Results for today; Ideas for tomorrow

Meat Technology Update

Newsletter 2/05 April 2005

The cold chain for cartoned meat exports

Although there have been efforts to come up with alternatives, the majority of Australian meat will continue to be exported in fibreboard cartons. Most of the cartons are packed in refrigerated shipping containers ('reefers') although a proportion of frozen exports to the United States is packed in refrigerated holds of ships. This newsletter outlines techniques for efficient packing of containers and suggests methods to reduce losses through rejection due to damage to cartons.

Containers

There are three types of shipping containers that are used to export both chilled and frozen meat from Australia:

1. 20 foot standard (20' x 8' x 8' 6");
2. 40 foot standard (40' x 8' x 8' 6"), and
3. 40 foot high cube (40' x 8' x 9' 6").

Although 20 foot containers have been the norm, the use of 40 ft containers will become more extensive, bringing additional issues to loading and road transport.

All reefer containers are now fitted with integral refrigeration units which allow the temperature to be set to any value between –25°C and +30°C. Containers for frozen meat should be set at a temperature of –20°C and for chilled meat at –1.0°C. Although there are different manufacturers of refrigeration units, the temperatures on all can be set using temperature controller keypads. When operating in chilled mode, the air temperature is controlled via the supply air temperature sensor; whereas, when operating in the frozen mode, it is controlled via the return air probe. Quality assurance staff should check that the temperature settings are correct.

If the container is transported to shipping terminals off-power, QA staff should ensure that the correct setting is provided. The terminal will plug in the container and set it to the designated operating temperature and monitor it until it is loaded onto the ship.

There is little current information on the limits to time off power for containers of frozen meat. This particularly applies to 40 ft containers that will have a greater head space above the load than 20 ft ones.

The refrigeration controller may have a digital display and/or a chart to display the temperatures. Modern units are also fitted with data loggers which can be downloaded to provide temperature histories throughout transport and holding.

The container refrigeration system is not designed to reduce the product temperature therefore the meat should be at or close to the carriage temperature when loaded.

Containers should not be pre-cooled before loading. When the doors of a pre-cooled container are opened, warm, moist air condenses on the cold internal surfaces. This condensation will need to be removed by the container refrigeration equipment, or it will condense as ice on the evaporator coil, thus reducing cooling efficiency at the time when maximum cooling is required.

Loading containers

The method of loading meat cartons into a container is important from several aspects. Some of these are:

- OH & S issues with manually handling frozen cartons;
- cost and efficiency of manual versus unit loading;
- disturbance to air circulation by improper loading;
- potential for carton damage during transit and on unloading.

OH & S issues

Manually loading cartons into containers is an OH & S black spot. Lifting 27 kg cartons above the shoulders or below the knees has the potential to increase the risk of injury. About 40% of all injuries in the meat processing industry are sprains and strains, some of which are due to lifting, carrying and handling cartons. Across all

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industries, there were 655 accident compensation claims in Victoria alone from July 1999 to May 2002 as a result of packing and unpacking shipping containers and enclosed trailers.

The risk of injury can be eliminated or significantly reduced by mechanically handling cartons as unit loads.

Unit loading

Unit loading of containers with pallets of cartons of frozen meat has been advocated for nearly 30 years. Several procedures have been developed which improve the efficiency of loading, almost eliminate manual handling, and present a load with improved stability and appearance. All unit-loading methods require a forklift that can enter a container, and some require special attachments to the forklift.

Slipsheets

A slipsheet is a corrugated, solid fibreboard, or plastic, sheet that replaces a pallet. It has a tab on at least one side that extends past the load so that it can be gripped by a forklift clamping device. The tab is gripped and the load pulled onto the forklift tines. It is unloaded by the forklift pushing mechanism.

A slipsheet takes up very little space, is lighter and cheaper than a pallet, and can be used by the customer when unloading; however, the slipsheet must be waterproof and, if the tab is damaged, the load may need to be transferred to another sheet.

A 40 ft container can be loaded in about 45 minutes by one person with a special forklift, compared with three people taking about 2 hours to load a container manually.

