# PRODUCTION
OF
# BATTERED AND BREADED FISH PRODUCTS
FROM
# MINCED FISH AND SURIMI

ASEAN - CANADA FISHERIES
POST - HARVEST TECHNOLOGY PROJECT - PHASE II

# ASEAN-CANADA FISHERIES POST-HARVEST TECHNOLOGY PROJECT - PHASE II

The ASEAN-Canada Fisheries Post-Harvest Technology Project - Phase II was started in April 1992. The Project's objectives are to strengthen and upgrade fisheries product quality and fish inspection services within ASEAN countries; to assist in the development and implementation of improved methods and technologies in fish processing, preservation and packaging, on the basis of regional collaborative efforts, to enhance the transfer/ adoption of appropriate technologies to the fish processing industries through training and extension services.

The Project activities are coordinated and administered by the ASEAN Executing Agency (AEA) which is incorporated in the Marine Fisheries Research Department (MFRD) of the Southeast Asian Fisheries Development Center (SEAFDEC). In cooperation with the ASEAN governments, the Project established regional centres for fish processing technology (RC-FPT, Singapore), fish inspection and quality control (RC-FIQC, Indonesia), and information preparation and dissemination (RC-IPD, Malaysia) developed work programs of national importance and regional interest for all ASEAN countries.

Each ASEAN country except Malaysia conducts two activities on either seafood processing or quality control in order to develop technical training manuals/materials and assist the RC-IPD in the production of extension materials based on these Project activities. The technologies developed are then transferred to the fish processing industries in the region through end-of-activity exhibitions and workshops and dissemination of information/training materials by government and private sector extension personnel.

The contribution of the Canadian International Development Agency (CIDA) for providing funds to assist the development of this work and its publication is gratefully acknowledged.

LIAISON OFFICE: ASEAN Executing Agency ASEAN-Canada Fisheries Post-Harvest Technology Project - Phase II Changi Fisheries Complex Changi Point Singapore 1794.

PRINTER: Regional Centre for Information Preparation and Dissemination, Department of Fisheries Malaysia , 5th Floor Wisma Awal Jalan Raja Muda Abdul Aziz Kg. Baru, 50300 Kuala Lumpur MALAYSIA

Authors:

Mr Tan Sen Min, Coordinator, RC-FPT
Ms Ng Mui Chng, Senior Research Officer
Mr Lee How Kwang, Senior Research Officer
Dr Gordon Brown, Food Technology Specialist
Dr Jim Smith, Food Packaging Specialist
Mr Jim McClare, Food Engineering Specialist



[1]Marine Fisheries Research Department
Southeast Asian Fisheries Development Centre
Changi Fisheries Complex
Changi Point
Singapore 1749

ISBN 981- 00 - 6117 - X

# FOREWORD

Fisheries play an important role in the socio-economic development of all ASEAN countries. While the fisheries industries of the various countries are at different stages of development, some common problems are encountered in post-harvest technology. Recognizing this, the Canadian Government opened discussions between ASEAN-Canada in 1976 which led to the ASEAN-Canada Fisheries Post-Harvest Technology Project. The project commenced in 1983, and is currently in its second phase.

One of the focal points of the Project is the Regional Centre for Fish Processing Technology (RC-FPT). It has been working on activities in seafood processing, specifically the development of battered and breaded products from surimi and fish mince derived from low market value fish, and the identification of suitable packaging material and techniques for battered and breaded fish products. The RC-FPT is located in the Primary Production Department of the Ministry of National Development, Singapore. Also collaborating in this project is the Marine Fisheries Research Department of the Southeast Asian Fisheries Development Center. The RC-FPT has also been assisted by consultants provided by Coastal Associates and Consultants Ltd. of Newfoundland, Canada.

This manual, prepared by the RC-FPT, addresses all aspects of the project's objectives : to strengthen fish processing plant quality control and fish inspection services; to develop improved methods in fish processing technologies; and to communicate this information to the ASEAN countries. Specifically, it contains material on the development and implementation of improved methods and technologies in fish processing, preservation and packaging. It also contains information on Hazard Analysis Critical Control Points and on Good Manufacturing Practices required to produce a quality product: this information is intended for use by both fish inspection services and fish processors. Finally, it is presented in a form that will facilitate the transfer of this technology to the fish processing industries in ASEAN and outside the region.

This manual was prepared in collaboration with, and designed and published by, the project's Regional Centre for Information Preparation and Dissemination (RC-IPD). Located in Kuala Lumpur, the RC-IPD is managed by the Fisheries Department of Malaysia.

I trust this manual will prove useful to the fish processing industry. I would like to congratulate the authors, collaborating organizations, and all those involved in its preparation.

Thora Broughton
Councillor, Development
Canadian High Commission, Singapore

# ACKNOWLEDGEMENT

The Regional Centre for Fish Processing Technology gratefully acknowledge the valuable guidance and assistance of Mr Leonard G Limpus of AEA during the preparation of this manual.

We would also like acknowledge SEAFDEC for use of equipment and photographs used in this manual.

We also gratefully acknowledge the cooperation and assistance provided by the two cooperants of the project viz Mr Lim Boon Chay, Managing Director, Thong Siek Food Industry and Mr Lim Poh Chun, Managing Director, Lim Hong Thye Fish Ball Manufactory.

Acknowledgements are also due to the following companies for supplying information and photographs on the processing and packaging equipment, used in this manual:

Zenia Singapore, Newlyweds Foods, Tetra Laval Food (Singapore), Griffith Laboratories, Frigoscandia Food Process Systems AB, R.A. Pearson, 3M masking & Packaging Systems Division, Multivac Inc, Blue Water Seafoods, Triangle Package Machinery Company.

We would also like to thank the staff of PPD and MFRD for their technical assistance, the RC-IPD for editing and printing of this manual and the staff of the AEA for their assistance in the preparation of the manuscript.

Note : The mention of trade names in this publicaton does not imply endorsement of the product

# CONTENTS

## PRODUCTION OF BATTERED AND BREADED FISH PRODUCTS FROM MINCED FISH AND SURIMI

# Illustrations

# Tables and Charts

# PRODUCTION OF BATTERED AND BREADED FISH PRODUCTS FROM MINCED FISH AND SURIMI

# INTRODUCTION

There is a perceived opportunity to compete in markets now being supplied with battered and breaded fish products made from increasingly expensive fillets. This manual describes how cheaper products of similar texture can be made from mixtures of minced fish and shredded pre-cooked surimi through a "cut and mix" procedure.

Underutilised fish and residual "frames" left over after fillets have been removed through conventional processing can be readily converted into 'minced fish' by using a mechanical meat-bone separator. If the resulting minced fish is of suitable quality, it can be upgraded into 'leached meat' by thorough washing with water. Good quality leached meat can be converted into 'frozen surimi' by partial dewatering and addition of sugar as a cryoprotectant and polyphosphates as a water- binding agent prior to freezing.

Good quality frozen surimi is marketed world-wide. A strong gel is readily formed by cooking a conditioned mix of surimi, water, salt, and other additives. The cooked gel is shredded and mixed with a minced fish paste. This mix is formed into shape and processed into the desired battered and breaded fish products.

The first section of this manual clearly explains the steps involved in the manufacture of battered and breaded fish products; for each step, important information related to quality control is included.

The second section presents information about packaging on battered and breaded fish products.

Three appendices provide detailed technical information for each topic: 1) processing/ manufacture; 2) packaging; and 3) quality control.

## 1.0 SHREDDED PRE-COOKED SURIMI

Surimi is pre-cooked and shredded to produce a component which will give textural variation in the final products.

The greatest texture variation, giving texture akin to fillet fish, is obtained by using a content of about 30% of shredded pre-cooked surimi.

Highest gel strength, with attendant greatest effect on texture, is achieved by using first quality surimi, with optimum addition of salt, water and other additives.

Gel strength is increased by pre-conditioning prior to cooking. Holding at room temperature for several hours (or better, from a microbiological quality viewpoint, for several minutes at 40°C) prior to cooking, will increase the gel strength.

Cooking in water at 90°C to a minimum internal temperature of 80°C is necessary to give satisfactory cooked surimi.

Water (or rapid) cooling makes the cooked surimi firmer, easier to shred and less perishable.

Shredding gives the form of cooked surimi component recommended for texturising the final mixture.

Thin shreds seem more desirable than other forms of comminution. The final choice is determined by equipment availability and consumer preference.

**QUALITY CONTROL CHART 1**

| STEP | HAZARD CONTROL MEASURE | QC CHECK |
|---|---|---|
| Thawing | Check surimi quality.<br>Use quickly once thawed. | Check odour on thawing.<br>Monitor temperature. |
| Mixing | Keep cool using ice and or ice water.<br>Process quickly | Check temperature each batch |
| Setting | Maintain bath temperature at 40 - 45°C | Check hourly |
| Cooking | Maintain bath temp. at 90° min.<br>Cook to 80°C | Check hourly<br>Check product temp. hourly |
| Cooling | Use chlorinated water.<br>Keep at room temp. by changing water regularly. | Check chlorine level daily.<br>Visual check and temp check hourly |
| Inter-step Storage | Keep in room at 0 - 5°C.<br>Use within 24 hours | Monitor inventory |

# PRODUCTION OF BATTERED AND BREADED FISH PRODUCTS FROM MINCED FISH AND SURIMI

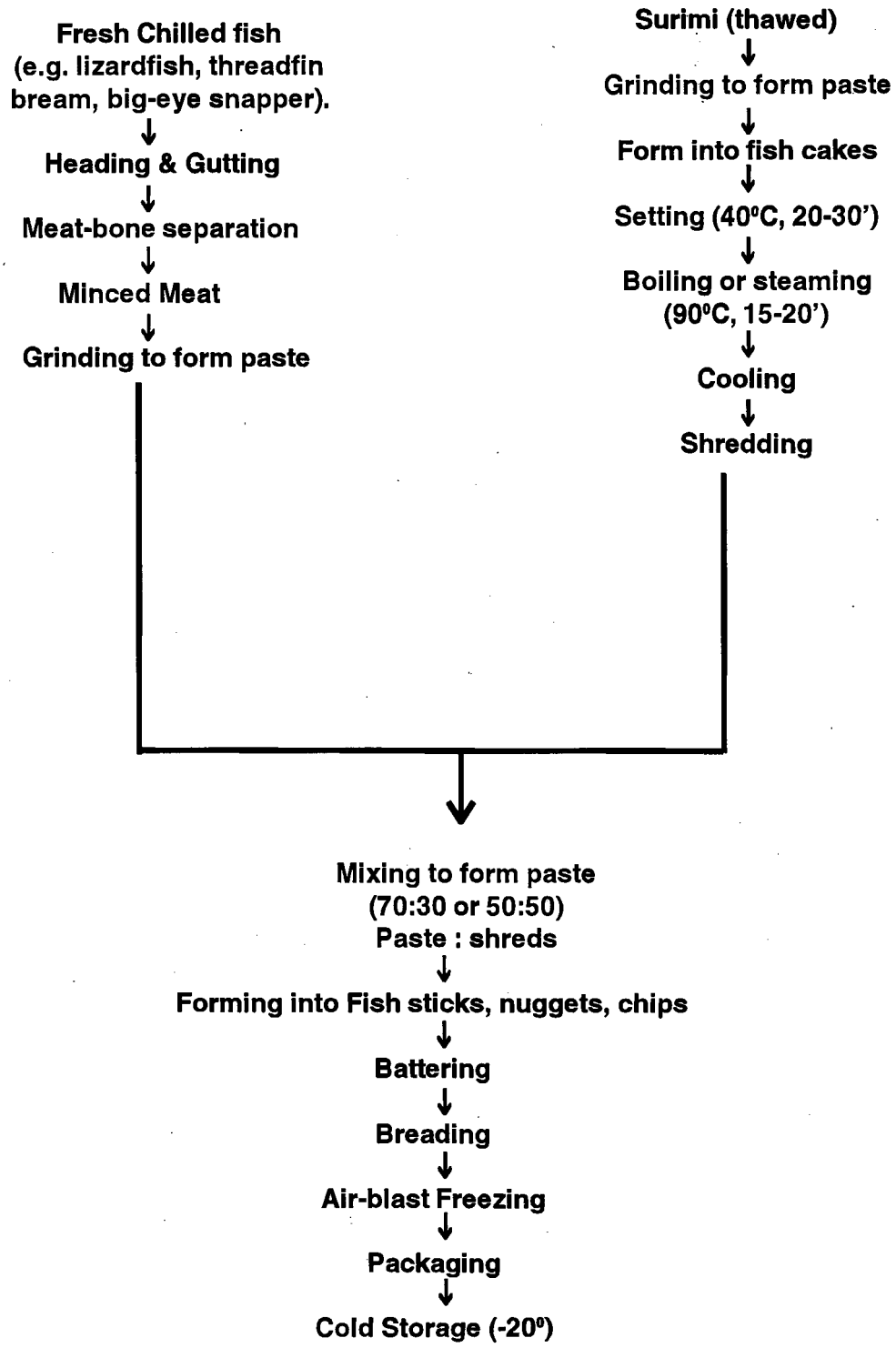


Figure 1. Fresh chilled fish SEAFDEC

Figure 2. Frozen surimi SEAFDEC

Figure 3. Final product RC-IPD


Figure 4. Ingredients SEAFDEC

Figure 5. Silent cutter SEAFDEC

## 1.1 PREPARATION OF SHREDDED PRE-COOKED SURIMI

Shredded pre-cooked surimi (fish cake) can be made from good quality leached meat using existing fish cake/fish ball techniques.

The product can also be made from frozen surimi. After thawing to about -5°C, the surimi is ground, using a silent cutter, and salt, water and other ingredients are added. An example of a formulation using threadfin bream surimi is (with ingredients added as % of the original weight of surimi):

| | | |
|---|---|---|
| Salt | : | 2.5% |
| Water | : | 30% (or proportionately less with lower quality surimi) |
| Wheatflour | : | 3% |
| Egg white powder | : | 1% |
| Mono-sodium glutamate | : | 0.75% |

The mix is quickly formed into fish cakes, using a forming machine (or a mould) and then set in water at 40°C for 20-30 minutes prior to cooking in water at 90°C for about 20 minutes.

The cooked fish cakes are chilled and kept below 5°C until ready for use.

Using a shredder the cakes are shredded into 3mm thick strands. A silent cutter may also be used for shredding but care must be taken to ensure that the "shreds" are not cut too finely.

SEAFDEC

Figure 6. Forming and setting of fish cakes

Figure 7. Shredder SEAFDEC

## 2.0 RAW FISH PASTE FROM MINCED FISH

## 2.1 PREPARATION OF MINCED FISH

### 2.1.1 Raw Materials

In the Southeast Asian region, the trawl by-catch comprises a number of low-value fish species which can be used as a fish mince binder for breaded fish products.

While almost any white meat fish species can be used, consideration should be given to freshness, colour of the minced meat, and its ability to form at least a weak gel. Species commonly found in the trawl by-catch, such as lizard fish, threadfish bream, big-eye snapper, croaker, and goatfish (tends to give pinkish colour mince meat) can be used, but freshness is important.

Minced meat from pelagic fish species like sardine, selar and ponyfish tends to be dark red and gives a greyish colour to the end-products. Gel-strength is also low and, depending on freshness, does not bind as well and gives the product a more fishy taste. However, it can be used for products containing spices (e.g. otak-otak breaded fish products).

It is not advisable to use mixed fish species, as changes in the species composition will effect the quality and colour of the end-product.

The raw fish should be washed with chilled water and kept iced until ready for use. Heading and gutting should be done as quickly as possible, while maintaining the fish at a low temperature (<5°C). The kidney tissues around the backbone should also be removed.

Headed and gutted fish should be kept chilled until ready for meat-bone separation.

### 2.1.2 Meat-Bone Separation

The quantity and small size of the fish used makes it too laborious and costly to fillet the fish manually. A drum type meat-bone separator with a 3mm stainless steel mesh drum is used to extract the meat. As this process generates heat, it is important to chill the fish before beginning.

Figure 8. Meat bone seperator SEAFDEC

### 2.1.3 Minced Meat

The minced meat contains blood, fats, and enzymes, and deteriorates very quickly under ambient (room) temperatures. It should be kept chilled at all times and used immediately.

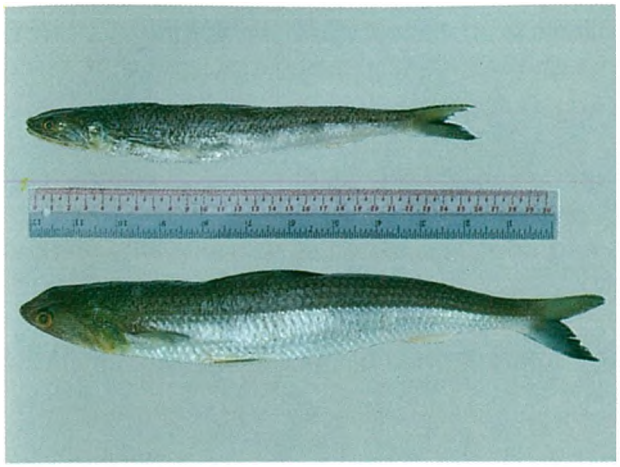


Figure 9. Lizard fish SEAFDEC

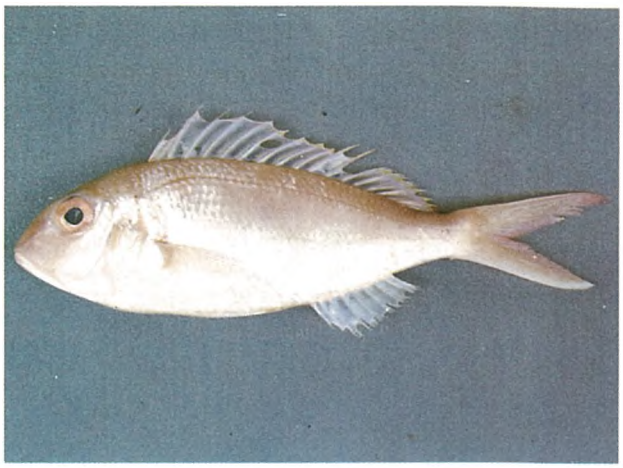


Figure 10. Threadfin snapper SEAFDEC

Figure 11. Big eye snapper SEAFDEC

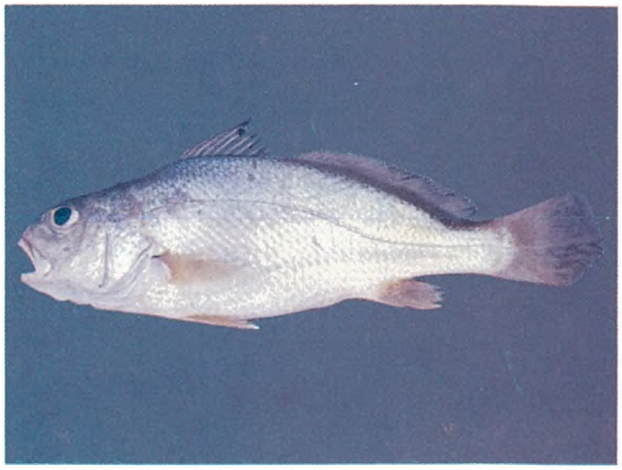


Figure 12. Croaker SEAFDEC

Figure 13. Goat fish SEAFDEC

Figure 14. Minced fish meat SEAFDEC

## 2.2 RAW FISH PASTE

This is a low cost blend of minced fish with additives to improve texture, flavour, water holding (binding) capacity etc. When mixed with shreds of pre-cooked surimi, this paste gives the mix which will be the centre material for the product.

Addition of salt gives taste and improves the texture and water holding capacity of the mix.

Wheat flour improves texture and the water holding capacity, particularly in the final cooked products.

Egg white powder is optional but is usually worth the added cost because of improved texture in the final cooked products.

As the fish paste is highly perishable, it must be kept cool and used quickly. The paste firms rapidly with time, particularly at higher temperature. A firmer mix will be more difficult to blend with cooked shreds, and to shape.

| QUALITY CONTROL CHART 2 | | |
|---|---|---|
| **STEP** | **HAZARD CONTROL MEASURE** | **QC CHECK** |
| Raw Material | Check quality by incoming inspections. | Visual, texture and odour check on receipt. |
| Receipt of whole fish | Incoming lot inspection. Keep in chilled store. | Odour, appearance, freshness evaluation. Monitor store temp. |
| Wash Fish | Use chlorinated water. | Check $Cl_2$ level daily. |
| Process fish into minced paste | Clean and sanitize equipment regularly. Maintain good personal hygiene. Use quickly. | Check before starting. Check temperature hourly. |


Figure 15. Ingredients SEAFDEC

### 2.2.1 Preparation of Raw Fish Paste

Example - based on using fresh, good quality, lizard fish with ingredients added as a % of the original weight of minced lizard fish:

| | |
|---|---|
| Salt | : 1.5% |
| Water | : 30% (or proportionately less with lower quality minced fish) |
| Wheatflour | : 7.5% |
| Egg white powder | : 1.5% |

The chilled minced lizard fish is put in a silent cutter and mixed with the salt.

The iced water and other ingredients are gradually added.

The mix is highly perishable, and must be kept cool and used quickly.

