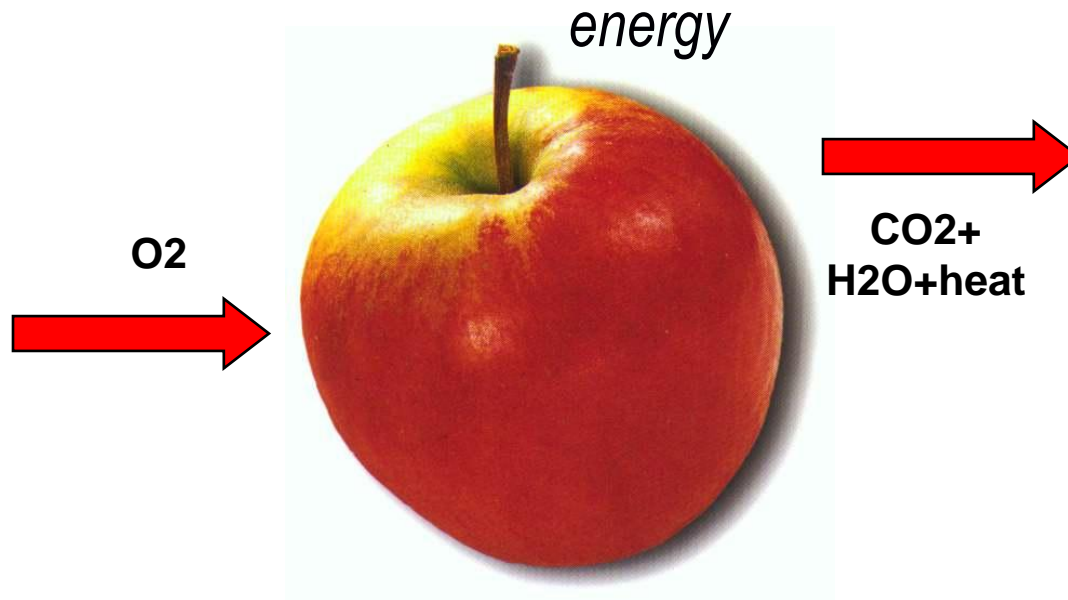


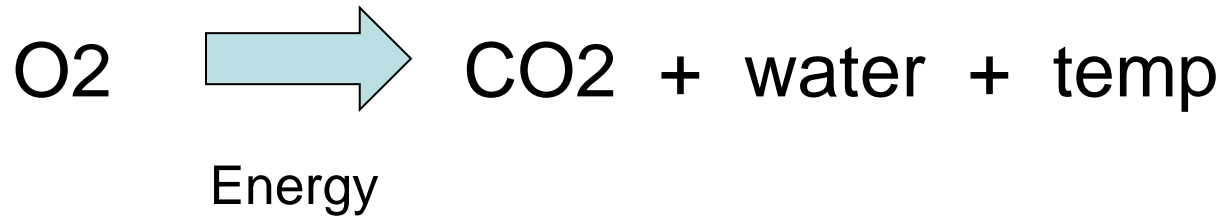
Respiration of fruit ripening

Fruit is still alive after harvest, and continues to breathe
So it will consume oxygen (O_2), and produce carbon dioxide
(CO_2).



