Avoid cold treatment shipping problems with these recommendations

An assessment of in-transit cold treatment container shipments of citrus fruits from South Africa to The People’s Republic of China and South Korea, have yielded some valuable insights that could help producers reduce these incidents.

Although there is no clear indication of the number of container shipments deemed non-conforming across the intensive in-transit cold treatment markets, there is a perception that it is a higher than acceptable number; particularly when it comes to shipments to the People’s Republic of China and South Korea. The CGA, in partnership with participating exporters and stakeholders, therefore embarked on an assessment of the probable causes contributing to the potential non-conformances.

The assessment specifically focused on shipments to The People’s Republic of China and South Korea, as it was deemed that container shipments to these markets resulted in more non-conformances than other markets. The assessment was conducted on a stream of shipments from the Durban port over a period of weeks. Key findings related to, but were not limited, to the following:

1. Certain carton types were identified that possibly restrict airflow throughout the cartons and specifically to the critical positions of the probes placed in the cartons. The restricted airflow could lead to the pulp/probe temperatures failing to maintain temperature, therefore exceeding the required protocol temperature.

2. Pallet bases being used that do not comply with the CRI Packaging Guidelines. In many cases the pallet base slats obstruct the airflow into cartons, because ventilation holes on the first row of cartons are being blocked. The restricted airflow could lead to the pulp/probe temperature failing to maintain the required protocol temperature.

3. In some instances, the pre-cooling temperature of pallets did not achieve the required protocol temperature (the guidance temperature range is -0,8°C to -1,2°C).

4. Containers packed for in-transit cold treatment shipments are not pre-cooled prior to packing the container (the guidance temperature range is +1,5°C to -1,5°C being recorded on the container probe readings). A container that is not precooled, potentially destabilizes the pulp temperature therein, exceeding the required protocol temperature. The container is therefore unable to commence the in-transit cold treatment process.

5. Pallets packed into containers, where the probe temperature exceeds the required protocol temperature at time of packing the container. In many cases the pulp/probe temperature does not subside and decrease to the required protocol temperature. The container is therefore unable to commence the in-transit cold treatment process.

6. A number of power off and defrost cycles occur within the first 24 hours after packing the container. This potentially destabilizes the pulp temperature wherein exceed the required protocol temperature. The container is therefore unable to commence the in-transit cold treatment process.

The assessment critically evaluated current and historical shipments which failed to initiate the in-transit cold treatment process. After evaluating the conditions during the first week of the

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Dawid Groenewald of the CRI Post Harvest Forum & Co-Ordination Packaging Work Group investigates whether citrus is being cooled correctly.
assessment, stricter measures and controls were applied to certain shipments. The results of those shipments was that each container successfully engaged the in-transit cold treatment protocol directly after the container was packed. None of the containers packed under strict control, reported a non-conformance up to the point that the containers were loaded on-board. It should however be remembered that there are a number of factors that could lead to a non-conformance; particularly in the case where a pulp/probe temperature fails to maintain the required protocol temperature.

**KEY RECOMMENDATIONS**

Since the export agent or producer carries all the risk of a non-conformance, it’s up to the export agent or producer to manage the risk by applying best practice (SOPs) through the entire process. Based on the findings of the assessment, the following key general recommendations can be made. First of all it should be understood that there are three critical phases in the in-transit cold treatment engagement process:

1) the pre-cooling phase – conditioning the pallets to an acceptable uniform temperature range, thus providing a good base for the container to stabilize,

2) the container packing phase – the transfer of the pallets from the pre-cooling chambers into the container with the probes being placed into the pallets, and

3) the pulp/probe temperature stabilization phase – at which time the pulp/probe temperature remains stable at an acceptable level ranging between -0,6°C to -1,2 °C, with a constant DAT of -1,5 °C (remaining unchanged).

If all 3 phases are implemented correctly and strictly without any deviation to the recommendations to follow, the in-transit cold treatment process will most likely be signed off by the PPECB.