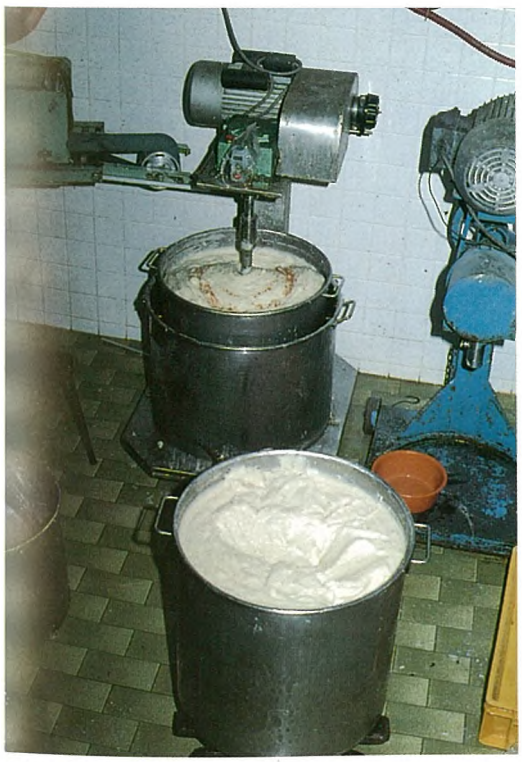


Figure 16. Mixer SEAFDEC

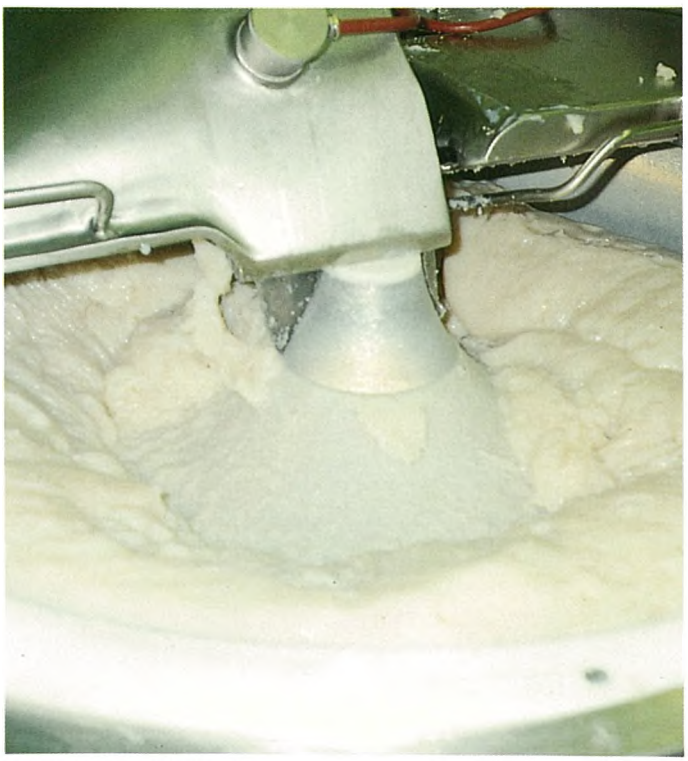


Figure 17. Silent cutter SEAFDEC

## 3.0 BLENDING "CUT AND MIX"

The objective is to achieve a uniform blend of the raw fish paste with the surimi shreds.

The best ratio of the two components will have to be determined by the processor, but a 7:3 ratio of paste to shreds is recommended. This ratio has given products with texture similar to ones made from fillet fish. Raw paste is cheaper than shredded surimi, so it is obviously more profitable to use a higher content of paste.

The mixer must have a gentle action, to avoid damage to the shreds and attendant loss of textural variety with less of the fillet character. A silent cutter is vigorous and disintegrates pre-formed shreds.

The mix must be kept cold and used rapidly, to prevent both microbiological growth and setting of the paste . Such setting would interfere with the shaping stage.

| QUALITY CONTROL<br>Chart 3 | | |
|---|---|---|
| **STEP** | **HAZARD CONTROL MEASURE** | **QC CHECK** |
| Weigh Batch quantities | Keep equipment and containers clean and sanitized.<br>Maintain good personal hygiene. | Inspect before start up .<br>Instruct personnel. |
| Blend surimi and mince | Use quickly.<br>Keep cool. | Check temperature regularly. |

Figure 18. Hand mixing SEAFDEC

Figure 19. Ribbon blade mixer SEAFDEC

## 3.1 PREPARATION OF "CUT AND MIX" BLEND

Requisite proportions of shredded cooked surimi and of raw fish paste (3:7) are put into a gentle action mixer. A blade or ribbon mixer is ideal, and the mix should be an even blend.

A silent cutter is not recommended, as this breaks down pre-formed shreds and leads to a less desirable texture in the final product.

However, a silent cutter can be used for both the shredding and the mixing operation. In this case the fish cake should be added towards the end of the mixing operation. This will avoid excessive comminution of the fish cake.

The mix is highly perishable, and should be kept as cool as practicable and used as soon as possible after mixing.

Figure 20. "Cut and mix" blend SEAFDEC

## 4.0 SHAPING

Although the mix can be shaped by hand (e.g. with the aid of plastic moulds), this is not recommended. Cost, microbiological hazards and the need to freeze such hand formed shapes prior to breading and battering favour mechanical forming.

No problems have been encountered with continuous mechanical forming, although it is conceivable that the texture of the mix may have to be optimised to suit a specific machine. Variation in water content of the raw paste is the simplest way of achieving this variation.

The machine should be operated with cold mix, and should be thoroughly cleaned and sanitised at regular intervals to reduce bacterial contamination of the shapes.

| QUALITY CONTROL<br>Chart 4 | | |
|---|---|---|
| **STEP** | **HAZARD CONTROL MEASURE** | **QC CHECK** |
| Shaping | Keep equipment clean and sanitized.<br>Maintain good personnel hygiene.<br><br>Use mixed paste quickly.<br>Keep cool. | Inspection at start.<br>Instruct personnel.<br><br>Check temperature regularly. |

Figure 21. Hand forming SEAFDEC

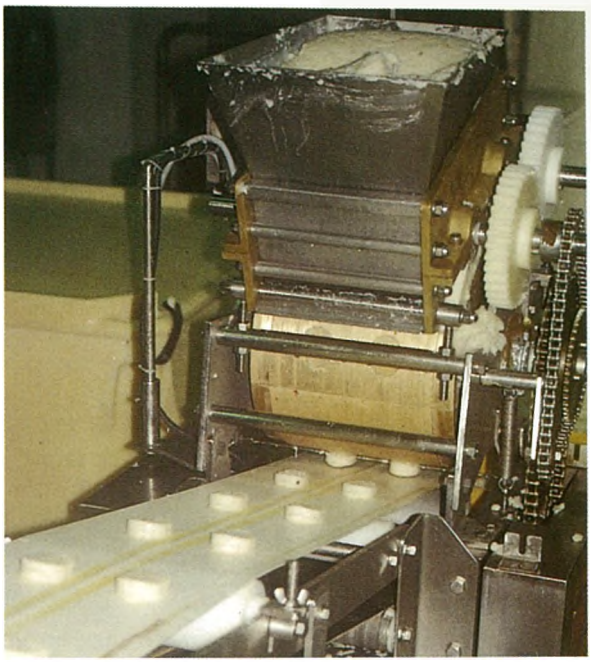


Figure 22. Forming machine SEAFDEC

## 4.1 PRODUCTION OF FORMED SHAPE

The cool mixture of fish paste and shredded surimi is formed into shape.

This can be done by hand, using plastic forming moulds.

Several types of machines are available for continuous formation of the mix into virtually any shape. The output of such forming machines can be directly deposited onto the feed belt of the battering and breading unit.

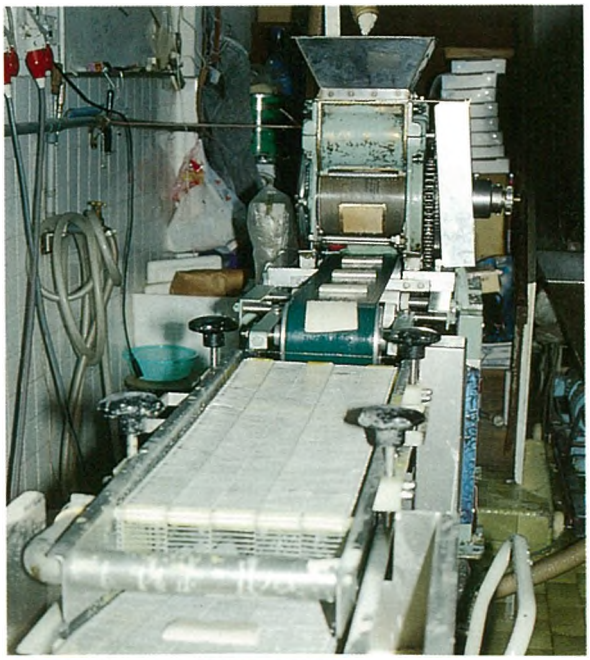


Figure 23. Forming machine SEAFDEC

## 5.0 BATTERING AND BREADING

The processor must choose from essentially three basic types of batter:

- thin adhesive batter, which aids breading;
- regular fish and chips style batter;
- thick self raising tempura batter.

The processor must also choose from an enormous variety of different breadings. Specific breadings could in fact be made to the processor's own need. The most common breadings are of the large fragment Japanese style crumb, usually pre-coloured.

The surface of products to be coated may have to be pre-coated with water and/or wheat flour, to help subsequent adhesion of batter.

The batter itself must be prepared to a constant consistency and kept as cool as possible. However, thick batter of the self raising tempura batter must be relatively warm to be effective, and they should not be vigorously agitated or pumped.

Both batter and breadings are applied mechanically. The design of particular equipment and accessories must be determined by the individual types of batter to be applied. This is especially the case with the tempura batter and breading applications for the fragile Japanese style product.

Problems with uniformity of coating and correct pick-up are addressed by adjustments to line speed, batter consistency, ingredient flow level and correct setting of the air curtain, vibrator, "flip" transfer, or pressure roll attachments.

| QUALITY CONTROL<br>Chart 5 | | |
|---|---|---|
| **STEP** | **HAZARD CONTROL MEASURE** | **QC CHECK** |
| Prepare batter mix | Keep cool. Use quickly. | Check temperature hourly. |
| | Ensure equipment is clean and sanitary.<br>Ensure good hygiene. | Check before start.<br>Check correct practice is followed. |
| | Maintain uniform coverage. | Check coverage frequently. |
| Battering and breading | Ensure equipment is clean and sanitary. | Check before start daily. |

Figure 24. Batter mixer STEIN

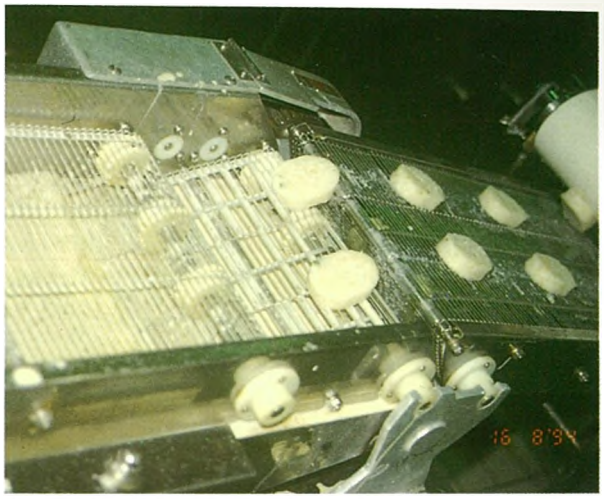


Figure 25. Batter applicator SEAFDEC

## 5.1 BATTERING AND BREADING PRE-FORMED SHAPES

The pre-formed shapes are directly battered and breaded by suitable continuous mechanical equipment.

Since no predust (water or flour) is needed for the "cut and mix" product, the shapes are directly battered.

The batter is prepared in a separate mixer and transferred continuously to the battering unit which works on both a dip and curtain flow principle.

Excess batter is removed by an "air curtain" and the battered product (with the exception of very thick tempura batter) is then directly breaded by a trough and falling curtain application of the breading.

It is stressed that Japanese style breadings need special design of crumb transfer and applicator. Excess breading is removed by a vibrator or "flip over" device, and adhesion is assured by use of a squeeze roll.

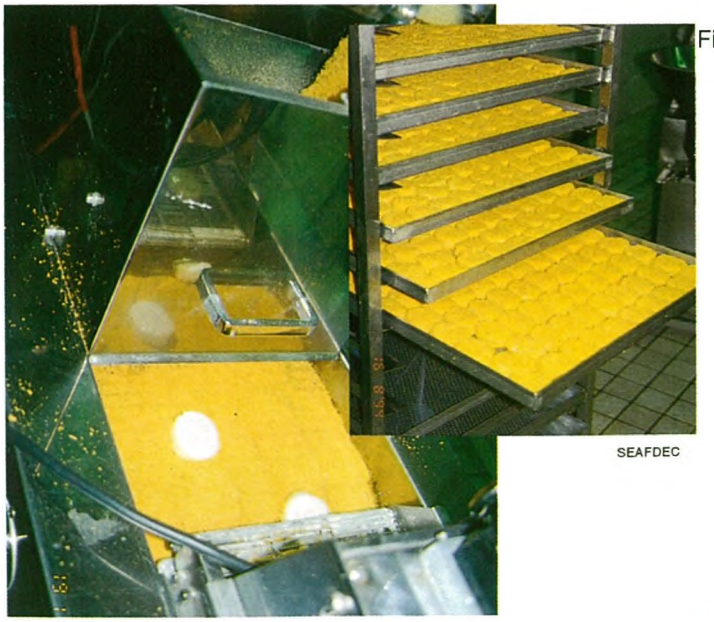


Figure 26. Breading SEAFDEC

Figure 28. Breaded Product For Freezing SEAFDEC

Figure 27. Breaded Product SEAFDEC

## 6.0 FRYING AND FREEZING

Frying gives a firmer product with a fried appearance and taste. The usual processing gives a partly fried ("par fried") product, rather than a completely fried (cooked) product.

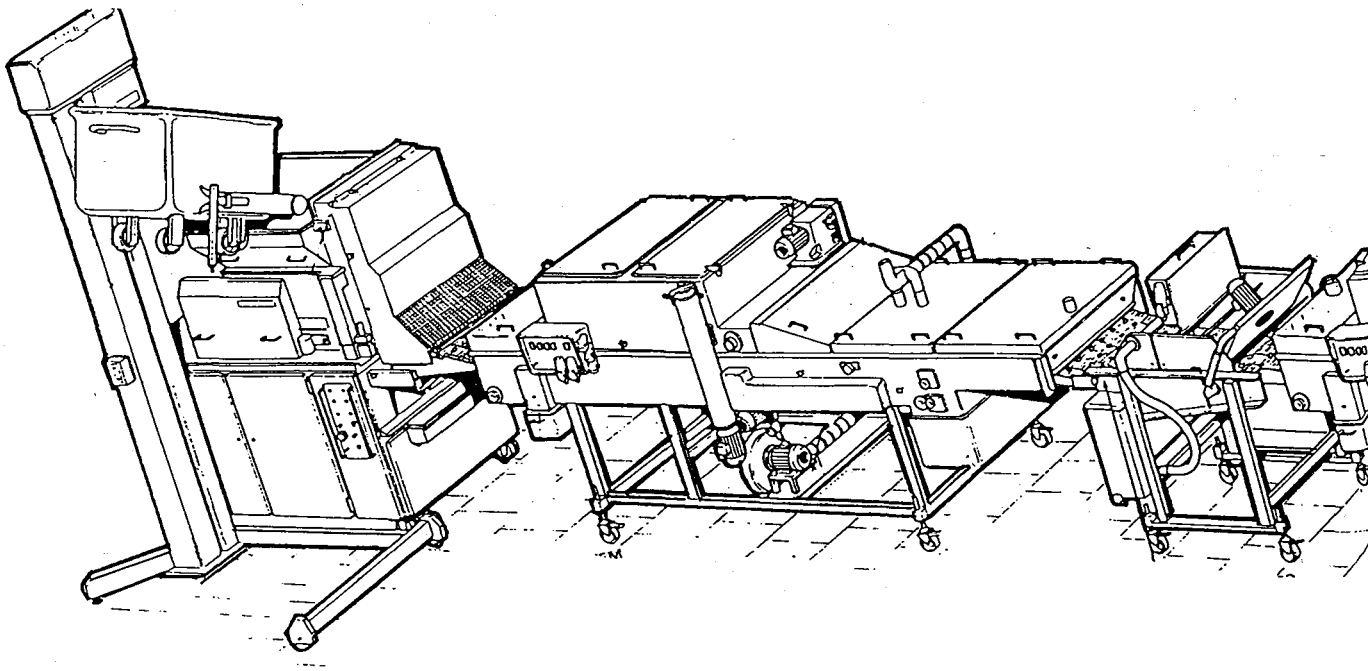
Frying is not obligatory, other than for products with an outer coating of tempura batter which would otherwise be too soft to handle for freezing. However, frying does give a more attractive colour (which can alternatively be obtained by the use of coloured batter and breading) and a coating of oil, which is required for products intended for final oven cook rather than frying.

On the negative side, frying adds to the cost of the operation. Without careful control of the frying oil the "par fried" product can have decreased shelf life due to the development of rancidity, both hydrolytic (measured by free fatty acid) and oxidative (measured by peroxide value and/or Thiobarbituric acid - TBA value). Rancidity is minimised by using good quality frying oil, particularly hydrogenated oil, according to the supplier's recommendations.

Frying is usually carried out directly after battering and breading. In some cases the battered and breaded products are "par fried" after freezing. This technique is desirable for products, which would otherwise shrink or loose their shape on "par frying". Such products must, of course, be refrozen after "par frying".

Blast freezing should present no problems in any but tempura coated products. For these products, special transfer devices are available.

Figure 29. Production line graphic



| QUALITY CONTROL<br>Chart 6 | | |
|---|---|---|
| **STEP** | **HAZARD CONTROL MEASURE** | **QC CHECK** |
| Frying | Maintain oil temperature. | Check temperature hourly.<br>Check fried colour hourly. |
| | Prevent rancidity by filtering and/or replacement. | Check oil quality twice/day. |
| Freezing | Maintain freezer at -30°C.<br>Complete freezing. | Check freezer temperature twice/day.<br>Check for complete freezing after each batch. |

TETRA-LAVAL

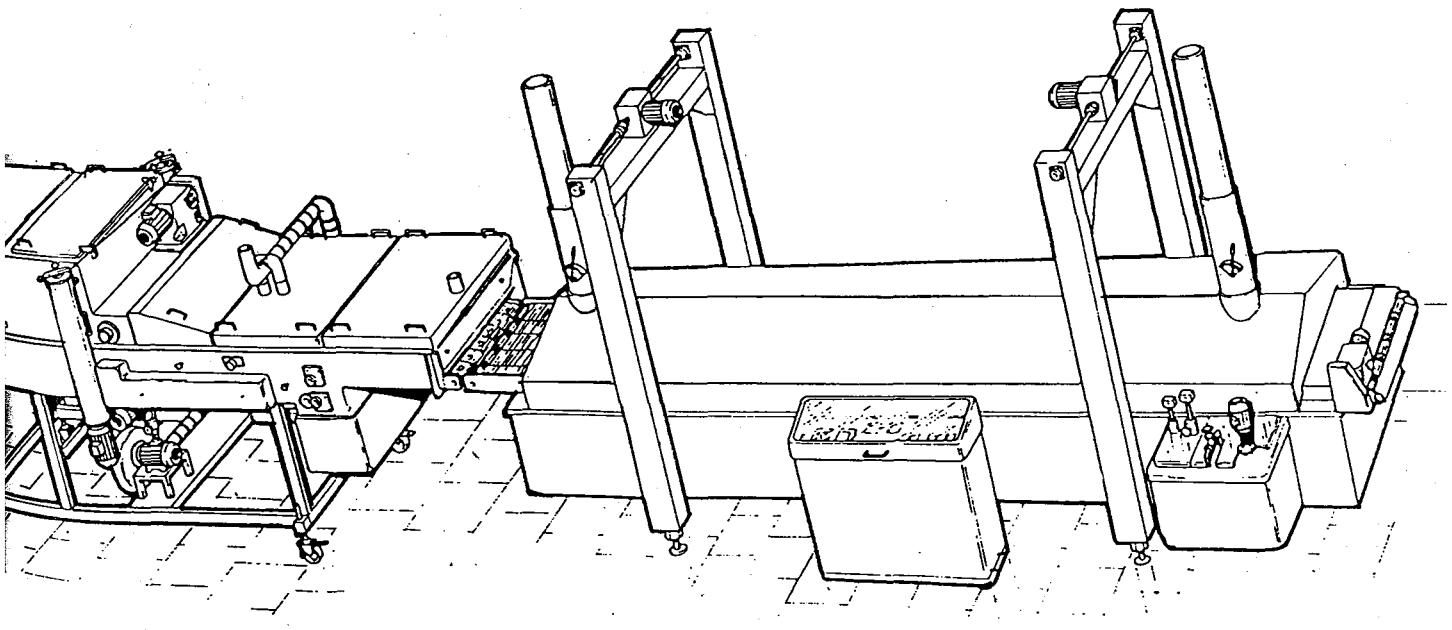


Figure 30. Fryer STEIN

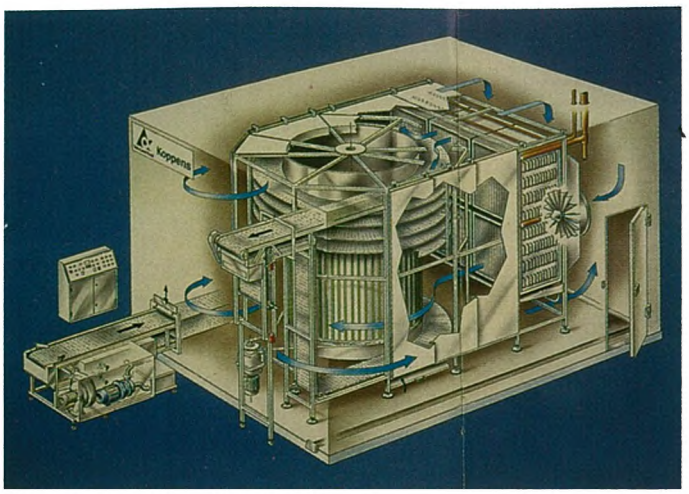


Figure 31. Spiral Freezer TETRA-LAVAL

Frying, where needed (e.g. for products coated with tempura batter alone or those products intended for oven cooking), is carried out either by batch frying or, more commonly, by continuous operation.

