average temperature	12.9°C
Total average temperature	16.2°C
Maximum temperature	37.0°C
Minimum temperature	minus 11.0°C

Average number of days with frosty weather per year: 9

Rainfall.

Maximum rainfall in one day	353 mm
Average annual rainfall	1809 mm

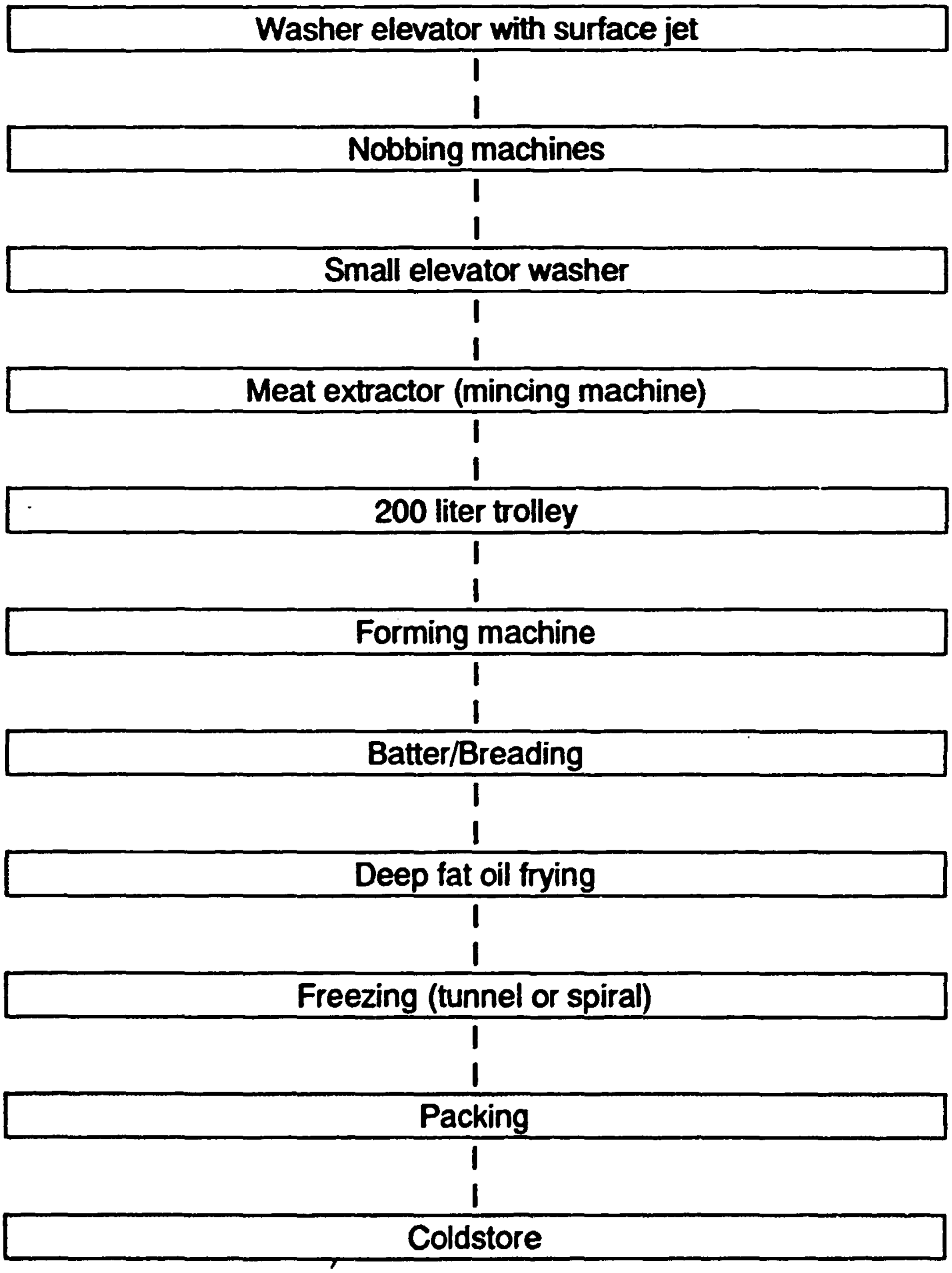
Relative humidity.

Average RH at 6.30	91%
Average RH at 12.30	75%

Altitude	minus 22 metre.

Flow chart processing line

Capacity 200kg/h



PROCESSING AND ANCILLARY EQUIPMENT LIST

ANNEX 11

200 Fish Boxes of 20kg Capacity (10kg fish 10kg ice).

100 Fish Containers similar to those described in annexe but of a smaller size.

1 off Flake or Tube ice maker
Capacity 1.5 to 2 MT. per 24 hours.

Insulated Ice Hopper for up to 3MT of ice.
Suitable hoppers are described in annexe(pges 69 to 71TRI)

Refrigeration equipment to maintain chill room temperature
at 0C to 3C in ambient of 25C

1 off Washer/Elevator/Hopper with quick empty valve.
Output side to feed tables of selected nobbing machines.

2 off Nobbing Machines with extended feed tables to accommodated 3/4 operators.
Capacity approx. 400 fish per minute each with belly cut device if the manufacturers are able to guarantee belly cut for use with Kilka. Otherwise specify vacuum unit to clean guts.
Tail cut not to be used.

1 off Elevator / Spray washer.
Small hopper and water sprays along the raising elevator. Input side to receive from the nobbing machines selected. Output to the height of the chosen meat extractor feed table.

1 off Meat Extractor suitable for small boned pelagic fish.
Capacity approx. 400kg per hour. 2mm drum perforations.

2 x 200 Litre Trolley/Mobile lift.

1 off Forming/Battering/Breading line, preferably of one manufacturer, consisting of

Complete Product Former 400 mm wide with 30 strokes per minute capacity with interchangeable product formers for Fishburgers/ Fishsticks/ Fishfingers/Fishballs/ Fishkebabs with the capability of the addition at a later stage of stick inserter for the Fishkebabs.

Connected by conveyer to Battering/ Breading line 40 mm wide capacity of from 1.5 metres per minute to 15 mpm.

1 off Batter Mixer with capacity for the chosen line.

1 off Continuous Deep Fat Oil Fryer 400 mm wide with hold down conveyer with hold down conveyer with sediment removal system, heating elements of approx. 50 kW fitted with CO2 fire extinguishing system. speed to match the chosen battering breading line.

1 off Continuous Tunnel or Spiral Freezer with conveyer capable of freezing product to a centre temperature of -18C output conveyer to the height of the packing table.
Capacity to suit chosen Forming/ Battering/ Breading line.

1 off Circular packing table.

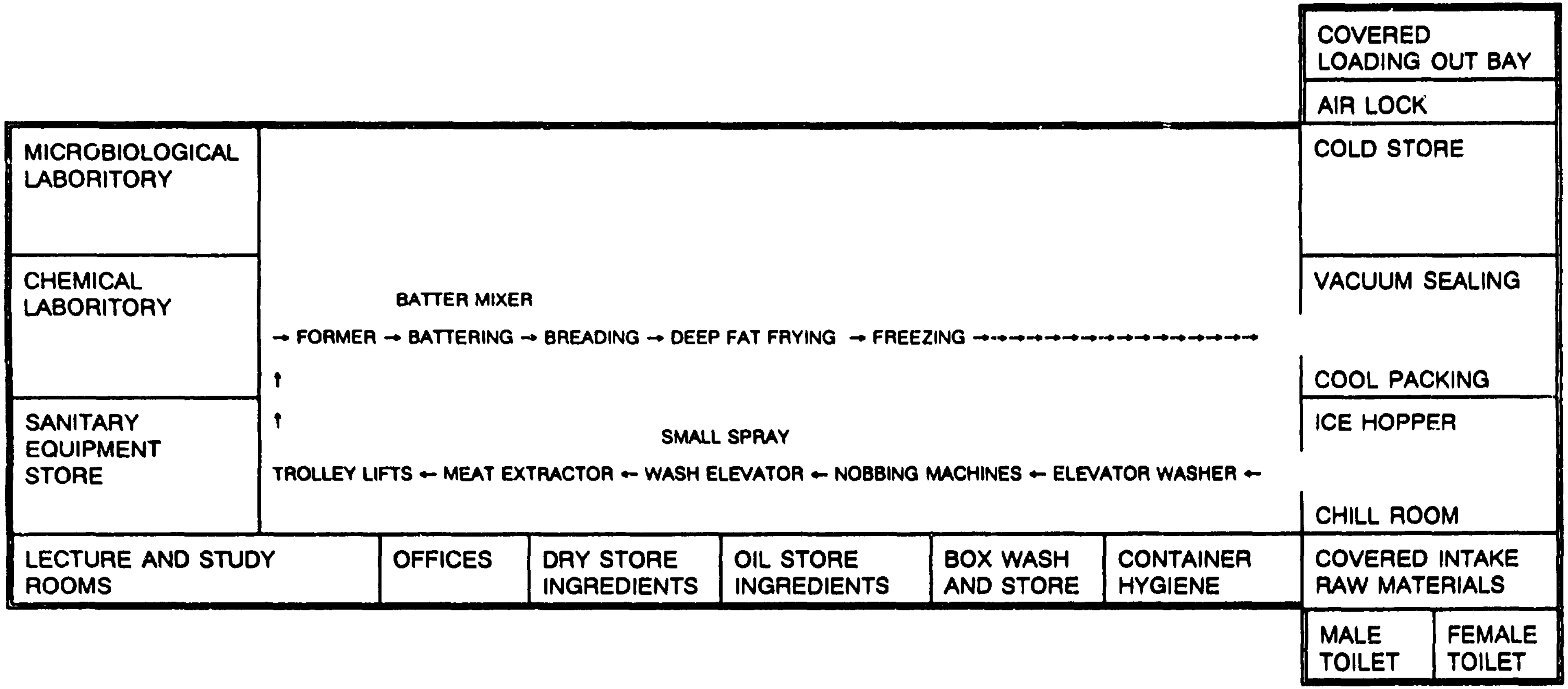
1 off Double Chamber Manually Operated vacuum packing /sealing machine.

1 off Refrigeration equipment for a cold store of 25MT approx. capacity to receive goods at -18C and reduce to -20C.

Air conditioning equipment to maintain temperature in the processing area at not more than 15C.

1 off High Pressure Steam or water cleaner for hygiene use.

2 off Pallet Jack Trolleys for movement of containers inside the chill room and factory.



PROGRESS CHART FOR LAYOUT ONLY...............NOT TO SCALE.

MICROBIOLOGICAL STANDARDS.

ANNEX 13

An example:

Raw frozen fish:

TPC at 25 C 4 days	< 500.000 bac/g
Feacal Strep.	< 100 bac/g
Coliforme, RVG	< 100 bac/g
Faecal Coli.	< 10–50 bac/g

Frozen shrimps:

TPC at 25 C 4 days	< 100.000 bac/g
Faecal strep.	< 500–1000bac/g
Staphylococci.	< 50 bac/g

According to Mr. Niels Skovgaard and I.C.M.S.F. University Toronto Press 1974.

TVN < 30–35 mg TVN/100g

According to Connell 1975.

In Denmark the level is < 25 mg TVN/100g

For canned products, you always look at the rawmaterial to see if it is suitable for canning.
Testing the final can, you should look for the most resistant bacteria, which is Cl. botulinum. The demands in USA are that that there must not be more than one Cl. botulinum pr. 10(12) can, which are the same as saying no Cl. botulinum at all.
Incubation should be made at 37 C for normal products and at 55 C for tropical products, to check whether there is microbiological growth, bombage, discoloration etc.

