

# CHAPTER 5

## PREPARATION OF CONVENTIONAL VESSELS PRIOR TO LOADING

Ships' holds for the transport of perishable products must be absolutely clean, free from any taint and protected from any pollution such as oil and bunker fumes and exhaust gasses. Reliable and accurate temperature maintenance and air handling systems as well as a recording or logging system are basic requirements for the carrying of perishable products. Some of the more important PPECB requirements are briefly discussed in this chapter.

### 1. PRECOOLING OF DECKS

All decks to be used for the carrying of South African perishable produce must be thoroughly cleaned and then precooled prior to a PPECB inspection.

#### 1.1 PPECB requirements

All decks to be used for the carriage of South African perishable produce must be precooled for at least 48 hours and the following return air temperatures (RAT) must be maintained for at least 24 hours prior to commencement of loading.

- Chilled produce – precool to minus 0,5°C plus/minus 0,5°C (minus 0,5 +/- 0,5°C).
- Chilled produce for in-transit cold treatment – All decks to be used for in-transit cold treatment must be precooled for at least 48 hours and all the cargo and air sensors must record a constant temperature of minus 0,5°C for at least the last 24 hours prior to commencement of loading.
- Deep frozen produce – precool to minus 18°C or colder.

This means that the temperature control thermostat can be set slightly colder to deliver air at a lower temperature (e.g. minus 1,0°C and minus 20°C for chilled and frozen cargo respectively) in order to maintain the specified RAT's. The precooling process including defrost cycles, must be accurately logged or recorded for scrutiny by the PPECB.

#### 1.2 Agent's instructions

The ship's agent is considered to be the local contact person for vessels carrying South Africa perishable produce. All PPECB communication with vessels at sea, during loading and after discharge will be via the local ship's agent unless otherwise arranged. The ship's agent must therefore:

- Inform the Master of the vessel of the PPECB precooling, technical and deadline requirements.
- Supply the PPECB with a valid copy of the USDA certificate for the particular vessel should such a vessel be used for the carriage of fresh produce to the USA or for in-transit cold treatments to other destinations.
- Inform the Master of the PPECB requirements re temperature management (Chapter 9 par 2) and the voyage temperature logs (Chapter 10 paragraph 6)

#### 1.3 Records required from the Master

It is strongly recommended that the Master arranges for the following actions and documents to assist the PPECB during the preloading inspection process:

- Calibration certificates for all temperature and carbon dioxide (CO<sub>2</sub>) instruments.
- Calibration data on the precalibration done by the crew in preparation of an in transit cold treatment.
- Logs of the previous shipment to confirm that carrying conditions can be maintained.
- Records of cargo carried on previous voyages to assess any taint and product contamination risks.
- Records on maintenance and repairs of refrigeration equipment, temperature controlling and recording systems.
- Records on cleaning and deodorisation of decks and maintenance of floor gratings and cargo handling equipment.

### 2. PREPARATION OF VESSEL

All shipping spaces must comply with national and international requirements to minimize product quality losses and to guarantee food safety and traceability. The responsibility of PPECB, in terms of the PPECB Act and the accompanying regulations, is to ensure that the perishable cargo is handled and shipped under most optimum conditions. Some of the more important aspects are highlighted in this paragraph.

#### 2.1 Structural maintenance

The vessel shall, over and above PPECB requirements, comply to internationally accepted maritime requirements in terms of seaworthiness and other legal requirements. Some of the more important conditions are:

- Hatch covers must open and close freely and must seal properly to minimise heat leakage into the cargo decks.
- All cargo handling gear must be in a good working condition to ensure fast and uninterrupted loading, handling and discharge of cargo.
- All floor gratings and cargo securing structures must be in a good state of repair to ensure efficient loading, stability and discharge of cargo.
- All air ducts, water draining pipes and systems shall be clean and provide an efficient unobstructed flow of air and water.
- All insulation shall be intact, well secured and dry. Damaged insulation shall be replaced with clean and new insulation of the correct specification.
- All container handling and securing devices for on deck containers as well as power supplies shall be in a good, safe and working condition.
- All materials used, maintenance methods and procedures applied as well as the training and competency of the personnel shall be according to the international specifications of Lloyds or similar classification bodies.

