MINUS40

GUIDE TO ENERGY EFFICIENCY

Fruit production
– refrigeration plant

MINUS40

Consultants, Designers, Project Managers

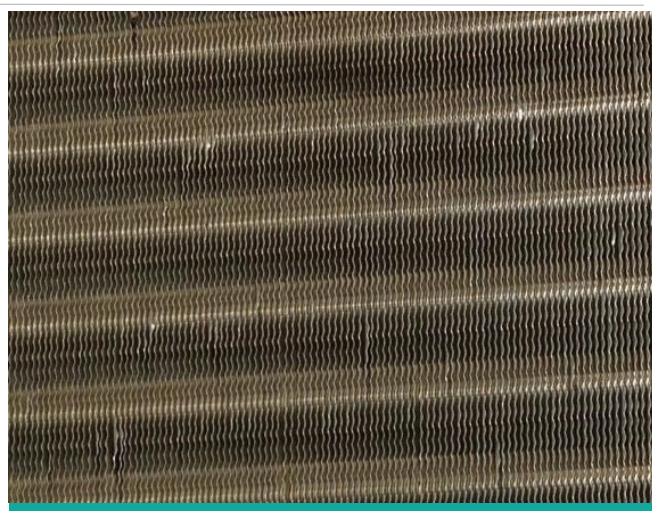
Fruit production and storage sites typically use R22, R409a, R408a, R404a or/and R134a refrigerants in their commercial refrigeration equipment.

Condensing Units and Air Cooled Condensers

The condenser is the element that rejects the heat and therefore needs a good supply of cooling air.

Do this

Position the condensing unit or air cooled condenser clear of the ground and on the roof.



Use clean coils.

- Locate condenser on the roof.
- Locate condensers away from other heat sources
- Locate condensers well clear of the ground to prevent entry of dirt.
- Install variable speed drives (VSDs) on fan motors.

Avoid this

Avoid enclosing and placiing on the ground.

Avoid exposure to westerly sun.

Avoid using dirty coils.

- Locate condensers or condensing units within enclosed spaces, such as ceiling spaces or subterranean garages. Exceptions are OK if these are very well ventilated to the outside, or otherwise conditioned.
- Locate condensers where they can be fouled, e.g. near kitchen exhaust outlets
- Locate condensers against walls.
- Locate condensers on the leeward side of buildings in windy areas, as this will cause recirculation of the air through the condenser.

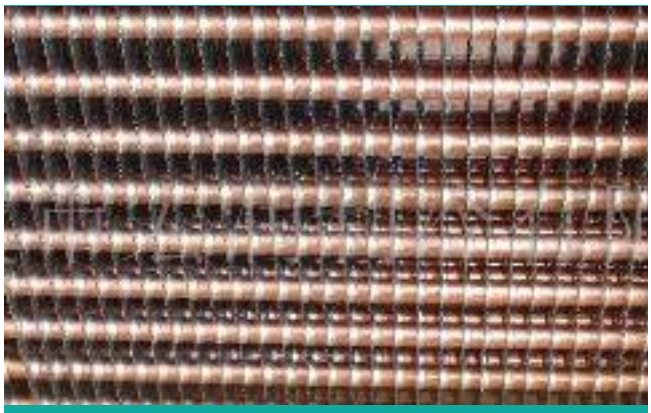
Evaporators and Cool Room

Icing occurs if the there is too much differential between the evaporating temperature and the room temperature the stored fruit.

Evaporators can be defrosted by 10-20 minutes overrun of the fan, and by electrically heating the fins.

The highest temperature in the room is at ground level. For that reason, always leave space between product boxes to avoid heat pockets that reduce efficiency. The airflow will ensure constant circulation of temperature and moisture.

Do this



Regularly defrost fins

- Defrost the evaporator regularly but do not over-defrost it – this will only increase the heat ingress to the coolroom.
- Provide enough space between product boxes, so that the airflow ensures a constant circulation of temperature and moisture.
- Insulate doors and wall, ideally using automatic roller doors.

Avoid this

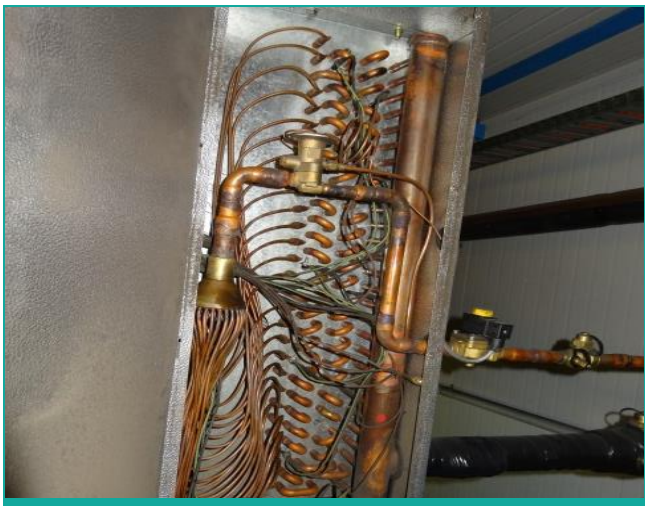
Avoid icing on fins

- Design of the evaporator to small, then condensed water or even icing on the fins will occur.
- Heat pockets between product boxes cause a lower efficiency.
- Too much additional moistening causes in a higher amount of condensing water on the evaporator as well as in a higher amount of icing on the fins.

Solenoid Valves

Solenoid valves are electrically-controlled valves that control the flow of refrigerant, used for temperature control and many other purposes.

Do this



Install solenoid valve close the expansion valve

Avoid this

Avoid placing solenoid valve on the unit.