Continuous fryers operate on the principle of conveying the product, submerged, through a long bath of heated edible oil. The needed degree of "par frying" is accomplished by residence time and oil temperature. The best fryers incorporate filters, to maintain good quality in the heated oil.

The "par fried" product is air cooled before freezing.

Freezing can be on a batch basis (on trays) or, preferably, in a continuous blast freezer.

Figure 32. Air blast freezer SEAFDEC

# PACKAGING OF FROZEN BATTERED AND BREADED FISH PRODUCTS


Examples of packaged frozen battered/breaded fish products

RC-IPD

## 1.0 PROCESS

Packaging in various paperboard/plastic container which have good barrier properties to moisture vapour.

## 1.1 PURPOSE

To contain, protect and sell product; to prevent dehydration and freezer burn during frozen storage; to ensure product quality until time of consumption.

## 1.2 METHODS

**1.2.1 Manual:** Filling by hand. Sealing done manually using a foot-operated impulse heat sealer or a mechanically operated horizontal bag sealer.

**1.2.2 Mechanical:** Manual or automatic filling sealing with vertical/horizontal form filling, sealing equipment.

## 2.0 PACKAGING REQUIREMENTS

The packaging materials used for frozen, battered/breaded fish products should:

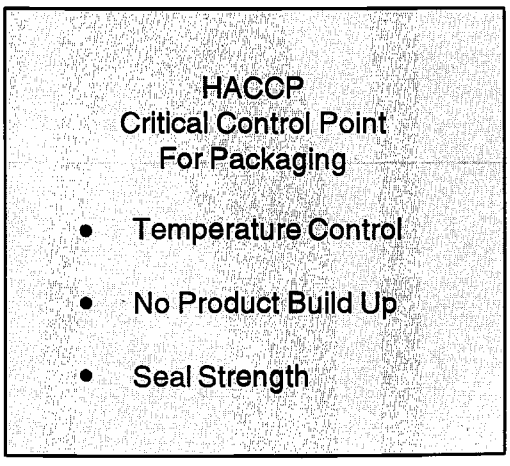
- Not become brittle or deteriorate during prolonged storage at -20°C;
- Be puncture resistant;
- Be impervious to moisture and, if possible, to oxygen

This latter requirement is important to prevent **FREEZER BURN.**

Long term packaging of frozen, battered/breaded fish products can be sub-divided into :

(i) Individual Unit Packaging;

(ii) Bulk Packaging.



## 3.0 INDIVIDUAL UNIT PACKAGING

Examples of packaging materials commonly used for individual unit packaging are:

PS/PP trays overwrapped with LDPE or PP plastic film;

PE or PP bags inside a paperboard box;

Paperboard boxes with PE liners at bottom, middle, top of product;

PS/PP trays overwrapped in shrink film;

PE coated paperboard trays;

Microwaveable paperboard/PET/aluminum foil trays inside a PE coated paperboard tray.

In the South East Asia region, products are packaged manually into PS or PP trays and then overwrapped with PP film using a Horizontal Pillowpack or Horizontal Form/Fill/Seal equipment. This equipment can wrap and seal about 30-45 trays/minute.

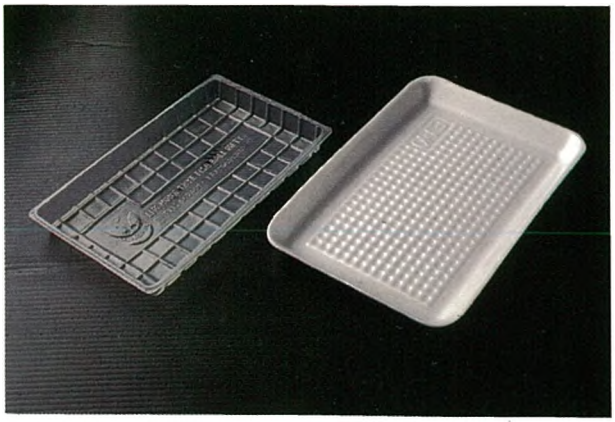


Figure 34. PS/PP trays RC-IPD


Figure 35. PS/PP trays overwrapped with LDPE or PP plastic film RC-IPD

Figure 36. PE or PP bags inside a paperboard box RC-IPD

Figure 37. Paperboard boxes with PE liners at bottom, middle, top of product. RC-IPD


Figure 38. Paperboard boxes with PE liners at bottom, middle, top of product, sealed with tape. RC-IPD


Figure 39. PS/PP trays overwrapped in shrink wrap film RC-IPD


Figure 40. PE coated paperboard box RC-IPD

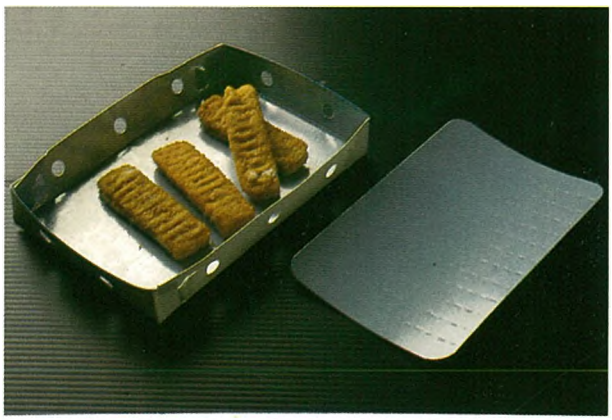


Figure 41. Microwaveable paperboard/PET/aluminium foil trays inside a PE coated paperboard box. RC-IPD

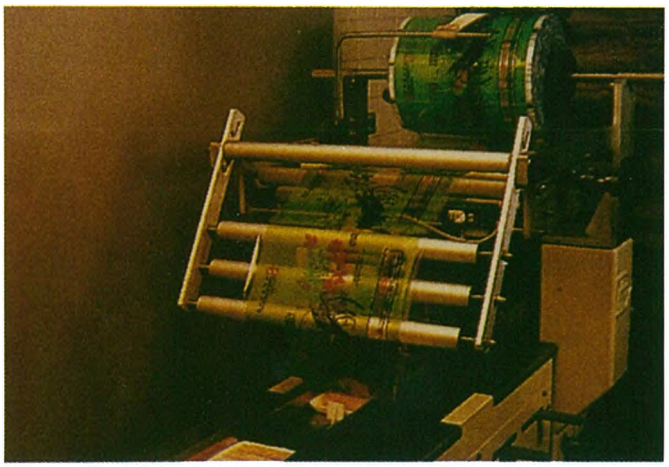


Figure 42. A horizontal pillowpack machine. Lim Hong Thye

GLOSSARY OF PACKAGING TERMS

| | | | | | |
|---|---|---|---|---|---|
| **EVA** | = | Ethylene vinyl acetate; | **HDPE** | = | High density polyethylene; |
| **LDPE** | = | Low density polyethylene; | **PET** | = | Polyester; |
| **PA** | = | Polyamide. | **PS** | = | Polystyrene; |
| **PP** | = | Polypropylene; | **PVC** | = | Polyvinyl chloride; |
| **PVDC** | = | Polyvinylidene chloride; | | | |

Another alternative packaging is to overwrap PS trays with shrink film e.g. PVC or PP using a heat shrink tunnel.

Individual unit packaging can also be done using uncoated paperboard boxes with PE liners placed between layers of product to prevent moisture loss and freezer burn. The boxes are sealed manually using adhesive tape.

In North America, PE coated paperboard is mainly used to package battered/breaded frozen fish products. Product is packaged manually into containers on horizontal form/fill/seal equipment. The filling process can be automated using a computer controlled filling system.

Microwaveable packaging materials are being used more frequently in North America for par fried frozen, battered/breaded fish products. The innermost tray acts as the heating tray. It is filled with product and placed inside a PE coated paperboard box. Instructions for microwaving product are placed on the lid of the inner microwaveable tray. Examples of the various types of individual unit packaging containers and packaging equipment are shown in Figures 34 - 44 respectively.

Figure 43. Heat shrink tunnel SEAFDEC


Figure 44. Automated shrink wrap equipment SEAFDEC

## 4.0 BULK PACKAGING

The two main packaging systems which can be used for bulk packaging are;

PE/PP bags;
PE liners/bags inside a corrugated board container.

PE/PP bags can be filled manually and heat sealed with an impulse heat sealer.The packaging process can be automated using a vertical form/filling/sealing system.

Alternatively, PE bags can be filled, heat sealed and then placed inside a corrugated board container for added physical protection.

Figure 45. PE/PP bags. RC-IPD


Figure 46. PE liners/bags inside a corrugated board container. RC-IPD

Figure 47. Impulse heat sealer. RC-IPD

Figure 48. Corrugated board container plus sealing. RC-IPD

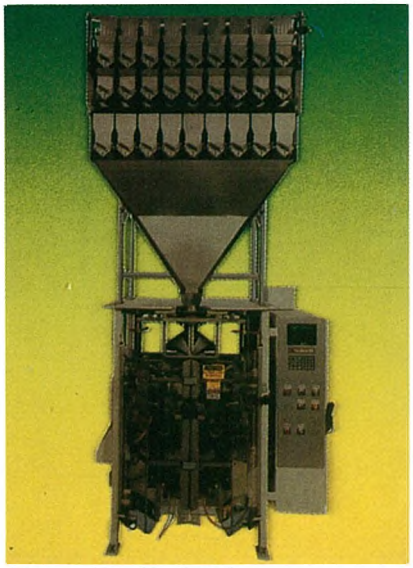


Figure 49. Vertical form fill seal equipment. Triangle Package Machinery Co.

## 5.0 SECONDARY PACKAGING

To protect further the primary package, many battered/breaded fish products are packed in another container (i.e. secondary package). This usually consists of single walled or double walled corrugated containers. In smaller plants the containers are filled and sealed manually using a hand held sealing dispenser. In larger plants, cases can be automatically formed. The cases can also be sealed using an automatic case sealer.

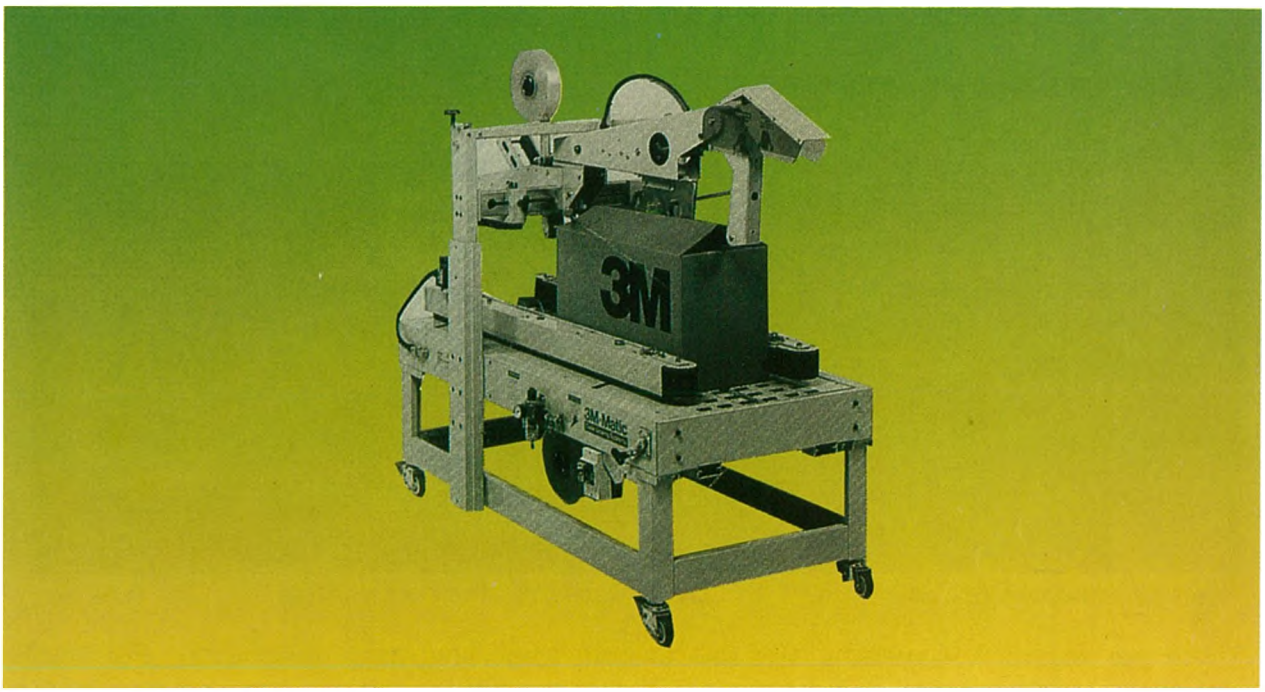



Figure 50. Automated case sealer 3 M

In a few North American plants, the process of case forming/filling/sealing can all be done automatically using more advanced adjustable case packers. These machines are designed to erect, pack, close and seal cases at a rate of 20 cases per minute.

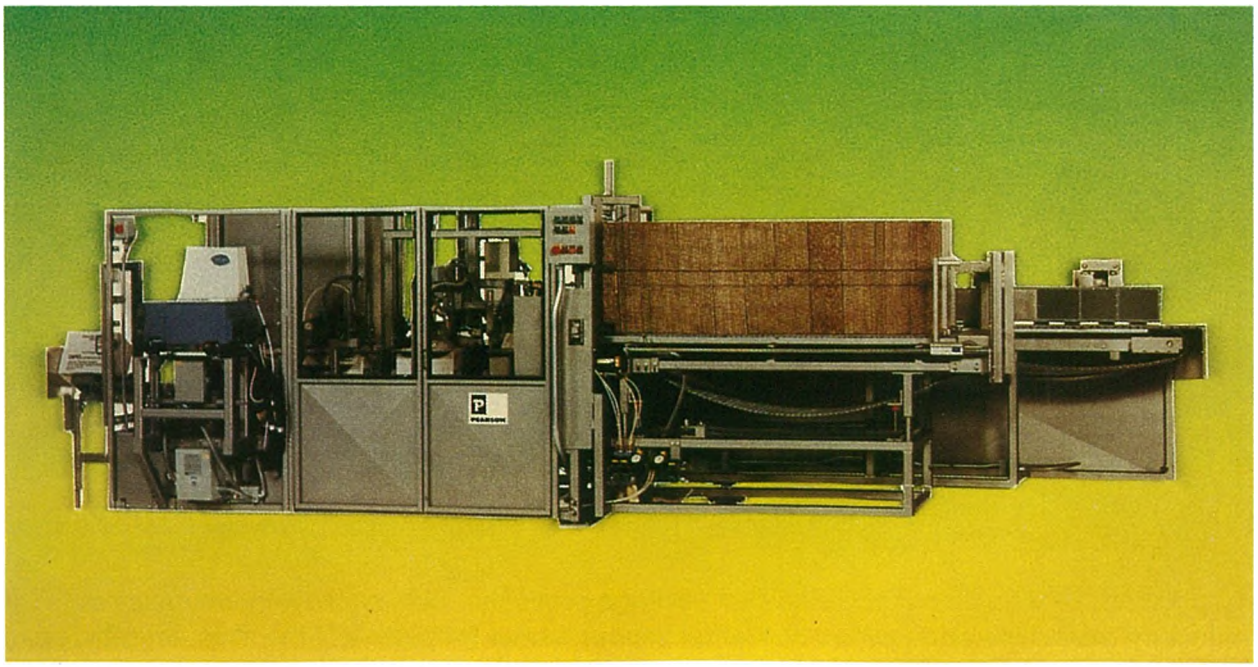


Figure 51. Automated case forming filling sealing system R.A. Pearson .

## 6.0 ALTERNATIVE PACKAGING (VACUUM PACKAGING)

Battered and breaded fish products may be par fried, to seal the batter, and cooked to crisp the breadcrumbs, prior to freezing and packaging. Vacuum packaging(VP) can be used in conjunction with freezing to:

(i) Prevent oxidative rancidity problems;

(ii) Prevent dehydration/freezer burn.

Figure 52. Chamber VP machine SEAFDEC

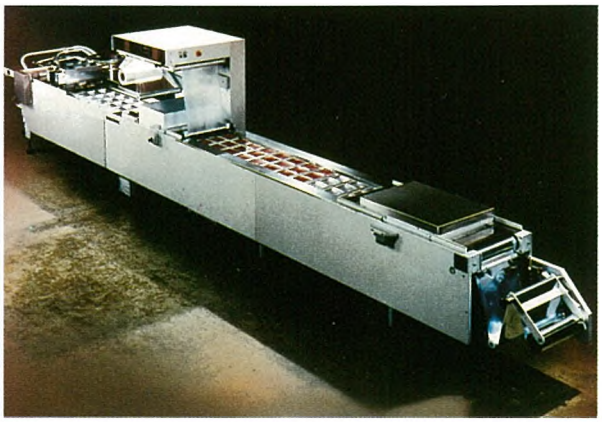


Figure 53. Roll stock machine Multivac Inc.

There are several VP systems available to both small and large processors. For smaller processors, various chamber machines are available, while the larger processors have at their disposal a range of rollstock vacuum packaging/gas packaging machines. Examples of suitable high barrier laminated packaging materials for use with both chamber and rollstock machines are: PP/PA/PP, PP/PA/PE, PA/PE, PA/PP, PA/PVDC/PE, Cellophane/PE, PET/PE, and PS/PE/ coated paper.


Figure 54. Vacuum skin packaging machine SEAFDEC

In addition, VP equipment can also skin package products. Skin packaging increases both the puncture resistance and the gas and water vapour barrier properties of the films, thereby giving additional control over dehydration (i.e., freezer burn and oxidation problems).

# PRODUCTION OF BATTERED & BREADED FISH PRODUCTS FROM MINCED FISH & SURIMI

## APPENDIX I

## Manufacturing & Technical Aspects

## 1.0 INTRODUCTION

Declining stocks of most varieties of popular fishes, accompanied by higher prices, have led to considerable effort both to utilise the catch more completely and to utilise so called underutilised species.

Availability of durable and easy to operate meat bone separating equipment (mechanical deboners) enables the fish processor to produce an essentially boneless raw minced fish from the residual frames of filleted fish or from trimmed, headed and gutted, whole fish.

The minced fish may be used directly as an ingredient, in fish cakes, fish paste etc., or, depending largely on the particular species and its freshness, can be converted into a higher value surimi ingredient through a process of thorough washing and partial dewatering.

Surimi is now available as a commodity item on world markets with current supplies being mainly derived from Alaskan pollock. Various grades are marketed with price largely dependent on colour, water binding and gel strength capacity and freedom from visible blemishes or odour. Surimi has the ability to form strong elastic gels when mixed with salt, water and other functional ingredients. The heat set gels, such as the Japanese kamaboko and the Chinese fish balls, have long been popular in Asia. Similar products such as crab leg analogues have recently become popular in the western world, proving that there is a good market for cheaper products which are near to the eating quality of the natural product.

Western markets are seemingly accustomed to the fillet type of texture in most of their fish products. Products made from minced fish (e.g. fish sticks and portions now on sale) have a soft texture and command much lower prices than similar products made from fish fillets.

Thus we have a dilemma. Cheap minced fish gives a texture less popular than much more costly fish fillets. Higher quality minced fish preparations (surimi) give a tough/rubbery texture which, apart from use in shell-fish analogues, seems restricted to Asian taste.

We have found that a combination of a pre-mix containing raw minced fish with a shredded pre-cooked surimi gel component gives products of intermediate eating quality which is nearer to that of fish fillet.

The relatively low ingredient cost of the blended products should offer profitable business opportunities.

It is suggested that the greatest potential for these low ingredient cost blends is in the production of frozen battered and breaded fish products. A wide range of battered and breaded fish products are now on international and local markets. Many of these, particularly those now made solely from minced fish, could surely be replaced by products of improved texture.


Figure 55. Battered and breaded fish products. RC-IPD

A wide range of commercial processing equipment is available to form the fish mixture into virtually any desired shape.

Similarly, equipment is readily available to batter directly, to bread and, if necessary, to fry the shaped fish mix prior to final freezing and packaging. A wide range of both batter mixes and breadings is commercially available. The wide assortment offers vast variety in surface appearance texture and taste together with potential savings from the lower cost of the coating and components of the final product.

This publication is intended to be a working guide on the production of consistent good quality battered and breaded fish products from mixtures of raw minced fish and pre-cooked surimi. Although mention is made of specific suppliers of equipment and of ingredients, no recommendations are made concerning what the individual processor should purchase.

Nothing contained in, or referred to by, this publication shall be construed as a guarantee of performance, or as recommendation/authority to practice any invention covered by any current patent without a licence from the patent owners.

It is stressed that the composition of these mixes does not conform to the Codex Standard for quick frozen fish sticks and fish portions because of the necessary inclusion of certain additives (salt, starch, egg white, etc.) in the fish portion of the product. Labelling and ingredient declaration would have to consider that Standard.