## 2.2 Cleanliness requirements

All spaces to be used for perishable products must be absolutely clean. The three basic food safety requirements, i.e. physical, biological and chemical cleanliness (see Chapter 4 par 2.2) shall therefore be checked by PPECB. Of particular importance are:

- All gratings must be free from any foreign matter and clean.
- All floor surfaces underneath the gratings, especially joints in the floor structure must be clean and rust free.
- All side walls ceilings and deck covers must be clean, free from any fungal growth, dry and smooth to minimise accumulation of dust.
- All air ducting shall be clean on the inside and outside.
- All drain pipes shall be clean to ensure efficient drainage and to eliminate pollution of the cargo spaces.
- All air circulation fans and fan housings must be absolutely clean. No deposits shall be on the fan blades fan housings and protective screens.

Clean unpolluted water must be used to wash the cargo spaces. Only approved and registered detergents and other cleaning material may be used. If any trace of fungal growth is present in the decks, gratings, deck heads or sides, it must be correctly treated with an approved fungicide at the correct concentration.

## 2.3 Deodorization of shipping spaces

All decks for perishable products must be taint free prior to loading and kept free from any contamination and pollution during loading and the voyage. Most taints are from materials used (paints, silicone sealants, detergents) or from previous cargo (onions, garlic, fish, and chemicals). Important aspects to consider are:

- Only approved and registered paints, sealants, cleaning products etc. must be used according to the recommendations of the manufacturer.
- Special care must be taken when carrying cargo that may taint the shipping space. This includes certain chemicals (solvents, petroleum products) and other cargo (onions, hides).
- All remnants of cargo, especially after carrying loose fish, must be removed immediately after discharge.
- The origin and nature of the taint will dictate the method of deodorization. It is therefore difficult to give guidelines but the following should be considered:
  - Thorough cleaning followed by adequate fresh air ventilation immediately after discharge must be a standard practice.
  - If any odour is detected after normal cleaning, a 6% Hydrogen Peroxide (H<sub>2</sub>O<sub>2</sub>) solution can be used to wash down the contaminated area.
  - Activated charcoal (1kg/100m<sup>3</sup> space) can be used while ventilating with fans at half speed. It must be remembered that the charcoal only removes the odour from the atmosphere and not the source of the taint.

## 2.4 Cooling system maintenance

Routine maintenance must be done according to the instructions prescribed by the manufacturers of the refrigeration system. Only approved materials, spares and procedures must be used and followed by experienced and trained personnel. It is however important to ensure that:

- Detailed records of all maintenance and repairs are kept.
- That routine inspections and tests are performed according to the recommendations of the manufacturers are done and documented.
- The general appearance, functioning and records of previous voyages must create confidence that the cooling system is reliable and will perform within the tolerances during the next voyage.

## 2.5 Calibration of temperature control systems

Temperature control thermostats or electronic controlling devices should also be calibrated. It is a requirement that the temperature in all refrigerated spaces be controlled at the specified product temperature with a

maximum deviation of plus/minus 0,5°C (specified °C ±0,5°C). Measuring and recording the temperature of the delivery air approximately three meters from the cooling coils indirectly check the temperature controller. (See also Chapter 2 par 4.1). It is recommended that:

- The calibration test includes at least one defrost cycle to ensure that the controller “restart” correctly.
- The controller is checked for linearity at a warmer (e.g. plus 5,0°C) or a colder (e.g. minus 18°C) temperature if subtropical fruits or deep frozen produce respectively is to be carried.

## **2.6 Calibration of temperature recording systems**

It is the responsibility of the Master of a vessel to ensure that all controlling, measuring and recording devices are calibrated. PPECB will check that these calibrations were done and may require a calibration certificate from an accredited organization should proof be required that the instrumentation is reliable and functioning properly. Quarantine regulations for in-transit cold treatments or certain exporters and importers may require that PPECB perform an extensive calibration on all temperature measuring and controlling devices. (See also Chapter 2 par 4.4).

## **2.7 Maintenance of temperature logging systems**

It is in the interest of the owner of a vessel that all temperature controlling, measuring and logging equipment are well maintained to ensure accurate and reliable functioning during the voyage. Quarantine Authorities of countries requiring in-transit cold treatment also require a guarantee that the temperature equipment functions accurately for at least one month after departure. It is therefore essential that:

- Personnel are well-trained and experienced to do routine equipment maintenance and minor repairs.
- Only spares and procedures specified by the manufacturer are used.
- A competent and qualified representative of the manufacturer must be available to do major repairs should it be required.
- The Master of a vessel to carry perishable produce from South Africa must ensure that the necessary maintenance procedures are carried out and that the local ship’s agent is informed well in advance of spares and specialized repairs and maintenance required.

