# Chilling Of Seafood

## The Cold Chain

- Harvesting to Table

or: Fishing boat to Fork

| | | |
|---|---|---|
| Harvesting | or | Harvesting |
| Chilling | | Chilling |
| ↓ | | Freezing |
| Storage | | Storage |
| Distribution | | Distribution |

## The cold chain 1

- Temperature-controlled storage and distribution are increasingly important.
- Manufacture, storage and distribution to retail outlets.
- Constant temperatures are required

## Maintain chill temperatures

- Fresh fish must be maintained at temperatures between - 1 and +5 °C
- Use ice to maintain at chill temperature
- In some cases a thin sheet of polyethylene is used to separate the fish from the ice, especially when dealing with fillets, or placing the ice inside a polyethylene bag to act as a heat sink .

## Icing

- Types of ice:
- Block ice
  - Crushed block ice
- Flake ice
- Plate ice
- Tube ice

Block ice used in tropical and temperate fisheries.

In the tropics fishermen take block and break into smaller pieces as required when fish are caught.

The resulting sharp edges may damage the fish.

## Block and crushed

## Flake / Plate ice

- Flat surfaces give faster cooling
- Less bruising
- Melt faster!

- Extensive use throughout UK in fish factories

## Flake ice

## Plate ice

## Tube ice

- Smooth surfaces
- Less bruising
- Melt slower than flake and plate ice

- Often used on fishing vessels to replace crushed block ice

## Crushed Tube ice

## Fish in chill store

- Fish kept in a chill store will dry out on the surface.
- Avoid dehydration by:
  - Keeping in closed container
  - Cover with ice
  - Cover with a sheet of plastic film such as polythene

## Pictures of fish in containers

Whiting

Scampi

Farmed Cod

Squid

## The cold chain

- Planning:
- Product type
- Lot sizes
- Seasonal fluctuations
- Arrival temperature
- Pallets used
- Tonnages
- Expected turnover
- Packaging
- Transport system
- Pallet size
- Ancillary services e.g. check-weighing, marking, sorting, distribution

## The cold chain 2

- The Cold Store
- Conventional insulated envelope has:
- an external steel frame
- Internal insulated panels
- Protected by a weatherproof sheeting over roof and walls
- Height depends upon stacking arrangements
- Building regulations.
- EU intervention stores must be Lloyds registered

## Frozen storage

Frozen foods

- Foods below -18 °C (0 °F) Legal requirement
- Fish at -30 °C

## Chill stores

- Maintain chill store at temperatures and just above °C
- Record temperature regularly
- Keep clean
- Maintain good stock rotation FIFO
  - **F**irst **I**n **F**irst **O**ut

## The cold chain 3

- Mechanisation
  - Fork-lift trucks
  - Computer-controlled stacker crane operation
  - Moveable aisles
  - Pallet frames

## The cold chain 4

- Storage methods
  - Block stacking
  - Terminology
    - Stow
    - Row
    - Column
    - Tier
    - Block

## The cold chain 5

- Frames, or Corner posts
- Frames are rigid
- Corner posts with crossbars give stability close to rigid frames
- Palletainers
  - Used for packing into bulk
  - Frame + card liner + polyethylene inner. Closed after filling to prevent dehydration.

## The cold chain 6

- Chamber layout
  - Racking systems
  - Static racks
  - Mobile racks, Drive-in racks
  - Live storage
  - Rack entry module
  - Stacker crane storage

## The cold chain 7

- Standard pallets
  - Europallet
    - 0.8m x 1.2m
  - UK recommended standard
    - 1.0m x 1.2m
- Palletainers

- Loading bays
- Insulated
- Refrigerated
- 'Airlock'
- Distribution bays
- Picking areas
  - Clothing
  - Space

## Loading bays

- Trunkers reverse up to loading bays and are 'sealed' to the bay by means of a cushion.
- This virtually eliminates the exchange of air between the outside and the loading bay, thus keeping the loading bay cool. Roller doors are only opened once the body is sealed against the cushions.

