Packaging of Frozen Fish Products

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World trade in frozen fishery products has been increasing every year. In India, frozen fishery products constitute a major constituent of the export earnings. About 80 percent of the total aquatic products exported from India to the Europe, USA, Japan and Middle East countries is frozen in different forms and packs. Fish being highly perishable, transportation and storage of frozen fishery products requires a cold chain. They are transported by sea in refrigerated freight containers of the reefer type. The kind of material and the packaging used depends on the value of the product and the requirement of end user or customer. Both consumer and bulk packaging are used to facilitate trade. The retail pack of smaller quantity is used for household purposes whereas bulk packs with larger quantities are meant for restaurants, catering services or for repacking into consumer packs.

The main item of export of frozen products are block-frozen shrimps, cephalopods and fishes. IQF and value added fish products form only a minor portion of the trade. Market research has indicated that there is need for standardization of current materials, styles and modes of packaging of frozen foods. At the same time it is necessary to give attention to cost – effectiveness also.

Fishery products are frozen at – 40^0 C. However cold storage temperature where they are subsequently stored varies from -30 to -18^0 C. The enzymatic activities bring about deteriorative changes like rancidity in frozen fish products. Exposure to low temperatures for a long time may result in freezer burns. Hence for extending shelf life and further storage, packaging is of absolute importance. To get a quality frozen product in perfect condition the package must provide protection against dehydration, oxidation, flavour and odour loss and physical changes. Evaporation of moisture from the surface of the fish may occur resulting in freezer burns. In order to over come these problems suitable packaging is absolutely necessary.

The advantages of packaging frozen fish

- Prevention of dehydration
- Prevention of rancidity in fatty fishes
- Protection against contamination and physical damages
- Retention of flavour and colour
- Attractive appearance of the product
- Can be used for cooking or heating along with the packaging material.
- Provides for pack for thawing without leaching
- Convenience in handling and using a portion of the product.

The packaging used for frozen fish products should be of good quality as well as odour and taint free. It should protect the product from transit and storage hazards as well as provide a barrier for retention of moisture. Laminated packs are usually used for IQF products

Current Packaging for Indian Seafood

Packaging material used for frozen fresh fish is mainly polythenes, either as premade bags or wraps which are then packed into waxed duplex cartons. Frozen fish are also over wrapped in polystyrene trays for display. Individual fillets are packed in cellophane or PVC. Vacuum packaging of fish fillets and steaks in laminate films, and PVDC copolymer system is also practiced. The corrugated fibreboards are usually waxed or provided with a liner. Sometimes an inner slab of polystyrene foam is effective in providing increased insulation. The sequence of packing starts with the primary inner wrap and finishes at the master carton

Primary wrap for block frozen products

The material used as a primary wrap for contact with the food is mainly Low-density polythene (LDPE). This can be in the shape of a bag or a film. Usually 2 kgs or 5 pounds of material is packed along with 10-20 % glaze. Glazing should be optimum at the recommended level, since this will increase weight and add to packaging and transportation. Alternately films of high molecular weight high-density polyethylene (HM-HDPE), which is not as transparent as LDPE film can be used, being more cost effective. 100 gauge LDPE is used to wrap while 200 gauge is used for bag. The corresponding values for HDPE are 60 and 120 gauge. Polythene films should be of food grade conforming to IS: 9845 specifications, which are given below.

Duplex carton/ Inner carton

There are four types of cartons used for packaging of seafood products, which are top opening, end opening, end loading and tray type. In top opening carton system filling is done from the top. This is mainly for filling larger pieces of fish and cephalopods. End opening type cartons are used when the product is smaller and free flowing, like packaging of fish curry or soup. Here the carton is coated with polyethylene on both the inside and outside. The end loading system feeds the product from one end into a horizontal glued carton. End flaps are heat sealed or closed by tucks in flap. End loading is suitable for products packed in aluminium /carton trays. Tray type cartons consist of cartons systems/ polypropylene trays, which are sealed with a lid and used for production of frozen pre cooked food that will be heated and thawed in the package itself. To withstand heating, the board is coated with polypropylene.

The frozen blocks are wrapped in film and then packed in duplex cartons. A number of such blocks are packed in a master poly bag and then packed into master cartons. The carton should have details like net weight, type and size, name and address of the producer and the country of origin.

Water vapour transmission rate	: 18 gm/ sqm/ 90 ± 2 % RH /24 hrs / 37 ^{0} C
Tensile Strength	: Not less than 120kg/cm^{2}in machine direction 85 kg/cm^2 in crosswise direction
Elongation at break	: 100 per cent in machine direction
	: 350 per cent in cross direction
Overall migration residue	
IS test at 48^0 C for 24 hours	: 60 mg/ litre or 10 mg/dm^2

Table 1: Specifications for duplex cartons

Material	Duplex board
Style of carton	preferably one-piece staple fewer cartons
Grammage	300g/m2 (minimum)
Bursting strength	4 kg/cm² (minimum)
Wax coating	inner & outer side.
	10g/m² on each side (minimum)
Polythene coating	20 gsm on each side
Ring stiffness	270 N
Printing details	Brand name, product type, net content, size grade. identification of packer, country of origin.

