Banana Ripening Economics – doc D103W1

1. Content

2. Introduction

2.1. Previous box ripening

Until 1990 the banana rooms in Europe were built for box ripening by manual handling.
The boxes were loaded manually into the room and piled in a honeycomb arrangement, leaving space between boxes for air circulation.
In every box the sealing PVC was cut on the upper side and somewhere the carton box cover was removed.
The evaporator fans were sized to push and circulate air through the boxes and a humidity producer was installed to avoid weight losses during heating cycle.
Where correctly implemented this technology lead to a fairly good ripening quality at the expense however of demanding labour for box handling.

2.2. New technology for pallet ripening

During recent years technology shifted towards pallet ripening pushed by operator request to reduce labour and handling costs.
Usually banana boxes are shipped directly onto pallets from the country of origin or are palletised in the receiving seaport. In any case the ripener receives banana boxes on pallets.
Before introducing the pallets into the room the ripener cuts the banana plastic in every box from the accessible side.
The pallets are stored in the room along two rows, creating a central corridor and two side free spaces.
The ripening plants create depressure in the central corridor to let air travel from the side free spaces across the pallets and into the corridor.
The humidity producer is no more necessary.

2.3. Two facing depressure technologies

Since the beginnings two different technologies have been adopted for pallet ripening.
The curtain depressure, originally used by Del Monte, is actually implemented and recommended by MICHELETTI IMPIANTI, please refer to the brochure d113x and description d103v.
The rooftop depressure, originally used by Chiquita, is also popular in Europe and implemented by several providers of ripening plants, please refer to their documentation.

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In the curtain technology dedicated fans put in a depressure box produce pressure difference, while in the rooftop the depressure fans are located inside evaporators put over the central corridor.
In any case the central corridor is kept at a lower pressure respect to the side free spaces.
If correctly implemented (and that is a big if!) both technologies for pallet ripening can produce better results and more uniform ripening than the older box technology.

3. Economic advantages of depressure technology

3.1. Correct vs. incorrect ripening – up to 57000 USD per room per year

The profit margin of the ripener is tightly linked to the ripening quality, that is why it is necessary

- maximum uniformity of ripened bananas
- minimum ripening time
- minimum top temperature during ripening

Those requirements are particularly critical where the market pretends yellows bananas.
When correctly ripened the bananas can resist in the shops two more days and create more value for the shopkeeper.
A perfect ripening plant can be compared to the travel agent because brings bananas exactly where the ripener wants and all at the same level of ripening.
Good quality bananas can be sold up to 5 USD cents more than bad ones, so considering 50 ripening cycles per year in a room of 24 pallets (about 23000 kg), it is possible to get a price difference up to 0.05 (USD/ kg) x 23000 (kg/ room) x 50 (cycles/ year) = 57500 USD per room per year.
That is why also a small difference in banana quality can make a big difference in the long run earnings.

3.2. Curtain vs. rooftop – 400 USD per room per year

A big chunk of electric consumption in a ripening plant is due to the depressure fans.
A MICHELETTI IMPIANTI 24-pallet room uses three fans during the ripening cycle to produce a 200 Pa depressure and an air flow of 33000 m^3/ h, with an absorption of 3.3 kw, while during the storage the ventilation is reduced at 11000 m^3/ h, with an absorption of 1.1 kw
All of the depressure created in the curtain system is used through pallets because pressure drop of the air path is less than 1% elsewhere.
By contrast there is an additional 700-watt consumption due to the evaporator fans that are switched on only during refrigeration, i.e. 30% of working time.
Considering in a year 250 days of operation – 200 for ripening and 50 for storage – the total consumption is 200 x 24 x 3.3 + 50 x 24 x 1.1 + 250 x 24 x 30% x .7 = 18420 kwh per year per room.
In the rooftop system there are several smaller fans located inside the evaporators. To get the same depressure and air flow with blades of smaller size there is a minor efficiency that can be estimated at 10%.
Moreover there is a slight pressure drop in the evaporator, due to the battery and to the air flow bending, this can be estimated at 10 Pa, i.e. 5% of the total depressure.
Usually the ventilation can not be reduced during the storage so the total consumption can be estimated as 250 x 24 x 3.3 x 1.15 = 22770 kwh per year per room.
So the total difference in electric consumption, considering a 10 cents cost per kwh is about (22770-18420) x 0.10 = 435 USD per year per room.

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It has to be said that in real life, some rooftop rooms fail to get 200 Pa pressure drop through pallets and in those cases the consumption is similar to a curtain room but at the expenses of minor ripening quality.

3.3. Discus vs. scroll compressor – 300 USD per room per year

In the recent years scroll hermetic compressor have gained wide acceptance in Europe as replacement of traditional semi-hermetic compressors, mainly in commercial refrigeration.
Indeed scroll compressors ensure smooth operation, low noise level and a really cheap purchase cost if compared to traditional semi-hermetic compressor.
However the use of scroll compressor in industrial refrigeration raises some doubts where reliability is paramount and energy costs are taken into account.
To compare fairly the two products it is extremely convenient to stick to the data from Copeland who is the leader manufacturer in Europe and produces both of them.
The following table resumes main data from Copeland Selection Software Version 4.12 / 36972

Feature	Discus	Scroll refrigeration
- model	D3DA-75X	ZS75K4E-TWD
- refrigerant	R404A	same
- evaporation	0° C	same
- overheating	6 K	same
- condensation	45° C	same
- sub cooling	0 K	same
- capacity	23.54 kw	23.47 kw
- power in	7.7 kw	9.46 kw
- cop	3.06	2.48
- max op current	18 A	22 A
- weight	163 kg	100 kg

Considering 250 days of operation per year with refrigeration running 30% of the time, there is a consumption of 250 x 24 x 30% x 7.7 = 13860 watt for discus compressor and 250 x 24 x 30% x 9.46 = 17028 watt for the scroll compressor.
So the cost difference supposing 10 cents per kwh is (17028-13860) x .1 = 316.8 USD per room per year.
On top of that the discus semi-hermetic compressors can be opened and repaired while hermetic scroll can just be substituted in case of fault.

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