CHEMICAL SPECIFICATION

ANNEX 14:

Product: Kilka (Skin-on fillet)

Inspection requirement: TVN (Total Volatile Nitrogen)

Purpose: Identify the fresh level of the fish

Reference: Conway, E.J Byrne, 1933. An absorption Apparatus for the Micro-dertermination of certain substances.

Appliances:

* Beaker, 250 ml
* Thermometer, 110 C
* Measuring glass, 100 ml
* pH meter
* Moisture balance
* Funnel
* Filter paper
* Erlenmeyer, 150-250 ml
* Pipettes, 1-2 ml
* Conway set
* Burette, 3 ml.

Reagents: HCl app. 2N: 165 ml conc. HCL is dissolved with distilled water to 1000 ml

HCl app. 0.025N : Dissolve 250 ml 0.1 N HCl with distilled water to 1000 ml

K_2CO_3: 112 g K_2CO_3 (s) in 100 ml distilled water

NaOH app. 0.025N: Dissolve 250 ml NaOH 0.1N with distilled water to 1000 ml.

A.C. Andersen indicator: 0.05g methyl blue and 0.1 g methyl red dissolved in 100 ml alcohol

Vaseline

Operation: The sample is crushed and mixed well, 25 g is transferred to a beaker and 75 ml of distilled water is added

pH is lowered to 5.2 to denatuate the proteins and make filtration easier, using 2N HCl

The sample is warmed to 70 C and cooled to room temperature

The sample has to be filtered

2 ml of the filtration is transferred to the outer ring

2 ml 0.025 N HCl is transferred to the inner ring

1 ml $K2CO3$ is transferred to the outer ring and a lid is put on immediately

The Conway dish is slowly rotated to mix the sample

After 4– 20 hours incubation, A.C.Andersen indicator is added to the inner chamber and titrated with 0.025N NaOH until the colour changes from violet to greenish blue

Blank test is made

Calculations:

$$\text{mg N/100 g} = \frac{(\text{ml HCl} - \text{ml NaOH} * f) * N * 14 * Z * 100}{2^{*}\, g}$$

N = Concentration of HCl

f = Ffactor HCl/NaOH

Z = Dry stuff in the sample

g = Weight of sample

14 = Weight for N

ORGANOLEPTIC EXAMINATION SHEET

ANNEX 15:

An example of how to describe an organoleptic examination

EX.No.I

Name:______________ Date:______________

Fish:____________________

LOOK:

Colour: ___________ little -- a lot

TASTE:

Taste: ___________ little -- a lot

Taste: ___________ little ---------------------------------- a lot

TEXTURE:

Texture:___________ little ---------------------------------- a lot

Texture:___________ little ---------------------------------- a lot

Final result: Good_____, Acceptable_____, Unacceptable_____.

EX. No II.

A second example of how to describe an organoleptic examination
:

Name:______________ Date:_____________ Fish:_____________

	little	a lot
Colour:____________	------------------------	------------------------
	little	a lot
Colour:____________	------------------------	------------------------

TEXTURE:

	little	a lot
Crumbly:	------------------------	------------------------
	little	a lot
Elastic:	------------------------	------------------------
	little	a lot
Hard:	------------------------	------------------------
	little	a lot
Soft:	------------------------	------------------------
	little	a lot
Juicy:	------------------------	------------------------
	little	a lot
Dry:	------------------------	------------------------

TASTE:

	little	a lot
Taste:___________	------------------------	------------------------

Describe the taste of the fish.

Final Result: Good:_____, Acceptable:_____, Unacceptable:_____

THE CONCLUSIONS:

The samples should be prepared carefully and kept warm during the testing. A cold sample taste different from a warm one.

The surroundings should be quiet, no bad odours or smell.

The examiners should be instructed before each sample. The schedules are given with either written or verbal instructions, how to test. (Ex. Either the texture should be measured with a fork, fingers or with the mouth.

The examiners should not test more than 3 samples at a time to avoid taste problems.

IN HOUSE TRAINING OF ALL STAFF BOTH PROCESSING AND QUALITY CONTROL

ANNEX 16:

The best way of learning fish processing is by doing the work, under supervision. It is important that every member of the staff, both quality control and processing, should be quality conscious and the actual training for work will be done by the trainers who have been on fellowships. Every one from management down should spend some time getting the feel of fish and knowing the quality from the feel by handling the fish, they also learn to know the temperature of the raw material.

There should be no demarcation between jobs and all staff should be rotated so that each person spends some time doing every job in this way they will learn to appreciate the whole process and what must be their contribution to a perfect result. They should also have planned formal training and we suggest the Infofish course would be suitable, the curriculum for formal classroom training.

CURRICULUM FOR FORMAL CLASSROOM TRAINING

1, The need for fish inspection and quality assurance programmes
2, Introduction to main fish harvesting methods
3, Notions of fish anatomy and physiology.
4, Recognition of main commercially valuable species
5, Fresh fish and quality changes.
6, Public health aspects of fish as food.
7, Fish import sanitary regulations and their impact on developing countries.
8, Basic fish handling and processing practices.
9, Plant sanitation and hygiene.
10, Development and application of the HACCP concept.
11, Organisation of national fish services.
12, Organisation of plant quality control units.
13, Quality management.
14, Implementation of fish inspection at government levels.
15 Standards and codes of practices for fish and fishery products.
16, Laboratory methods of quality control of fish and fishery products:
    Basic principles and practical demonstrations.
17, International trade of fish and fishery products.
18, Training of fish inspectors, quality controllers and plant personnel.

According to the needs of the trainees differing emphasis can be placed on the specific production and species.

A complete training schedule as listed above together with suitable slides is available from INFOFISH in English.

ANNEX 17

KILKA YIELD FLOW
MACHINERY ESTIMATES

MACHINE	DAILY INPUT	% YIELD	DAILY OUTPUT	EQUIPMENT ONLY EST BUDGET PRICE IN USDOLLARS FOB	ESTIMATED LOWEST PRICE AVAILABLE
CHILL ROOM COOLER MAX	7000.00	98.00	6860.00	10000.00	
HOPPER/WASHER/ELEVATOR	3000.00	98.00	2940.00	25000.00	
TWIN NOBBING MACHINES	2940.00	80.00	2352.00	120000.00	
SPRAY WASHER ELEVATOR	2352.00	98.00	2304.96	8000.00	
MEAT EXTRACTOR	2304.96	80.00	1843.97	6000.00	
2X 200L TROLLEY/LIFT	1843.97	98.00	1807.09	15000.00	
PRODUCT FORMER	1807.09	98.00	1770.95	60000.00	
BATTER/BREADING SYSTEM	1770.95	110.00	1948.04	30000.00	
CONTINUOUS FRYER	1948.04	105.00	2045.44	60000.00	
FREEZER	2045.44	98.00	2004.53	100000.00	
VACUUM PACKER	2004.53	98.00	1964.44	10000.00	
COLD STORE	1964.44	98.00	1925.16	20000.00	
			TOTAL	464000.00	0.00

IDEAL DAILY YIELD PRODUCTION ESTIMATES	INPUT	CUTTING CAPACITY	NUMBER OF MACHINES	PER CENT YIELD	OUTPUT TO MINCER
	8.5	360	2	0.8	2350.08

	MAX	WEIGHT	PACK SIZE		NUMBER OF PACKS
FINISHED FROZEN YIELD PRODUCTION ESTIMATES	DAY	1925	500	GRAMMES	3850
	WEEK	11551	500	GRAMMES	23102
	MONTH	46204	500	GRAMMES	92407
	YEAR	554445	500	GRAMMES	1108889

APPENDIX 1
BUILDINGS

Buildings must be big enough to avoid crowding of people and equipment. Any fish working factory should be designed and built specifically for its intended purpose. Figure 37 shows a possible layout for a shrimp freezing plant as an example.

All buildings should be at least 3 m high internally. They must be well constructed and kept in good repair. All areas where the product will be handled must be kept separate from any part such as living quarters or offices or engineering facilities. Fish should not be processed in the same room as meat, frogs, chickens etc.

Construction must prevent entry of insects, birds and vermin such as rats and mice.

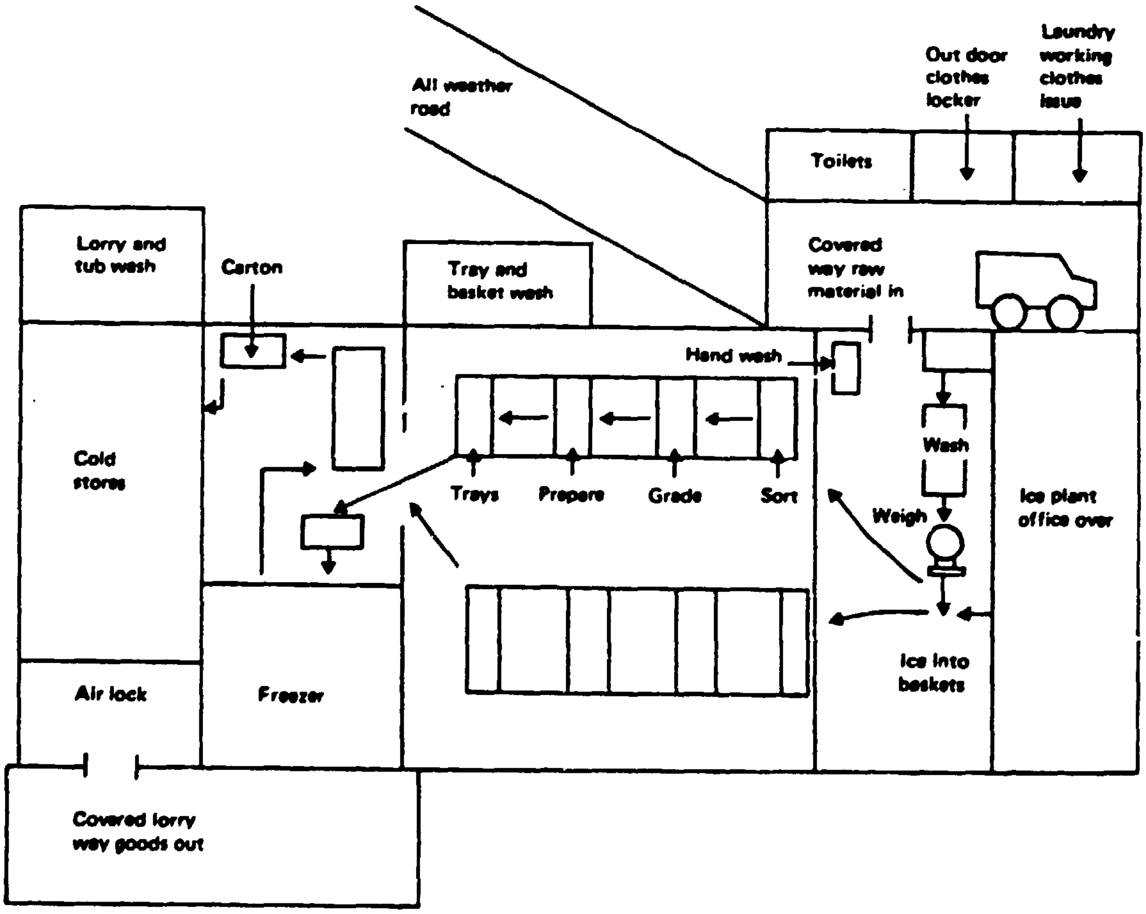
Single-storey buildings are preferable to multi-storey buildings; this avoids having a load-bearing second floor, and makes the movement of raw material and products easier. It is also difficult to arrange adequate drainage above ground floor level.