Breathing

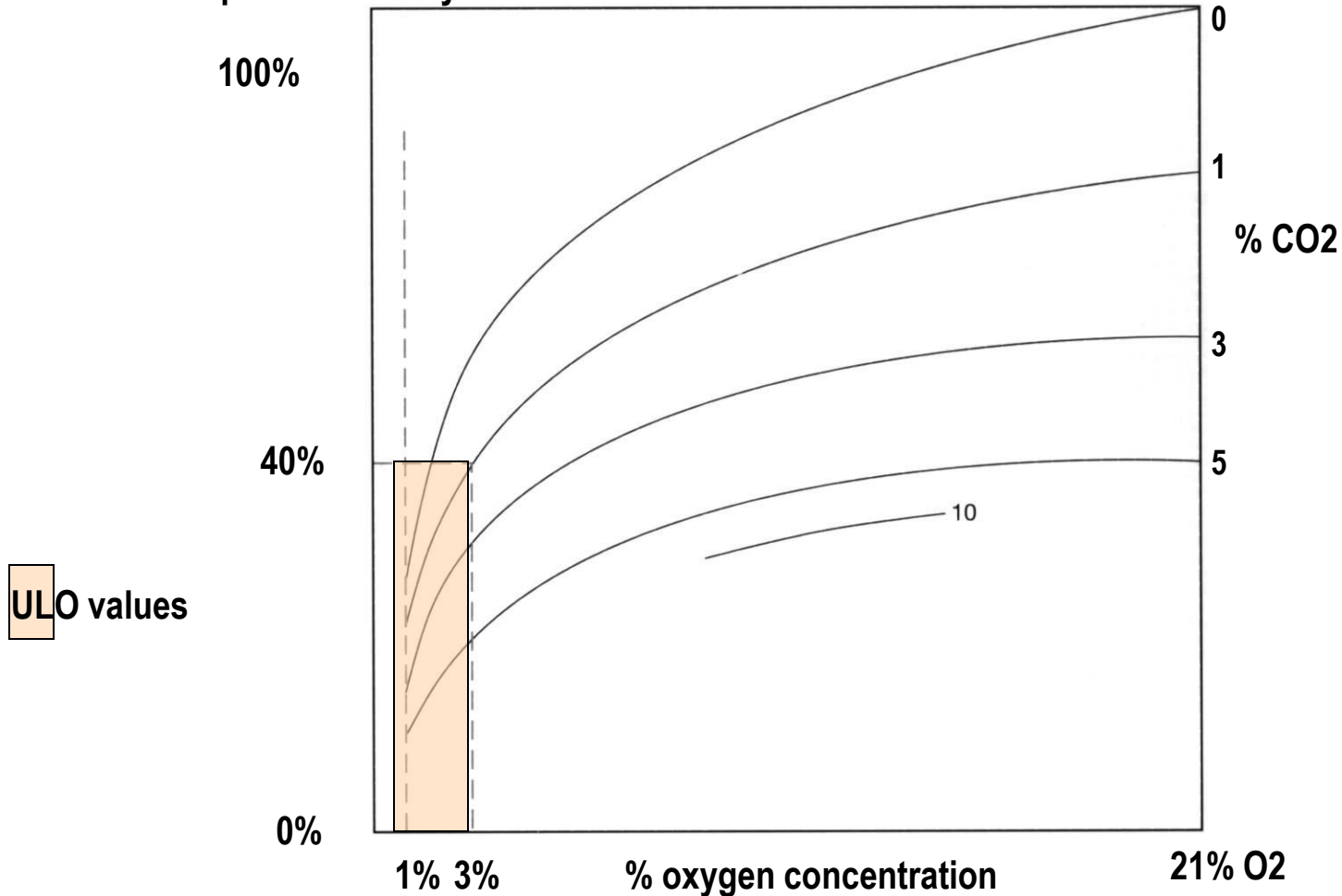
RESPIRATION



Respiration graphic

The effect of oxygen and carbon dioxide levels on respiration activity during storage

