Part 3 in a Series of Informational Articles about Forced-Air Precooling

We are pleased to present an article by Jim Thompson, who has been an adviser to our company for a number of years, and a great help to us. *(To contact Jim, eMail to jamfthompson@gmail.com, or see UC Davis page here.*

Tips for Successful Forced-Air Cooling

by Jim Thompson

The key principle behind forced-air cooling is to force cold air past individual fruit or vegetables in a packed box or bin. This close contact between the produce or floral, and the refrigerated air, causes quick and complete cooling.

Fast and thorough cooling requires:

1. Strong fan capacity:

    a) A minimum fan capacity of 1 cfm/pound (1 m^3/sec/MT) of product weight. Stronger airflow can be used for faster cooling - particularly for small diameter items – and this faster cooling usually costs less per pound than slower cooling *(there can be less fan-motor-runtime per pound of product, saving on both fan motor electrical consumption per pound, and also on the associated cost of additional cooling to remove the fan motor heat from the space.)*

2. Adequate refrigeration capacity:

    a) Fast cooling requires the air temperature in the cooler to be constant during the last half of the cooling cycle. Air temperature can rise a little when the cycle is first

started and a great deal of heat is being removed from the product. But later on it should be a few degrees Fahrenheit lower than the desired final product temperature.

b) If multiple forced-air coolers are located close to each other, make sure the hot air from one cooler does not influence the temperature of the air in a neighboring cooler. Redirect air from one cooler away from neighboring coolers or install an air barrier, such as an uninsulated wall or plastic curtain, between the cooling units. An air barrier should not block access to a refrigeration coil.

3. Proper packaging:

a) Master containers need to be vented to allow air to flow through them. The vent area should be at least 5% of sidewall area and vents should align between boxes stacked on a pallet – even if the boxes are "cross-stacked".

b) Minimize the use of interior packaging, if possible. Interior box liners dramatically reduce airflow through boxes and cause long cooling times. If they must be used, design the packaging system to allow air to flow through an open volume in the top of each box.

c) Use interior packaging with vents if possible. Clamshell containers for berries with about 10% vent area can be cooled very quickly. Vented consumer bags also speed cooling compared with solid bags.

4. No air leakage around the boxes:

a) Tarps in tunnel-type coolers must be deployed so they do not allow air gaps.

b) Seal between the wood pallets themselves, so air cannot bypass through them. Fan suction will tightly hold fabric or long pads placed next to pallets.

c) Install a pressure gauge ("magnehelic") in each cooling position to measure return channel air pressure. With experience, cooler operators will learn the expected pressure for a given number of pallets for each commodity. Low pressure indicates an air leak. Unexpectedly high pressure indicates blocked box vents.

d) Do not mix box types on a cooler. Boxes with a high vent area, such as most RPCs, and boxes with a low vent area, such as most corrugated designs, have very different resistances to airflow. Much more air will flow through the highly vented boxes and they will reach target temperature much faster than product in boxes with less venting. This can lead to overcooling and possible frost damage to the easy-to-cool packages, or undercooling with loss of net weight and shelf life for the hard-to-cool ones.

5. Do not add pallets to a cooler after it has started:

a) The first pallets placed on the cooler will finish cooling before the others and will be exposed to unnecessary airflow and moisture loss.

NOTE: Some moisture loss is unavoidable during product cooling. The amount of loss is closely related to the temperature drop of the product during cooling. Items that come in warmer lose more moisture than the same items requiring less cooling. In coolers operating near 32°F (0°C) cooling air, relative humidity will have little effect on reducing moisture loss, so long as relative humidity is at least about 80%. In any case, the loss during precooling is always less than the loss if room cooling, or no cooling, is used.

END OF THIS ARTICLE.

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