Non-porous material should be used for all construction; wood is not suitable for walls or floors.

Floors

All floors should be hard-wearing, non-porous material. They should be washable and should slope evenly to the drains. Five cm thick clay tiles bedded in furane or cashew nut cement are best. Granolithic cement is also suitable; ordinary cement

Figure 37
Possible layout for shrimp freezing plant (not to scale).



soon wears, is porous and subject to attack by acids and fish oils. Whatever surface is used in the fish handling areas, it must be such that it can be scrubbed and hosed down. The floor material should be carried up the walls for 15 cm and the joints should be rounded (coved) where this is practicable.

Using trolleys with rubber-tyred wheels prevents the damage which occurs when heavy boxes or tubs are dragged across the floor.

The floors should fall to the drains. A 1 in 90 or 1 in 100 slope is suitable. Slopes of more than 1 in 40 are dangerous. If any ribbing is used, the ribs should run towards the drains, not be parallel with them. All joints must be smooth and close fitting.

Drains

Floor drains should be wide and deep and have an even fall so that water cannot remain in them. They should be covered with removable metal gratings which should be level and flush with the floor. Outlets should have a catch basin outside the process area made of waterproof concrete. Drainage pipes should have a minimum internal diameter of 10 cm. Where a drain goes through a wall, a vermin-proof seal is essential. All drains should be designed so that cleaning with a rod is easy.

Walls

Walls in the process area must be waterproof, smooth surfaced and washable. Ceramic tiles are best but these are expensive. Corrosion-resistant metal such as stainless steel (expensive) or aluminium is also good. Such protection should be carried up the wall above shoulder height. Where concrete is used, it should be painted with high gloss, light coloured, non-toxic paint.

Ceilings

These should be in a continuous, smooth, unbroken surface, painted with white, high gloss, non-toxic paint. Flush light fittings and ventilation fittings are desirable.

Doors

These should be wide and self-closing. They must be smooth surfaced for easy cleaning. Metal plates should be fitted flush with the floor surfaces to prevent rat damage and entry. A metal or washable well-painted light-coloured surface is needed. Wherever fly screening is needed, either a metal mesh screen or air curtain should be fitted.

Windows

Natural light is both better and cheaper than artificial light, so large simple windows should be fitted. Glass is not essential and is a potential hazard to the product. If glass is used it should be in a few large panes, not a large number of small ones. All windows should be at least 1 m above the floor. Window sills, if any, should be of concrete and sloped downwards at an angle of 45 degrees. Window frames should be of aluminium or well painted galvanised steel; where wooden frames must be used, these must be well painted.

If glass windows which open for ventilation are used, fly screens which can be removed for cleaning should be fitted. Fly screen mesh can often be used instead of glass windows.

Ventilation

Air conditioning is not really needed and is expensive to install and operate in commercial premises but good ventilation is essential. Air conditioning is not a substitute for using plenty of ice. Exhaust fans are very useful; these must be fitted so as to exclude insects when not running – a correctly weighted flap is adequate. Ventilation ducts should be flush fitted and all ventilation openings screened with fly mesh on frames which can be removed for cleaning (except where fans are fitted).

Lighting

Fluorescent lights provide the best alternative to natural daylight. In the general working areas a minimum of 20 foot candles is needed; this is roughly equal to a loading of 2–3 watts per square foot (or 20–30 watts per square metre) using fluorescent tubes. In inspection areas, 50 foot candles are needed. Light must be good wherever knives are used.

Toilet facilities

Rooms should have walls of smooth, washable light coloured surfaces. Floors should be non-porous, washable and easily cleaned. Rooms should be well lit and *must be kept clean at all times.* They must not open directly on to the processing area.

Flush toilets should be provided at the following ratios:

Number of employees	*Number of toilets*
1 to 9	1
10 to 24	2
25 to 49	3
50 to 100	5

One additional toilet for every additional 30 employees.

A handwashing facility is best provided in the factory entrance *so that it is used every time anyone enters.* It should have hot running water and soap; pedal operated taps are best. Single-use towels should be provided; however, no towels are needed for a wet process room. Where paper towels are used, a bin must be provided and the contents burned at intervals well away from the process area.

WATER SUPPLY

This is one of the most critical factors in making products which will be safe to eat and will meet the required microbiological standards. Water from rivers which are also used as lavatories is certain to contaminate the product with faecal bacteria. Dock water is always filthy. Such water is always quite unsuitable for any part of any process or for washing down premises. Even local authority water supplies may need both filtration and chlorination to suitable levels. The water supply should be checked for microbial contamination at frequent intervals. The interval varies with conditions found at earlier examinations and may be from once a week to about once a month.

Both hot and cold water supplies for use on the process lines and in wash basins should be at a minimum pressure of twenty pounds per square inch (1.4 kg/cm^2). Pipes must be big enough to carry the required volume.

A high pressure system should be available for washing down the premises and equipment at a pressure of 400 pounds per square inch (28 kg/cm^2). A portable system such as the 'Maelstrom' is very good.

All water used on the process line or for cleaning down should be chlorinated. This is *not* a substitute for clean working but it will reduce both the number of micro-organisms and prevent or reduce odours. When chlorine or a chlorine salt is added to water, chlorine molecules are released. If the water contains protein particles or bacteria, molecules of chlorine attach to these, so some chlorine is used up i.e. is no longer free to do its work. Some comes off as a gas — you can smell it — chlorine is poisonous and has been used as a war gas so it must not be breathed. Only water containing free chlorine has any value as a bacteriocide and this is why the level of free chlorine must be checked at frequent intervals using a disc comparator.

An in-line chlorination system is best; this should be of a type in which the level of chlorine can be varied as and when necessary. A maximum of 5 ppm of free chlorine should be present in water which comes into contact with the product. Fifty ppm should be used for cleaning down the premises where a two- or three-stage cleaning process is employed; where a one step cleandown is used, as with the 'Maelstrom', 200 to 400 ppm is used.

Chlorination may be effected by:

(1) Injection of chlorine gas.

(2) Injection of sodium hypochlorite liquid.

(3) Adding calcium hypochlorite as a powder.

Whatever method is used, a disc comparator should be available to check the level of free chlorine. Daily checks are needed with an automatic system, or every two hours if a manual system is used. Where a manual system with a tank is used, the dwell time in the tank should be at least 20 minutes.

EQUIPMENT

All equipment must have smooth, easily cleaned surfaces. Tables should be of metal, preferably stainless steel. Toxic metals, e.g., copper, must not be used. Plastic cutting boards should be used. Plastic, plastic reinforced with glass fibre (GRP), aluminium, and stainless steel are all suitable materials for containers such as fish boxes and tubs; freezer trays should be of metal.

Sinks and other facilities for cleaning equipment should be in a separate room from the process area. Equipment should be washed with detergent in preferably hot water, scrubbed with a plastic-handled nylon bush and then rinsed in water chlorinated to 50 ppm. Containers should be left upside down to dry.

CLOTHING

Protective clothing such as caps, gowns or coats, gloves and boots should be provided. Cloth items should be washed, preferably in boiling water. Plastic and rubber items should be washed inside and out and then soaked in water chlorinated to 50 ppm and then drained. They should be inspected before reissue. The laundry should be outside the main process area, as should the issue room.

Chilling: some alternatives to direct icing

In earlier lectures we have noted that, if fish can be cooled to the temperature of melting ice, their storage life will be much increased. We also noted that placing fish in direct contact with melting ice is the ideal method of cooling.

There are, however, some circumstances in which it is difficult to practise direct icing properly. The most obvious examples of this are where schooling fish are captured in great quantities in a short time. The great catches of herring formerly caught by driftnet in the North Sea were never iced – the quantities of fish taken in one night were enormous and it was impracticable to ice the fish as they were taken from the net. Similarly, it is never possible to ice the vast quantities of anchovies, mackerel, sardines or tuna taken by purse seining. Nor can the crews of trolling vessels spare time to ice the catch since the lines must be tended constantly. In all these fisheries, it is now common practice to stow the catch in seawater which has been cooled to near the temperature of melting ice.

REFRIGERATED SEAWATER (RSW)

Seawater has a salt content of around 30–35 parts per thousand (3–3½ per cent). At 3½ per cent salt, seawater has a freezing point of about –2°C. Thus, if seawater is refrigerated, it is possible to reduce the temperature so that a storage temperature of –1°C can be achieved. The most important advantage of refrigerated seawater (RSW) over icing is the ease of handling and stowage on board, with a resultant saving of labour. In a purse seiner, for instance, the fish can be brailed from the net direct into a tank and brailed out of the tank at the landing point. Pumping systems have been developed for unloading fish as large as 10 kg each at a rate of more than 25 tonnes/hour. In the most sophisticated systems the vessel can be equipped with a pump which pumps the fish out of the sea into holding tanks and the same pumps can be used for unloading. Pumping has the advantage that the RSW storage can be extended to the fish after they are put ashore, in the same water, and without any significant increase in temperature.

CHILLED SEAWATER (CSW)

It is also possible to cool seawater by mixing ice with it. These systems are usually referred to as chilled seawater (CSW) and can be extremely simple. There are also cases where it is advantageous to mix the two systems so that some cooling is supplied by refrigeration and some by the use of ice.

For any system, the recommended ratio of fish to seawater is between 3:1 to 4:1. In RSW systems, it is usually necessary to provide pumped circulation of the water to ensure even mixing. This is sometimes done with CSW systems but, with these, pumping is usually unnecessary, the motion of the vessel providing adequate mixing.

A rough calculation of the amount of ice needed to provide adequate cooling in a CSW system can be made quite easily:

Calculation

Suppose you want to cool *8 tonnes of fish (8 000 kg) from 24 to −1°C* and decide to use a 4:1 ratio of fish to seawater. The mixture of seawater and fish would weigh 10 tonnes (10 000 kg the amount of heat to be removed would be:

$$10\,000 \times 25 \times 1 \text{ (taking 1 to be the specific heat of both fish and water)}$$
$$= 250\,000 \text{ kcal.}$$

But when ice melts, it absorbs 80 kcal thus the weight of ice required:

$$\frac{250\,000}{80} = 3\,125 \text{ kg of ice.}$$

Thus, just over 3 tonnes of ice would be required to provide the initial cooling. This, of course, would only reduce the temperature of the fish and would not be sufficient to maintain the lower temperature. Additional ice would be required to provide against the heat leak which would be expected. The amount of additional ice needed would depend on the adequacy of the insulation of the tank or fish room, the outside ambient temperature, and the duration of the trip.

It is somewhat more difficult to make a calculation for RSW loads and these are best left to competent refrigeration engineers. As a guide, however, it may be noted that if one wished to cool the same 10 tonne mixture of fish and seawater as in the previous example to the same temperature, it would impose a load of some 1 000 megajoules on the refrigeration system. If you needed to remove this amount of heat in about 6 hours, you would have to have a plant with a power requirement of about 12 kW for the compressors.

Chilling in CSW or RSW can be rather faster than chilling in melting ice because of the more intimate contact between the fish and the cooling medium. In practice, however, cooling will *not always be quicker* because there are limitations to the circulation in both systems and, also, there are limitations in the mechanical refrigeration system used in RSW.