Master carton

In the case of frozen shrimps about 6 units of 2 kg each or 10 units of 2 kg each are packed into master cartons. Corrugated fiberboards are used for the packaging of frozen fish. They may be of virgin material and having three or five ply with liners. The cartons may be wax coated or supported with liner paper with higher wet strength to make it moisture resistant. The specifications for master carton vary depending upon the country or the type of pack.

Table 2 : Specifications for master carton (10 units carton)

Material	Corrugated fibreboard
Style of box	Constructed from one piece of board
Number of plies	3 or 5 ply corrugated paper board
Type of flute	B or C and combination of these
Position of flute	Vertical
Bursting strength	14 kg/cm² min
Puncture resistance	160 oz in. / tear in
Cobb value (30min)	120 g/m² max
Compression strength (kg)	350 (minimum)
Manufactures joint	Staples on the outside. Overlap not less than 3 cm. Staples not more that 6 cm apart and not further than 2.5cm from beginning and end of joint
Type of glue	Water resistant, preferable starch based or any other neutral adhesive.
Wax coating	Inside and outside of 20 g/m² (min) on each side.
Printing details	Product details, country and packer/exporter details.

Strapping and tying

Boxes are now mainly closed at the top and bottom by using cellophane tapes. They are also stapled or strapped using polypropylene / high density/ rayon extruded straps. The straps are clipped or heat-sealed. The tensile strength should be sufficient to withstand the load. In the case of polypropylene the fluctuations in the tensile strength and elongation at break (%) at -20°C are comparatively less. Hence this material is most suitable when compared to HDPE where the tensile strength and elongation at break vary.

Table 3: Specification for straps

Closure	Minimum of 2 straps to be tensioned and heat sealed
Type of strap	Polypropylene (pp)
Width of strap	12 mm
Tensile strength	1,500 kg/cm^2
Elongation	20 % minimum
Breaking load	75 (minimum)

Packing slip (Code slip)

Two packing slips are usually used. One placed on each side of the block. The slips should record the type, quantity, batch number, producer code and packing details.

Printing

The printing should be in one colour. The exterior of the master carton should have the following information printed.

1. Name of the processor and exporter
2. Country of origin and destination
3. Gross and net weight
4. Type of packing
5. Name of the product and code of packing
6. Name and address of the consignee
7. Transit instructions (perishable, hold at -20°C)

Storage and ware housing

The use of pallets and racks to store the filled boxes is recommended throughout in-factory handling and storage to ensure that damage is avoided before the boxes leave the plant.

Containerization

A large variety of sizes and dimensions of shrimp packaging has been used in India and it is essential that the optimum use be made of the freight container. This means that boxes of suitable dimensions that fit closely in the container should be made.

Packaging of Individually Quick Frozen (IQF) Products

Packaging requirements of IQF shrimps vary from those of block frozen. IQF shrimps are mainly packed for retail market in consumer packs ranging from 100g to 5 kg. An IQF pack has a single glaze on its surface and because of the larger surface area, they are vulnerable to several risk. Essential characteristics required for packaging materials of IQF shrimps are

- Low water vapour transmission rate to reduce the risk of dehydration
- Low gas/oxygen permeability, thereby reducing the risk of oxidation and changes in colour, flavour and odour
- Flexibility to fix the contours of the food
- Resistance to puncture, brittleness and deterioration at low temp.
- Ease of filling

IQF shrimps are filled in primary containers along with code slip and weighed. The product is filled into primary pack which is heat sealed and further packed in master cartons for storage and transportation. The primary pack may be plastic film pouches (monofilm, co-extruded film or laminated pouches). The unit pouches may be provided with unit/ intermediate cartons or directly packed into master cartons. The unit/intermediate cartons are made of duplex or three ply corrugated fibreboard laminated with plastic film on the inside and outside to improve the functional properties as well

as aesthetic value of the pack. The most cost effective film in this respect has been identified as 10 μ biaxially oriented polypropylene (BOPP). Bar coding is nowadays adopted which will depict various product and inventory details through a series of bars on the packaging films. Bar coding is compulsory for products imported to the EEC and US markets. Some duplex cartons are also wax-coated. One major requirement of the master carton is high compression strength to bear weight without damage to the product. Compression strength of 500 kg is the minimum recommended specification for master carton, which might give reasonable safety to the product. The cartons made of 5 or 7 ply corrugated fibreboard satisfying the above requirement can be safely used.

Packaging of battered and breaded fish products

These are value added products in convenience form. A number of value added marine products for export and also for internal markets are prepared from shrimps, cephalopods, fish and minced fish. Battering and breading process increases the bulk thus reducing the cost element.

Thermoform trays produced from food grade materials like PVC,HDPE are suitable for packaging of battered and breaded fishery products. These trays are unaffected by low temperature and provide protection to the contents against desiccation, discolouration and oxidation during prolonged storage.

Defects in master cartons

Master cartons used for packing seafood exported from India are of low mechanical strength. They are easily weakened by moisture absorption. The main problems of master cartons currently in the market are

- Use of near cubical corrugated box as master carton instead of rectangular ones leads to instability in stacking.
- Since the corrugated boxes tend to absorb moisture from condensation, absence of waxing on the outside affect their strength and cause distortion.
- The prevalent use of the same size of duplex carton for packing both 2kg and 5 lbs net weight brings about distortion of the master carton, since 5 lbs packs contain 13 % more product by weight.
- Poor quality of kraft paper and low grammage