PPECB will not authorize commencement of loading unless convinced that the temperature controlling, measurement and recording systems are operating within the relevant specification.

## **3. VESSELS FOR IN-TRANSIT COLD TREATMENT**

Certain countries require that in-transit cold treatments be applied to the product to eradicate certain insects. These requirements are very specific and must be very strictly applied. Non-conformance will result in the product either returned to South Africa or directed to another country. Bilateral agreements between the South African National Department of Agriculture (DoA) and the Department of Agriculture of the importing country govern the export conditions and the treatments required. PPECB was appointed by the DoA to ensure compliance to the relevant bilateral agreement. Detailed protocols, approved by the importing country are maintained and applied by PPECB. The general requirements are however discussed in this document to serve as guidelines.

### **3.1 Verification of cold treatment certificate**

All vessels to be used for in-transit cold treatment must have a valid cold treatment certificate. (See also par 3.6 below). The following two bodies issue certificates for the South African trade:

- An accredited United States Department of Agriculture (USDA) official issues the USDA certificate. This certificate is valid for three (3) years and can only be renewed following a re-inspection by an accredited USDA official. PPECB may, under very special conditions and by prior arrangement, issue a temporary certificate that must be endorsed by the USDA.
- An accredited PPECB official issues the PPECB certificate following a detailed inspection. The criteria is basically the same as for the USDA but certain countries also require a guarantee from the relevant shipping line that all temperature controlling, measuring and recording devices hold calibration for a minimum of one month. Some countries also require an “empty deck” test under PPECB supervision as part of the cold treatment certificate.

The more important criteria for certification are discussed in the following paragraphs.

### **3.2 Cargo and space temperature sensors**

These sensors are used to measure the cargo (fruit or pulp) temperature as well as air temperature in different positions in the ship’s deck. The number, positions and construction of the resistance thermometers (thermistors) required are fairly well standardized internationally but vary with deck size and configuration.

- **Independent decks** – Three (3) fruit and two (2) air temperature sensors for the smaller decks with four (4) fruit and three (3) air sensors for larger decks are minimum requirements.
- **Twin compartment decks** – Three (3) fruit and two (2) air temperature sensors per deck is a minimum requirement.

The connecting cables must be at least five (5) meters long to reach different positions depending on the stowage pattern. Special care must be taken when handling these sensors because it is of a delicate construction, can get damaged and loose connections may occur.

### 3.3 Maintenance and precalibration of temperature data logging system

Quarantine requirements for in-transit cold treatments are extremely strict. Any malfunctioning of the temperature controlling and recording system will result in the total shipment be rejected and diverted to another country or returned to the country of origin. Vessels equipped and certified for in-transit cold treatment must:

- Be in possession of all the relevant service manuals.
- Have well-trained and experienced technicians to do routine maintenance at sea.
- Carry the necessary spares of the correct specification for maintenance.
- Carry out the routine maintenance as specified.
- Have an agreement with a competent and experienced service provider in South Africa who can execute advanced repairs and who carries the correct spares for service and repairs.

It is extremely important to note that the temperature recording or data logging equipment must maintain calibration for at least one month. All temperature data must also be stored for at least one month to ensure that all temperatures recorded during loading, the voyage and discharge are available as one set of data, printout or graph. This therefore requires special attention to good maintenance procedures. It is also strongly recommended that the ship's crew do a precalibration of all temperature control and logging systems prior to arriving in a South African port. A precalibration should point out most problem areas, especially faulty temperature sensors and connections due to handling during discharge in the previous port of call. The following general guidelines can be given:

- Ensure that the thermostatic temperature controllers are set to deliver air at minus  $0,5 \pm 0,5^{\circ}\text{C}$ .
- Ensure unobstructed airflow across the cooling coils into the air supply plenum provided by the floor gratings.
- Ensure that the fixed air sensors are properly mounted, well protected from any heat source e.g. light fittings or air circulating fans and that the airflow over the sensors is unobstructed.
- Ensure that all cable connections are intact and well protected against damage from moisture and handling.
- Ensure that the connecting cables are of the required length and stored in such a way that it can be easily loosened for placement in the product.
- Ensure that all the cabling is well protected, undamaged and neatly fixed and identified (numbered) to assist in possible faultfinding.
- Ensure that the temperature data loggers or recorders are properly maintained, serviced and commissioned for the next voyage.

Proceed with the calibration procedure as outlined in par 3.5 below. Submit the precalibration records to the PPECB prior to the official calibration.