It is perhaps obvious that, if a refrigeration system is particularly good, it would be possible to cool fish below the temperature at which they would freeze. This should be avoided because slow freezing results in fish of very poor eating quality. Freezing, however, is impossible in CSW systems, in RSW systems freezing could be avoided by using thermostats and by sensible choice of the size of the compressors provided. If one avoids undue build-up of ice on the refrigerating coils, there should be no problems with freezing.

There is one further problem associated with using cooled seawater for fish stowage: that of salt penetration into the fish. The amount of increase in salt depends on several factors: the size and species of fish; whether they have been gutted or not; the ratio of fish to water; and the length of the storage period.

Gutted fish, or fish which have been cut, will absorb salt at the cut surfaces. With the recommended ratio of fish to seawater of 4:1, and where there is no introduction of seawater after the initial stowage, the amount of salt taken up by the fish cannot exceed 1 per cent by weight. However, a concentration of 1 per cent would be objectionable in many fish products and, in many markets where fresh fish are sold, the housewives would reject such fish. Where fish are to be frozen after landing, any rise in salt concentration would be objectionable since salt can accelerate some of the changes which take place in cold storage and thus decrease the storage life. Even if the fish are to be used for fishmeal manufacture, an increase in salt content is objectionable since this will be proportionately increased approximately five times when the meal is made.

APPENDIX 3

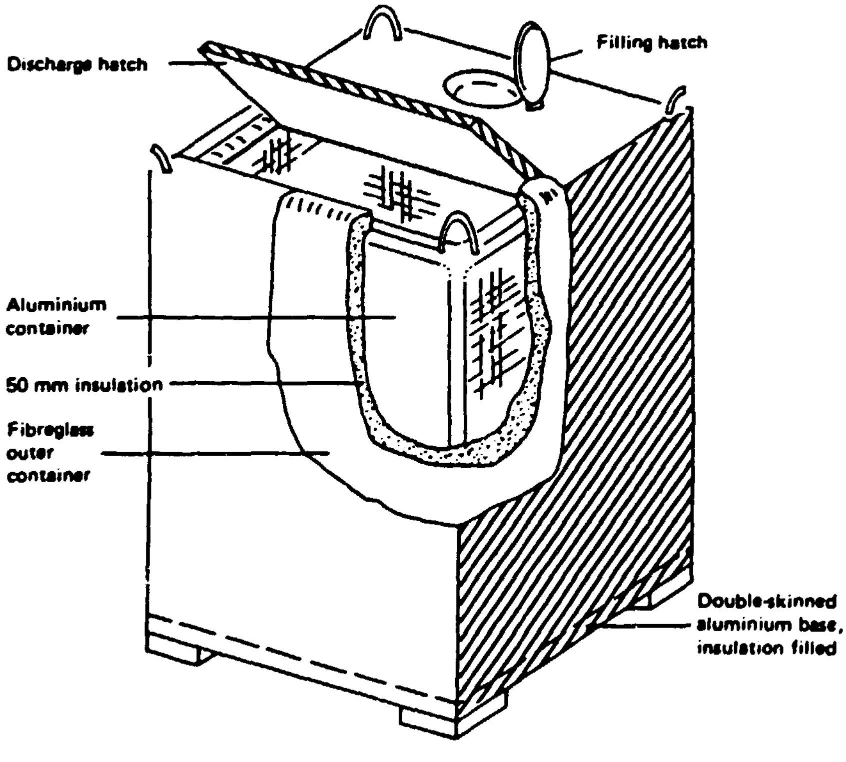
Containerised bulk stowage on fishing vessels using CSW

This is a portable tank system developed by the Industrial Development Unit of the British White Fish Authority. The majority of herring are nowadays packed into 30 kg boxes with about 5 kg of ice. This is carried out aboard the catching vessels which are typically from 20 to 25 m length overall. The fish travel about the country in the boxes and 40 hours could elapse between the time they are caught and the time they are processed in a factory. The system described here was developed in order to expedite handling.

It was decided that CSW would be a suitable method since ice is freely available in the fishing ports. A standard aluminium transport container of 2.1 m capacity was selected and modified by providing an insulated outer covering and special filling and discharge arrangements (see Figure 16). The containers are put in the fish room at the start of the voyage. At this time, each of them holds 450 kg of ice. When fishing starts, each container is charged with 500 l seawater and the herring are run directly into the containers through a deck opening. Each container holds 1 350 kg fish. Compressed air is used to provide agitation and ensure that the entire contents are at the same temperature. When the vessel arrives in port the containers are lifted directly on to road vehicles and carried to the processing factory; the vessel can take on new containers at once. At the factory, the container is placed on a tilt unit, when the fish are needed for processing, and the contents fall into a dewatering trough which admits the fish to the production line.

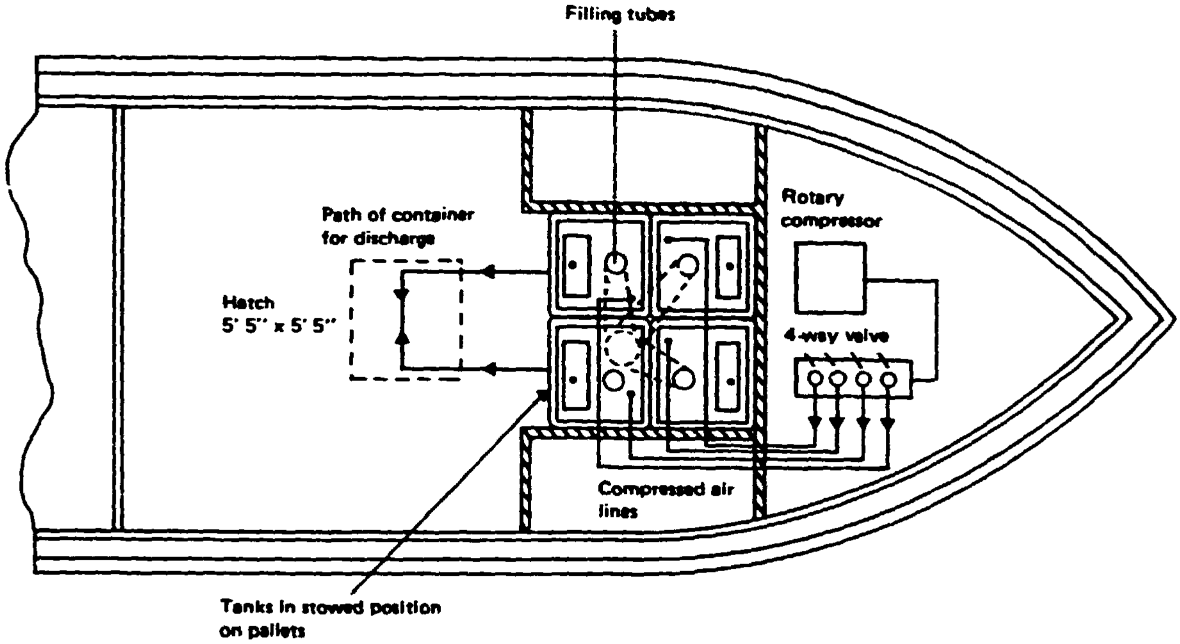
The arrangements of the containers on board is shown in Figure 17. It should be noted that the tanks are stowed on pallets for ease of handling. The system provides fish of better quality than those obtained through traditional icing and offers a number of other advantages over the boxing system. It is much easier for the crew to pack the fish into the containers rather than into boxes and a smaller crew is needed

Figure 16
Insulated aluminium container measuring 2.1m^3.



Source: Redrawn from 'Fishery Products', Edited by Rudolf Kreuzer. Published by arrangement with the Food and Agriculture Organization of the United Nations, © FAO (1974) by Fishery News (Books) Ltd, West Byfleet, Surrey, England.

Figure 17
Four-container CSW system, MFV Ajax.



Source: Redrawn from 'Fishery Products', Edited by Rudolf Kreuzer. Published by arrangement with the Food and Agriculture Organization of the United Nations. © FAO (1974) by Fishery News (Books) Ltd, West Byfleet, Surrey, England.

than when boxing. Handling of the fish is avoided entirely during transport; the containers are easy to handle by crane or fork lift truck. The fish are in an insulated container in an efficient cooling medium and the safe holding time from catching to processing can be accurately predicted.

There is only one major disadvantage, which is that using the containers reduces the carrying capacity of the vessel; in a 25 m herring trawler, the capacity for containers is only about 60 per cent of that for fish stowed in 30 kg boxes.

The most important result from the point of view of the fishing industry has been that herring stored in containers of this type are of much superior quality to herring stowed in conventional ice boxes. Very soft fish, which had a high oil content, were acceptable after a storage period of 87 hours; firmer fish were kept for much longer periods. A limited amount of work has been carried out on the quality of white fish stored in CSW but, whilst holding periods of up to 6 days have given acceptable quality, more work is at present being progressed.

THE COLD CHAIN

Fishery products are easily perishable. For most fishery products maintaining suitable temperatures is of overriding importance. Temperature is the single most important factor influencing fish spoilage. The cold chain is a temperature chain. It means 0°C for fresh fish and -20°C for frozen fish from the producer to the consumer. Every fisherman, every processor and every retailer is a link. A break in the chain increases quality loss.

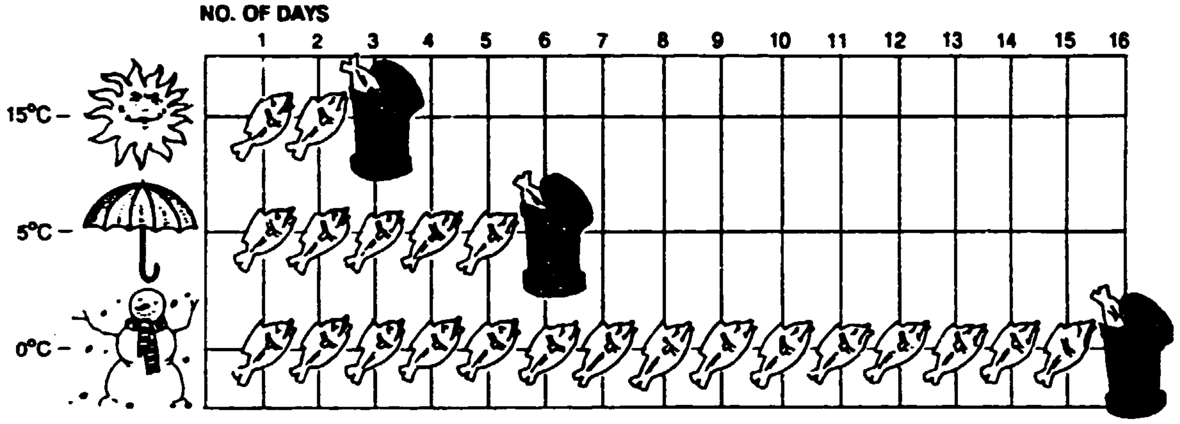


Figure 10: Shelf life of fresh fish at different temperatures (*Source: Billington, 1983*).

Temperature rise and temperature fluctuation will accelerate quality deterioration and have to be avoided. Especially sensitive to temperature abuse are fresh, live and lightly cured (e.g. smoked fish) products. These should be kept at 0-1°C, and their temperature should never rise above 3°C.

With frozen fish even temporary rise in temperature of a few degrees can have a marked effect on the product quality and shelf life. Temperature fluctuations accelerate the reformation of small ice crystals into larger crystals damaging the cells. Also, desiccation will increase because of temperature fluctuations.

