Comparison of Univeg storage locations

M. Montsma
F. van de Geijn

Report 1518

Colophon

Title	Comparison of Univeg storage locations
Author(s)	M. Montsma
	F. van de Geijn
Number	1518
ISBN-number	978-94-6257-356-7
Date of publication	15 December 2014
Confidentiality	No
OPD code	--
Approved by	Ben Langelaan

Wageningen UR Food & Biobased Research
P.O. Box 17
NL-6700 AA Wageningen
Tel: +31 (0)317 480 084
E-mail: info.fbr@wur.nl
Internet: www.wur.nl

Abstract

On request of Univeg Waddinxveen, Wageningen UR Food & Biobased Research has studied the technical specifications of three different storage locations.

- Univeg Waddinxveen
- RFW, Rotterdam Fruit Warf
- NordFrost

The technical information has been provided by Univeg in cooperation with each location. After comparing the data, the main differences between the facilities were pointed out. The main question was if the technical differences cause local "hot spots" or high humidity zones. Technical differences in settings and the effect on the quality of storage conditions and product quality was not part of this study.
Besides the facility comparison some operational research of (product) temperature within the main storage rooms has been done for the Univeg Waddinxveen location. These measurements were carried out by staff members of Univeg . The results were interpreted and discussed by Wageningen UR.
The results of these temperature studies give an indication of the specific (product) temperature range and show only differences that are accepted in storage practise. According to the experience of Wageningen UR Food & Biobased Research, the identified temperature profile is good. Depending on some operational variables, like product temperatures on arrival, the temperature difference within the room may be larger. The main advice is to set up a clear product temperature control and policy on adjustments of settings, based on the measurements of product temperature, settings of temperature control and air circulation.

Content

1 Introduction

Wageningen UR Food & Biobased Research has been asked to identify and explain possible impact of those differences in storage behaviour of different storage locations. The cold rooms who were part of this study were at the following locations:

- Univeg Waddinxveen
- RFW, Rotterdam Fruit Warf
- NordFrost

The facilities were compared, based on the available and relevant technical information provided by staff members and an expert visit of each location. At all locations cold rooms used for "longer" storage periods were studied. Longer storage is defined as longer than three weeks. In section 2 of this report the results of the technical comparison are described. The influence of operational handling and the effects of the technical difference on the product quality are no part of this study.

Based on the technical comparison between the three locations the translation to actual storage conditions cannot be made. Therefore Wageningen UR Food & Biobased suggested to measure the air and product temperature during operation at the Univeg Waddinxveen location. The difference of temperature (product and air) at most critical positions in the storage room give the right information about temperature transfer between product and air, or in other words the air distribution. During several runs of 6-8 days the temperature has been monitored in two different cold rooms.

2 Results

The results of this study consist of two parts, first the technical comparison between the locations Waddinxveen, RFW and NordFrost and second the temperature measurements at the Univeg location in Waddinxveen.

2.1 Technical comparison storage locations

Dimensions and configuration

In Table 1 the dimensions and configuration of the three compared storage rooms are described. In Figure 1 the differences in rack positions and the evaporator position with the air outlet direction are shown.

Table 1: Dimensions and configuration of the three different cold rooms.

	Univeg	Nordfrost	RFW
Dimensions	25.6*16.2*10.8=4501m^3	61.5*6*12.2=4513m^3	600*10=6000m^3
# racks	2	2	2
# pallets on rack	(17*5*3)*2=510	(54*1*4)*2=432	(25.5*5*3)*2=765

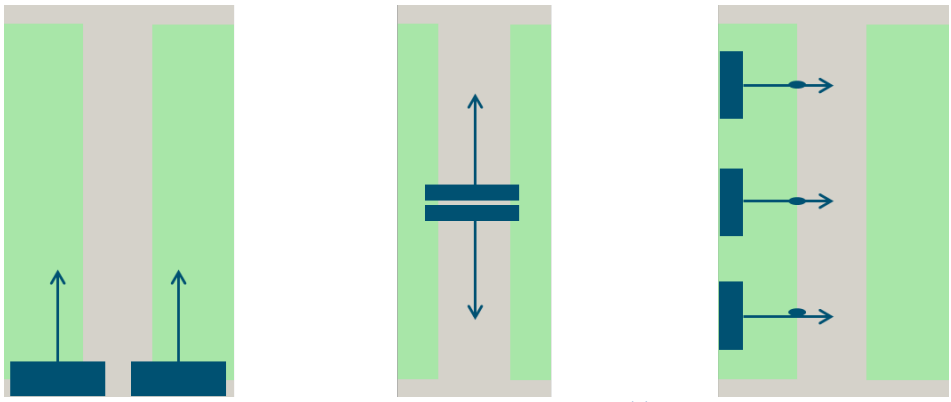

Figure 1: Schematic overview of the rack and evaporator position. The arrows indicate the direction of the cooling air outlet.