### 3.4 Precooling of the holds

All decks to be used for the carriage of South African perishable products must be precooled to minus  $0,5^{\circ}\text{C}$  for at least 48 hours and be maintained at a constant temperature of minus  $0,5^{\circ}\text{C}$  for at least the last 24 hours prior to commencement of loading. All decks to be used for in-transit cold treatment, all the cargo and air sensors must record a constant temperature of minus  $0,5^{\circ}\text{C}$  for at least the last 24 hours.

### 3.5 Temperature checks and calibration

The following are general procedures followed by the PPECB when performing temperature checks and temperature calibration for in-transit cold treatments. Detailed procedures are documented in the PPECB ISO 9001 system. (See also Chapter 2 par 4.3.3).

- Check the temperature records of the previous voyage(s) and the precalibration done by the ship's personnel.
- Check on the general condition of the temperature controlling, measuring, and recording equipment.
- Check the records on routine maintenance done.
- Have new charts installed in the loggers and set the recording/printing interval at 60 minutes.
- Have the precooling switched off.
- Prepare ice cubes of approximately  $2 \times 2 \times 2\text{cm}$  from pure distilled water.
- Fill insulated ice buckets with clean ice cubes. A very small amount of clean clear distilled water can be added. The ice-water mixture must be stirred slowly and continuously.
- The temperature of the ice-water mixture must register a temperature of  $0,0^{\circ}\text{C}$  on a certified calibrated thermometer.
- Submerge the temperature sensors in the ice-water mixture, keep on stirring and ensure that the calibrated thermometer registers  $0,0^{\circ}\text{C}$ .
- Do a printout of the temperatures recorded during the calibration in the ice-water mixture.
- Make a second printout of the temperatures.

- The temperature sensors must register a temperature within the range of  $0,0^{\circ}\text{C} \pm 0,2^{\circ}\text{C}$  and the maximum difference between any two sensors may not be more than plus/minus  $0,1^{\circ}\text{C}$ .
- If these parameters are not met, a third printout must be made and if the parameters are still not met, the total system must be serviced.

The Japanese Plant Quarantine Authorities also require a 24-hour empty deck test under their supervision. This test will be done directly after completion of the PPECB calibration.

### 3.6 Approval of vessels for cold treatment.

The United States of America only acknowledge certificates issued by the US Department of Agriculture (USDA). This certificate is valid for a period of three (3) years but may be terminated sooner should the vessel not meet the criteria. PPECB can, by special arrangement with the USDA, issue an extension certificate that will be endorsed by a USDA calibration on arrival in the US. A number of other countries also acknowledge the USDA certificate whilst countries such as Japan require a PPECB calibration certificate irrespective of a valid USDA certificate. The PPECB certificate is also valid for a period of three (3) years but will be cancelled if the vessel fails to successfully execute a cold treatment procedure. A complete list of vessels certified for cold treatment of South African perishable products is available form PPECB.

## 4. VESSELS FOR CARRYING CONVENTIONAL CA CARGO

WARNING: Controlled (CA) and modified (MA) atmospheres do not sustain human life.  
Normal atmosphere must be restored before anybody is allowed into a space used for CA.

Controlled atmosphere (CA) and modified atmosphere (MA) storage and transport require reduced oxygen ( $\text{O}_2$ ) and increased carbon dioxide ( $\text{CO}_2$ ) in the atmosphere. Very special care must be taken to ensure correct gas concentrations as well as personnel safety. CA decks are completely gas tight including deck and hatch covers. The gasses are measured and controlled by introducing nitrogen ( $\text{N}_2$ ) to reduce (flush) excess oxygen and by reducing (scrubbing) excess carbon dioxide. Oxygen must be introduced by controlled venting with outside air to replace the oxygen used by the respiring fresh product. MA is usually applied on a carton or pallet basis. The product is packed inside a sealed bag of specially formulated polyethylene laminations. The polyethylene is selectively permeable to certain gasses and creates and maintains a specific modified atmosphere around the product. No special equipment is therefore necessary for carrying MA produce. MA is however very temperature dependant and it is therefore important that the product is precooled to the carrying temperature and that temperature increases are minimized throughout the total cold chain.