## The cold chain 8

- **Administrative routines**:
- Location systems
  - Bar coding
- Stock records
  - Computerised
- Stock control
  - FIFO
- Working practices
  - Multi shift
  - Continuous
  - JIT philosophy
  - Consistent high service levels

## Chilled foods

- Controlled atmosphere storage
  - Atmosphere differs from ambient air
  - Low oxygen and/or high Carbon dioxide
- Modified atmosphere storage
  - Pack flushed with a pre-mixed gas
  - Differs from CA above in that no correction takes place in the storage period
- Modified Atmosphere Packing
  - The same as Modified Atmosphere Storage above.
  - Used extensively in the UK retail trade for extension of shelf-life, especially in the fish trade.

## Modified Atmosphere packing

- High quality raw fish
- Gasses used:
  - Nitrogen
  - Carbon dioxide
  - Oxygen

## Carbon dioxide

- Inhibits growth of most bacteria and mould
- Dissolves on surface of fish to form carbonic acid
- Results in pack collapse
- Also reduces pH and a loss in water holding capacity resulting in drip loss.

## Oxygen

- Inhibits the growth of anaerobic organisms

## Nitrogen

- Used primarily as a filler gas to exclude oxygen thereby reducing oxidation problem
- Prevents pack collapse due to absorption of carbon-dioxide

## Gas :Product ratio = 2 : 1

- $CO_2$ dissolves in the water on the surface to produce Carbonic acid.
  - Inhibits common spoilage aerobic bacteria, e.g. *Pseudomonas sp.* and *Acinetobacter sp.*
- $O_2$ inhibits growth of *Clostridium botulinum* type E
- $N_2$ is present as a filler gas to prevent collapse of the pack

## Temperature control

- Temperature control of the packs is critical and chill storage at temperatures below 2°C is required to achieve the desired shelf life extension.

## Storage temperatures

- Store and transport MAP fish products at temperatures between -1 and +2 ºC

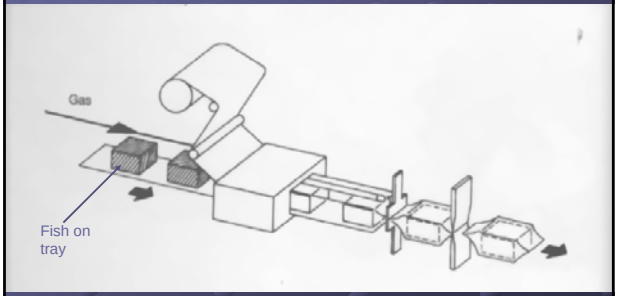
## Gas ratios for MAP of fish

| The product | Carbon-dioxide | oxygen | Nitrogen |
|---|---|---|---|
| White fish | 60 | 10 | 30 |
| Smoked fish | 60 | 10 | 30 |
| Shrimp | 40 | 40 | 30 |
| Oily fish | 60 | 0 | 40 |

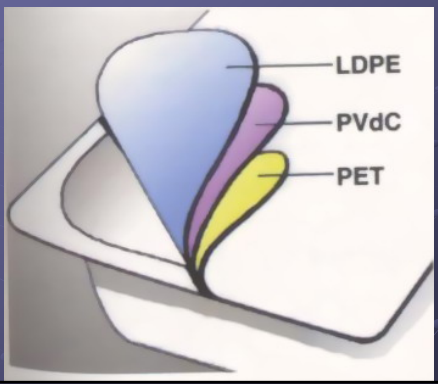
## Shelf life

- Supermarkets require seven days
- Depending upon species, this may vary
- Claims can be 7-21 days

## MAP for fish




## Laminated film for MAP




## Summary

- Keep fish cool - < 4 ºC
- Use potable water for ice
- Maintain chill temperatures
- Distribute M A P products at temperatures below 2 ºC