## 2.0 PROCESS OUTLINE

The complete operation involved in making frozen battered and breaded fish products from mixtures of surimi and minced fish (or indeed any mix-based products) involves many consecutive stages, referred to as unit operations:

Ingredient selection

Storage

Preparation

Mixing

Forming into desired shape

(pre-dust - e.g. with flour to give better adhesion of batter)

Battering (may be repeated if thicker coating required)

Breading (may be repeated if thicker coating required)

Frying (for specific products, particularly ones using tempura batters)

Cooling

Freezing

Packaging

(The flow diagram for virtually all types of battered and breaded fish is shown on **page 3.**)

The process may seem complicated, but overall it is little different from that involved in making any of the numerous frozen battered and breaded fish products now on the market. In fact the only additional stage is the preparation and shaping of the raw fish/surimi mixture prior to the initial battering.

Although it is true that several of the unit operations of the flow diagram can be carried out manually (i.e without the use of continuous, and often expensive equipment), most products are now made on continuous production lines. Only a few high value products such as battered shrimp are routinely made by hand dipping to apply the batter without affecting the attached tail.

For anyone considering a new production line, or even an addition to an existing line, the best advice is to talk to both existing processors and to reputable equipment suppliers and contractors, etc., prior to making final decisions.

Whatever the ultimate choice in equipment, it is essential that any material in direct contact with the product or ingredients, at any stage, should be made of appropriate grade stainless steel or approved plastic. All equipment should be of sanitary construction, permitting regular cleaning and sanitation.

If possible, pieces of equipment should be sized, both in capacity and speed, to be compatible with each other and allow the best use of the working space.

In general, each subsequent piece of unit equipment should have slightly higher belt speed without abrupt change in height between the two belts.

Subsequent sections of this guide detail several of the different types of equipment now in use for each of the unit operations.

## 3.0 INGREDIENT SELECTION AND PREPARATION

Ingredients are added to food products for their functional value. Consistent with existing regulations and with consumer acceptability, most processors will consider making maximum use of cheaper ingredients. Such use will often necessitate the co-addition of affordable amounts of more expensive ingredients. Thus, without opening a Pandora's box of "natural" food criticism, water is the most common ingredient added to fish products. Water itself is obviously a very low cost bulking agent which can even serve to improve the texture of the products. Careful use of polyphosphates will improve the water holding capacity of fish meat, during both frozen storage and gentle cooking. Co-addition of salt, as in the case of making cooked gel products from surimi, will give yet firmer texture on cooking. Other additives such as starches will permit the addition of higher water content and, with the possible addition of egg white, give a range of useful textures.

The food technologist has a vast range of ingredients, both natural and man made (food additives), to select from in order to maintain or increase profitability. The final selection will usually represent the best 'added value' at lowest cost.

Although all processors have access to most ingredients and additives it is sometimes desirable to buy simple mixes of additives and even products fabricated by another processor. Thus certain patented blends or trade secret mixtures (such as additives to surimi) must be purchased as the mix rather than much cheaper components. Fabricated products such as batter mixes and breading are usually purchased from suppliers rather than made by the fish processor. In this case the technical difficulties associated with their manufacture justify the processor for going part of the extra profit he might realise if he made these products for himself.

Let us now consider two areas where the processor will have to use food additives:

- as a binder in the fish mix
- to improve batter mixes

The ideal binder, or combination thereof, would allow the processor to include that amount of water deemed necessary to reduce ingredient cost, and yet allow processing of the raw mixture on existing equipment and give the required texture in the cooked product.

### 3.1 Binders

Several binders are worth consideration.

#### 3.1.1 Raw Fish

The raw material fish should be washed with chilled water and kept iced until ready for use. Heading and gutting should be done as quickly as possible, while maintaining the fish at a low temperature (<5°C). The kidney tissues around the backbone should also be removed. Headed and gutted fish must be kept chilled until ready for mechanical meat-bone separation.

#### 3.1.2 Surimi

Good quality surimi is able to absorb a minimum of 30% or so of its own weight of added water and, depending on the specific processing conditions (largely centred on time/ temperature regimes and correct addition of salt and polyphosphate), give cooked products of acceptable tough/springy/gel-like texture. Fullest practical use should be made of the natural water binding capacity of any surimi component.

Various grades of frozen surimi are now marketed (AA, A,B,C and D), and the processor is advised both to buy from a reliable source and to do his own checks on quality of dubious supplies. The supplier should provide information on fish species used, dates and place of manufacture and moisture content.

The quality of surimi is usually judged on its gel strength and colour, which depends on the following factors:

- fish species;
- freshness of fish; with on-boat processing preferred or within no more than 2 days if kept well iced;
- processing method and control thereof; freedom from strong or foreign odour and absence of coloured specks, etc;
- moisture content, where high moisture content is equated with lower value to the processor who has to compensate by adding less water to his mixtures;
- control of freezing, storage, handling and distribution systems, bearing in mind that quality deteriorates both with time and with increasing temperature (and very rapidly at near thawing temperature).

The exact quality of a particular batch of frozen surimi can be determined by several methods which have industry/trade recognition. These methods are well documented in the "Handbook on the Processing of Frozen Surimi and Fish Jelly Products in Southeast Asia" by the Marine Fisheries Research Department, SEAFDEC, Singapore. Optimum use of surimi is achieved by placing partially thawed frozen surimi pieces into a silent cutter. Salt is added whilst chopping (minimum of 1% maximum of 3%) followed by slow addition of cold water, iced water, or crushed/flaked ice and water (30%) making sure that the temperature remains below 4°C. Other ingredients (starches, proteins, gums, etc.,) are then added.

The final mix is 'conditioned' prior to final cooking. Different schools of thought exist as to what is the best 'conditioning' treatment. Setting at 40°C for 20-30 minutes, or at ambient temperature (28°C) for 2-3 hours, is commonly done. However our observation is that leaving the pre-formed shape (e.g. raw mix placed in a cooking mould) for 3 or more hours at ambient temperature (28°C), either in air or water, gives the strongest gelled final product.

Final cooking (heat setting) is achieved by cooking in a water bath(90°C), or steam cooking, to a minimum product temperature of 80°C.

The cooked material is air cooled and can be kept refrigerated for up to 2 days before use as a shredded component of the fish mix described more fully in a later section.

### 3.1.3 Flour/Starches

These are relatively cheap and widely used. However, their use often leads to a pasty texture and sometimes to product quality problems (thinning, syneresis, dough-like taste, etc.). In general, maximum possible use should be made of the cheapest available flour (which will probably be wheat flour) or starch (which will probably be tapioca). Here it is noted that performance characteristics (water binding, low gel temperature and reasonable freeze/thaw characteristic) favour the use of tapioca starch and potato starch rather than cereal starches (rice, corn, wheat).

While flour, by virtue of its gluten content, can contribute some stiffness to the raw mix, its full binding effect only occurs on cooking. Starches alone contribute little or nothing to the texture of a raw product. If firmer texture is required (for example for ease of shaping and handling), a short 'conditioning' (hardening)) after mixing should give sufficient improvement. Alternatively, pre-gelatinised starches or gums might be used together with the raw starch.

### 3.1.4 Heat Setting (Gelling) Proteins

Certain protein water systems (including surimi) set to a gel when heated. Egg albumen, or even raw egg white, is commonly used, but is rather expensive. Cheaper proteins are available, particularly (beef) blood plasma derivatives, soya protein concentrates or isolates, and gluten. The plasma proteins may be limited by religious/ ethnic considerations or by their own taste. Soya protein isolates are widely used in meat sausages, but have yet to find major use in fish mixes. Apparently resultant gels with added soya protein are weaker than gels made from good quality surimi alone. Gluten is limited by relatively high price and by the dough like texture and taste which accompanies its use.

### 3.1.5 Gel Forming Mixtures

Scientific literature abounds in examples of mixtures, primarily of gums and inorganic ions (salts), which form gels, some of which are stable on heating.

Sodium alginate is probably the best known and widely used. Solutions of sodium (or potassium or ammonium) alginates form heat stable gels when correctly mixed with calcium salts. The system has been widely used for fruit and vegetable products and for meat. Some success has been achieved (e.g. by Kelco Corp.), in using alginates in restructured fish products. However, once the gel is formed it is not reversible, and this restricts the use to cooked products and those where the gel is formed after shaping.

Carrageenates form relatively heat resistant gels when mixed with potassium salts. They also interact with proteins enabling better binding of water during cooking. Use in meat products, particularly poultry, is widespread. They are also used to some extent in surimi products, but is doubtful if they are better than much cheaper flours or starches.

Separate solutions of xanthan gum (soluble in the cold) and of locust bean gum (carob gum) or guar gum form gels on mixing. However, these gels are not heat resistant nor would they probably help to bind water in fish products.

### 3.1.6 Gums

These are commonly used for thickening food products, particularly fluid products. Their use is generally more restricted than that of starches, because of a gummy texture/taste. Guar gum, locust bean gum, xanthan gum and the man-made cellulose gum (sodium carboxymethyl cellulose), together with several other cellulose derivatives, are the commonly used gums. Each of these gums has potential application to our product. However, their greatest use is likely to be as viscosity (thickness) controlling aids in formulating batters. Here, xanthan gum, albeit expensive, would probably be the first choice, with guar gum and then cellulose gum being the next choices.

## 3.2 Batter Mixes

Two types of batter are commonly used: the normal (unleavened), and the thick leavened Tempura-type.

At their simplest, both types can be based solely on wheat flour and water, with the addition of baking powder or other raising agent for the Tempura batter.

A mixture of approximately 1/3 wheat flour and 2/3 water would serve as a poor normal batter. A mixture of approximately 50% wheat flour and 1% baking powder in water would serve as a poor Tempura batter.

Use of wheat flour and water alone is found to give a batter which is tough rather than crisp. As a result, many additives have been tested, and modern batter mixes are the result of much trial and are particularly suited to the processor's desired product and equipment.

Ingredient listings on two good quality commercial batter mixes are as follows:

> Standard batter mix: corn flour, corn starch, wheatflour, salt, dextrose and guar gum. For use, mix 25kg batter mix with 50kg water.
>
> Tempura batter mix: modified starch, wheatflour, cornflour, salt, hydrogenated vegetable oil, baking powder, soya flour, milk solids, dried egg whites and guar gum. For use, mix one part batter mix with 1.3 to 1.5 parts water.

The use of quality commercial batter mixes is highly recommended. However, worth while savings in ingredient costs can be achieved by those who make their own, preferably with the advice of a food technologist.

Mainly as an aid to those processors, let us consider the function of the batter, and the role therein of several ingredients.

Essentially, the prime role of a batter is as a coating on a product. As a coating, it is expected to provide a textural/flavour eating contrast on cooking, and is often used to ensure the adhesion of breading, which in turn gives even greater contrast.

Thinly applied batters serve mainly as an aid to satisfactory adherence of breading. While thin batters, or even milk itself, may serve as the anchor for very small size breading (e.g. domestic breading mix), the much larger crumb size breadings, like the Japanese (Pandora) style, need a much thicker batter. Very thick batters including a raising agent are usually used without any breading. Here, the thick puffy coating of batter must serve by itself as the sole texture/flavour eating contrast.

As well as adhering correctly to the product, (which in many cases can be assisted by a predust with, for example, wheatflour), the batter must remain on the product during cooking and have the desired colour, taste, and texture.

Starches, particularly cornflour (for its yellowish colour), cornstarch and wheatflour, are the commonest components, comprising more than 75% of the total solids.

The greatest problems with starches, which are otherwise preferred to wheatflour for their better texture and colour after frying, is that they do not, by themselves, stay suspended in

the wet batter. A practical way of keeping them suspended is to add other ingredients, which increase the viscosity (thickness) of the mix. Where affordable, xanthan gum is probably the best suspending agent. Wheatflour by itself is ideal for staying in suspension, but pre-gelatinised starches (modified starch) and guar gum are common additives to increase thickness. Soya flour and egg solids also help to keep a good suspension of the solids (starches, etc.), and also help improve the adhesion of the batter to the product.

Ingredients with unique properties, such as heat coagulable cellulose gums, are available to help both in stabilising the suspension and giving improved texture and lowering fat pick up during frying.

Other ingredients may be added to improve the taste (e.g. salt, MSG, and spices). In the case of spices, which could otherwise give visible specks in the batter, use is made of commercial preparations of flavour oils and oleoresin.

Batter colour is important in both the raw and cooked product. The desirable yellow batter of raw products is due to the cornflour, soyaflour and egg yolks, or even added food colour. The desirable golden brown colour of the cooked product is only partly due to colour in the raw batter. Most of the cooked colour comes from natural reactions (the so-called Maillard reaction) between amino acids and reducing sugars. Keeping the protein content of the batter low will tend to give paler batters. Addition of sulphur dioxide, where permitted, will also give paler colour. Addition of reducing sugar (e.g. dextrose or lactose or milk solids), which provide both protein and reducing sugar, give quicker colour formation on frying.

Fat in the form of milk or milk solids and vegetable oils are sometimes added both to help with the subsequent adhesion of the batter and to soften the texture of the cooked batter. The fat should be well dispersed in the batter mix, and this is commonly achieved by the use of emulsified fats (e.g. milk) or by adding emulsifying/dispersing agents such as caseinate, soya protein, egg yolk and even synthetic emulsifiers.

A prime objective in all batters is to have sufficient solids present, mainly starches, in stable suspension and with the right thickness and 'adhesive' properties to give complete coverage and desired pick-up. Thickness of the batter is the prime determinant, but changes in battering time (i.e. in line speed) and in the setting of the machine's air curtain can also be used to control the pick-up of coating.

Since all battering equipment works on a dip through a reservoir principle (note, though, that normal batters are also enrobed on top surfaces, at least, by flowing curtains); it is essential that the batter should be readily pourable.

In the case of normal batters, the batter mix can be kept stirred in a preparation tank and pumped to the enrober. In the case of the thick 'self raising' Tempura batters, because the batter must not be continually agitated, it must be transferred to the enrober either by manual pouring or by the use of special equipment.

Finally, mention must be made of the need to keep the batter mix at as low a temperature as practicable, both to minimise microbiological spoilage and to keep the batter thick. However, in the case of Tempura batters higher temperatures are needed to get the correct 'aeration' in the raw batter from reaction between the baking powder ingredients and water.

## 3.3 Breadings

Many different breadings are available, ranging from normal bread crumbs, cereal flakes, crackers, potato flakes and vegetable flakes, to very soft material such as cheese.

Flour based bread crumb type products are the most common, and these are available in a vast range of particle size, particle shape, colour (both raw and cooked) and texture.


Figure 56. Types of bread crumb RC-IPD

Although commercial breadings are rather expensive, due partly to transportation cost for a bulky and relatively fragile material, most processors would be well advised to use the commercially available breading.

Should the processor decide to make his own breading, the following factors should be considered.

As well as numerous variations in colour flavour and texture, which may be achieved through changes in the formulation of the basic wet 'bread' dough, there are also three types of baking process and several types of milling/flaking processes.

Basic raw dough can be similar to that used in conventional bread (i.e. flour, fat, salt and yeast pre-mixed with water) and then proofed before baking in a hot air or steam oven. The cooked loaves are then shredded, dried, and milled, to give desired particle size largely dependent on milling conditions and hardness largely dependent on dough composition.

A special way of baking is employed to make the very large and flaky Japanese (Pandora) type of breading. Here, the raw dough is cooked by direct resistance heating and the cooled loaf is milled in special equipment.

Firmer breadings, particularly those of the cracker-meal type, are made from fairly dry dough mix, by either conventional baking or by using extrusion cookers. The cooked product is shredded, dried if necessary, and milled to the desired particle size.

Hardness of the breading is mainly controlled by the amount of 'rise' in the dough mix and through the amount of fat in the dough. Changes can also be made by using emulsifiers to give a softer crumb, or strong wheatflour or added gluten to give firmer crumbs.

The breading can be coloured by adding natural or synthetic food colour to the dough. Final cooked colour, either in baking or frying the coated product, can be controlled by addition of dextrose and or milk solids to increase the rate of colour generation, or by the use of higher starch content doughs, which have lower protein, and reducing sugar contents to delay colour generation.

In the case of slow browning crumbs, the colour in both the raw and cooked crumb component is due to the original colour added to the dough mix.

With such a wide range of available breadings, the processor is offered almost infinite possibilities. However, once a particular breading is chosen the supplier must pay careful attention to ensure that the breading has the requisite particle size (mesh size), bulk density, colour, browning rate, and both water and oil absorption characteristics.

## 4.0 PROCESSING EQUIPMENT

A wide range of new equipment, with performance guarantee for making virtually any type of battered and breaded fish product, is available from several reputable suppliers. Modern equipment purchased for the intended products and capacity gives, overall, reliable and satisfactory performance. The same, indeed, applies to commercial batter mixes and breading.

Processors can, obviously, economise by reconditioning/modifying existing equipment, although in such case performance is by no means assured. Allowance would almost undoubtedly have to be made for the cost of outside assistance needed to solve operational/ performance problems.

Existing equipment supplied with the appropriate batter(s) and breading(s) must be able to coat the desired 'filling' with a consistent and coherent coating, comprising the desired amount of both batter(s) and breading. The correct equipment for the precise battering and breading operation achieves this goal. However, additional subsequent processing is usually needed (e.g. par-frying to harden the surfaces of the coated product prior to freezing and packaging. Such par-frying is virtually obligatory for products which are only coated with batter, particularly tempura batter).

Operational details and trade brochures, etc. are available from reputable equipment suppliers and given the exact details of the processors' requirements 'turn-key' operations can be supplied.


Figure 57. Processing equipment. Tetra-Laval

In essence, though, all of the wide range of equipment available has the function to apply uniform coating of batter(s) and breading(s) in a continuous fashion. Exact details of the operation vary amongst different suppliers. However, common factors involve:

Loading with the (preshaped) raw product onto a continuous belt;

Optionally giving the raw product a coating with either water and/or flour (a predust), in order to make subsequent batter or breading application adhere to the product. This stage is usually accomplished by a 'top submerger conveyor' principle, for the water coating, and by passage through a turbulent stream of dry flour etc. for the application of the pre-dust;

Coating with batter. This is commonly accomplished by a falling film technique for normal batters or through a dip technique using a top submerger conveyor for thicker and Tempura batters. The amount of batter pick-up is governed primarily by the product, its temperature, prior pre-treatment (e.g. pre-dust), nature and consistency of the batter, belt speed, and (not least) by an 'air-blow-off' device immediately after the battering;

Coating with breading. This is accomplished by conveying the battered product through a bottom layer of the breading, in a dip pan principle, while the top portions are exposed to a continuously falling 'curtain' of breading. Prime control of the amount of applied breading is achieved through the type of breading, speed of machine, and use of belt vibrators, surface pressure rolls and 'flip' mechanisms at the end of the conveyor, to remove loose particles.

## 5.0 PRODUCTION PROCEDURE

The production of the battered, breaded surimi plus raw fish products involves the following stages.

Preparation of a shredded cooked surimi component (fish cake)
Preparation of raw minced fish blend (fish paste)
Mixing the shredded fish cake with the fish paste
Forming that mix into the desired shape
Battering and breading
(Frying)
Freezing
Packaging
Storage

Let us consider the equipment requirement for each of these stages, together with some consideration of the raw material requirements.

## 5.1 PREPARATION OF SHREDDED FISH CAKES

The fish cakes can be made from good quality surimi. After thawing to about -5°C, the surimi is ground, using a silent cutter; at the same time other ingredients are added.

Example of a formulation using threadfin bream surimi:

Based on the weight of surimi -

| | |
|---|---|
| Salt | : 2.5% |
| Water | : 10 - 30% (Depending on quality of surimi) |
| Wheat flour | : 3% |
| Egg white powder | : 1% |
| Mono-sodium glutamate | : 0.5 - 1% |

Once the paste is ready, it is quickly formed into fish cakes using a forming machine. The fish cakes are then set in water of 40° for 20-30 minutes, and cooked at 90°C for about 20 minutes. The cooked fish cakes are then chilled and kept at 5°C until ready for use. Using a shredder the fish cakes are shredded into 3mm thick strands and then mixed with the lizard fish paste. Experiments show that a mixture of 70% paste with 30% shreds give an acceptable appearance and texture when formed into breaded fish cakes. If preferred, a 50:50 mixture can also be used.

## 5.2 PREPARATION OF FISH PASTE

### *5.2.1 Raw Materials*

Although just about any white meat fish species can be used, consideration should be given to the freshness, colour of the minced meat, and the ability to form at least a weak gel. Species commonly found in the trawl by-catch, such as lizard fish, threadfin bream, big-eye snapper, croaker, and goatfish (which tends to give a pinkish colour mince meat) can be used, but freshness is important.

The raw fish should be washed with chilled water, and kept iced until read for use. Heading and gutting should be done as quickly as possible, while maintaining the fish at a low temperature (<5°C). The kidney tissues around the backbone should also be removed. Headed and gutted fish should be kept chilled until ready for meat-bone separation.

### *5.2.2 Meat-Bone Separation*

The quantity and small size of the fish used makes it too laborious and costly to fillet the fish manually. A drum type meat-bone separator with a 3mm stainless steel mesh drum is used to extract the meat. As this process generates heat, it is important to chill the fish before beginning it. The minced meat should also be kept chilled at all times.

### *5.2.3 Grinding to Form Paste*

In forming the fish paste, the minced fish is first ground with salt. Salt enhances the formation of a complex network with the salt soluble protein extracted. This network, when 'fixed' by cooking, forms a gel and gives 'springiness' to the product. Salt also adds to the taste of the final products. The amount of salt added, therefore, depends on the amount of water and other ingredients added and is usually between 1.5 - 3%.

The minced meat may be ground using a paddle mixer or silent cutter. The silent cutter is faster but generates heat. Ice-water is usually added, to maintain the material at low temperature. Once formed, the paste begins to set and harden at ambient temperature, and should be used immediately.