Less sensitive to temperature abuse are canned products and some cured products like hard, salted and dried fish.

When shipping chilled seafoods, temperature control and stability can only be achieved by using sufficiently insulated transport vehicles and containers and adequate quantities of coolant or good mechanical refrigeration. Refrigeration requirements vary considerably depending on the duration of transportation, the temperature at which a product has to be maintained, the quality of insulation material, the dimensions of a container and the temperature of the environment.

It is imperative that refrigerated produce is packed for shipment only when it has reached the correct temperature – 0°C for fresh fish and below -18°C for frozen fish. The cooling capacity of refrigerated transport is limited. It is designed to prevent the product temperature from rising and not designed to lower the product temperature during transit. Chilling warm produce to 0°C with ice during transit is difficult to achieve and not recommended. Thus prior to packaging and loading, always check the produce temperature with a thermometer.

Figure 11: The Cold Chain (*Source: Billington, 1983*).

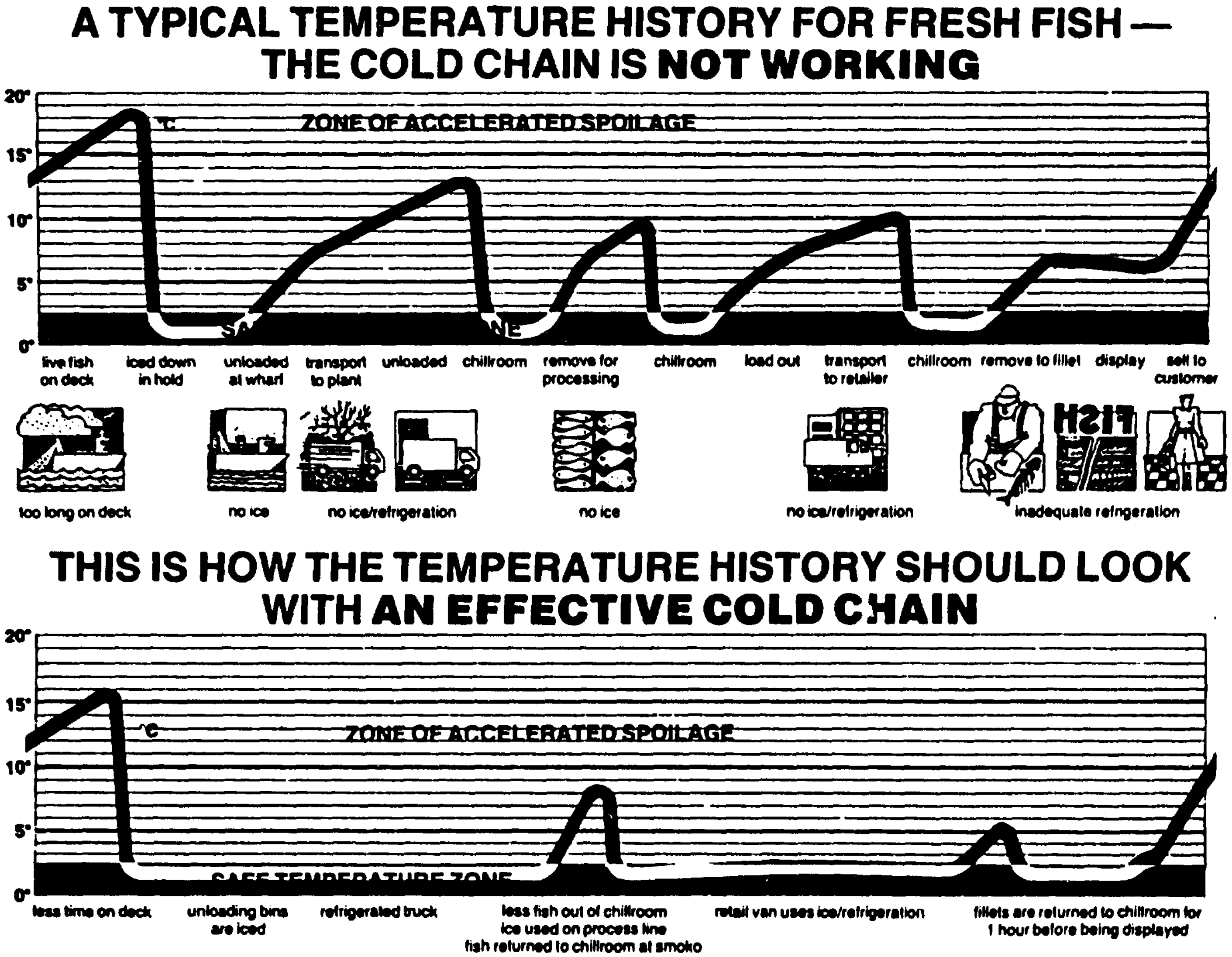
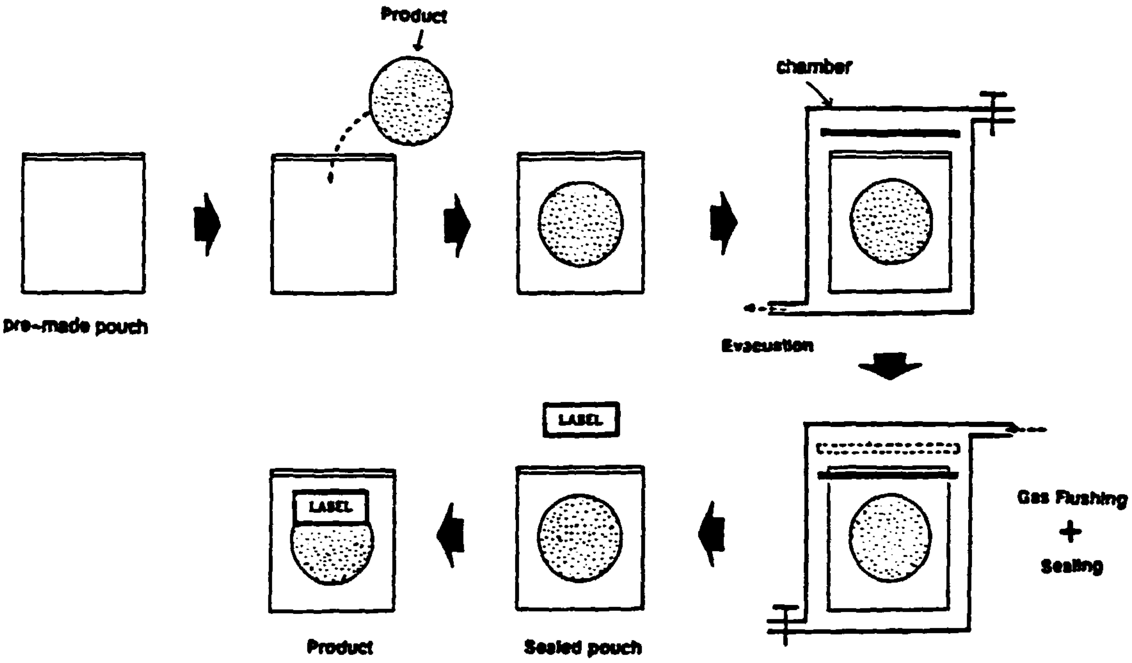


Fig. 25 Packaging using a chamber machine with evacuation and gas flush possibility



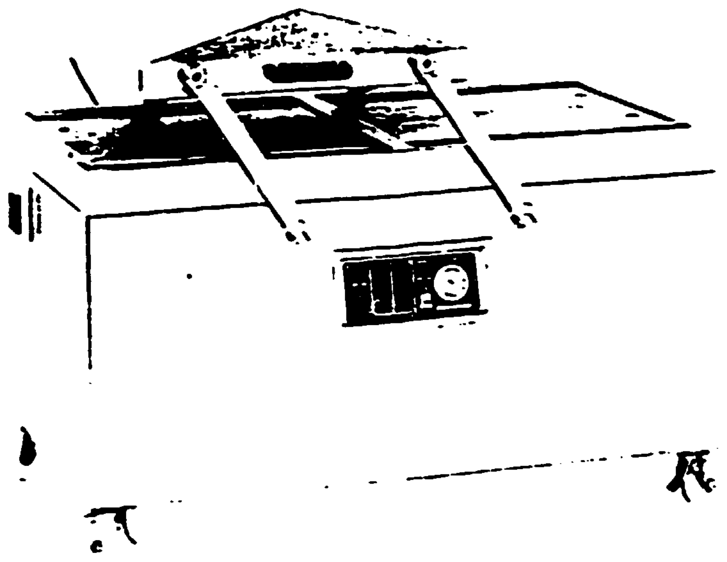
Oxygen-sensitive products could be better preserved by vacuum packing *ie* by removing the air from the pack during the sealing process. Nylon/polythene laminates are preferred for this purpose as the material is resistant to pin-hole formation.

As a result of removal of air vacuum products will exhibit better keeping qualities and the process also offers a better visual effect of the product due to the close contact of the packaging material and the product. This also helps to prevent ice build up within the pack. The technique cannot be used for products which would be affected by the pressure exerted as a result of the vacuum e.g. shucked flesh of mussels, fish roe, caviar etc. Surface distortion as a result of the vacuum could also affect the readability of the print on the pack.

If the products are to be manually filled a chamber sealer or a probe-sealer could be employed to vacuum-seal the pack. A probe sealer is basically a conventional heat sealer carrying a probe connected to a vacuum pump for evacuating the pouch. Once the pouch is evacuated the probe is withdrawn and the pouch is sealed.

A chamber sealer basically consists of an impulse type two bar sealer mounted in a chamber. Filled pouches are placed between the bars and the chamber lid closed activating a vacuum pump which removes air from the chamber. When the preset vacuum is reached the bar sealers are automatically activated. When the sealing is complete air is automatically readmitted to the chamber, releasing the lid of the chamber. Large chamber sealers have two rows of bar sealers enabling them to accommodate two rows of pouches. Single-chamber machines can handle 2-6 sealing cycles per minute.

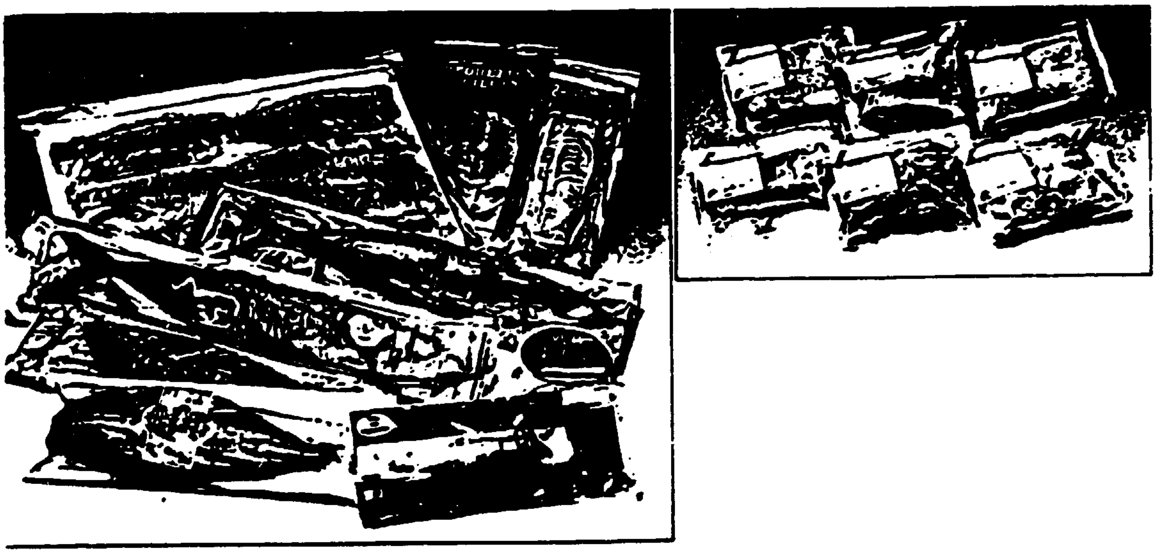
Fig. 26 A 'double chamber' vacuum packing machine



Röscherwerke GMBH

uble-chamber machines have two adjacent chambers with a swing lid which moves between ıem. While the evacuation/sealing cycle is in progress in one chamber the other chamber ould be loaded and prepared for an evacuation/sealing cycle thus increasing the output of ıe machine. In more advanced *belt-fed* machines packs are conveyed to the evacuation/seal hamber by a conveyor system. Chamber machines could also be used to gas-pack pouches. he gas is released into the chamber after evacuation.