Disposable pallet

The use of cheap disposable pallets made from timber, fibreboard or synthetic material has the advantage that they can be handled using a standard forklift, and can be more easily unloaded in unit form; however, there is the significant cost of the pallets, and the lightweight pallet may also be easily damaged before or during loading.

One man with a standard forklift can load a 40 ft container in about 45 minutes.

De-palletising methods

Two methods have been developed for removing the cartons from the pallet and loading them into the container as a unit.

a) Pushing method

To obtain maximum efficiency, two forklifts trucks are required, one of which should be fitted with wide tines and a push mechanism. The appropriate number of pallets of cartons are removed from the cold store and placed in the marshalling area—and portmarked if necessary. One forklift places each pallet load on a depalletiser which has a roller conveyor and barrier, so that the top and bottom boards of the pallet are at right angles to the rollers.

The forklift with the wide tines pushes the pallet out from under the load (which is restrained by the barrier), and the load then drops onto the tines and is carried into the container. A loading rate of about 700 cartons per person per hour can be achieved with this method.

b) Lifting method

This method was developed by the CSIRO Meat Research Laboratory and is similar to the pushing method except that this requires only one operator with a forklift equipped with wide tines and push mechanism, and a specially designed pallet is also required (Sirolift pallet).

The pallet is constructed so that when the tines are inserted from one direction both the pallet and the load are raised. Inserting the tines at 90° raises only the load. Loading rates of 1500 cartons per hour have been achieved with this method.

No depalletiser is required, but a stock of Sirolift pallets is needed; they will remain in house.

In order to take maximum advantage of unit load handling:

- carton and unit load dimensions must be compatible with the container dimensions;
- the forklift truck which handles the unit load must be capable of entering the container;
- a suitable loading dock and bridging system between the dock and the container floor must be provided;
- if the lifting, pushing or slipsheet methods are used, the forklift must be fitted with a push or push/pull attachment;
- the unit load must be suitably secured, by strapping or wrapping, if stability of the load is not adequate for handling; and
- the marshalling area should be large enough to accommodate the quantity of goods to be loaded out at any one time, with some spare capacity.

Air circulation

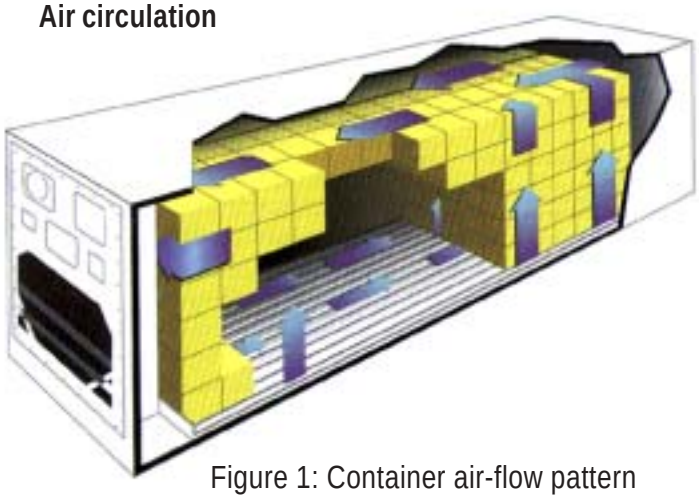

Figure 1: Container air-flow pattern (courtesy of P & O Nedlloyd)

Refrigerated air normally enters the container via the T-bar floor and returns along the ceiling to remove any heat leakage through the floor, walls and ceiling (Figure 1). Therefore the cargo must not be loaded above the red load line and space must be left between the rear of the cargo and the doors. The cartons should be stowed as a solid block with no space between the cargo and the side wall ribs but should not extend beyond the T-section flooring. Space must not be left between cartons and if any flooring is left exposed, it should be covered to prevent short circuiting. Research has shown that a free floor area greater than 5% of the total area can have a detrimental effect on air flow.

Figure 3: Interlocked stacking and banding technique (courtesy of Mullica Hill Group)

Prevention of carton damage

Over half the rejections of Australian meat arriving in the United States in 2003–04 were due to carton damage. This amounted to over 400 t of meat valued at about $A1,300,000. It is believed that the majority of damage occurred during shipment and on unloading the container.