Cooling, circulation and ventilation capacity

Besides the different dimensions of the room, the position of the evaporator (cooler), the rack system (single, triple), the pallet position/stacking (in relation with the airflow direction) is different. The above mentioned items have impact on the air distribution and thus the temperature profile in the storage room.

Table 2: Technical information related to cooling, circulation and ventilation capacity of three storage rooms.

	Univeg	Nordfrost	RFW
Cooling capacity	2*53=106kW	2*40=80kW	3*29.3=87.9kW
Capacity per ton	0.26kW/ton	0.23kW/ton	0.14kW/ton
Airflow coolers	2*42900=85800m^3/h	2*42000=84000m^3/h	3*33970=101910m^3/h
Air circulation	22.4 times	21.9 times	20.0 times
Fresh air capacity	0.2 times/h	1.5 times/h	0.23 times/h
Exchange surface	6.7m^2/pallet /section	8.3m^2/pallet /section	6.7m^2/pallet /section

The main technical parameters of cooling, circulation and ventilation are shown in Table 2. The cooling capacity of RFW is low compared to the other locations (in kW/ton). The capacity of the evaporator depends on the temperature difference between air temperature and the temperature of the (evaporating) coolant. This has been taken into account in this study.

The fresh air capacity is 6-7 times larger at the Nordfrost location. For all locations the operational time of fresh air ventilation is not known. At the Nordfrost location the ventilation can be regulated by CO_2 measurements. At the other locations no CO_2 measurements are available.

We expect that the air exchange surface of each pallet is important for a proper heat and moist exchange between pallet and air. Because of the rack system design the Nordfrost location has the largest exchange surface.

Technical difference in measurements and control

In Table 3 an overview is given of the measurements and control options of the measured parameters.

Table 3: Measurement parameters and control options.

	Univeg	Nordfrost	RFW
# T-sensors	1	1	2
# RH-sensors	No	1	2
Humidity control	No	Yes	No
CO_2 -measurement	No	Yes	No

At all three locations temperature is measured and controlled by the cooling system. Humidity is monitored at Nordfrost and RFW. Univeg Waddinxveen doesn't have humidity control. The humidity control of Nordfrost is based on cooling/heating air inlet (fresh air), heat exchanger air inlet – exhaust air and steam humidifier of the fresh air inlet. CO_2 control is based on fresh air ventilation. Only at Nordfrost this is based on CO_2 measurement, although the control setting may cause excessive ventilation and dehydration.

2.2 Temperature measurements Univeg Waddinxveen

The temperature (air and product) has been monitored with temperature loggers. The loggers were calibrated at a stable temperature. The positions of the loggers were defined by Wageningen UR and scheduled below (see Figure 2). The expected warmest and coldest positions were chosen.

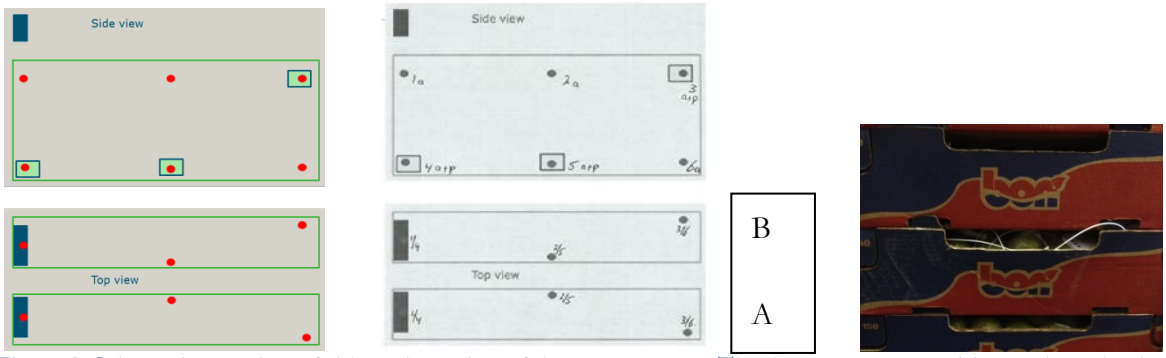

Figure 2: Schematic overview of side and top view of the storage room. The dots are sensor positions, where the dots in rectangular marked are also product temperature positions. The sides are marked with A and B. On the right the picture shows how sensors placed in the pallet.

The focus of the temperature measurements is on the product temperature. The air temperature measurements at several positions are available.