% Respiration activity



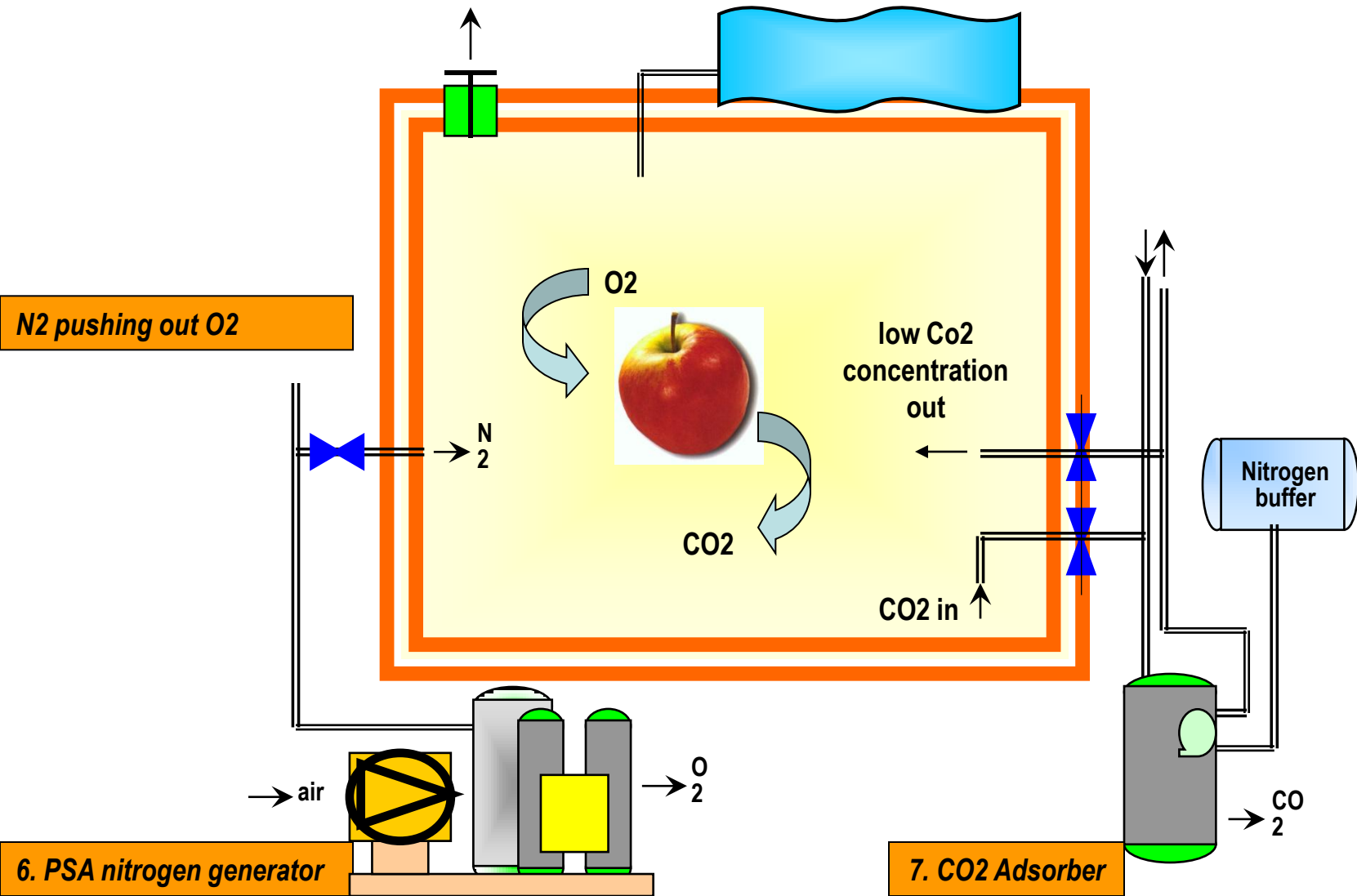
Aim : minimal respiration in the fruit without choking it. **Solution :** storage in the maximum CO2 level and minimum O2 level (these levels are different for each variety)

Cooling-down of the warm fruit

Reduction of oxygen level by blowing in nitrogen (N₂) from the nitrogen generator.

The fruit itself will also consume O₂, and transfer it into CO₂ (respiration).

CO₂ level controlled with the CO₂ adsorber (adsorption with active carbon).





STORAGE OF HORTICULTURAL PRODUCTS UNDER **U.L.O.** “Ultra Low Oxygen”

TEMPERATURE

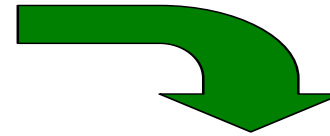
OXYGEN CONCENTRATION



JUST ABOVE THE MINIMAL ACCEPTABLE LIMIT FOR THE PRODUCT

The characteristics of the most plants are
**TO STAY ALIVE UNDER VERY
LOW CONDITIONS**

Possibility to store horticultural products
**AT THE LIMIT OF THEIR
ACCEPTABILITY**



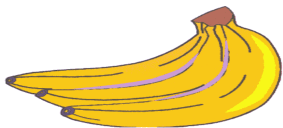
**TO REDUCE THE PHYSIOLOGICAL
LIFE OF THE PRODUCT**
ainsi
**TO RETAIN ITS HARVESTED
QUALITIES AS LONG AS POSSIBLE**