The main cause of damage is movement of the load. This can cause scuffing of the cartons leading to the obliteration of the label and, more importantly, possibly result in the cartons resting against the container doors where they can fall to the ground on opening (Figure 2). Movement of the cargo can result from poor and uneven loading of the container. The photograph in figure 2 was taken at Mullica Hill Cold Storage near Philadelphia. It shows graphically, the consequence of poor stacking.

Suggestions to improve the stability of the load, including those made by Mullica Hill Cold Storage to improve manual loading procedures, are:

- an interlocked stacking technique;
- strapping (banding) the final rows;
- installation of a cargo net; and
- wrapping or strapping unit loads.

Interlocked stacking

The loading pattern should be planned in relation to the length and width of the container. Cartons should be stacked flat with cartons in one row placed side by side and the next row end to end (Figure 3). This interlocking pattern should be followed for the complete load. This will create a more stable load than just stacking one carton on top of another.

In the case of chilled meat, CSIRO recommends that cartons should be stacked directly one above the other to avoid carton collapse. To prevent movement in transit, vertical packing (e.g. polystyrene foam) should be used to fill any gaps.

Figure 2: Fallen cartons on opening container doors (courtesy of Mullica Hill Group)

Banding

The banding suggestion involves placing a plastic band (strapping) right around the last two tiers of cartons in a container. The straps should be at half height, three quarters and the top layer of the load. The banding alone, or preferably in combination with interlocked stacking, has been found to prevent cartons falling from the container on opening the doors. Strap tensioning and sealing equipment is required but the cost of the strapping is minimal.

Cargo net

It is possible to fit a cargo net inside the door of the container to prevent cartons spilling out on opening; however, this would require the modification of fitting four rings to the walls of each container, and the purchase of nets to attach to the rings.

Wrapping unit loads

The stability of unit loads can be improved by wrapping them in stretch or heat-shrink film, or by the application of strapping to one or two layers. Companies report that stretch wrapping has reduced damage due to scuffing and load movement. The stretch wrap can be applied manually but mechanised stretch wrapping using a turntable provides a stable unit. If an additional row of cartons needs to be loaded to fill up the container, it should be placed in behind the last row of pallets rather than adjacent to the doors so that they do not fall out when the doors are opened.

40 ft containers

The use of 40 ft containers for transporting frozen meat presents special problems because the volumetric capacity of the container cannot be fully utilised. A 20 ft container loaded with 700 cartons of bulk-packed meat will carry just over 19 tonnes. A 40 footer may be limited to only 25 t (about 920 cartons) which is not much more than 50% of its cubic capacity. If the container is transported using a vehicle with 'road-friendly suspension' and a higher-mass-limit route is available, then a higher weight of about 28 t may be loaded.

The container should be loaded to an even height throughout, to ensure a stable load. For cartons that are loaded as a unit, this may require reducing the number of cartons per pallet or manually loading the upper layer.

Bulk shipping

Frozen meat is exported to the United States from some Australian ports in ships with conventional refrigerated holds. The normal procedure is to assemble double height pallets (70 cartons) at a cold store near the wharf and transport them to the ship in un-refrigerated trucks. The pallets are then loaded from the wharf directly into the open hold of the ship. When the hold is full, the hatches are closed and the refrigeration applied.

Logging the temperature of the product has shown that the surface temperature rises to near zero during the time the pallets are exposed to ambient temperatures, but falls rapidly once loaded into the hold. There is only a small rise in temperature within the pallet.

In order to minimise any temperature rise during the loading process:

- palletised cartons should be held at –18°C to –20°C before despatch;
- transport distances should be kept to a minimum; and
- pallets should not be left standing on the wharf during work breaks.

Further reading

Chua, H M & Cain B P (1978) Unit load handling of cartoned meat. Meat Research Report 4/78.

Restraint device and transit damage seminar (2004). Presentation to MICA by Mullica Hill Group. (Available from AMIC).

For more information, contact one of the Meat Industry Services staff listed below.

Food Science Australia Meat Industry Services

Meat Industry Services (MIS) of Food Science Australia is an initiative supported by Meat and Livestock Australia (MLA) and the Australian Meat Processor Corporation (AMPC) to facilitate market access for, and support world-class practices in, Australia's meat industry.

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