Example of a formulation using fresh lizard fish:

Based on the weight of lizard fish

| | |
|---|---|
| Salt | : 1.5% |
| Water | : 10 - 30% (Depending on fish quality & desired gel strength) |
| Wheat flour | : 7.5 % |
| Egg white powder | : 1.5% |

## 5.3 BLENDING FISH PASTE WITH SHREDDED SURIMI

Pre-weighed amount of fish paste and shredded surimi (a 7:3 ratio is suggested) are gently mixed to form the complete blend.

Vigorous mixing or any cutting action should be avoided at this stage. Silent cutter and similar mixers are not suitable.

Hand mixing, with appropriate attention to hygiene, could serve for small scale production. Larger operations could use a batch mixer, such as a ribbon blender, or even direct feed, at the right rate, of the two separate components (fish paste and shredded cake) into the auger feed of a forming (shaping) machine.

It must be remembered that the blend of fish paste and shredded cake is highly perishable, and will also rapidly increase in firmness. Cold mixing is essential, and the mix should be used as soon as possible.

## 5.4 FORMING INTO THE DESIRED SHAPE

The mix can be shaped by hand with simple plastic moulds. However, such hand formed shapes are too soft to be directly battered and breaded. Freezing overcomes this, and the frozen, shaped product can then be battered and breaded.

A variety of commercial equipment is available to form the mix into virtually any shape and allow for direct feed into the battering and breading machine.

## 5.5 BATTERING AND BREADING

Hand battering, followed by breading, could be done on a small scale but is not practicable or recommended for commercial production.

Many reputable suppliers offer satisfactory equipment for accomplishing the desired batter and breading application in a single pass through the equipment. Given the vast range of both batter (ranging from thin batters such as milk itself, through thicker slurry batter, to the very thick self raising' tempura batters) and breading (ranging from fine bread crumb like particle to large flake-like breading), the purchased equipment is normally only specific for certain types of batter and breading. Attention must also be paid to the batter mixing operation where there is need to maintain a constant consistency (viscosity) and as low a temperature as practicable to minimise microbial growth. In the case of the thick tempura batters the mix has to be made at a higher temperature and should be handled, i.e. stirred, pumped or otherwise transferred, as little as possible.

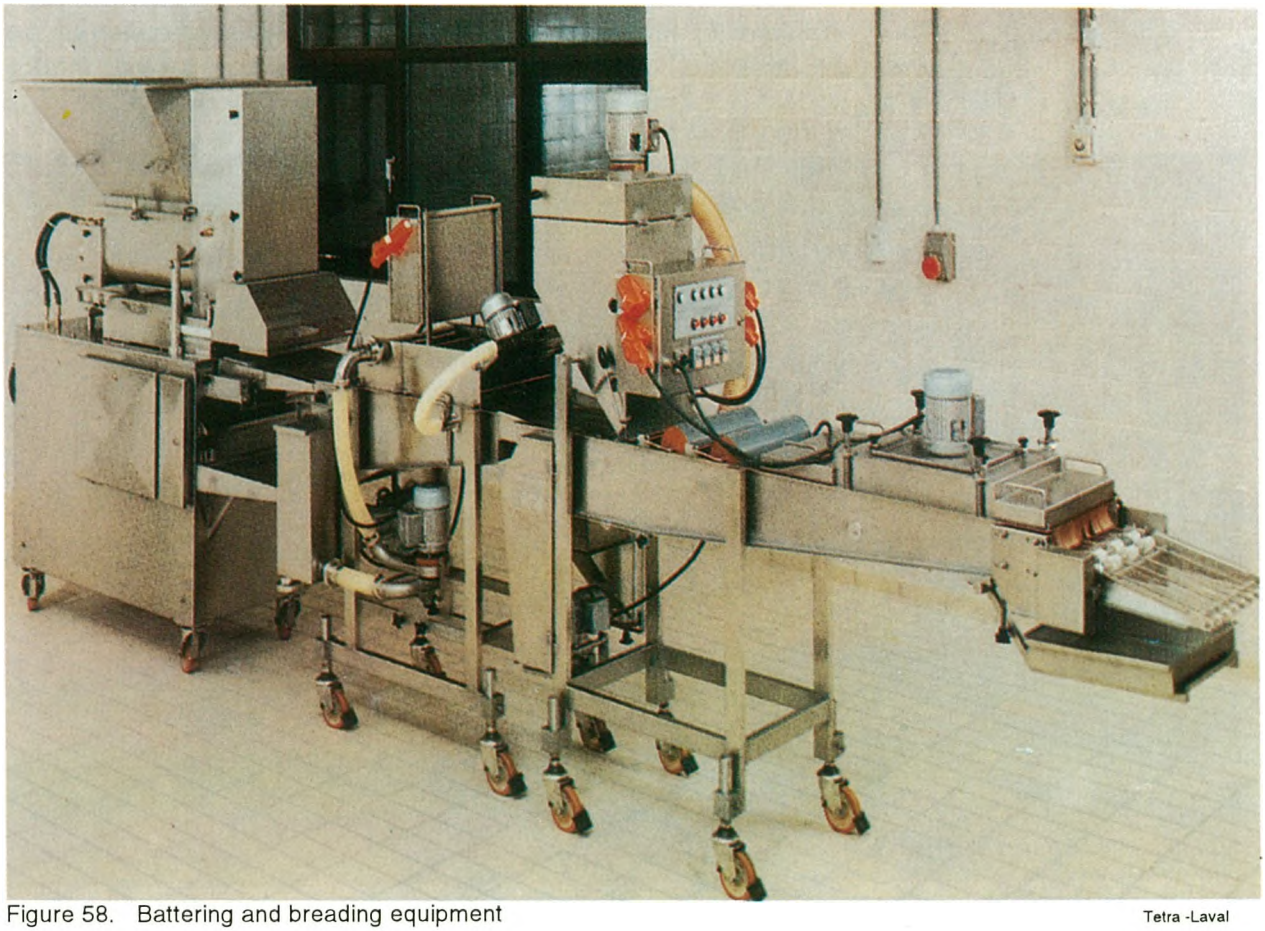


Figure 58. Battering and breading equipment

Tetra -Laval

Without going into detail of the different types of commercial equipment available (of which some is shown in **Figure 58**), let us consider the simplest system:

Preformed shapes are directly fed to, or deposited on, the feed belt of the equipment.

The belt moves the shapes through a shallow trough of batter and under falling curtains of batter.

Excess batter is removed by an 'air curtain'.

The battered shape is then passed through a shallow trough of breading and a falling shower of breading.

Excess breading is removed by mechanical vibration, and adherence is improved by light compression rollers.

## 5.6 FRYING

Frying is not an essential stage for all products, apart from those coated with tempura batter which would otherwise be too soft for further handling. Where used, the frying operation gives a much firmer and more easily handled 'par-cooked' product, which in many cases is easier for the consumer to use and can be oven heated rather than refried before consumption.

A range of commercial frying equipment is available from several reputable suppliers. All of them operate on the principle of conveying the battered and breaded products through a long trough of heated, edible oil in a manner which ensures complete immersion of the product, without damage to its shape. The fried product is normally air cooled prior to freezing.

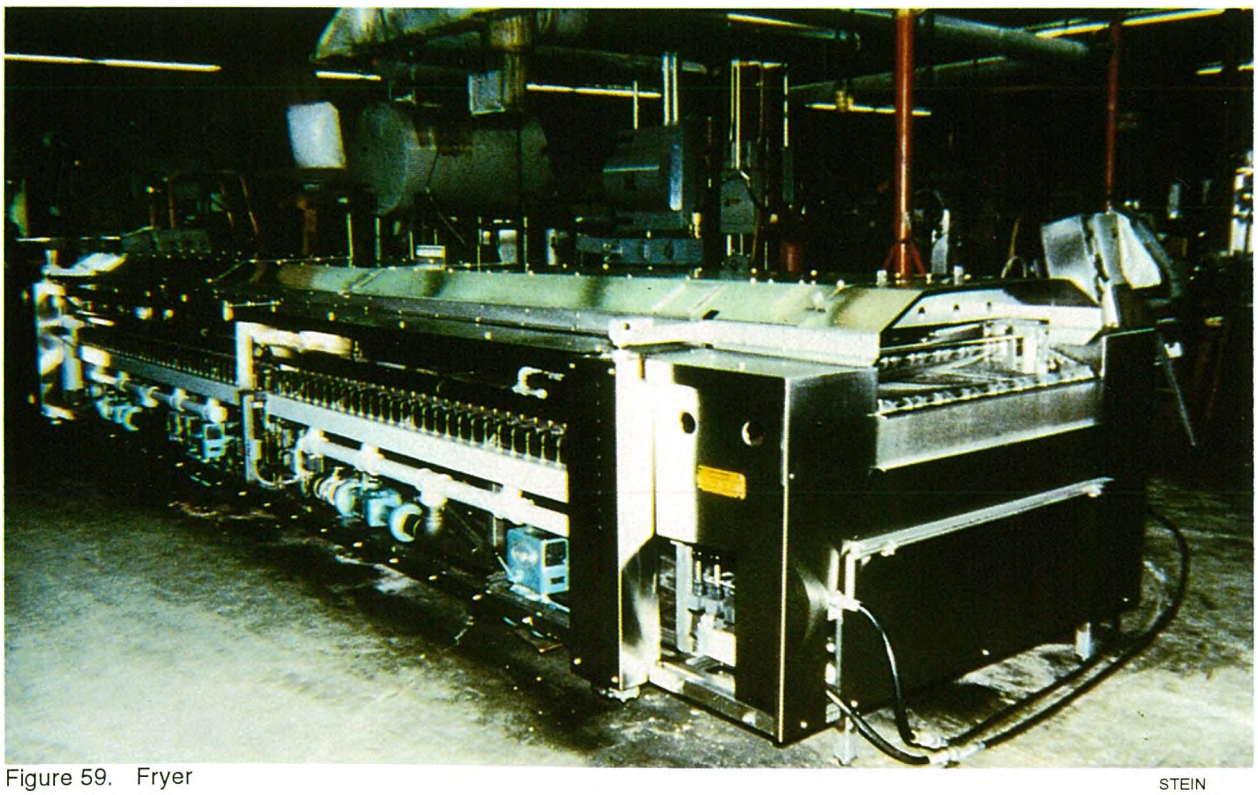


Figure 59. Fryer

STEIN

## 5.7 FREEZING

The product may be frozen on trays or more commonly in a continuous blast freezer. The frozen product can then be packed for frozen storage.

## 5.8 TROUBLE SHOOTING

Operation of the requisite equipment, especially if using breadings and batter mixes from reputable suppliers, should result in few non-mechanical problems.

Most problems occur with the uniformity of coating of batter and breadcrumbs and with their lack of adhesion.

In most cases the fault will tend to lie with relatively minor changes in the physical properties of the materials. These include: surface condition of the fish to be coated; lack of adequate pre-dust; inconsistent batter (viscosity being a prime factor); breadings outside size/density specifications; excessive, or insufficient air-blow-off of batter; irregular transfer between line belts, in particular lack of correct inter-alignment; excessive breading due to incorrect setting of pressure rolls and vibrator.

Further advice can be obtained from equipment and ingredient suppliers and from technical literature (e.g. "Batter and Breading Technology", Sunderman & Cunningham, AVI Publishing Company Inc., Westport, Connecticut).

# PRODUCTION OF BATTERED & BREADED FISH PRODUCTS FROM MINCED FISH AND SURIMI

## APPENDIX II

**Packaging Requirements of Frozen Battered and Breaded Fish Products**

## 1.0 INTRODUCTION

Today's consumers have less time to prepare meals and are relying on the food industry to take over this task and so are becoming more dependent on pre-prepared packaged, convenience foods. The success or failure of any product on the market place will depend on its packaging which has often been referred to as "THE SILENT SALESMAN."

## 2.0 DEFINITION OF PACKAGING

There are several definitions of the term packaging. One definition is "the enclosure of products, items or packages in a wrapped pouch, bag, box, cup, tray, can, tube, bottle or other container to perform the following functions: containment; protection and/or preservation; communication; and utility or performance". If the device or container performs one or more of these functions it is considered a package. This definition implies that packaging is polyfunctional. Each of the main functions of a package will be briefly discussed.

## 3.0 FUNCTIONS OF PACKAGING

According to the above definition, the basic functions required of any package, can be grouped under four major headings:

### *3.1 Container*

To contain and facilitate handling, storage and distribution of product all the way from the manufacturer to the ultimate user. Individual packs must also be convenient for use. They must be easy to:

- pick up and handle
- fit into cupboards, shelves, refrigerators, etc.
- open and dispense from - reclose if "multi shot" packs
- dispose of - return, recycle or reuse, when finished with
- they must also be safe, presenting no hazards in the way of sharp or jagged edges, etc.

### *3.2 Protection*

The package must protect the product contained against any forms of loss, damage, deterioration, spoilage or contamination which might be encountered throughout the distribution chain.
Physical protection must be provided against structural damage to prevent material loss or spillage of contents. The package must also protect the food against the ingress of:

(1) physical contaminants eg dirt, dust;
(2) chemical agents e.g. oxygen moisture, odours;
(3) biological agents such as insects and most importantly microorganisms.

### *3.3 Medium of communication*

The package must identify the product and its origin, and inform the consumer how to use and store its contents. It must also provide any other information needed or required e.g. nutritional information to attract customers to purchase the packaged product.

### *3.4 Means of minimizing costs*

Frequently overlooked is the fact that good packaging helps efficient and mechanized handling, distribution and marketing of product thus eliminating high labour costs which would have to be absorbed into the price of the product.

## 4.0 TYPES OF PACKAGING MATERIALS

There are several types of primary packaging materials commercially available including metal, aluminum foil and glass. However, the most important packaging materials for breaded and battered fish products are plastic films and paperboard.

## 4.1 PLASTICS

In recent years plastics have been used in many food packaging applications replacing traditional packaging materials such as glass, metal and paper. The raw materials for synthetic plastics are petroleum, natural gas and coal. They are formed by a polymerization process which creates chemical linkages between many small repeated molecular units to form very large molecules or macromolecules (Polymers). Most plastics contain small amounts of additives such as plasticizers, lubricants, antioxidants, antistatic agents, heat stabilizers and UV stabilizers. These are added to facilitate processing of plastics or to impart some desirable properties to the plastics. For example, plasticizers are added to soften the film thus making them more flexible and less brittle for use in cold climates or with frozen food products.In general, plastic films have the following properties:

1. Their cost is relatively low;
2. They have various barrier properties against moisture and gases;
3. They are heat sealable to prevent leakage of contents;
4. They are suitable for high-speed filling;
5. They have wet and dry strength;
6. They are suitable for printing;
7. They are easy to handle and convenient for the manufacturer, retailer and consumer;
8. They add little weight to the product;
9. They fit closely to the shape of the food, thereby wasting little space during storage and distribution.

Plastics are widely used for packaging of food products. When choosing the appropriate packaging material, the following factors should be considered:

1. Gas barrier properties;
2. Moisture barrier properties;
3. Anti-fog properties;
4. Machinability;
5. Mechanical strength;
6. Sealability;
7. Performance Versus Cost

One of their most important characteristics is their barrier properties to oxygen and moisture vapour which vary greatly from film to film. Examples of the barrier properties of various plastics are shown in **Tables 1 & 2.**

High barrier materials usually have high barrier properties to both moisture vapour and oxygen. However, the barrier properties to one or both gases may change at higher relative humidities. A good example is Ethylene Vinyl Alcohol (EVOH), a hydrophilic film which has excellent gas barrier properties at low relative humidities. However, at higher relative humidities it absorbs moisture which has a plasticizing effect and lowers the barrier characteristics of this film to oxygen. Some films have mixed barrier properties i.e. low oxygen barrier characteristics and high water vapour characteristics. Good examples are low density polyethylene (LDPE) and polypropylene (PP) which explains why these films can be used for packaging frozen fish products to prevent freezer burn.

**Table 1**

**OXYGEN TRANSMISSION RATE (OTR)**

| | | cc/m²/day |
|---|---|---|
| **I.** | **High Barrier Materials** | |
| | Glass | 0 |
| | Aluminum | 0.1 |
| | EVOH (0%RH) | 0.2 |
| | PVDC | 2.5 |
| | AN Copolymer | 12.4 |
| **II.** | **Medium Barrier Materials** | |
| | Oriented Nylon 6 | 28 |
| | Oriented PET | 36 |
| | Nonoriented Nylon 6 | 78 |
| | Nonoriented PET | 109 |
| | Rigid PVC | 150 - 205 |
| | EVOH (100%RH) | 160 - 280 |
| **III.** | **Low Barrier Materials** | |
| | Polystyrene | 1500 |
| | HDPE | 1705 |
| | PP | 2320 |
| | Polycarbonate | 3500 |
| | LDPE | 7500 |

Measured @ 23°C & 0% RH

**EVOH** = Ethylene Vinyl Alcohol;
**PVDC** = Polyvinylidene Chloride;
**AN** = Acrylonitrile;
**PET** = Polyester;
**PVC** = Polyvinyl Chloride;
**HDPE** = High Density Polyethylene;
**PP** = Poly Propylene;
**LDPE** = Low Density Polyethylene

**Table 1**

**OXYGEN TRANSMISSION RATE (OTR)**

| | | cc/m²/day |
|---|---|---|
| **I.** | **High Barrier Materials** | |
| | Glass | 0 |
| | Aluminum | 0.1 |
| | EVOH (0%RH) | 0.2 |
| | PVDC | 2.5 |
| | AN Copolymer | 12.4 |
| **II.** | **Medium Barrier Materials** | |
| | Oriented Nylon 6 | 28 |
| | Oriented PET | 36 |
| | Nonoriented Nylon 6 | 78 |
| | Nonoriented PET | 109 |
| | Rigid PVC | 150 - 205 |
| | EVOH (100%RH) | 160 - 280 |
| **III.** | **Low Barrier Materials** | |
| | Polystyrene | 1500 |
| | HDPE | 1705 |
| | PP | 2320 |
| | Polycarbonate | 3500 |
| | LDPE | 7500 |

Measured @ 23°C & 0% RH

**EVOH** = Ethylene Vinyl Alcohol;
**PVDC** = Polyvinylidene Chloride;
**AN** = Acrylonitrile;
**PET** = Polyester;
**PVC** = Polyvinyl Chloride;
**HDPE** = High Density Polyethylene;
**PP** = Poly Propylene;
**LDPE** = Low Density Polyethylene

**Table 2**

**MOISTURE VAPOUR TRANSMISSION RATE (MVTR)**

| | | g/mil/day |
|---|---|---|
| **I.** | **High Barrier Materials** | |
| | Glass | 0 |
| | Aluminum | 0.6 |
| | HDPE | 3-8 |
| | PVDC | 4 |
| | PP | 6-10 |
| | LDPE | 18-23 |
| | Oriented PET | 19 |
| **II.** | **Medium Barrier Materials** | |
| | EVOH | 22-59 |
| | Surlyn | 27 |
| | Rigid PVC | 39-48 |
| | Non Oriented PET | 46 |
| | AN copolymer | 78-95 |
| **III.** | **Low Barrier Materials** | |
| | Polystyrene | 78-132 |
| | Oriented Nylon 6 | 158 |
| | Polycarbonate | 217 |
| | Non Oriented Nylon 6 | 340 |

Measured @ 37.8°C & 100%RH

1 mil = 25 microns = 0.001"

## 5.0 LAMINATED FILMS

Lamination of two or more materials improves the appearance, barrier properties or mechanical strength of a package. Materials which can be laminated to each other include plastic to plastics, paper to plastic, paper to aluminum foil and paper to aluminum foil to plastic.

Laminated films are used when protection against oxygen is required. Laminated high gas barrier films are commonly used in Modified Atmosphere Packaging (MAP) e.g. Vacuum Packaging. Laminated structures consist of an outer, tougher, protective layer e.g., nylon or PP, a middle, high barrier layer e.g. EVOH or PVDC and an inner heat sealant layer. LDPE is commonly used as a heat sealant because of its low melting temperature. However, it sometimes does not give a good seal with greasy or starchy food products. With these products, the choice of sealant layer is either Ethylene Vinyl Acetate (EVA) or Surlyn. Examples of laminated structures and their barrier properties are shown in **Table 3.**

**Table 3**

**EXAMPLES OF LAMINATED FILMS**

| | |
|---|---|
| **I.** | **High Barrier (Flexible)** |
| | Nylon/Saran/EVA |
| | Nylon/Saran/EVA |
| | Nylon/Saran/Surlyn |
| | Nylon/Saran/EVOH/Suryln |
| | Polyester/Saran/EVA |
| | Polyester/Saran/Suryln |
| **II.** | **High Barriers Film (Semi-Rigid)** |
| | PVC/EVOH/EVA coextrusion |
| | PVC/EVOH/Surlyn Coextrusion |
| **III.** | **Medium Barrier Films** |
| | Nylon/EVA |
| | Nylon/Surlyn |
| | Polyester/EVA |
| | Polyester/Surlyn |
| **IV.** | **Low Barrier Film** |
| | OPP/EVA |
| | OPP/Surlyn |
| | PP/EVA |
| | PP/Surlyn |
| | Surlyn coextrusion |

**OPP** = Oriented Polypropylene
**EVA** = Ethylene Vinyl Acetate

## 6.0 SHELF LIFE

"Can be defined as "the period during which a packaged product maintains marketable or acceptable quality under specific storage conditions". The shelf life of a food product depends on the initial quality of the food product, the amount of quality change that can be allowed, the prevailing environmental storage conditions, the barrier properties of the films and the compatibility between the food package and the food product.