After the container has been packed and the doors of the container have been closed, the pulp/probe temperature needs to stabilize within the required protocol temperature range of -0,6 °C to -1,2 °C. The stabilization of the pulp/probe temperature should be achieved from the onset, without further manipulation of the DAT being set lower than the required protocol of -1,5 °C or to close the container air vents. It was found that if the container did not have a good base temperature to start from, the possibility of a non-conformance occurring is quite high.

It must be emphasised that the belief is that an Integral Reefer container is not designed to cool cargo, it is designed to maintain the cargoes pre-cooled temperature. To ensure a container starts off from a good base temperature and that the pulp/probe temperature remains within the required protocol directly after the container was packed. None of the containers packed under strict control, reported a non-conformance up to the point that the containers were loaded on-board. It should however be remembered that there are a number of factors that could lead to a non-conformance; particularly in the case where a pulp/probe temperature fails to maintain the required protocol temperature.

**1. Pre-cooling Phase**

Although the protocol requirement stipulates that the pre-cooling phase should be conducted over a period of 72 hours to achieve a uniform fruit pulp/probe temperature of -0,6°C to -1,2°C it is recommended to increase the pre-cooling phase to 96 hours with the last 24 hours in which all the fruit pulp/probe temperatures are uniform within a range of between -0,8°C to -1,2°C.

The recommended pre-cooling temperature range of the pallets should ensure that after the container is packed, the container stabilizes within 24 hours with all the pulp/probe temperatures remaining lower than -0,6 °C as required. There should be no compromise to this recommendation.

**Figure 1:** The 3 Phases to the In-transit Cold Treatment Engagement Process
2. Container Packing Phase

As a critical component to the pulp/probe temperature stabilization phase, it is recommended that, prior to packing the container, the container should be operating at full power mode from the time the container is collected from the container depot to when the container arrives and is about to be packed at the cold storage facility.

The container DAT set point should be at -1,5 °C as per the protocol set point. The probe temperature should be in range of +1,5 °C to -1,5 °C prior to packing the container. If a container is not sufficiently pre-cooled, the cooling applied to the container will first be required to remove the latent heat from the container interior panels before maintaining the fruit temperature. This could destabilize the fruit temperature leading to a non-conformance, as heat from the container is more than likely transferred through to the fruit.

It was found that the container interior panels were sufficiently cooled after running the container at high speed for three hours prior to packing, with the probe temperatures reflecting a range of +1,5°C to -1,5 °C. The sidewalls and interior of the container were deemed to remain sufficiently cooled after 40 minutes, during which time the containers were packed to completion. No evidence of moisture could be detected on the container inner sidewalls, while the containers were being packed during which time the power to the container was turned off.

Another aspect that should be considered is the container cross docking area. This area should be a sealed air locked area, with cooling applied to the area being targeted at a maximum temperature of +8,0°C. The area should have sufficient curtaining and sealing mechanisms to ensure no warm ambient air enters the cross docking area while containers are being packed. Container bay doors should also be closed when not in use at time of packing a container. The container should be packed and the doors to the container closed in as short a timeframe as possible to ensure the fruit pulp temperatures do not increase beyond -0,7 °C.

As each probe is placed into the respective pallet, the probe temperature, as reflected on the container panel, should not be warmer than -0,7 °C. In the case where a container is packed for the Peoples Republic of China, the pallet where probe P2 and P3 are placed should be side shifted slightly away from the container sidewall (this to allow airflow to move upwards between the pallet and the container sidewall in order to remove any heat infiltrating through the container sidewall).

It is recommended to leave a small space between the pallet with probe P2 and P3 and the pallet at the door end of the container (this is done to allow airflow to move from the T-bars upwards between the two pallets to ensure airflow is being delivered to the probe areas). A void plug must be placed to close the void between the last row of pallets and the container door. No spaces and gaps should be left open above the floor T-bars and the sections between the face of the two pallet bases.