Température and oxygen
concentration are different for
each type of product

◆ **ACCURATE VALUES TO (RE-)DETERMINE
ACCORDING TO THE VARIETY OF THE PRODUCT**



Pears
-1,5° à +2° C
1% à 5% O₂



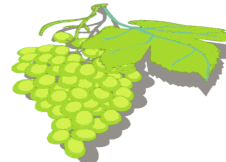
Bananas
12° à 15° C
5% à 6,5% O₂



Tomatos
2° à 12° C
2% à 5% O₂



Appels
0,5° à 5° C
1% à 2,5% O₂

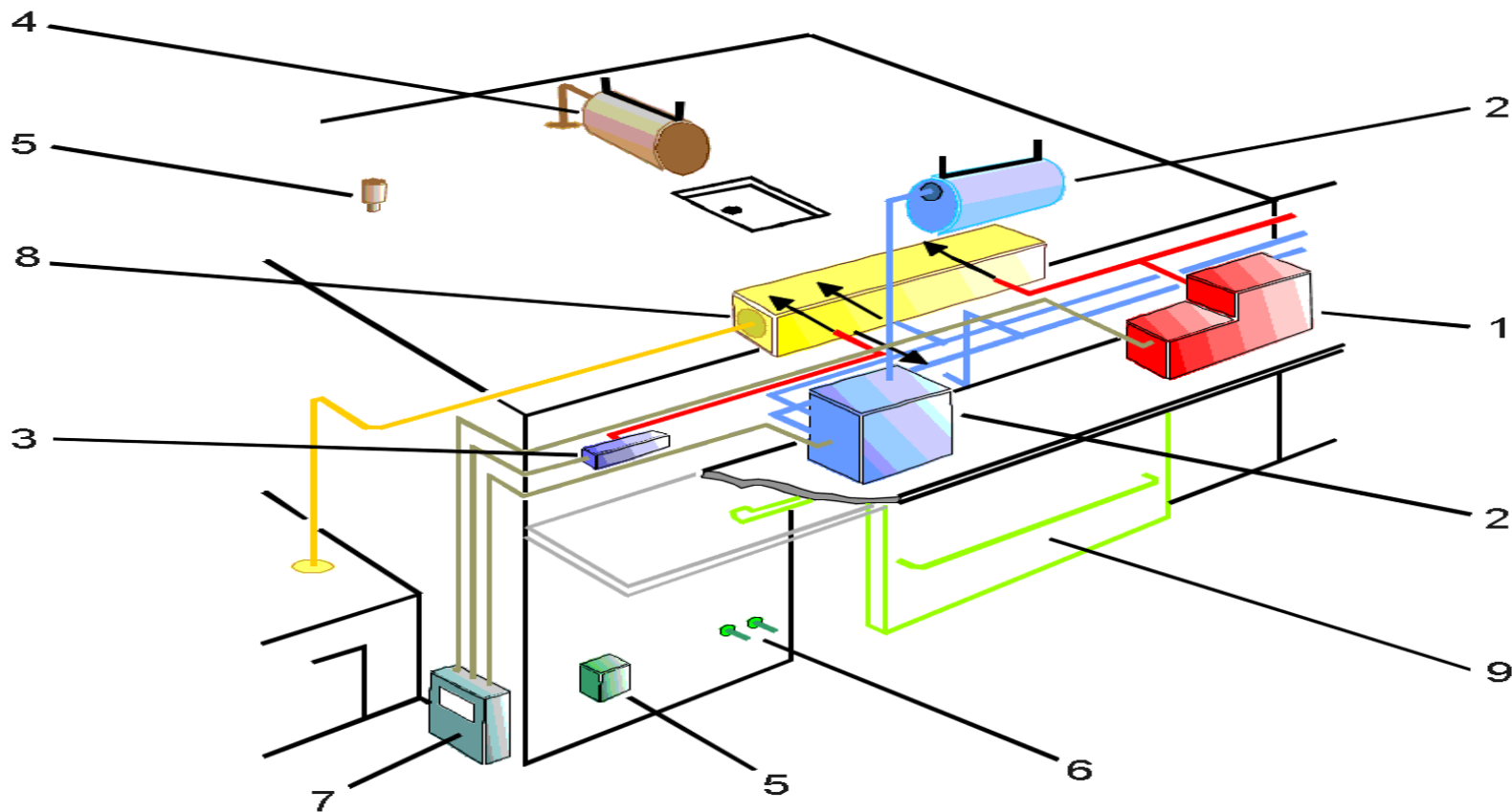


Dessert grapes
-0,5° à +0,5° C
0,5% à 1% O₂



Vegetables
Example: **Cabbages**
0° à 1° C
2% à 4% O₂

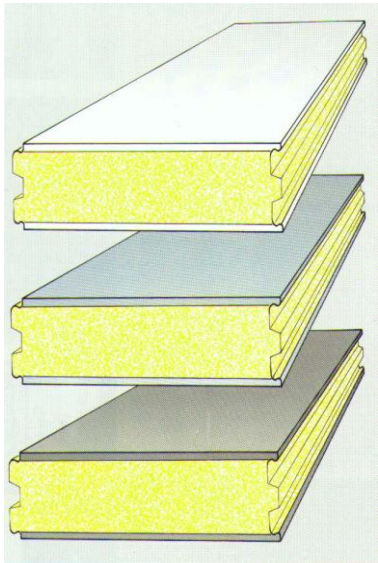