Run 1

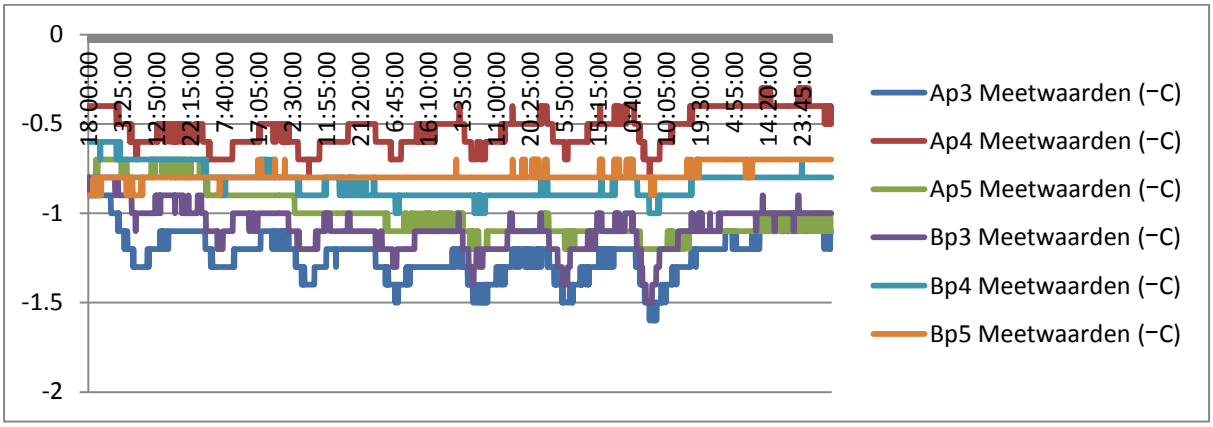

Figure 3: Room 6, run 1, product temperature measurement on side (rack) A and B, position p3, p4 and p5.

The differences in product temperature (side A and B) at evaporator side and backside of the room are acceptable. Even the product temperature seems to decrease during the night time. Based on these measurements there seems to be a different temperature setting during the registration. The most variable temperatures in time will probably respond more directly to the average air temperature.

Run 2

In run 2 all six product sensors were placed in the rack of side A. Figure 4 shows the measurement results of the product temperature.

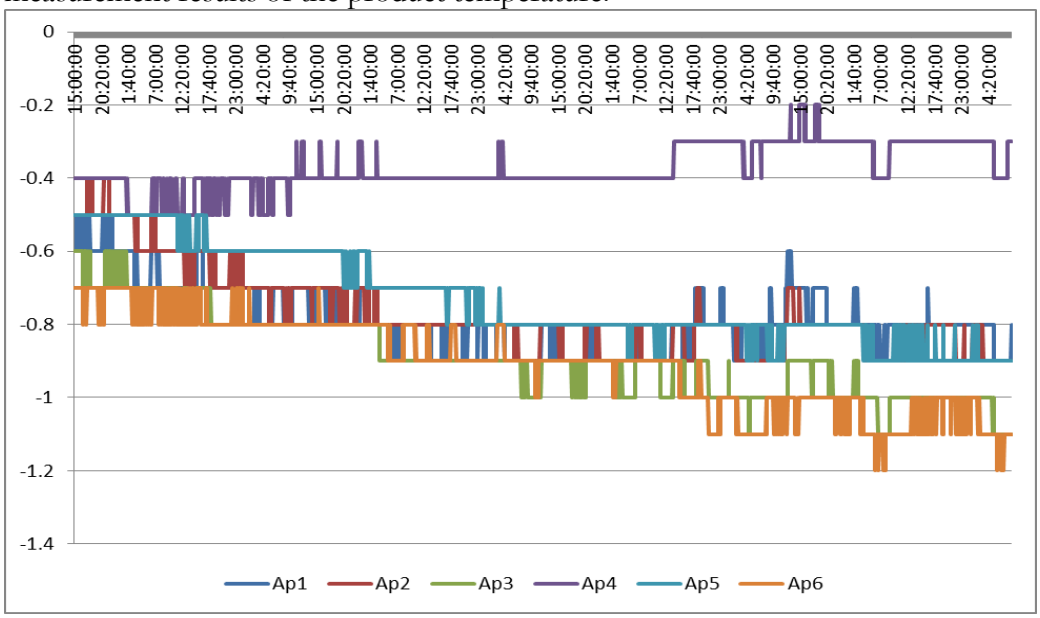

Figure 4: Room 6, run 2, the six product sensors are all positioned at side A.

