

Best Friends or Perfect Strangers?

When potatoes are stored for a longer period of time in a hot or very cold climate outside air ventilation only is not suitable to maintain potatoes at storage temperature only. In these situations, mechanical cooling is an essential tool to extend the storage period and keep potato quality high.

This article by **Product Manager Jan van Maldegem of storage technology specialist Tolsma-Grisnich** will focus on how systems should be designed in relation to the specific needs of the potato and gives practical tips for the storage operator to optimize settings in the climate control computer. A cooling system can be just supporting, which means its capacity is limited or with full capacity. An optimal storage design for processing potatoes should be designed in advance both with ventilation and cooling. Also, a smooth integration of both systems in the climate control computer will enable storage operators to fine tune on minimal weight loss and energy consumption.

A PHYSICAL APPROACH TO POTATO COOLING WITH VENTILATION OR COOLING

The choice for a specific system can also be taken from a more theoretical approach. The cooling process can be physically split up into the convection part and the evaporation part and a to be neglected part caused by conduction between tubers. The reason why we use air as a heat transfer medium for potatoes is that it can be transported easily through a pile or a box and can easily exchange heat with the potatoes. This convection is forced by fans. Another thing that happens is that due to fact that cold air contains less water than warm air and by taking up heat from

the tubers by the air the relative humidity of the air will drop (vapor pressure deficit will increase) and moisture from the tubers will evaporate more easily and is removed from the storage by the ventilation or cooling system. For this evaporation of moisture energy is needed, which is extracted from the potatoes. Luckily a healthy potato has a protective skin/peel to protect the tuber from losing moisture too quickly. So, one can imagine that there is an optimum ratio between these processes where cooling down is done quickly and, in the meantime, limiting the extraction of moisture from the potatoes with a high energy efficiency of the storage system.

WHAT ARE THE DIFFERENCES FOR VENTILATION AND COOLING SYSTEMS IN RELATION TO THE PRINCIPLES DISCUSSED ABOVE?

Ventilation: depending on settings like “difference air duct to product” and “difference outside/product” and the suitability of the outside climate itself (cold and dry compared to warmer and humid) cooling down can be done quickly because of a high ventilation rate of the fans. This means that cooling down by convection goes so fast that the time the potatoes are evaporating moisture is relatively short. At bigger duct temperature differences that maximum evaporation rate of moisture through the potato skin is reached. So, the shorter this time takes the less weight loss will be the result. Of course, this will result in some more internal ventilation afterwards.

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Cooling: when using a cooling system, it's depending very much on the design of the system with what temperature difference over the air cooler is running. Many cooling systems (direct expansion) have a fixed temperature difference where some systems (indirect) have an adjustable temperature over the air cooler. So, a well-designed cooling system can result in a very low dehydration of the potatoes but a (low cost) cooling system designed for e.g., onions will dehydrate the potatoes excessively. With buying a

cooling system the dehydration percentage for the future of the potatoes is already fixed.

HOW VENTILATION AND COOLING IS COMBINED IN PRACTICE

The most flexible solution is to have a combination of forced ventilation and cooling in the storage. This gives more control in the drying and wound healing phase and enables the operator to maintain storage temperature constantly when outside conditions are not

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Ventilation and Cooling in Potato Storage



suitable for ventilation. It's depending on a number of factors whether this cooling should be done quickly or slowly. In random order these factors are variety, storage period, ventilation/cooling system, potato diseases and what goal the potatoes will be used for in the end. The combination of these factors together with the outside climate conditions and planned storage time will result in a choice for only outside air ventilation, cooling, or a combination. Besides this a choice has to be made for a cooling system with 100% capacity or for a supportive system which is able to maintain potatoes at the end storage temperature and the cooling down is done with outside air. This can be more economic because of the smaller investment and running costs.

The challenge in the combination of ventilation and cooling lies in the operation. Climate control computers are there to help the operator with the operation and have an optimal storage efficiency at the end. With the modern storage control technology this is



automated to a high level. The climate control computer takes care of an optimal co-operation between the ventilation and refrigeration system. The algorithm is based on items like:

- Outside air ventilation can dry with higher capacity than refrigeration, so the climate control computer will make the decision which system is the most efficient.
- Weight loss will be higher at a higher storage temperature (respiration rate)
- Regular refreshing of the air in storage is necessary to keep the CO₂ level low
- During application of

sprout inhibitors outside air ventilation should be blocked for a certain time.

- Mechanically cooling is more expensive to run.

FUTURE OF STORAGE

In the nearby future climate control computers will become more and more intelligent. Climate computers will operate as an energy management system within an agricultural company. The alignment of energy production e.g., solar or wind energy and the consumption by ventilation, cooling and e.g., grading lines can be controlled and tuned to each other. Weather forecast will be integrated in the climate computers in short time. This enables the climate control computer to plan ventilation or refreshing with outside air anticipating on the weather forecast. Also new developed sensors will make it possible to automatically adjust computer settings based on unique quality models and measurements on the potatoes. •

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