## 7.0 SELECTION OF PROPER PACKAGING

The shelf life of packaged foods is controlled by the properties of the food, (including water activity, pH, susceptibility to enzymic or microbiological deterioration, mechanism of spoilage, and the requirement for or sensitivity to oxygen, light, carbon dioxide and moisture) and the barrier properties of the package. Moisture loss or uptake is one of the most important factors that controls the shelf life of foods. There is a microclimate within a package, which is determined by the vapour pressure of moisture in the food at the temperature of storage. In some foods a change in moisture content leads to microbiological or enzymic spoilage, whereas in others this causes drying out or softening of the food. The effect of changes in moisture content is shown by the water sorption isotherm of the food and depends on the water vapour transmission rate of the package. Control of moisture exchange is also necessary to prevent condensation on the inside of packages and to prevent freezer burn.

Some foods (for example fatty foods and freeze-dried foods) are susceptible to oxidation, and it is therefore necessary to use a package with low oxygen permeability. This also reduces losses of vitamin C in other foods (for example fruit and vegetable products). In contrast, fresh foods require oxygen for respiration and a permeable or perforated package is used.

Packaging should retain desirable odours (for example in coffee or snackfoods) or prevent odour pickup (for example by powders or fatty foods). There should also be negligible odour pickup from the plasticisers, printing inks, adhesives or solvents used in the manufacture of the packaging material.

Most foods deteriorate more rapidly at higher temperatures, and storage conditions are therefore controlled to minimize temperature fluctuations. Heat-resistant packaging is required to retain the heat in hot foods that have a short shelf life (for example take-away foods), to prevent heating of other foods (for example chocolate confectionery) that are not stored at low temperatures and to prevent freezer burn. Some packages are required to withstand processing conditions (for example hot filling or heat sterilization).

Packaging protects food from mechanical damage, caused by transportation or handling (for example impact, vibration and compression damage). Compression damage during storage may arise due to overstacking. Corrugated board cases prevent mechanical damage. Groups of retail containers are similarly immobilized by shrink or stretch-wrapping. The functional requirements of packaging materials are summarized in **Table 4.**

**Table 4**
**FUNCTIONAL REQUIREMENTS OF PACKAGING MATERIALS**

| FUNCTIONAL PROPERTY | SPECIFIC FACTORS |
|---|---|
| Gas permeability | $O_2$,$C0_2$,$N_2$,$H_20$ vapour |
| Protection against environmental factors | Light, odour, microorganisms, moisture |
| Mechanical properties | Weight, elasticity, heat-sealability mechanical sealability, strength (tensile, tear, impact, bursting) |
| Reactivity with food | Grease, acid, water, colour |
| Marketing related properties | Attractiveness, printability, cost |
| Convenience | Disposability, repeated use, resealability, secondary use |

## 8.0 MATERIALS COMMONLY USED IN PACKAGING OF FROZEN BATTERED/BREADED FISH PRODUCTS

### 8.1 PLASTIC

The most commonly used plastics for packaging frozen battered/breaded fish products are :

1. Polystyrene (**PS**);
2. Polyethylene (**PE**);
3. Polypropylene (**PP**).

#### 8.1.1 Polystyrene

Polystyrene is widely used to make trays, egg cartons, cups and containers. Unfortunately it has a low melting point ~89°C (190°F) and it is not suitable for hot foods or other high temperature applications. It also has poor impact strength and is a poor barrier to oxygen and moisture vapour. Polystyrene trays are used in conjunction with polyethylene or polypropylene overwraps which provide the necessary barrier properties to moisture vapour.

### 8.1.2 Polyethylene

Polyethylene is the most used polymer in food packaging applications. Polyethylene can be classified into low density polyethylene (LDPE) and high density polyethylene (HDPE). LDPE is heat sealable at low temperatures (-80°C) is chemically inert, odor free and shrinks when heated. It is a good moisture barrier but a poor gas barrier. It is less expensive than most films and it is commonly used for packaging frozen products. HDPE is stronger, thicker, less flexible and more brittle, less permeable to gases and moisture vapour and more expensive than LDPE. It is used for packaging frozen products where higher gas and water vapour characteristics are required. It can be used as bags, as liners or as an overwrap.

### 8.1.3 Polypropylene

Polypropylene (PP) is the lightest of all plastics. Compared to polyethylene, PP is harder and more transparent. It has also better gas and moisture vapour barrier properties and higher heat resistance than PE which makes it suitable for food products which have to be heated e.g. boil-in-bag or retortable products. However, it is more difficult to heat seal than PE and the seals are not as strong. It is commonly used in tray form or as an overwrap in many frozen food products.

## 8.2 PAPER AND BOARD

Paper and board are commonly used either as primary packaging for breaded and battered fish products i.e. (the product comes in direct contact with the packaging material) or as secondary packaging where it is used for protection of the primary package. Paper and board are poor barriers to oxygen and moisture vapour. However, the barrier properties of paper/paperboard can be improved through lamination with other materials e.g. wax, plastics.

Wax provides a moisture barrier and allows the paper to be heat sealed. However, a simple wax coating is easily damaged by folding or by abrasive foods. This is overcome by laminating the wax between layers of paper and/or polyethylene. Waxed papers are used for bread wrappers and inner liners for many products e.g. cereals, frozen products.

Paper board is made in a similar way to paper but is thicker to protect foods from mechanical damage. The main characteristics of board are thickness, stiffness, the ability to crease without cracking, the degree of whiteness, surface properties and suitability for printing. White paper board is suitable for contact with food and is often coated with polyethylene, polyvinyl chloride or wax for heat sealability. It is used for ice cream, chocolate and frozen breaded and battered fish products.

Corrugated board has an outer and inner lining of kraft paper with a central corrugating (or fluting) material. It is made by softening the fluting material with steam and passing it over corrugating rollers. The liners are then applied to each side using a suitable adhesive. The board is formed into "cut-outs" which are then assembled into cases at the filling line. Smaller, more numerous corrugations give rigidity whereas larger corrugations or double and triple walls give resistance to impact (cushioning). A high storage humidity may cause delamination of the corrugated material. This is prevented

by lining with polyethylene, which also reduces moisture migration and tainting. Alternatively, the liner may be a laminate of a reaseproof paper, coated with microcrystalline wax and polyethylene. Corrugated board resists impact abrasion and compression damage and is therefore used as secondary packaging containers.

## 9.0 PACKAGING REQUIREMENTS OF BATTERED/BREADED FISH PRODUCTS

Most battered/breaded fish products are sold in the frozen section of the supermarket to ensure a long shelf life (~6 months at -20°C). The factors affecting the quality of frozen breaded fish products are:

Moisture loss;
Oxidation;
Rancidity;
Change in odour and flavour;
Loss of volatile flavours;
Enzymatic activity;
Loss of vitamins.
Protein denaturation.

Therefore, packaging materials/technologies should be used to minimize these deteriorative changes in the frozen battered and breaded products throughout storage. The specific packaging requirements of frozen battered/breaded fish products should include the following considerations in the selection of the appropriate packaging material(s);

Flexible materials should be used to fit the contours of the frozen product and minimize free air space;

The packaging material should not become brittle or deteriorate during prolonged cold storage at -20°C;

The packaging material should be impervious to moisture and, if possible, oxygen ($O_2$)

This latter requirement is very important to prevent an important defect in frozen storage of products called FREEZER BURN which is caused by sublimation of water.

Long term packaging of frozen battered and breaded fish products can be sub-divided into :

**(i) INDIVIDUAL UNIT PACKAGING**

**(ii) BULK PACKAGING**

### 9.1 INDIVIDUAL PACKS

While bulk packaging is normally used by large retailers e.g. restaurants and fast food outlets, individual packs are preferred by most consumers since they are convenient to handle and store. The packaging materials commonly used for individual packs are:

PP/PS trays overwrapped with PE/PP film.

Cellophane/PE bags inside a paperboard box;

Waxed coated paperboard boxes;

PE coated paperboard boxes;

Microwavable paperboard/PET/aluminum foil trays inside a PE coated paperboard box (for par-fried products).

All of these packaging systems protect the battered/breaded products during prolonged storage at -20°C. The coatings also prevent the paperboard box from absorbing moisture and "delaminating". The PE/paperboard box is most commonly used in North America (for par fried products). With the increase in ownership of microwave ovens, microwavable packaging materials for par fried products are being demanded by the North American consumer. The innermost tray, comprising of paperboard/polyester/ aluminium foil, which acts as a susceptor film, is filled with product and placed inside the outer PE/paperboard box. The consumer simply opens the packet, takes out the inside container and microwaves the product according to the instructions on the lid of the microwavable tray. This technology enables a crisper and browner product to be cooked in a shorter cooking time to deep frying and offers the consumer the ultimate in convenience.

As an added measure of protection, individual trays or one, two or three packs can be placed inside an outer sleeve of LDPE or PVC or PP and shrink wrapped. The shrink wrapped packages not only offer greater barrier protection but this method of packaging is also aesthetically pleasing to the consumer.

Packaging of individual packs can be automated using horizontal form-fill-seal equipment shown in **Figure 60.**

## 9.2 BULK PACKAGING

Examples of the main packaging systems which can be used are for bulk packaging of frozen battered and breaded products are:

*Wax coated paperboard/corrugated board;*

*PE bags/corrugated board;*

*PE plastic bags.*

Wax coated paperboard/corrugated board was the packaging choice many years ago as it offered good protection against loss of moisture, flavour and oxidation problems. However, a major problem with this type of packaging was flaking of wax during storage which was both unsightly and decreased the barrier properties of the packaging material. These cartons have nearly all been replaced with corrugated cartons with polyethylene liners which offer better moisture protection and heat sealing. Low density polyethylene bags (2-3 mil thick) are also commonly used for bulk packaging of products. The major advantages of the polyethylene bags are:

*Good moisture barrier and prevention of freezer burn;*

*Heat sealable at low temperature;*

*Clear view of product;*

*Printable;*

*Used with high speed vertical filling systems*

However, problems can sometimes occur due to pinholes caused by the frozen breadcrumbs. This problem can be overcome by selecting a slightly higher gauge of film e.g. 4mil thick. The filling process can be automated using vertical form/fill/sealing equipment shown in **Figure 61.** For further protection these bags can be distributed in corrugated containers.

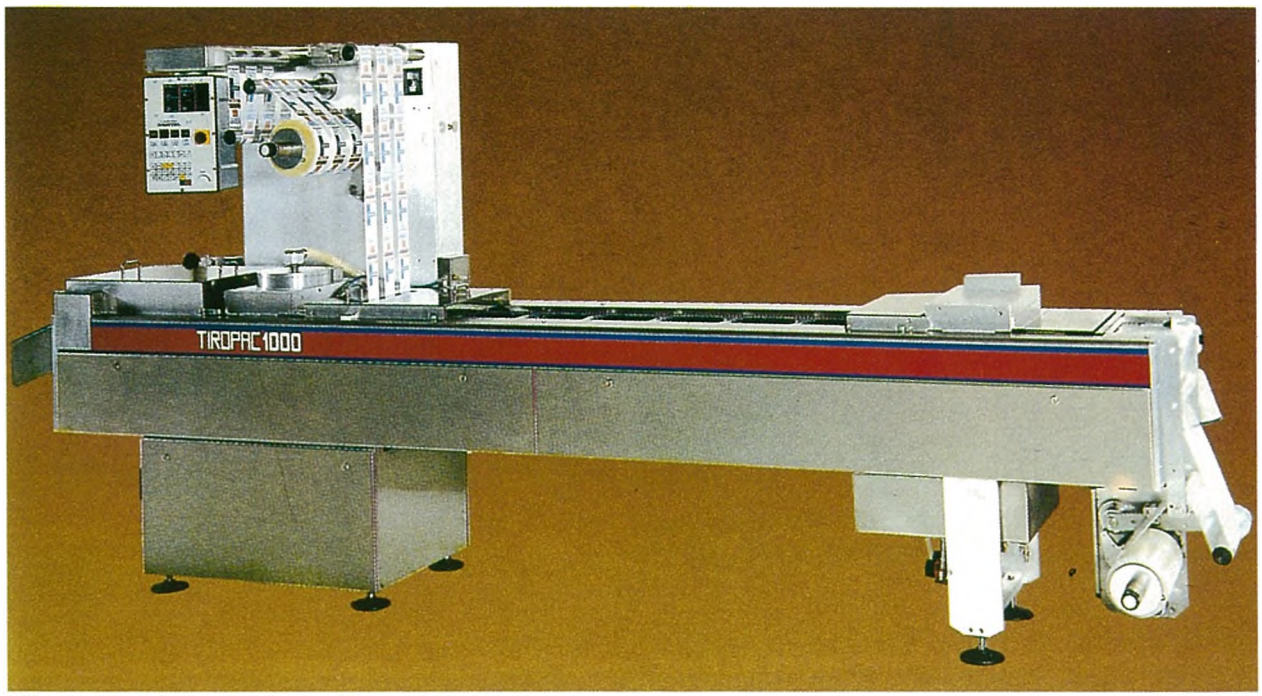



Figure 60. Horizontal form - fill - seal equipment Tetra-Laval -TW Kutter

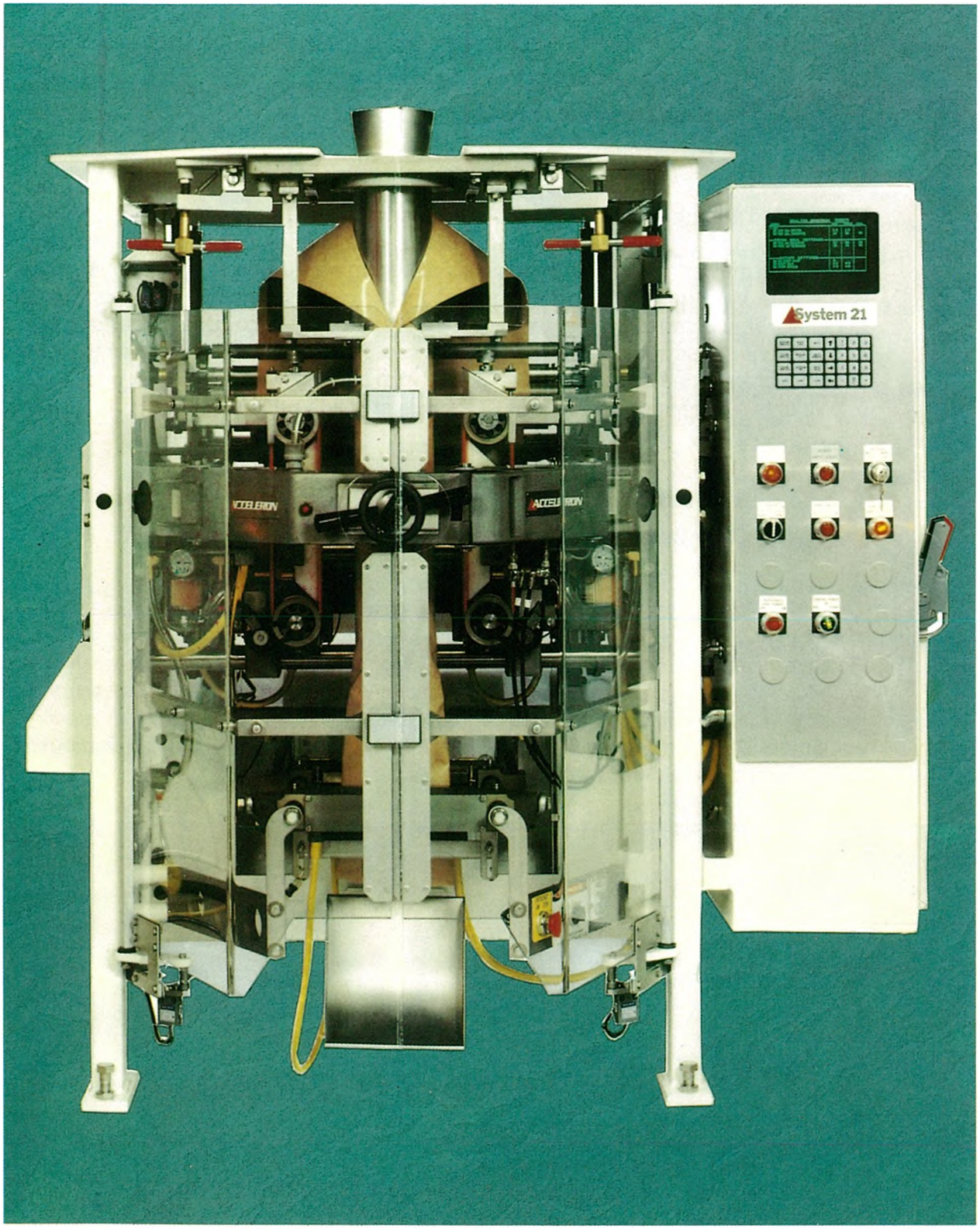



Figure 61. Vertical form and/or fill bulk packaging system

Triangle Package Machinery Company

# 10.0 ALTERNATIVE PACKAGING SYSTEMS FOR SHELF-LIFE EXTENSIONOF BATTERED/BREADED FISH PRODUCTS

Modified Atmosphere Packaging (MAP) can be defined as "the enclosure of food products in a high gas barrier film in which the gaseous environment has been changed or modified to slow respiration rates, reduce microbiological growth and retard enzymatic spoilage with the intent of extending shelf life". The growth of MAP technology, for long term preservation of food products, is due to a number of inter-related factors as follows:

Developments in new polymeric barrier packaging materials;

Developments in packaging equipment;

Extended market areas as a result of longer shelf life;

Consumer concerns about preservatives.

MAP is an increasingly popular method for shelf life extension of food products. Several methods can be used to modify the atmosphere within the packaged products. These include vacuum packaging, gas packaging and the use of oxygen absorbents.

## 10.1 VACUUM PACKAGING

Vacuum packaging can be used to extend the shelf life of frozen battered and breaded fish products. Removal of oxygen reduces oxidative rancidity problems, dehydration, weight loss and freezer burn in tray stored products. There are various vacuum packaging systems available depending on the size of operation.

### 10.1.1 Small Scale Operations

For small scale operations, vacuum chamber machines are used. The machines are essentially an open-an-closeable chamber in which plastic pouches filled with materials are placed inside the chamber. A built in vacuum pump evacuates air from the product and the product is hermetically sealed by heat and pressure.

### 10.1.2 Large Scale Operations

For large scale VP operations "rollstock machines" are commonly used. The name rollstock machines implies that the packaging materials are supplied as rolls of films. Films used are similar to those used in VP using chamber machines.

The film molds itself around every contour of the product while at the same time seals itself to the tray close to the edge of the product.

### 10.1.3 Packaging Materials

The choice of packaging material is also important to prevent air, water vapour and maybe even light through the product. For most frozen battered and breaded fish products medium barrier films can be used because microbial spoilage is not a problem. Frozen products require a barrier against water vapour to prevent freezer burn and therefore laminates e.g. Nylon/PVDC/PE, PP/PE, PA,PE or can be used either alone or in connection with polystyrene/ polypropylene trays.

**Table 5**

**ADVANTAGES AND DISADVANTAGES OF VACUUM PACKAGING OF BATTERED AND BREADED PRODUCTS**

| Advantages | Disadvantages |
|---|---|
| Increased shelf life | High initial cost of packaging equipment, films, etc. |
| Increased market area | Discoloration (meat products) |
| Reduction in production and storage costs | Leakage |
| Improved presentation of products | Potential growth of microorganisms of public health concern |
| Fresh appearance of products | Concern if product is temperature abused |

## 10.2 OXYGEN ABSORBENTS

While vacuum packaging has been used to slow down or inhibit aerobic deteriorative changes, aerobic spoilage can still occur in such products depending on the level of residual oxygen in the package headspace. The level of residual oxygen in vacuum pakacging or gas packaged products could be due to a number of factors such as (i) oxygen permeability of the packaging material; (ii) ability of the food to trap air; (iii) leakage list of air through poor sealing; (iv) inadequate evacuation and/or gas flushing.

A novel and innovative method of oxygen control and of atmosphere modification involves the use of oxygen absorbents. Oxygen absorbents can be defined as "a range of chemical compounds introduced into the MAP package (not the product) to alter the atmosphere within the package". Developed in Japan in 1976, oxygen absorbents were first marketed by the Mitsubishi Gas Chemical Co., under the trade name Ageless. Several other companies also produce a range of absorbents with the best known being the Toppan Printing Company which produces a range of absorbents under the label Freshilizer Series.

Ageless, made by the Mitsubishi Gas Chemical Co., consists of a range of gas scavenger products designed to reduce oxygen levels to less than 100 ppm in the package headspace. While organic types (based on ascorbic acid) and inorganic types (based on iron powder) are available, the inorganic types are most commonly used in the Japanese market. The basic system is made up of finely divided powdered iron which, under appropriate humidity conditions, uses up residual oxygen to form non-toxic iron oxide, i.e., it rusts.

Several types and sizes of Ageless are commercially available. However, only one type of Ageless ie Ageless SS could be used with refrigerated or frozen battered and breaded fish products. The characteristics of Ageless SS are shown in **Table 6.**

**Table 6**
**TYPES OF AGELESS OXYGEN ABSORBENTS FOR USE WITH FROZEN BATTERED/BREADED FISH PRODUCTS**

| | Product | | Absorption Speed (Day) |
|---|---|---|---|
| Type Function | Moisture Status | Water Activity | |
| SS Decreases $O_2$ (self working) | High moisture | >0.85 | 2-3 (0-4°C)<br>10 (-25°C) |

One other type which is new to the market and could be used in conjunction with microwaveable packaging is Ageless type FM, the first oxygen absorbent for use with microwaveable foods.