Fig. 27 Some vacuum packed seafood products. Vacuum packing helps to extend the shelf-life of most seafood products



"MARKETING REPORTS"

"of kilka products in seventeenth Tehran International Fair"

This report reflects a summary of marketing results in relation to kilka Industries Co. Participation in the Seventeenth - International Trading Fair in Tehran.(2-12 OCT.1991)

In this fair kilka products (kilka- cutlet,kilka kentuki, and kilka Sausage) has been presented in cooked form as a lunch or as a snack.For evaluation of consumer's reflex and idea about quality, taste, price, and other marketing Subjects, a number of 10000 question - forms designed and distributed during the ten days period of fair.

Furthermore some interviewing has been done with consumers and experts about above mentioned subjects.

For Analysis of results from 2000 completely filled forms, a computer package of SPSS used.

The most important marketing results and consumer's Viewpoints for presented kilka products are as follow:

1)Major of purchasers(maybe completely) said that were Satisfied from kilka products quality and price.

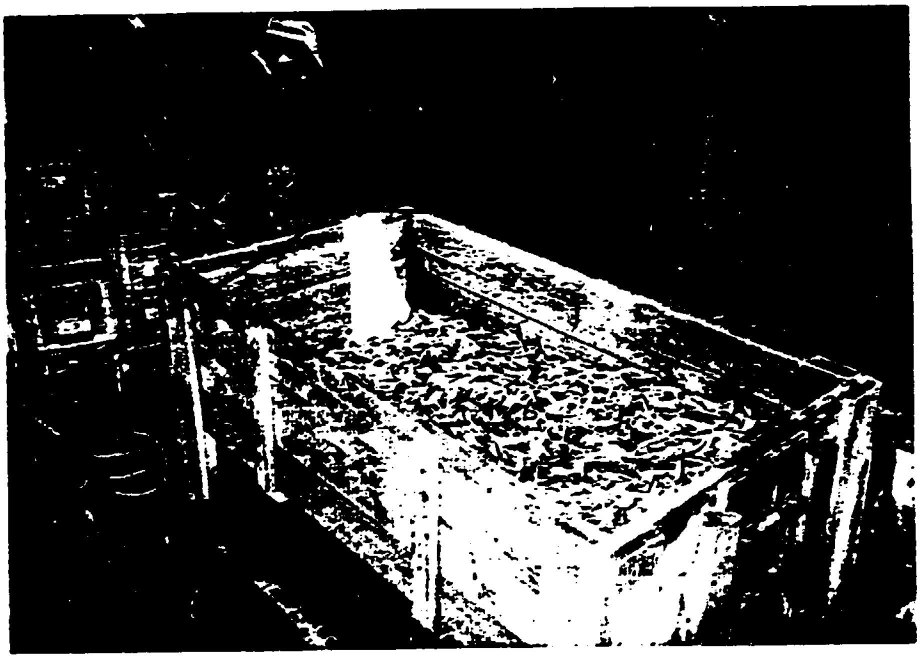
2) Regarding with "effect of sex in degree of consumer s Satisfaction" was cleared that,there weren't any difference between men and women for consumption of kilka products .

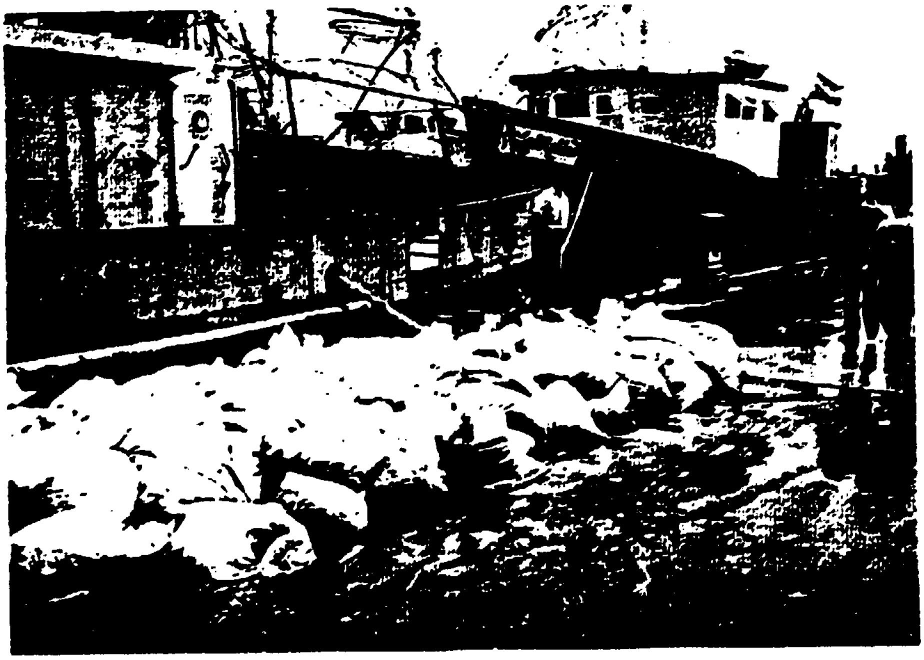
3) Related to" effect of status of educations and knowledge" we be informed that there wasn't any important relation Between degree of educations and their satisfaction

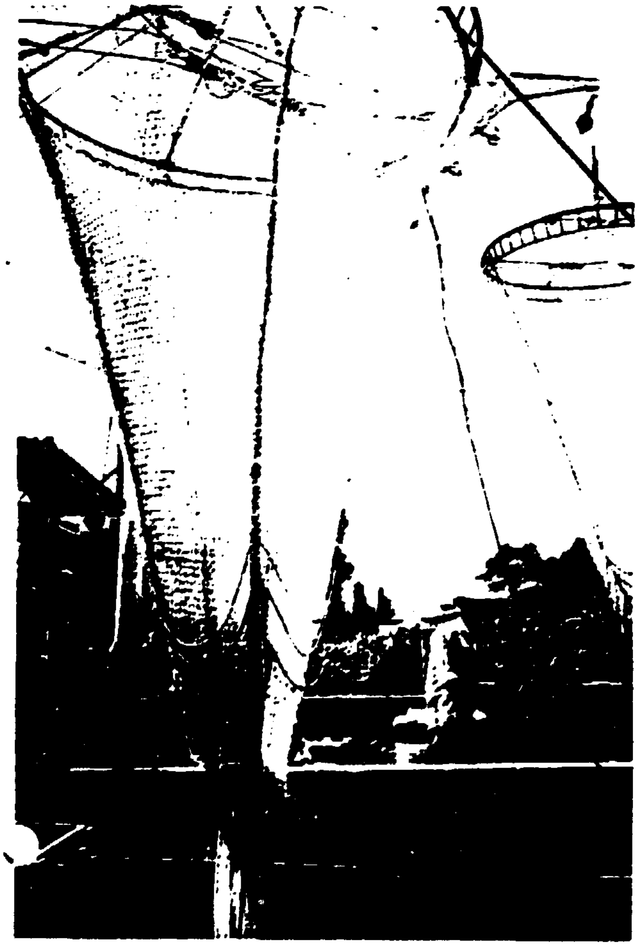
4) There isn't any correspondence between age and degree of satisfaction from kilka products.

5) original reason of purchaser's satisfaction was good taste and high quality of kilka products and no low price.

It must be mentioned that during ten days about 70000 persons purchase and eat kilka products.







Appendix 8

SANITARY CONTROL-FISH PROCESSING INDUSTRY

In order to be able to supply sea food products to specific markets it is necessary to comply with the quality standards of those markets.

High product quality can only be obtained by the establishment of a set of sanitary procedures for each operation in the production process and also for cleaning and maintaining the production factory.

Of equal importance is the standard of personal hygiene required of the staff and the enforcement of those standards.

A high quality product requires a high level of factory hygiene which possibly increases the expenses incurred in maintaining a high standard in the facility.

It is of the utmost importance that the management formulate a strategy to satisfy the quality demands of their priority markets.

Following the sanitary procedures meticulously will allow the factory to confidently issue product certificates guaranteeing healthy products with consistently low content of foreign objects and low count of micro-organisms.

Such health certificates are already demanded by most buyers in the developed world will provide a recommendation to new customers in that they can buy with confidence. The amount saved in marketing expenses can be more than the additional cost of cleaning and maintaining high sanitary standards.

Good sanitary practices are rewarded by increased prices and by reduction of losses caused by product rejection on health grounds.

This document is a guide to common rules and procedures which the individual management should tailor into a specific set of rules and standards to be applied before commercial production starts.

CLEANING AND HYGIENE

The company should take all reasonable arrangements to ensure the following.

a, Disease control
Anybody who has a contagious disease, abscess, sore, infected wounds or anything which could contribute to the microbiological infection of the product must not be allowed to work with food stuff, ingredients, or any material or machine which is in contact with food.

b, Personal hygiene
All personnel must,
1, Wear clean clothes, keep a high personal standard of hygiene and work in a way which prevents the contamination of the food.

2, Wash their hands properly, if necessary they should use a sterilising soap product, before they start work and each time they leave and return to the working area and at any time the hands become contaminated inside the work area.

3, They may not wear rings or jewellery .

4, When gloves are used they must be intact, clean and in good hygienic condition. Gloves must be of non-permeable material.

5, All staff, male and female, when in the work area must wear hairnets, caps or other suitable protection which keeps the hair fully covered. This should also apply to visitors or management when visiting the production area.

6, There will be no eating of food, drinking or smoking in work areas or in areas used for the storage of ingredients.

7, They must be careful not to contaminate by perspiration, cosmetic, tobacco, chemicals, medicines etc.

c, Cleaning procedures,

1, The should have a permanent staff responsible only for the cleanliness.

2, The floor areas must be kept clean at all times , during production offal and waste should be removed from the production area continuously.

3, All surfaces in contact with raw material or products should be sterilised between each shift and at the end of the working period.

4, All surfaces in the processing area such as floor walls and ceilings should be properly hosed down at the end of a working period.

5, The floor drain should be kept clean and free running at all times and treated with approved disinfectants at the end of each working period.

6, In addition to the daily routines there should also be a systematic hygiene operation in depth on a weekly basis.

Control.

There person in charge of hygiene in the factory should have a college degree in food science, including microbiology and chemistry and should have some experience of a QC laboratory.

He should have direct access to management and should be empowered by management to enforce the sanitary regulations at all levels.