3. Pulp/probe

RECIPE FOR SUCCESSFUL COLD SHIPMENT

It seems that the guiding principle for a successful cold treatment shipment, is:

1) that the cold treatment process must start from a good base temperature,

2) the delivery air must be able to flow freely to all areas of the pallets, particularly to the critical area where the probes are placed, and

3) the container must be able to stabilize in the first 24 hours after packing, without power off and defrost cycles disrupting the delivery air flow and protocol temperature.
**Temperature Stabilization Phase**

It is important that, as soon as the container doors have been closed, the container is powered immediately by the Genset\(^3\) unit. The container's defrost cycle setting should be adjusted (if set to Auto mode) to 8 hourly intervals for the first 24 hours after the container has completed packing. The defrost setting may be left at a setting of 8 hourly intervals or the operator may adjust the setting to Auto after the initial 24 hour temperature stabilization period, and at which time the in-transit cold treatment process has been engaged.

There should be only a single power off and power on disruption to the container cooling unit, when the container is being delivered to the container terminal to be stacked in the reefer area. The container should remain on power whilst in stack at the container terminal and power supply must not be disrupted after the container is stacked (especially in the first 24 hours).

The power supply to the container should not be disrupted for a period longer than 30 minutes while the container is moved from the stacking area to on board the vessel, at which time power supply to the container must be restored immediately. If the power supply to a container is disrupted for a period longer than 30 minutes, the pulp/probe temperatures may increase potentially resulting in a non-conformance. If all goes well the container pulp/probe temperatures should stabilise allowing the in-transit cold treatment process to commence and remain successful.

It must be noted that not a single non-conformance was reported to have occurred during the assessment period in which the above measures were strictly controlled and applied for certain of the shipments. This does not imply that there will be no non-conformances if the recommendations are applied, as there are factors relating to but not limited to airflow restrictions through certain carton types and packaging that needs to be rectified.

If the correct pallet base specification is used in conjunction with the correct carton specification, and all ventilation holes are unobstructed (providing optimum vertical and horizontal ventilation through the entire pallet) and the above measures are applied, there should be limited reasons for a non-conformance relating to temperature deviations occurring.

If a temperature deviation non-conformance has been detected after the above measures have been applied, it needs to be thoroughly investigated to determine the probable causes.

A copy of the full report is available on request from mitchell@cga.co.za.

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**MAIN REPORTED ISSUES**

Numerous issues have been reported pertaining in-transit cold treatment container shipments of citrus fruits from South Africa to The People's Republic of China and South Korea; which causes either failure to engage the cold treatment protocol once the container has been packed, or failure to maintain the in-transit cold treatment protocol once engaged. The main issues that have been sited are that:

1. The pre-cooling temperature of the fruit to be shipped, is not within the required protocol temperature at the time of packing the container. The container was therefore not packed.
2. The container delivery air temperature (DAT) is required to be adjusted to below the required protocol DAT for a period of time, to reduce the fruit pulp/probe temperature to within the required protocol temperature.
3. The container vent setting is adjusted and closed for a period of time or closed erroneously for the duration of the shipment voyage.
4. The container was unpacked prior to shipping as the protocol temperature could not be achieved to engage the in-transit cold treatment process.
5. Additional cold treatment days were added to a shipment, thus increasing the in transit cold treatment period; in accordance to the requirements of the in transit cold treatment protocol for a specific market.
6. The delivery air temperature (DAT) was not adjusted after the in-transit cold treatment process had completed the required in-transit cold treatment duration, as outlined by the requirements of the in-transit cold treatment protocol for a specific market.
7. Fruit quality problems were detected on a shipment once received in the market.
8. The in-transit cold treatment process failed outright, thus an additional in-transit cold treatment cycle was conducted.
9. The in-transit cold treatment failed outright, where the shipment had to be diverted to an alternative market destination.

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\(^1\) A void plug is a sheet of cardboard that is inserted under the last row of pallets and extends to the container doors. All open areas on top of the T-bars are covered. A strip of cardboard is used to cover the open spaces on the face of the two side by side pallet bases. All voids and spaces must be closed and the cardboard stapled to the pallet base at various points to secure the cardboard to the pallet bases.

\(^2\) A Genset unit is a specific type of Diesel generator that is fitted to the underneath of a trailer. The Genset supplies power to the reefer container whilst being transported.

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