The difference in product temperature between coldest and warmest position is relatively good. The temperature at position 4 is relatively warm, position 6 is cold. At these positions verification of correct temperature registration has been done. There is no clear explanation for the difference. To solve specific hotspots in cold rooms we have good experience with local forced circulation. An example of a mobile fan is shown in Figure 5. Such a circulation must be controlled with specific temperature measurements. Extra circulation without reason only uses energy and increases the heat load of the room.

Figure 5: A mobile fan used for extra circulation.

Run 3

In run 3 the measurements are similar as in run 1 but carried out in room 2.

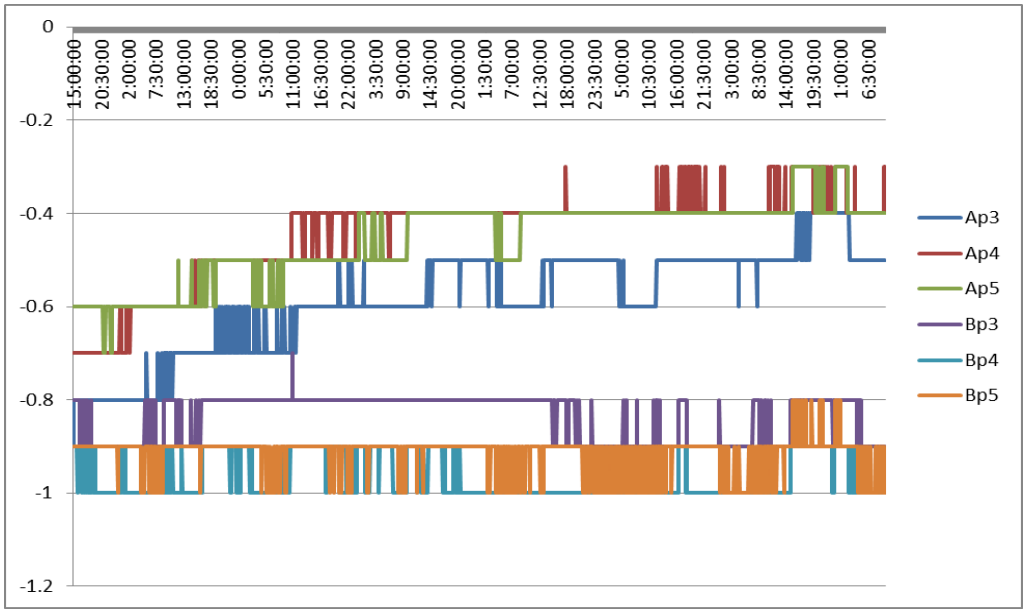

Figure 6: Room 2, run 3, product temperatures at side (rack) A and B, position p3, p4 and p5.

The variation of product temperatures in room 2 seems to be depending on specific stacking. Side A shows higher temperatures compared to side B. Within the rack the difference between position 3, 4 and 5 are small. The air temperature is not functional in finding the right product temperature. Only by measuring product temperature at several (critical) positions, the right settings can be chosen. With mobile fans the hot spot can be ventilated.

3 Conclusions

Technical comparison
Based on the available information of the technical comparison the indications are:

Pallet configuration

- Single rack systems > bigger exchange surface = better heat exchange with cooling air.

Cooling capacity and circulation

- For all locations the cooling capacity is similar.
- Air circulation determines heat exchange (air – product).
- Product temperature difference at different/extreme locations in the room is what really matters.

Fresh air supply

- Necessary for ethylene and CO_2 removal.
- For pears all locations have enough fresh air ventilation capacity.
- Ethylene removal is less important for pears.

CO_2 control is important for pears

- Frequent fresh air ventilation based on the measurements is sufficient.
- Measurement range up to 0.2% CO_2 can cause excessive ventilation (0.7% CO_2 is allowed).

Humidity control

- Necessary to avoid dehydration (with humidifying) and to avoid fungal growth and rot (drying).
- Humidity control of fresh air is an advantage because outside air normally has a high moisture load.

Temperature measurements
The temperature measurements of the product at different positions (see Figure 2) in room 2 and 6 during several logging periods give an indication of the product temperature difference within the rooms (see Figure 3, Figure 4 and Figure 6). This difference is acceptable and similar with measurements at other storage locations.

For optimal settings in temperature, circulation and control of optimal product temperatures monitoring of product temperatures is needed. These product temperature sensors can be hidden within the rack system (protected from the air) to simulate the buffer working of the product in the pallet.

General conclusion

The general conclusion is that based on the technical layout, compared with the other two locations and especially based on the product temperature measurements, the storage potential of the Univeg Waddinxveen location is good. The measured temperature differences within the room are acceptable for the operation of pear storage.

In order to optimize the storage conditions, especially important for storage times more than two months, more attention must be paid to product temperature differences within the room and improved air circulation.