He should be authorised to exclude any one who does not comply with the regulations for personal hygiene.

He should also be responsible for informing the staff and motivating them to high sanitary standards.

EQUIPMENT LIST
for laboratory equipment
Project DG/IRA/93/002

A. NON-EXPENDABLE EQUIPMENT

Item	Specifications	Quantity
	Apparatus:	
1	Homogenizer, Stomacher 400 (excl. bags)	1
2	Colony Counter, Gerber, Standard Electric 06.1300 or similar	1
3	Precision balance, electronic, capacity 3100 g, readability 0.1 g, excl. calibration weight, Mettler PB 3001 or similar	1
4	Calibration weight, 2000 g, ME 216520 or similar	1
5	Autoclave, CertoClay, CV-EL 12L GS or similar	1
6	Instrument basket with tripod	1
7	Instrument tray	1
8	Water bath, 19 l, Memmert W 350 T or similar	1
9	Precision incubator, +30/+70° C, 53 l, Memmert BE 400 or similar	1
10	Universal oven, +30/+200° C, Memmert UE 400 or similar	1
11	Test tube shaker, Heidolph REAX 2000 or similar	1
12	Bunsen burner with stopcock and pilot flame, for butane/propane	1
14	Media dispensing pump, Jencons Perimatic GP or similar	1
15	Hotplate, 1500 W, 250 x 250 mm, Gerhardt H22 or similar	1
16	Refrigerated circulator, Julabo F18-VC or similar	1
17	Binocular microscope, magnification range 75x - 1250x, Eschenbach 3477 or similar	1
18	Screw-on mechanical stage, Eschenbach 3401/83 or similar	1
19	Soxhlet Equipment: Extraction Heating Apparatus for flasks 250-500 ml, 6-place, Gerhardt 173200 or similar	1
20	Set of Soxhlet glass parts, Gerhardt 1336 or similar	1
21	Holder with clamp for Soxhlet glass parts, Gerhardt 1308 or similar	1

22	Cooling water feed pipe, Gerhardt 1320 or similar	1
23	Extraction thimble, 33 x 118 mm, pack of 25	1
26	Combined macro-Kjeldahl digestion/distillation apparatus, Gerhardt KJ 13/26, 177650 or similar	1
27	Digital burette, 25 ml, Brand 7074 65 or similar	1
28	Distillation system, Vapodest 30, Gerhardt 7630 or similar	1
29	Kjeldahl flask, 750 ml, Gerhardt 6467 or similar	1
30	Magnetic stirrer, Heidolph MR 3000 or similar	1
31	pH-package LT2, comprising: pH-meter, Knick 761 electrode stand, combined electrode, Ingold Inlab 403/120/Pt1000, 1.2 m cable with DIN plug, electrolyte 9823 and 2x500 ml buffer solution pH 4/01 and 7.00 or similar	1
32	Semi-micro equipment, MC-2 37-110 ml for Waring Blender 8011 HG or similar	1
33	TLC Tank for 200 x 200 mm plates	1
34	Waring blender, model 8011 HG 8000/15000 rpm or similar	1
35	Muffle furnace, Carbolite ELF 10/6 91/PID, Max. temperature 1000° C	1
36	Desiccator, 250 mm dia.	1
37	Analytical balance, 210 g/0.1 mg, Mettler AB 204 or similar	1
38	Spectrophotometer, HACH DR 2000 or similar	1

B. EXPENDABLE EQUIPMENT

Item	Specifications	Quantity
	Glassware and other laboratory items	
1	Erlenmeyer flask, 200 ml	10
2	Erlenmeyer flask, 250 ml	10
3	Measuring flask, 100 ml	2
4	Measuring flask, 25 ml	2
5	Measuring flask, 10 ml	2
6	Measuring flask, 50 ml	2
7	Measuring flask, 100 ml	2
8	Measuring flask, 250 ml	2
9	Test tube, AR-glass, rimless, 160 x 16 mm	1000
10	Dilution pipette acc. to Demeter, ring marks at 0.5 - 1.0 - 1.1 ml	100
11	Test tub cap, Cap-O-Test, 15/16 mm	100
12	Petri Dish, 90 x 15 mm, polystyrene, sterile, disposable, with triple vents, pack of 480	2
13	Reagent bottle, with ISO/GL45 thread, blue screw cap and pouring ring, 250 ml	20
14	Test tube rack, nylon coated, metal wire, 3 x 10 holes, 20 mm, height 75 mm	4
15	Graduated pipette, 1 : 0.01 ml	12
16	Graduated pipette, 10 : 0.1 ml	12
17	Graduated cylinder, tall form, 1000 : 10 ml	2
18	Test tube, AR-glass, rimless, acc. to Durham, 35 x 6/7 mm	1000
19	Micro slide, 76 x 26 mm, pack of 50	10
20	Inoculating spatula, glass, Drigalski pattern	100
21	Inoculating loop, 10 ul, polystyrene, sterile, disposable, pack of 50	10
22	Kjeltabs CX, pack of 1000	1
23	Reservoir bottle, amber glass, 2000 ml	2
24	Magnetic stirring bar, 25 x 6 mm	10
25	Ring of cork, ext. diam. 140 mm, int. diam. 90 mm	5
26	Volumetric pipette, 3 ml	2
27	Glass funnel, 100 mm	2

28	Measuring cylinder, 50 ml	1
29	Micropipette, Blaubrand, intraMark 1-2-3-4-5 ul, pack of 250 or similar	1
30	Micropipette, Blaubrand, intraMark 10 ul, pack of 250 or similar	1
31	Micropipette, Blaubrand, intraMark 20 ul, pack of 250 or similar	1
32	Pipetting Aid	1
33	Glass spray, 100 ml, complete	1
34	Bath cirulator, plexiglas, Julabo UC-8A or similar, max. temperature 65° C	1
35	Crystallizing dish, 80 mm dia.	10
36	Quartz crucible, 35 mm dia, capacity 20 ml	10
37	Porcelaine plate, 250 mm	1
38	Volumetric pipette, 10 ml	6
39	Volumetric pipette, 15 ml	6
40	Constriction pipette, 20 ul	2
41	Constriction pipette, 250 ul	2
42	Adapter for 10 mm cells	1
43	Cells, 10 mm, Hellma OS 100 or similar	4
45	Bag, sterile, 18 x 30 cm for Stomacher 400, pack of 500	5
46	Basket, stainless steel wire, l x w x h = 150 x 100 x 100 mm	4
47	Cotton, hydrofobic, 500 g	6
48	Sealing film, Parafilm M, width 10 cm, roll of 38 m	5
49	TLC-plates, alufoil, silicagel, 200 x 200 mm, pack of 25, Merck 5553 or similar	1
50	Filter paper, Schleicher & Schuell 1573 1/2 (or similar), 125 mm dia., pack of 100	1
51	Gas tubing, 9.5 x 2 mm, unit = 1 m	1

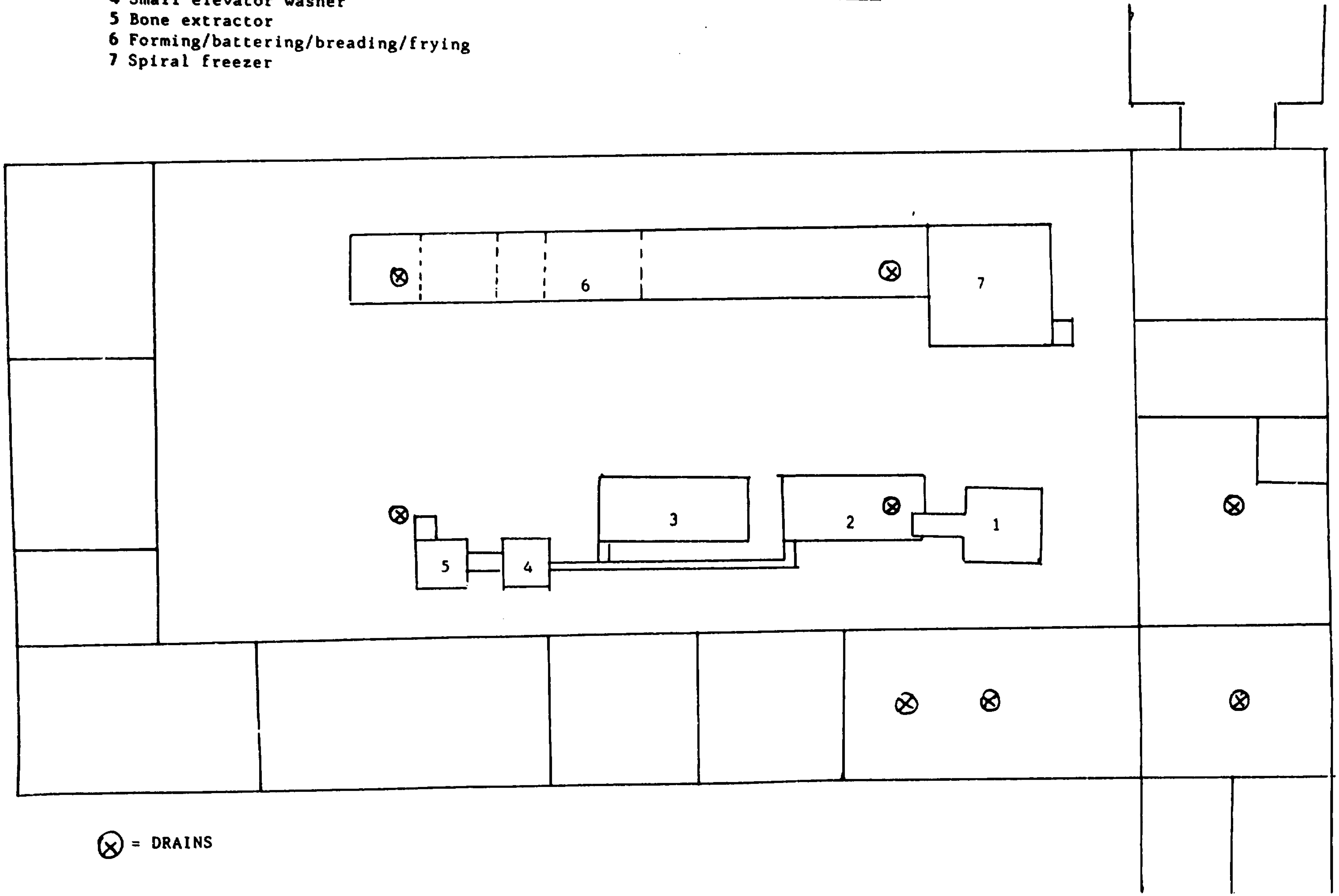
Item	Specifications	Quantity
	Chemicals	
1	Sodium chloride, cryst. 500 g, GR M 6404 or similar	1
2	Indole reagent, Kovacs, 100 ml	1
3	Hydrogen peroxide, 3%, 1 l	1
4	Gram-Color staining set for microscopy, Merck 11885 or similar	1
5	Petroleum benzine for residue analysis, 2.5 l, Merck 1772 or similar	1
6	Pumice, granulated, 2.5 kg	1
7	Sodium hydroxide sol. 32-33%, 5l	1
8	Hydrochlorid acid, 0.1 N, 5 l	1
9	Sulfuric acid, 95-97%, GR M 731, 2.5 l or similar	1
10	Boric acid indicator sol., Kjeltec, 5 l	1
11	Receiving liquid, TVN, 5 l	1
12	Hydrochloric acid, 0.05 N, 5 l	1
13	Magnesium oxide, 1 kg, Merck 5862 or similar	1
14	Ammonium hydroxide, GR, 25%, Merck 5432 or similar, 1 l	1
15	N-Butanol, GR, Merck 1990 or similar, 1 l	1
16	Water, de-ionized, 25 l	1
17	Acetic acid, glacial, GR Merck 63 or similar, 1 l	1
18	Ninhydrine, GR, Merck 6762 or similar, 10 g	1
19	Histamine hydrochloride, Merck 4370 or similar, 5 g	1
20	Methanol, GR, Merck 6009, 2.5 l or similar	1
21	Hydrochloric acid, 0.1 N, Titrisol, Merck 9973 or similar	1
22	Silicagel, blue, pack of 1 kg	1
23	Chloroform, GR, Merck 2445 or similar, 1 l	1
24	Methanol, GR, 1,1, Merck 6009 or similar	1
25	Ammonium thiocyanate, GR, 500 g, Merck 1213 or similar	1
26	Ferrochloride, GR, 250 g, Merck 3861 or similar	1

