Condensation in Carcase Chillers

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AMT
AUSTRALIAN MEAT TECHNOLOGY

Additional information

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The evaporator is the coldest surface in the room and will remove the excess moisture load. It is far better, and more efficient, to let condensation form on the evaporator surface and drain away rather than freeze. A wet evaporator gives maximum continuous heat transfer. Ice build-up rapidly reduces evaporator performance and early defrosting is required.

Clean evaporator surfaces

In a hot carcase chiller, a film of fat may build up on the evaporator fins and fan blades and act as an insulator and inhibit evaporator performance. Evaporators and fans must be cleaned with hot water and a detergent that will not damage the fin and tube materials. (Fins and tubes may be made be of aluminium, copper or galvanised steel. Fan blades may be made of aluminium, steel or plastic.)

To determine the necessary frequency of cleaning, measure evaporator performance before and after cleaning, and measure the temperature drop and air velocity through the evaporator. A simple vane anemometer may be used to measure air velocities.

Clean evaporator surfaces enable chillers to be operated at peak efficiency.

Condensation after rapid chilling

If rapid chilling is followed by an equilibration period to soften fat, the air temperature should rise no more than 2°C per hour. If the air temperature rises too rapidly, condensation may occur on steelwork.

Do not wash chiller floors and passages with hot water during loading

The use of hot water creates a major water vapour load, increasing the tendency for condensate to form. Chillers near the slaughter floor or spray from a carcase wash are the most susceptible to condensation problems caused by water vapour near chiller doors. If rinsing is necessary, use only cold water.

Maintenance

Repair burnt out fan motors promptly. Small hot meat chillers may have as few as four fans. Loss of one fan reduces refrigeration capacity by 25% and increases the risk of condensation.

Chiller management

Know the capacity of your chillers. Do not overload or load more quickly than the capacity of the refrigeration system to remove excess moisture.

Fans and refrigeration must run continuously during loading. Lights should not be left on unnecessarily.

Minimise door-opening periods

Close doors while chiller is not being loaded. A mechanical door closer will encourage operators to routinely close doors.

Air drying of washed carcases

Air drying of carcases prior to entry into the chillers will reduce the water vapour load. Space must be available, however, between the kill floor and chiller entry. A delay of more than 30 minutes between post-slaughter and the commencement of active refrigeration will increase weight loss. Thirty minutes is sufficient time to allow free water from carcase washing to drain off.

If these solutions do not solve condensation problems, a more detailed investigation of the refrigeration plant and chiller design may be needed.

Evaporator defrost drain trays

Condensation is likely to form on the bottom of defrost drain trays, especially if the trays are above hot carcases, because they are cooled by cold water running off the evaporator. Condensation is eliminated by insulating the underside of the drain tray. In severe cases, it may be necessary to fit tracer heat cables.

Stagnant pockets of moist air

If air circulation is poor or uneven, stagnant pockets of moist air may collect and cause condensation in parts of the chiller (mainly on steelwork). Strategically located additional fans or baffles to improve air flow will assist.

Remove moist air entering from loading passage of kill floor

Two engineering solutions will limit the impact of warm, moist air near the chiller entry:

1. Forced fresh air ventilation of the area

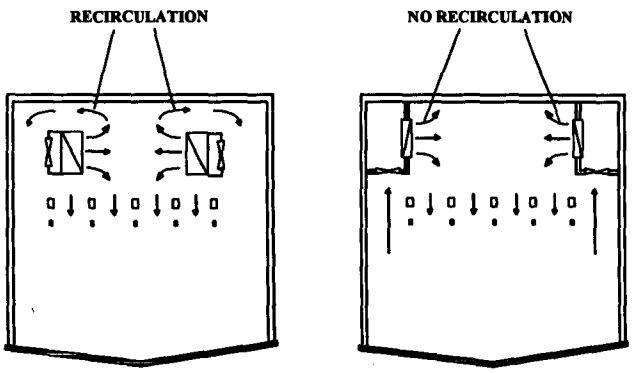
This may provide only a partial solution and be unsatisfactory during warm ambient conditions.

2. Installation of refrigeration in the loading passage to hold the temperature at 10°C
   The evaporator should be operated with a high TD (air-on to air-off temperature) across the coil to maximise moisture removal but the evaporator temperature should not be less than 0°C.

Cold air discharged from the evaporator returns to the inlet

An example of how this occurs is shown in Figure 2.

FIGURE 2



When evaporators discharge directly at walls or at each other, some cold air may re-circulate back to the evaporator inlet – an ineffective use of refrigeration. The airflow should be arranged to ensure that air discharged from the evaporator passes through the product before returning to the evaporator.

Baffles or turning vanes may be used to overcome this problem.

Chillers constructed under other refrigerated rooms

Unless chiller construction is carefully carried out with insulation in the floor/ceiling between the two rooms, ceiling condensation is inevitable. The only solution is the installation of effective ceiling insulation.

Refrigeration capacity

Undersized evaporators are usually incapable of removing water vapour load during chiller loading. Long cooling times or rising temperatures during loading indicate under-capacity in the evaporators or other problems with refrigeration plant. In this case, the condition and design of the refrigeration system should be re-assessed.

Slaughter floor ventilation

If the ventilation of the slaughter floor area is pressurised by a ventilation system, warm, moist air will enter the chiller passage. This can only be controlled by three means:

1. Effective balance between inlet and extraction on the slaughter floor
2. Refrigeration of the air in the chiller passage to remove the excess moisture load
3. Adequate fresh air ventilation of the chiller passage. This can often be effective and avoid the need for refrigeration.

Additional information

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