## 11.0 ADVANTAGES AND DISADVANTAGES OF OXYGEN ABSORBENTS

Oxygen absorbents have several advantages for the food processor both from a marketing and food quality viewpoint. These are:

- Inexpensive and simple to use;
- Non-toxic and safe to use;
- Prevent aerobic microbial growth and extend shelf life of product;
- Arrest the development of rancid off flavour in fats and oils;
- Maintain product quality without additives;
- Increase product shelf life and distribution radius;
- Reduce distribution losses.

The disadvantages of oxygen absorbents are:

- There needs to be a free flow of air surrounding sachet in order to "scavenge" headspace oxygen if an $O_2$ absorbent is used alone;
- Consumer resistance to sachets inside the packages and possible consumer misuse of sachets.

## 12.0 CONCLUSION

In conclusion, packaging is an essential unit operation for preserving quality of battered/ breaded frozen fish products, minimizing food wastage and reducing the use of chemical, additives and stabilizers. The food package serves the important functions of containing the food, providing protection against chemical and physical damage, providing convenience in use and conveying information to the consumer. It protects the product by acting as a barrier to oxygen, moisture, chemical compounds and microorganisms that are detrimental to the quality of frozen battered/breaded products. It provides consumers with convenient features such as microwaveability, resealability and ease of opening. It conveys useful information such as a description of package contents, weight to volume ratio, manufacturer's name and address, directions for preparing the fish product and nutrition values. It serves as an effective marketing tool for promoting product identification and selling battered/ breaded fish products.

# PRODUCTION OF BATTERED & BREADED FISH PRODUCTS FROM MINCED FISH & SURIMI

## APPENDIX III

## Application of GMP/HACCP

## 1.0 INTRODUCTION

This section describes procedures and practices aimed at ensuring that the finished product is safe, and possesses the level of quality desired. Manufacturers must observe hygiene and sanitation principles in conducting their processing; in addition they must be careful not to allow conditions under which microorganisms could thrive and multiply.

Two tools currently being used to accomplish these objectives are Good Manufacturing Practices (GMP) codes, and the Hazard Analysis of Critical Control Points technique (HACCP).

GMP codes are specific sets of guidelines laid down for the production of various types of food products, to ensure safety and fitness for human consumption. Various GMP codes for food products have been developed by regulatory agencies in various countries, as well as by some international bodies such as the Codex Alimentarius commission of the FAO.

HACCP is a technique for reviewing and analysing a specific manufacturing operation with the object of identifying control and preventive measures required to ensure safety and quality.

The term "Critical Control Points" refers to points in a food manufacturing process where failure to carry out control measures will introduce unacceptable risks for the consumer.

A "Hazard" is the potential to cause harm to the consumer (e.g. presence of pathogens or dangerous chemicals) or to the product (e.g. risk of spoilage).

This document seeks to summarize the main GMP guidelines which apply to the process for battered and breaded fish products, as described in the Flow Diagram on **page 3**, and to illustrate by example the use of the HACCP technique to develop a Quality Assurance system.

## 2.0 GOOD MANUFACTURING PRACTICES

### 2.1 General

GMP systems or, as they are often called, Codes of Practice, cover correct procedures for the receipt, control and storage of raw materials and product, and precautions recommended for the various manufacturing and product handling steps.

In this section, an overview of the application of Good Manufacturing Practices is presented for the manufacture of mince/surimi battered and breaded products. No attempt is made to deal with issues common to most manufacturing processes, such as sanitary building construction details or general personal hygienic practices, but, rather, the section deals with areas specific to this particular product line.

The application of GMP described here is based on the Process Flow Diagram for cut- and mixed breaded and battered products found on **page 3**.

### 2.2 Facility and Equipment

Ideally, the handling or primary processing of raw fish should be carried out in a separate building, or at least in an area physically separated from secondary processing operations. In some cases, due to space limitations, this may not be practical; in these instances primary processing should not be carried on at the same time as secondary processing. Thorough cleanup and sanitation should be done between primary and secondary processing runs.

The manufacturing area should be laid out so that product moves from one step to the next in an orderly fashion. The plant should also be constructed so that there is no undue delay in movement of the product in going from one stage to the next. Overall, planning of the plant and process should aim to minimize the period from the time the raw material is taken from the freezer store or fresh fish arrives at the plant, to the time the finished product is placed in the freezer.

Ideally, the plant should also be laid out to avoid "cross contamination"; that is, contact of raw fish which has high surface bacterial loading with product at a more advanced stage of processing where the microbial count is low, exposing the latter to transfer of micro-organisms from raw material. As well, the manufacturing area should be constructed so as to prevent the entry of rodents, dust, birds or flying insects, which could introduce another contamination hazard.

The plant should include adequate and appropriate facilities for storage of the various inventories required. For this type of product, this would include:

Freezer store for frozen raw materials (e.g. surimi, kept at -18°C or less);

Separate dry storage areas for dry ingredients and packaging materials, protected from entry of rodents, birds, insects and dust contamination;

Chilled (0-5°C) storage for fresh fish or mince in process;

A tempering room for frozen raw materials, kept at slightly below freezing.

Adequate cold storage for in-process product, where there is delay in going

from one step to the next;

A separate frozen store for frozen, packaged product.

In designing a manufacturing line for this or any other secondary product, GMP codes generally recommend as complete mechanization as possible. This is not always possible or practical in many of the small scale industries which are found in the region; in instances such as these, much emphasis should be placed on the practice of good hygiene and good training of plant employees by the plant owners or management.

All machines, conveyers, containers and surfaces with which the product comes in contact should be made of a smooth non-corrodible material such as stainless steel or polypropylene. Mild steel is corrodible and therefore not acceptable, nor is wood, as it provides crevasses between fibres which could harbour bacteria.

Also, equipment should be designed so that covers can be put in place to protect the product from environmental contamination. Machinery and equipment should be easy to disassemble at the end of the run for easy cleaning.

## 2.3 Receiving and Handling of Raw Materials

In designing a program to maintain product quality, one of the most important elements is the purchasing, handling and storage of materials.

The major raw materials used in these products (namely surimi and minced fish), are highly susceptible to microbial spoilage (i.e. they are "microbiologically sensitive"). When selecting materials having this characteristic, it is important to pick good quality material if possible, by choosing reputable sources of supply. The raw material or

ingredient should be inspected immediately upon arrival, to ensure that the shipment is fully frozen and that the protective outer packaging is in good condition and not damaged or torn, exposing product. Frozen raw materials should be placed in a freezer store at -18°C or less immediately upon arrival unless it is to be processed at once.

Dry raw materials such as starches, sugars, salt, batter mix, breading, etc., as well as packaging materials, should also be inspected upon arrival for damaged or torn containers or outer wrap, which could introduce the possibility of contamination. Damaged units should be separated from the rest of the shipment and either returned or disposed of. An area physically separated from the wet production area, preferably a storage room which is dry and protected from environmental hazards such as dust and insects, should be reserved for storage of these materials.

## 2.4 Processing of Fresh Fish

Fish for mince should arrive properly iced, and in a fresh state, and should be processed as quickly as possible. The fish and in-process material at all stages should not be left standing any longer than necessary; if there are any interstage delays, the fish or mince should be held in chilled storage or frozen.

Waste (heads, viscera, frames) should be removed as quickly as possible from the production area, as these are a source of bacteria and enzymes which could contaminate good product and accelerate spoilage.

## 2.5 Thawing of Frozen Materials

Frozen raw materials must be thawed or tempered (partially thawed) so that they can be easily processed. From a food safety perspective, tempering is the preferred method; this is simply the holding of frozen product at a temperature near the freezing point to soften, but not thaw, the material so that it may be processed in the cutting equipment easily. To do this, a controlled temperature room must be provided (maintained just below 0°C).

In some smaller plants, such a facility may not be available and the only feasible method of softening the material may be to temper in the chilled room (0-5°C), or to leave the material out on the process floor a specified time prior to production. In these cases it is important that space be allowed between individual blocks to allow air movement and uniform thawing. Once thawed the material should be used immediately or kept in the chilled storage. Production should be planned carefully so that no more material is thawed than is required for the day's run.

As an alternative, a warm water bath is sometimes used for thawing. However, in many cases the water could be in the optimum temperature range for microbial growth, and this method is not recommended. Even though there may be an outer wrap on the product, the water used should be of potable quality. Product should not be left in the thawing bath any longer than is necessary to bring it to a condition suitable for processing.

When thawing is complete, and before use in production, the lot should be sampled and examined for signs of spoilage or contamination which would make it unfit for use, and if these are present, a judgement made whether the product can be used or not. Unacceptable product should be removed from the production area as soon as possible, and not left around to contaminate good material.

## 2.6 Preparation of Fish Cakes

Weighing and measuring equipment, and containers used to weigh and hold ingredients for the batch should be cleaned and sanitized daily.

Dry ingredients should be inspected immediately before use, to ensure that there has been no contamination or excessive moisture. Care should be taken at all times to see that partially used containers of ingredients are kept closed when not required. Care should also be taken to see that oldest ingredients are used first. Ideally, dry ingredients should be kept in bins with lids, cleaned, sanitized and dried between use, and made of a non-corrodible, smooth material.

Weighed ingredients should not be left standing in the room too long before use. Care should be taken to ensure that surimi or mince is kept cold, if fully thawed. Sufficient ice should be added to the batch during mixing to maintain its temperature at less than 10°C. Cutting/mixing equipment should be thoroughly washed and sanitized at the end of each day.

After mixing, the batch should be put into the subsequent process steps as soon as possible, and not be allowed to stand longer than necessary. Standing time can be minimized by careful scheduling of mixing. It is recommended that material awaiting further processing be held in containers with lids in place and kept cold. The steps of forming, setting, cooking and cooling should be carried out in rapid sequence, with a minimum of delay time between steps. Equipment capacities for each step should be coordinated so that there are no bottlenecks, causing delay.

The water used for setting and cooking of the formed pieces should be of potable quality.

For the cooking step, temperature should be controlled at about 90°C by the addition of steam or hot water, and cooking time should be adequate to achieve a centre temperature of 80°C, to pasteurize the product. This cooking time should be established by test.

Cooling of the product should be accomplished as quickly as possible. This could be carried out in a cold water bath, which should utilize water of potable quality as before.

During shredding, the hopper feeding the machine should be covered and the cut material should be protected from environmental hazards as well.

In-process storage, prior to the battering and breading process, should be as short as possible, to minimize chances of microbial growth. Care should be taken to ensure that material stored for the longest time is used first.

## 2.7 Mixing and Forming

In carrying out these process steps, special care must be taken to avoid contamination and conditions which encourage microbial growth, because there is no subsequent process step which will ensure destruction of microbes. It is important to ensure, for example, that equipment is cleaned and sanitized at regular intervals, at least after each day's production.

The forming operation must be carried out so that the product is enclosed, and exposed to the environment as little as possible. Once the mince/surimi pieces are formed, they

should be fed into the battering and breading process as quickly as possible. This succession of steps should be carried out with the minimum delay possible in going from one to the next, and should be connected in a continuous manner by conveyers.

### 2.8 Battering and Breading

Dry coating materials, batter mix and breading should be inspected upon arrival at the production line for signs of contamination or spoilage due to excess moisture.

For preparation of batter, the water used should be of potable quality.

Batches of batter mixes should be of such a size such that they are used up quickly; they should not be allowed to stand for too long. The batch should be kept at a temperature not exceeding 10°C. Leftover batter should be disposed of at the end of each day's operation.

It should be noted that machine application of batter using a conveyor dip is much preferred over manual application. Machine operation will give a more uniformly coated product, and, in addition, will reduce risk of contamination due to human handling. If battering is carried out manually, it should be ensured that workers observe good hygienic practices. Specifically, it is desirable that gloves be worn by those handling product directly.

Breading should be applied in equipment which provides continual circulation and screens out moist lumps which may form from time to time. The latter should be discarded. Breading material in the machine at the end of the day should be cleaned out. This may be kept refrigerated and reused, provided that it is not kept more than 24 hours.

### 2.9 Freezing

Upon emerging from the battering and breading process, the product should be completely frozen (preferably to at least the cold store temperature). A cold store should not be used for freezing the product.

## 3.0 HACCP ASSESSMENT

Hazards inherent in a food manufacturing process could be any of a number of types. One classification is as follows:

Class "**A**": Content of ingredients which are microbiologically sensitive (in this case fish mince and surimi).

Class "**B**": Absence of a processing step which would effectively destroy harmful micro-organisms.

Class "**C**": Potential for recontamination after processing and before packaging.

Class "**D**": Significant potential for abusive handling in distribution, or at the consumer level, that could introduce hazards when consumed.

Class "**E**": Absence of a terminal heat process which destroys microbes after packaging or at the point of usage.

All of these but the last apply to the battered/breaded mince/surimi products under discussion, and these must be considered to have a high hazard level. Important product characteristics which govern the following hazard analysis are stated as follows:

Major raw materials used are microbiologically sensitive;

The cooking step in the process can destroy harmful micro-organisms in the fish cake portion only;

There is no application of heat once the mince is added;

The product is exposed in subsequent processing steps, hence there is potential for recontamination;

There is no terminal heat treatment step in the process once the product is sealed inside the package;

In the target market (food stalls, restaurant trade), the potential for abusive handling in distribution or at the point of final preparation is significant;

The product is intended for deep frying at the point of consumption.

### 3.1 Hazard Analysis

Once a flow diagram is constructed (as in Figure 1), the next step in a HACCP study is to identify and assess the hazards associated with each process step. Assigning a value to risk levels at the various points in a process will provide a basis for assigning priority to control measures for implementation.

Hazard risks are considered from two different perspectives:

1. The first is the severity or seriousness of the hazard and its consequences, should it occur. For example, some hazards, resulting in microbial or chemical contamination, could cause a severe case of food poisoning or even death. Others, such as contamination with dust, off flavours or labelling violations, may present little or no danger to consumer health.

2. The other perspective is the risk of occurrence. This risk will be high when much product exposure (processing in the open) and/or manual handling is involved, or when processing takes place under conditions which encourage microbial growth. It will be low when the product is enclosed in a package or inside closed equipment, or maintained under cold or hot conditions resulting in the inhibition of microbial growth.

In this example, hazards are rated 1 to 3, with 3 representing a high level and 1 a low level. Once risk levels are assigned from these two perspectives, an overall risk inherent in the processing step is determined. Where the two risk assignments are different, the average is normally taken. If the average is not a whole number, the severity aspect is given priority in assigning the values of "high"(3), "medium"(2), or "low"(1).

Using the Process Flow Diagram as a basis, hazard lists and ratings for the individual process 7steps can be prepared as shown in **Table 7.**

## Table 7
## Hazard List Analysis

| No. | Processing Step | Hazard | Severity | Risk of Occurrence | Overall Risk Rating |
|---|---|---|---|---|---|
| 1 | Receive Surimi | Damaged Package | 3 | 2 | High |
| | | May Have Thawed | 3 | 2 | |
| 2 | Store Frozen | System Failure | 3 | 1 | Medium |
| 3 | Thaw | Spoilage | 3 | 2 | High |
| | | Microbial Growth | 3 | 3 | |
| 4 | Rec Other Ingredients | Package Damage | 3 | 2 | High |
| 5 | Dry Storage | Spoilage | 1 | 1 | Medium |
| | | Contamination | 2 | 3 | |
| 6 | Perishable Storage | Spoilage | 3 | 3 | High |
| | | System failure | 3 | 1 | |
| | | Microbial Growth | 3 | 3 | |
| 7 | Weigh Ingredients | Wrong Composition | 1 | 2 | Medium |
| | | Contamination | 3 | 2 | |
| 8 | Grind to Paste | Contamination | 3 | 2 | High |
| 9 | Transfer to Process | Microbial Growth | 3 | 2 | High |
| 10 | Form Into Cakes | Contamination | 3 | 2 | High |
| 11 | Set | Microbial Growth | 3 | 1 | Medium |
| 12 | Cook | Low Temperature | 3 | 2 | High |
| 13 | Cool | Microbial Growth | 3 | 1 | Medium |
| 14 | Store | Microbial Growth | 3 | 1 | Medium |
| 15 | Shred | Contamination | 3 | 2 | High |
| 16 | Receive Fresh Fish | Spoilage | 3 | 2 | High |
| 17 | Wash Fish | Poor Water Quality | 3 | 1 | Medium |
| 18 | Head and Gut | Contamination | 3 | 3 | High |
| | | Microbial Growth | 3 | 2 | |
| 19 | Meat-bone Separation | Contamination | 3 | 3 | High |
| | | Microbial Growth | 3 | 2 | |
| 20 | Mincing | Contamination | 3 | 3 | High |
| | | Microbial Growth | 3 | 2 | |
| 21 | Weigh Mince, Ingreds. | Wrong Composition | 1 | 2 | Medium |
| | | Contamination | 3 | 2 | |
| 22 | Grind to Paste | Product too warm | 3 | 3 | High |
| | | Contamination | 3 | 2 | |
| 23 | Weigh Mince and Surimi | Wrong Proportions | 1 | 2 | Medium |
| | | Contamination | 3 | 2 | |
| 24 | Blend Mince and Surimi | Product Too Warm | 3 | 3 | High |
| | | Contamination | 3 | 2 | |
| 25 | Form Final Shape | Contamination | 3 | 2 | High |
| 26 | Prepare Batter Mix | Water Quality | 2 | 1 | Medium |
| | | Wrong Composition | 1 | 2 | |
| 27 | Hold Batter | Contamination | 3 | 2 | High |
| | | Microbial Growth | 3 | 2 | |
| 28 | Apply Batter | Contamination | 2 | 1 | Low |
| 29 | Apply Breading | Contamination | 2 | 1 | Low |
| 30 | Freeze | Inadequate Freezing | 3 | 1 | Medium |
| 31 | Par-Fry | Rancidity | 1 | 3 | Medium |
| 32 | Re-freeze | Inadequate Freezing | 3 | 1 | Medium |
| 33 | Package | Contamination | 2 | 2 | Medium |
| | | Poor seals | 3 | 2 | |
| 34 | Frozen Storage | System Failure | 3 | 1 | Medium |
| 35 | Shipping | Damaged Packages | 3 | 1 | Medium |

### 3.2 Critical Control Point Assessment

Once hazards have been identified and rated, critical control points can be identified and assigned priorities, as shown in **Table 8.** All processing steps having a "medium" or "high" rating are identified as Critical Control Points and assigned a CCP number. Steps having a "low" rating are considered individually, and may or may not be identified as Critical Control Points. For example, steps 28 and 29, which involve no manual handling, no addition of new materials, no process delays, and where frying at the point of consumption should destroy any microbes on the surface material, are not identified as Critical Control Points.

Hazard ratings may also be used to formulate Quality Assurance strategies in plants where time and personnel resources are limited, and where it may be felt impossible to implement all of the recommended measures at once. Construction of a matrix, similar to that in **Table 8**, will indicate the points where the process is most vulnerable to problems caused by hazards, and management can assign the highest priority to these areas for implementation of control measures. In this case, if management and time resources are limited, control points identified for immediate action would include the following, identified as "high":

Receipt of raw materials and ingredients;

Thawing of frozen raw materials;

Storage of perishable goods (e.g. fresh vegetables);

The cooking/cooling processes;

Processing steps to convert surimi into fish cakes (includes grinding, transfer, cooking);

Shredding of fish cakes;

Steps involved in the processing of fresh fish to paste (washing,

heading/gutting, meat-bone separation, mincing and grinding);

Blending of surimi and mince;

Forming of the final pieces for battering and breading;

Packaging.

Once it is ensured that control measures are in place at these points, the points rated "medium" can be dealt with, and so on.

Also included in this table is an identification of control options for each CCP. The measures to be considered for control of hazards or "Control Options" at the various CCP's can be classified into six types:

1. Ingredient Control. This includes measures such as selection, imposing standards on suppliers, incoming inspection, selection of ingredient lots during processing, and good storage practices which can be applied to eliminate unacceptable product defects at or before the start of processing.

2. Sanitation and Hygiene. These are applied in instances where product is exposed to contamination through equipment contact or direct handling.

3. Time-Temperature Control. This indicates instances where failure to process or store product within specified limits of one or both of these parameters may cause unacceptable hazards to occur.

4. Containment. These are instances where product is protected from hazards by ensuring that the product is protected from exposure to the environment; for example ingredient storage or in-process containers are kept closed, or hopper lids are kept in place.

5. Other Means. This classification includes, but is not limited to, using preservatives or manipulating product composition to produce the effect of inhibiting micro-organisms and contributing to food safety.