27	Bariumchloride, GR, Merck 1719 or similar, 500 g	1
28	Hydrochloric acid, 1 l, Merck 317 or similar	1
29	Ferrichloride, 250 g, Merck 3943 or similar	1
30	Hydrogen peroxide, 30%, GR, 1 l, Merck 7209 or similar	1
31	Ferrosulphate, GR Merck 3965 or similar, 100 g	1
	Media	
32	Plate Count Agar, Oxoid CM 325 or similar, 500 g	1
33	Lauryl tryptose broth, Oxoid CM 451 or similar, 500 g	1
34	Brilliant green bile 2% broth, Oxoid M 31 or similar, 500 g	1
35	EC Broth, Merck 10765 or similar, 500 g	1
36	Tryptone Water, Oxoid CM 87 or similar, 500 g	1
37	Slanetz and Bartley medium, Oxoid M 377 or similar, 500 g	1
38	Tryptone Soy Agar, Oxoid Cm 131 or similar, 500 g	1
39	Brain heart infusion broth, Oxoid CM 225 or similar, 500 g	1
40	Maximum recovery diluent, Oxoid CM 733 or similar, 500 g	1
41	Blood agar base, Oxoid CM 55, 500 g	1
42	Staphytect test kit for 100 tests, Oxoid DR650M or similar	1
43	Baird Parker Medium, Oxoid CM 275 or similar, 500 g	1
44	Egg Yolk tellurite emulsion, Oxoid SR 54 or similar, 100 ml	1

1 Hopper|elevator|washer
2 & 3 Nobbing machines
4 Small elevator washer
5 Bone extractor
6 Forming/battering/breading/frying
7 Spiral freezer

ANNEX 10 (not to scale)

SUGGESTED PLANT LAYOUT



⊗ = DRAINS

SUGGESTED DRAINS

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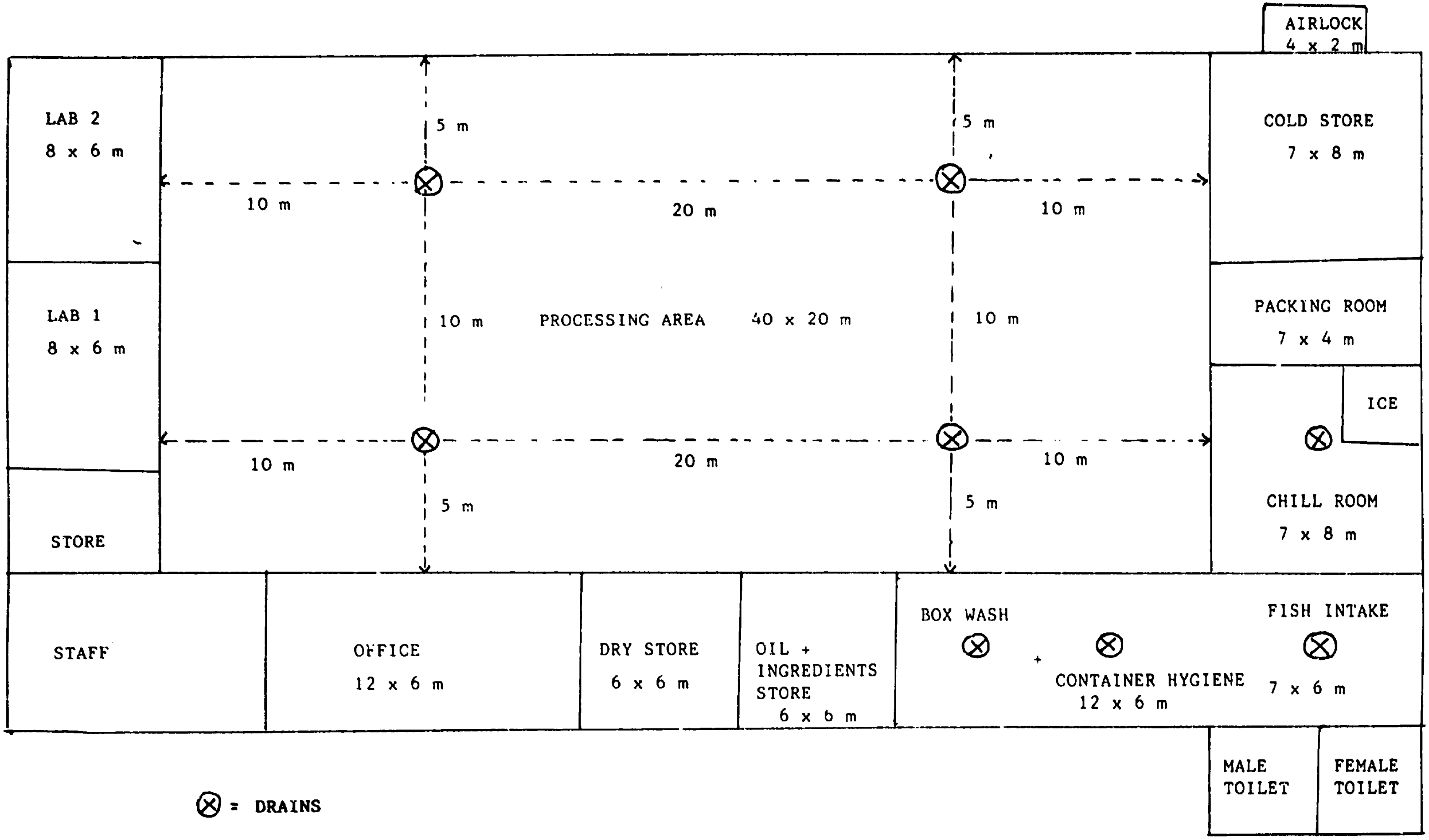

LABORATORY

(Example of how to equip the microbiological and chemical laboratory)

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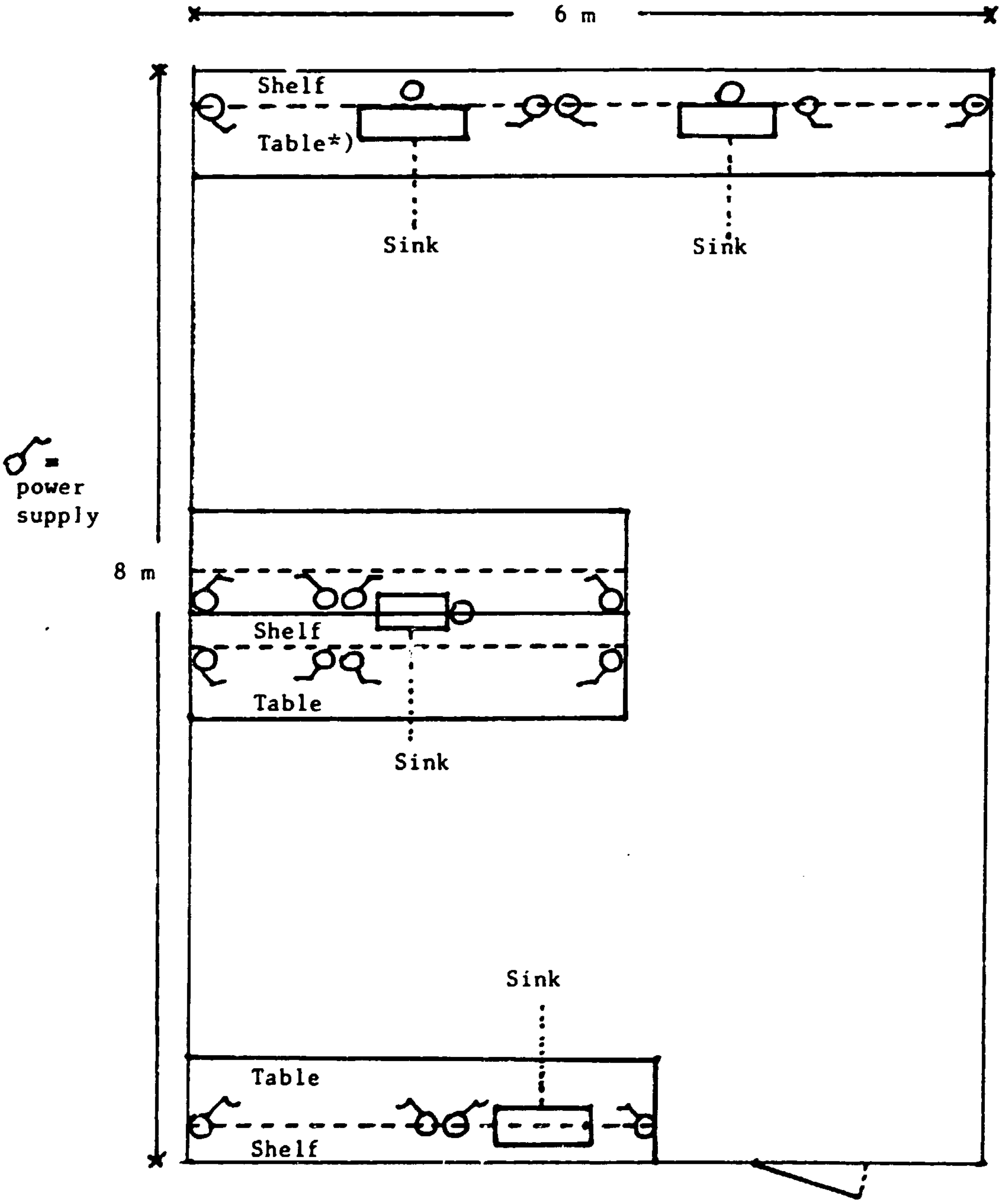

All tables should be made of stainless steel for easy cleaning.

*) This table should be ventilated to take away dangerous gases.

ANNEX 11

BACKSTOPPING OFFICER'S COMMENTS

The international consultants Messrs. D. Chatterton (fish processing) and B. Andreassen (quality control) completed their 1st split mission in 28 days, from 2 to 29 July 1994. The mission was split in field work (13 days) and home base work (15 days).

The technical report of the mission contains conclusions and recommendations for the achievement of the project output and the modular conception of the processing line, based on an integrated approach. Indeed, the idea to teach and demonstrate the appropriate techniques for fish handling and fish processing (starting with the fishing vessel until the marketing of the products) through a pilot plant is a sustainable approach. Also the modular option for fish processing recommending minced fish and leaving the possibility of producing surimi at a later stage, depending on the market opportunities and investment costs, is in line with the economic viability required by UNIDO for the establishment of pilot plants.