Insulation of the Suction Line

Insulation increases system efficiency and reduces wear of the compressor.

Do this

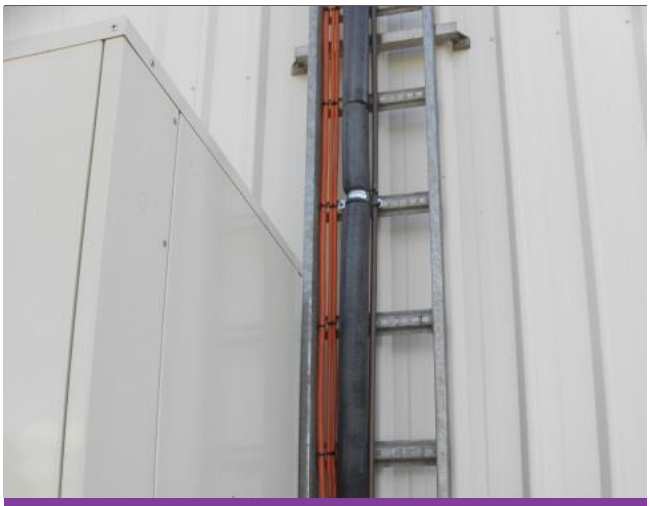
Install solenoid valve close the expansion valve

- Insulate the suction line. An uninsulated suction line creates a higher heat load in the system.
- Clad outdoors suction lines.

Avoid this

Avoid leaving the suction line uninsulated.

- Use damaged insulation.
- Leave outside Armaflex type insulation unclad.



Avoid exposing insulation to sun.

Compressors

Do this

Install fully hermetic unit

- Replace open drive compressors by fully hermetic compressors.
- Install variable speed drives (VSDs) on compressor motors.

Avoid this

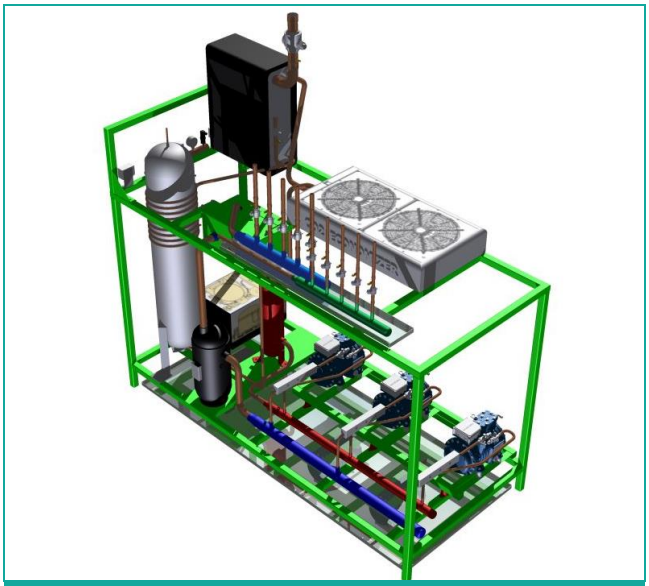
Avoid open drive unit

Overall System

Multiple single units consume more energy and have higher maintenance costs than a larger centralised system.

Well-designed CO_2 and glycol systems offer a reduction of HCFC and HFC refrigerant the system, sometimes even eliminating it completely. They also reduce maintenance costs and leakage risk, and often deliver major energy savings.

Do this



Install CO2 sytsem

- Replace multiple single units with a centralised CO2 or glycol system.
- Replace system with an ammonia system.
- Recover heat from centralised system.

Avoid this

Avoid multiple single units

Other Tips

Heat recovery

Small and medium abattoirs often need 4000 L per day of hot water. A heat recovery system can be used to supply the heating energy, but it is only feasible with a centralised system.

Heat Pump

If the recovered heat is not sufficient for the required conditions, it can be supplemented by a water/water heat pump.

Refrigerants

Many commercial refrigeration units are still using refrigerants that will be phased out in 2015 (R22, R123, R408A, R409A, MP39, MP66, HP80 and HP81). These systems should be replaced with a system using R134a, R407F, CO_2 or ammonia.

Reducing fan energy costs

Adding a variable speed drive (VSD) on condenser or evaporator fans can make a big difference to cost: reducing fan speed by 50% typically reduces energy demand by 80%.

Testing

Test run of the refrigeration plant before the storage season starts

Monitoring Room Humidity

Record the amount of water that condenses on the surface of the evaporators. This provides information about the dehumidification of the fruit, which can be used to control the refrigeration plant.

Controlling Room Humidity

Condensed water from the evaporator should be returned to the floor of the room. It evaporates and moistens the room air.

Ground watering

To avoid dehumidification of the fruit, the coolroom floor should be watered before the storage.

Additional air humidifier

If the fruit is subjected to too much dehumidification, aerosol must be used to provide supplemental humidity.

Avoid excessive humidifying, otherwise the amount of condensed water on the evaporator increases quickly, leading to icing on the fins.

Case 1: Fan of 100 Watt running at full speed all the time

% Speed	% Savings	Running Time	Consumption/Day
100%	0%	24hrs/Day	2.4Wh/Day
Annual Consumption			876kkWh/Year
Annual running cost (Based on average power costs of 0.15$/kWh			131.4$/Year

Case 2: Fan of 100 Watt running at 50% of its maximal speed 8h/Day

% Speed	% Savings	Running Time	Consumption/Day
100%	0%	16hrs/Day	1.6kWh/Day
50%	85%	8hrs/Day	0.12kWh/Day
Annual Consumption			627.8kWh/Year
Annual running cost (Based on average power costs of 0.15$/kWh			94.17$/Year