6. Packaging (Applied). This refers to protection afforded by the package once the product is sealed inside.

# Table 8

## Critical Control Point Analysis

| No. | | Processing Steps | Critical Control Points | Hazard Risk Level | Ingredient Control | Sanitation & Hygiene | Time Temp. | Containment | Other Means | Packaging (Applied) |
|---|---|---|---|---|---|---|---|---|---|---|
| I | 1 | Receive Surimi | CCP#1 | High | X | | | X | | |
| | 2 | Store Frozen | CCP#2 | Medium | | | X | | | |
| I | 3 | Thaw | CCP#3 | High | | | X | X | | |
| I | 4 | Rec Other Ingredients | CCP#1 | High | X | | | X | | |
| | 5 | Dry Storage | CCP#4 | Medium | | | | X | | |
| | 6 | Perishable Storage | CCP#5 | High | | | X | | | |
| IEM | 7 | Weigh Cake Ingredients | CCP#6 | Medium | X | X | | | X | |
| EM | 8 | Grind to Paste | CCP#7 | High | | X | X | | | |
| EM | 9 | Transfer to Process | CCP#8 | High | | X | X | | | |
| EM | 10 | Form Into Cakes | CCP#9 | High | | X | | | | |
| E | 11 | Set | CCP#10 | Medium | | | X | | | |
| E | 12 | Cook | CCP#11 | High | | | X | | | |
| E | 13 | Cool | CCP#12 | Medium | | | X | | | |
| | 14 | Store | CCP#13 | Medium | | | X | X | | |
| ME | 15 | Shred | CCP#14 | High | | X | | | | |
| I | 16 | Receive Fresh Fish | CCP#15 | High | X | | X | | | |
| IE | 17 | Wash Fish | CCP#16 | Medium | X | X | | | | |
| IE | 18 | Head and Gut | CCP#17 | High | | X | X | | | |
| EM | 19 | Meat-bone Separation | CCP#18 | High | | X | X | | | |
| EM | 20 | Mincing | CCP#19 | High | | X | X | | | |
| IEM | 21 | Weigh Mince, Ingreds. | CCP#6 | Medium | X | X | | | X | |
| EM | 22 | Grind to Paste | CCP#20 | High | | X | X | | | |
| IEM | 23 | Weigh Mince, Surimi | CCP#6 | Medium | X | X | | | X | |
| IEM | 24 | Blend Mince, Surimi | CCP#21 | High | | X | X | | | |
| IEM | 25 | Form Pieces | CCP#22 | High | | X | | | | |
| | 27 | Hold Batter | CCP#24 | High | | | X | X | | |
| E | 28 | Apply Batter | | Low | | X | | X | | |
| E | 29 | Apply Breading | | Low | | X | | X | | |
| I | 30 | Freeze | CCP#25 | Medium | | | X | | | |
| IE | 31 | Par-Fry | CCP#26 | Medium | X | | X | | | |
| I | 32 | Re-Freeze | CCP#25 | Medium | | | X | | | |
| IE | 33 | Package | CCP#27 | Medium | | X | X | | | X |
| | 34 | Frozen Storage | CCP#28 | Medium | | | X | | | X |
| I | 35 | Shipping | CCP#29 | Medium | | | X | | | X |
| | | | | | | | | | | |
| | | | | | | | | | | |

## 3.3 Critical Control Point List

**Table 9** comprises a list of the critical control points identified along with guidelines for establishing the quality control procedures appropriate for each. This table is developed from the data in **Table 8**, and may be used as the working document for developing the plant's Quality Assurance procedures.

The first three columns are simply a restatement of the assigned Critical Control Point numbers, the level of risk assigned to each, and the processing step name. The "Control Measure" is simply a more specific identification of the selected option in **Table 8**. For example: "Ingredient Control" will appear as "Inspection On Arrival" in the case of Critical Control Point 1. For CCP# 2 (Frozen Storage), the "Time-Temperature" option will translate in specific terms to "Freezer Room Temperature Control"

For each CCP, the table also identifies an "Acceptable Limit". This is a list of conditions which must be met once the control measures are implemented, for the product or process to be acceptable. If these are not met, then a "Corrective Action" is necessary, listed in the final column. The latter not only refers to correction of the condition which caused the fault (e.g. adjustment of temperature, modification of cleaning procedures); it also includes dealing with the suspect or defective product which has been produced. For example, if it is discovered that the raw material frozen storage room has risen to +2°C, obviously the fault causing this condition must be found and corrected as quickly as possible. In addition, the question of what to do with the frozen ingredients must be addressed. One would sample the material and "check the quality" (i.e. whether there is significant thawing, and whether there has been any deterioration). Then a person designated as responsible would decide what is to be done with the lot. It may be decided that there has been no significant deterioration and the lot could be used normally. Or it may be decided that the lot is unfit for use and should be disposed of.

A monitoring and recording program structure (quality control procedures) is an additional output of a HACCP study. In this example, the columns headed "Control Monitoring", "Frequency" and "Records" comprise a recommended quality control program for the process being described.

## Table 9
## Quality Control Measures By CCP

| CCP No. | Risk Level | Description | Control Measure | Control Monitoring | Frequency | Acceptable Limit | Records | Corrective Action |
|---|---|---|---|---|---|---|---|---|
| 1 | High | Receipt of materials | Ensure good quality raw materials | Purchasing control Inspection of incoming shipments | Each receipt | Frozen materials in well frozen state. Outer packaging intact Shipment in good condition | Incoming Inspection Report | Refusal of Shipment |
| | | | Place incoming material in storage quickly | Check receiving area | Daily | Shipment in storage immediately after reciept | Corrective action only | Check quality Decide disposal or use |
| 2 | Medium | Frozen storage | Maintain cold store temperature | Check freezer store temperature | Daily | Below -18 deg C | Freezer Store temperature log | Correct any mech. fault Check quality Decide disposal or use |
| 3 | High | Thawing of frozen materials | Maintain low temperature | Room temp. checks | Daily | 5 deg C Max. | Thaw room temperature log. QCReport | Correct any mech. fault Decide disposal or use |
| | | | Use quickly | Monitor time until use Odour check | Each lot | 24 hrs max. | | |
| | | | Check thawed quality | | Each lot | No decomposition | QC Report | |
| 4 | Medium | Dry material storage | Keep containers closed Keep clean and dry | Visual check | Daily | No contamination or moisture or mould growth | QC Report | Remove defective material Clean up area |
| 5 | High | Perishable ingredient storage | Keep in chilled room | Check cool room temperatures | Daily | 0 to 5 deg C | Cool room temp. log | Correct any mech. fault Check quality Decide disposal or use |
| 6 | Medium | Weigh out raw mat'ls and ingredients | Monitor ingredient quality | Visual check | Each batch | Ingredients in good condition | QC Report | Discard contaminated material |
| | | | Sanitation and hygiene | Inspection | Daily, prior to start | Equipment clean and sanitized Hands washed clean attire | Pre-starting plant hygiene inspection checklist | Re-clean equipment, pans, totes Re-instruct personnel |
| 7 | High | Grind to paste | Sanitation and hygiene | Inspection | Daily, prior to start | Equipment clean and sanitized before start Hands washed clean attire | Pre-starting plant hygiene inspection checklist | Re-clean equipment Re-instruct personnel |
| | | | Keep product cool | Temperature check | Each lot, when mixed | 10 deg C max. | QC Report | Check quality Increase ice |
| 8 | High | Transfer to Process | Keep standing time to minimum | Spot check | Twice daily | 1 hour max. inventory on floor | | Check quality Decide disposal or use |

| CCP No. | Risk Level | Description | Control Measure | Control Monitoring | Frequency | Acceptable Limit | Records | Corrective Action |
|---|---|---|---|---|---|---|---|---|
| 8 con't | | | Protect from exposure | Spot check | Twice daily | Covers on hoppers or transfer containers | QC Shift report | Check quality<br>Decide disposal or use |
| | | | Sanitation and hygiene | Inspection | Daily, prior to start | Equipment clean and sanitized before start<br>Hands washed clean attire | Pre-starting plant hygiene inspection checklist | Re-Clean equipment, pans, totes<br>Re-Instruct personnel |
| 9 | High | Form Into Cakes | Sanitation and hygiene | Inspection | Daily, prior to start | Equipment clean and sanitized before start<br>Hands washed clean attire | Pre-starting plant hygiene inspection checklist | Re-clean equipment, pans, totes<br>Re-Instruct personnel |
| | | | Keep cool | Check temp. | Each lot | 10 deg C Max. | QC Report | Check quality<br>Decide disposal or use |
| | | | Quickly into setting bath | Spot check | Hourly | Less than 1 hour to setting bath | Corrective action only | Check quality<br>Decide disposal or use |
| 10 | Medium | Setting | Maintain bath temperature | Check temperature | Hourly | 40 deg C min. | QC Report | Check quality<br>Decide disposal or use |
| 11 | High | Cooking | Ensure that minimum time and temp. are met | Check centre temperature at end | Hourly | 80 deg C min. | QC shift report | Check quality<br>Decide disposal or use |
| | | | | Check water temperature | Hourly | 90 deg C min. | | |
| 12 | Medium | Cooling | Use chlorinated water | Check Cl level | Daily | Min. 1 ppm | QC shift report | Adjust rate |
| | | | Maintain water temperature | Check temperature | Hourly | Max. 37 deg C | | |
| | | | Cooled product into storage quickly | Floor inventory checks | Hourly | 1 hour's production on floor max. | Corrective action only | Check quality<br>Decide disposal or use |
| 13 | Medium | Inter-step storage | Maintain room temperature | Room temp. checks | Daily | 0 to 5 deg C | Cool room temp. log | Correct fault<br>Check quality<br>Decide disposal or use |
| | | | Keep covered | Check that product is covered | Twice daily | Product is adequately protected | | |
| 14 | High | Shred surimi cakes | Sanitation and hygiene | Inspection | Daily, prior to start | Equipment clean and sanitized before start<br>Hands washed, clean attire | Pre-starting plant hygiene inspection checklist | Re-clean machine<br>Re-instruct personnel |

| CCP No. | Risk Level | Description | Control Measure | Control Monitoring | Frequency | Acceptable Limit | Records | Corrective Action |
|---|---|---|---|---|---|---|---|---|
| 15 | High | Receive fresh fish | Ensure good incoming quality<br>Keep cool | Inspection of fish | Each incoming shipment | Adequate ice present<br>Fish in good condition | Incoming fish inspection reports | Refuse lot |
| 16 | Medium | Wash fish | Maintain water quality | Check chlorine<br>Microbiological analysis | Daily<br>Every two months | Min. 1 ppm Meets potable standards | Daily log<br>Analysis report | Adjust addition<br>Improve treatment |
| | | | Sanitation and hygiene<br><br>Use quickly | Pre-startup check | Daily, prior to start | Pans/totes clean and sanitized before start<br>Hands washed, clean attire | Pre-starting plant hygiene inspection checklist | Re-clean equipment<br>Re-instruct personnel |
| 17 | High | Head and gut | Remove waste regularly | Spot check | Hourly | Minimal waste present | Corrective action only | Re-instruct personnel |
| | | | Keep cool | Check temp. | Hourly | 10 deg C Max. | QC Report | Increase Ice |
| | | | Sanitation and hygiene<br><br>Use Quickly | Pre-startup check | Daily, prior to start | Pans/totes clean and sanitize before start<br>Hands washed, clean attire. | Pre-starting plant hygiene inspection checklist | Re-clean equipment<br>Re-instruct personnel |
| 18 | High | Separate meat and bones | Remove waste regularly | Spot check | Hourly | Minimal waste present | Corrective action only | Re-instruct personnel |
| | | | Keep cool | Check temp. | Hourly | 10 deg C Max | QC Report | Increase Ice |
| | | | Sanitation and hygiene<br><br>Use Quickly | Pre-startup check | Daily, prior to start | Equipment clean and sanitize before start<br>Hands washed, clean attire. | Pre-starting plant hygiene inspection checklist | Re-clean equipment<br>Re-instruct personnel |
| 19 | High | Mince | Control temp. with ice<br>Use quickly | Check Temp. | Hourly | 10 deg C Max. | QC Report report | Increase Ice<br>Check product quality<br>Decide disposal or use |
| | | | Sanitation and hygiene | Pre-startup check | Daily, prior to start | Equipment clean and sanitized before start.<br>Hands washed, clean attire | Pre-starting plant hygiene inspection checklist | Re-clean equipment<br>Re-instruct personnel |
| 20 | High | Grind to paste | Sanitation and hygiene | Pre-startup check | Daily, prior to start | Equipment clean and sanitized before start.<br>Hands washed, clean attire | Pre-starting plant hygiene inspection checklist | Re-clean equipment<br>Re-instruct personnel |
| | | | Keep Cool<br>Use Quickly | Check Temp. | Each lot | 10 deg C Max. | QC Report | Increase ice |

| CCP No. | Risk Level | Description | Control Measure | Control Monitoring | Frequency | Acceptable Limit | Records | Corrective Action |
|---|---|---|---|---|---|---|---|---|
| 21 | High | Blend mince and surimi cakes | Sanitation and hygiene | Pre-startup check | Daily, prior to start | Equipment clean and sanitized before start<br>Hands washed, clean attire | Pre-starting plant hygiene inspection checklist | Re-clean machine<br>Re-instruct personnel |
| | | | Keep cool<br>Use quickly | Check temp. | Each lot | 10 deg C Max. | QC Report | Check quality<br>Decide disposal or use |
| 22 | High | Form pieces | Sanitation and hygiene | Pre-startup check | Daily, prior to start | Equipment clean and sanitized before start<br>Hands washed, clean attire | Pre-starting plant hygiene inspection checklist | Re-clean machine<br>Re-instruct personnel |
| 23 | Medium | Prepare batter mix | Check dry batter quality | Visual check | Each lot | Dry, no contamination | Corrective action only | Discard and replace |
| | | | Sanitation and hygiene | Pre-startup check | Daily, prior to start | Equipment clean and sanitized before start<br>Hands washed, clean attire | Pre-starting plant hygiene inspection checklist | Re-clean machine<br>Re-instruct personnel |
| 24 | High | Hold batter | Keep covered | Spot check | Hourly | Cover kept in place<br>No contamination | Corrective action only | Discard and remix |
| | | | Keep cool<br>Use quickly | Check temp.<br>Spot check | Hourly<br>Hourly | -15 deg C<br>Two hours mixed inventory max. | QC Report<br>Corrective action only | Discard and remix |
| 25 | Medium | Blast freeze | Ensure complete freezing and correct temp. | Check freezer temp.<br>Check product out of freezer | Each lot<br>Each lot | -30 deg C<br>Product well frozen | QC shift report<br>QC shift report | Correct any mech. fault<br>Check quality<br>Refreeze if necessary |
| 26 | Medium | Par-fry | Ensure correct time and temp. | Check oil temp. and fryer throughput | Hourly | 170-180 deg C<br>1.5 min. max. | QC Report | Adjust as required |
| 27 | Medium | Packaging | Keep cold | Check if frozen | Hourly | Well frozen | QC Report | Check quality<br>Decide disposal or use |
| | | | Minimum time out of freezer | Spot check | Hourly | No product accumulation | QC Report | Corrective action only |
| | | | Monitor seal integrity | Check for bad seals | Hourly | All seals good | | 100 % inspection<br>Correct fault |
| 28 | Medium | Finished product cold store | Maintain cold store temperature | Check freezer store temperature | Daily | Below -18 deg C | Freezer Store temperature log | Correct any mech. fault<br>Check quality<br>Decide disposal or use |

| CCP No. | Risk Level | Description | Control Measure | Control Monitoring | Frequency | Acceptable Limit | Records | Corrective Action |
|---|---|---|---|---|---|---|---|---|
| 28 con't | | | Finished product inspection | Visual checks | Each day | Good colour<br>Good package<br>Good overall appearance | Final Product Inspection forms | Resample and recheck<br>Decide disposal, rework or use |
| | | | | Organoleptic checks | Each day | No off odour or flavour | | |
| 29 | Medium | Shipment | Enable recall | Match lot nos. with shipments | Each shipment | Shipping records include lot nos. and destinations | Shipping report | Recall |

### 3.4 I-E-M Approach

In plants where it may appear difficult or expensive to install comprehensive quality assurance programs, much can be accomplished relatively simply by the "I-E-M" approach. These letters stand for the following:

**Inspection.** Points in the process may be identified where problems will be detected by visual or organoleptic inspections. This may be done as a routine duty of a Quality Control floorperson in a larger plants; or may take the form of a regular visual or olfactory check by a line worker in a smaller plant. While these inspections may be as simple as a quick look or smell as the product passes through the manufacturing process, specific instructions to carry out these checks and training of workers in detection of defects is necessary. In particular, it must be stressed to the worker that the owner or supervisor should be contacted if a defect is observed.

**Exposure.** Points in the process may be identified where the product could be exposed, either to the environment or to direct contact with equipment. These can be highlighted in the Critical Control Point Analysis, and identified as points where equipment sanitation or keeping covers in place are important to prevent contamination.

**Manual Handling.** These are points where there is direct manual handling of the product and good hygienic practices assume critical importance. Contamination from this source can be avoided by training of workers in hygienic practice and monitoring to see that such procedures are observed.

As an example, once the Critical Control Point list in Tables **8** and **9** are developed, one can go through the list and identify the "I" "E" and "M" points. An extra column is included in **Table 8** to illustrate this.

## 4.0 REFERENCES

Fiertag, Dr. Joellen. **Developing Your Own HACCP Program.** Manual for Workshop held in Fredericton, N.B., Canada, Feb. 27, 1992.

Smith, J.P., C. Toupin, B. Gagnon, R. Voyer, P.P. Fiset and M.V.Simpson. **A Hazard Analysis Critical Control Point Approach (HACCP) to ensure the Microbiological Safety of Sous Vide Processed Meat/Pasta Product.** Food Microbiology, 1990 pp. 177-198.

**Recommended International Code of Practice: Frozen and/or Breaded Fishery Products.** No. CAC/RCP 35-1985. First Edition. FAO, Rome 1988.

## DAILY PRE-START SANITARY CHECKLIST

**DATE :**

| **RECEIVING AREA** | |
|---|---|
| DOCK | |
| FLOOR | |
| GENERAL TIDINESS | |
| **PROCESSING ROOM** | |
| WALLS | |
| FLOOR | |
| CEILING | |
| PANS/TOTES | |
| TABLES | |
| SCALES | |
| UTENSILS | |
| DEBONER | |
| MINCER | |
| SILENT CUTTER | |
| FORMER | |
| SETTING /COOKING | |
| TANKS | |
| SHREDDER | |
| BREADING/BATTERING MACHINE | |
| DRAINS | |
| HAND WASH AREA | |
| PAN WASH AREA | |
| WASTE RECEPTABLES | |
| BLAST FREEZER | |
| CHILL ROOM | |
| COLD STORE | |

| **HOUSEKEEPING** | |
|---|---|
| INGRED. STORAGE | |
| CLEANING SUPPLIES STORAGE | |
| PACKAGING STORAGE | |
| UNUSED EQUIPMEN | |
| **WASHROOM** | |
| WALLS | |
| FLOORS | |
| SINKS | |
| TOILETS | |
| SOAP DISPENSERS | |

REMARKS :

_____

_____

_____

CORRECTIVE ACTION

_____

_____

_____

INSPECTION : _____

APPROVAL TO START : _____

SUPV. INITIAL : _____

## QUALITY CONTROL REPORT

DATE :

| | | | | |
|---|---|---|---|---|
| TIME : | | | | |
| THAWED SURIMI | | | | |
| ODOUR | | | | |
| APPEARANCE | | | | |
| TEMPERATURE | | | | |

SURIMI PROCESS:

| | | | | |
|---|---|---|---|---|
| TEMP; PASTE | | | | |
| TEMP, FISH CAKES | | | | |
| TEMP., SETTING BATH | | | | |
| TEMP., COOK WATER | | | | |
| TEMP., COOKED CAKES | | | | |
| TEMP., COOLING WATER | | | | |

FISH MINCE PROCESS

| | | | | |
|---|---|---|---|---|
| TIME | | | | |
| TEMP., FISH | | | | |
| TEMP., MINCE | | | | |
| TEMP., PASTE | | | | |
| SURIMI/MINCE BLEND | | | | |

FRYING/FREEZING/PACKING

| | | | | |
|---|---|---|---|---|
| TIME | | | | |
| FREEZER TEMP. | | | | |
| PRODUCTS FROZEN OK? | | | | |
| FRIED TEMP. | | | | |
| FIRED APPEARANCE | | | | |
| PACKAGING SEALS | | | | |
| PACKAGING APPEARANCE | | | | |
| COMMENTS | | | | |
| INITIALS | | | | |

## SHIPPING REPORT

DATE : _____

CUSTOMER : _____

_____

PRODUCT : _____

QUANTITY : _____ INVOICE NO. _____

CODE NOS : _____

CARRIER : _____

BILL OF LADING NO. : _____

## INCOMING SHIPMENT INSPECTIONS
## INGREDIENTS AND PACKAGING MATERIAL

| | | | | |
|---|---|---|---|---|
| DATE | | | | |
| ITEM | | | | |
| SUPPLIER | | | | |
| NO. UNITS | | | | |
| QUANTITY | | | | |
| CODE MARKS | | | | |
| CONDITION | | | | |
| ACCEPTED | | | | |
| INITIAL OF RECIEVER | | | | |
| CORRECTIVE ACTION | | | | |
| INITIAL | | | | |
| NOTES | | | | |

## COLD STORAGE LOG

| Date | Time | Cold Storage Room | Temperature |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

## FINAL PRODUCT INSPECTION

| | | | | | |
|---|---|---|---|---|---|
| PRODUCTION DATE | | | | | |
| PRODUCT TYPE | | | | | |
| CODE MARKS | | | | | |
| SAMPLE SIZE | | | | | |
| PACKAGE: APPEARANCE | | | | | |
| SEALS | | | | | |
| PRODUCT: TEMPERATURE | | | | | |
| COATING | | | | | |
| COLOUR | | | | | |
| FILLING: APPEARANCE | | | | | |
| ODOUR | | | | | |
| FRY TEST: COLOUR | | | | | |
| TASTE | | | | | |
| COMMENTS | | | | | |
| INITIALS<br>ACTION | | | | | |

## INCOMING SURIMI/LEACHED MEAT INSPECTION

| | | | | | |
|---|---|---|---|---|---|
| DATE | | | | | |
| PRODUCT | | | | | |
| SUPPLIER | | | | | |
| QUANTITY | | | | | |
| NO. UNIT | | | | | |
| LOT MARKINGS | | | | | |
| FROZEN | | | | | |
| CONDITION | | | | | |
| ACCEPTED | | | | | |
| INITIAL | | | | | |
| DATE USED | | | | | |
| THAWED ODOUR | | | | | |
| APPEARANCE | | | | | |
| INITIAL | | | | | |
| CORRECTIVE ACTION | | | | | |