### 4.1 CA decks

The shipping line must have a prescribed procedure for gas tightness, methods to check for tightness and procedures to maintain and restore gas tightness. Three aspects are however important i.e.:

- Regular maintenance of the deck structures e.g. joints in the insulation and gas seal and seals on pipes, cables and ducting passing through the gas seal and insulation.
- Gas tight sealing of deck and hatch covers according to the specifications of the shipping line.
- A gas equalizing system must be installed and fully operational to ensure equal atmosphere pressures on both sides (inside/outside) of the gas barrier.

### 4.1 Instruments required

Gas measuring and recording instruments are connected via manifolds and gas tight piping to different positions in the deck – this includes:

- These instruments measure, control and record oxygen and carbon dioxide.
- Some decks may be fitted with ethylene analysers to also control ethylene in an attempt to reduce fruit ripening and senescence in certain vegetables and flowers.

### 4.2 Calibration of gas analysers

It is important to ensure absolute gas tight sampling lines to the different CA decks. All gas analysers must be checked daily and calibrated according to the specifications of the manufacturers. Calibration records must be kept for future reference.

## 5. VESSELS CARRYING VENTILATED CARGO

PPECB does not recommend the carriage of perishable products under ventilated conditions. Some produce such as onions, dried fruit and canned produce may however keep well for short periods at ambient temperatures. Condensation of moisture is however always possible and usually causes product quality losses and damage to packaging. PPECB strongly recommends a constant temperature (usually  $16^{\circ}\text{C}$ ) for produce that usually keeps well at ambient temperatures. This also results in a constant relative humidity (RH) and drastically reduces the chances of condensation.

### 5.1 Air handling requirements

Heat of respiration and transpiration moisture, given off by the cargo must be continuously removed. The only way this can be done in unrefrigerated below deck spaces is to efficiently move large volumes of fresh air through the cargo.

5.1.1 **Fresh air ventilation** must be applied to maintain the carbon dioxide gas concentration below 0,5% at all times. A minimum of twelve (12) complete fresh air changes, based on the empty volume of the space, per every 24 hours is required. In practice this means that the exhaust fans must remove 1200 cubic meters (m<sup>3</sup>) of air for every 100m<sup>3</sup> of shipping space during a 24 hour period. Fresh air ventilators must be kept fully open during the voyage and continuous ventilation must be applied for as long as the temperature of the intake air (ambient) is equal to or less than the temperature of the exhaust air. When the inlet air temperature increases to more than the exhaust air temperature, continuous ventilation must be stopped. Fresh air ventilation fans must however be operated for at least two (2) hours during the coldest period per every 24 hours while the ambient air temperature exceeds the under deck air temperature. Fresh air intake must be stopped when the ambient air temperature drops below 5°C. Care must be taken to ensure that the carbon dioxide levels do not increase to above 0,5% during this period. If this happens only sufficient fresh air must be introduced to maintain the carbon dioxide levels below 0,5%.

5.1.2 **Air circulation** in the deck must be at least 90 but preferably 120 complete air changes per hour based on the empty volume of the deck. Cargo must be packed in well ventilated containers such as woven or knitted jute or polypropylene bags (onions and potatoes) or cartons with sufficient ventilated openings facing the direction of the air flow. Correct stowage is also very important to ensure that the circulating air is forced through the load. No open spaces must be allowed between pallets and the forklift entries in the pallet bases must all face in the direction of the air flow. Openings on the wings and flares must be blocked with air bags or other suitable material.

## 5.2 Instruments required

Ventilated spaces must be equipped with accurate temperature recorders to record air temperatures in at least three positions e.g.:

- Fresh air inlet ventilator
- Exhaust air ventilator
- Expected warmest position in the deck

The carbon dioxide concentration in the expected area of highest concentration, normally at floor level furthest away from the air circulation fans and fresh air inlet, must be continuously recorded. Temperature and carbon dioxide readings and records must be kept and made available on request to the PPECB.

## 5.3 Food Safety requirements

Basic food safety requirements are highlighted in Chapter 1 par 3.1. This is of particular importance for the loading, carrying and discharge of ventilated cargo contamination and taints.

- Contamination of cargo must be avoided at all times. Special care must be taken to load only perishable cargo into decks and never to mix any food products with cargo containing chemicals or packed in glass. This includes cargo such as cement, fertilizers, wine or canned food in glass containers.
- Tainting of the cargo becomes a high risk in ventilated cargo. Special care must be taken to introduce only pure, clean fresh air from the atmosphere. Fumes from bunkers, diesel and exhaust gasses must never enter the compartments containing perishable products.

Taints can also come from other perishable cargoes such as onions, dried fish and spices. See Chapter 8 for more detail.