GENERAL PLAN U.L.O. -INSTALLATION



- 1 N₂-generator
- 2 CO₂ adsorber
- 3 Aeration unit
- 4 Pressure compensator
- 5 Pressure securities

- 6 Additional connexions for (hand) analysis
- 7 Central control system
- 8 Cooling system
- 9 ULO-door

Gastight cooling chambers



**Polyurethane
insulation
panels (PUR)**



**Gastight floor
(concrete)**

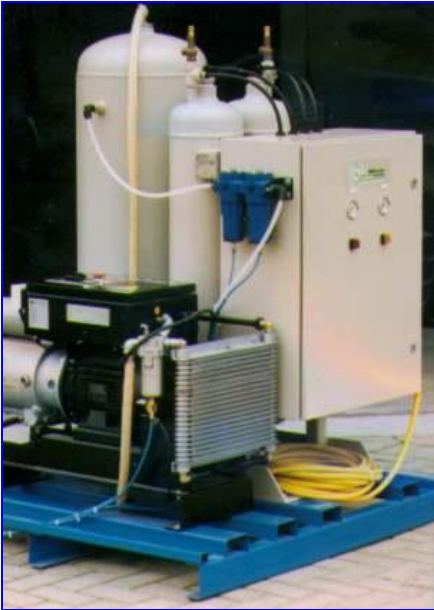


i

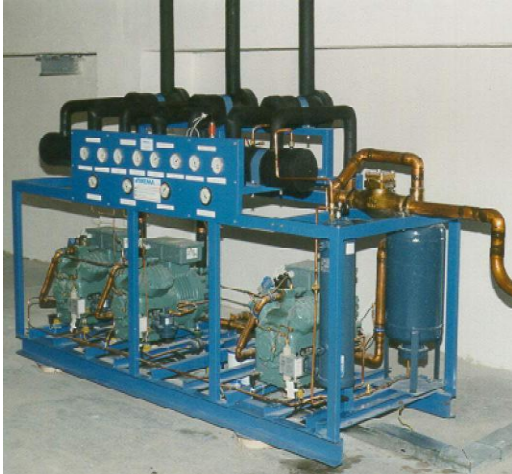
Gastight cooling doors



CO2 adsorber / Nitrogen generator

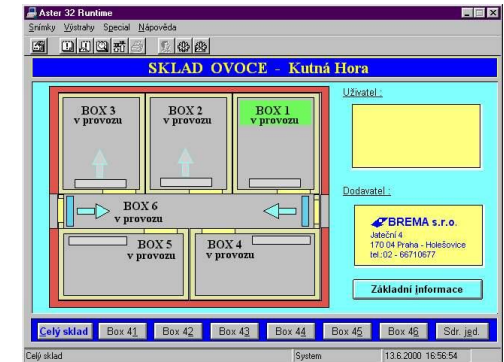
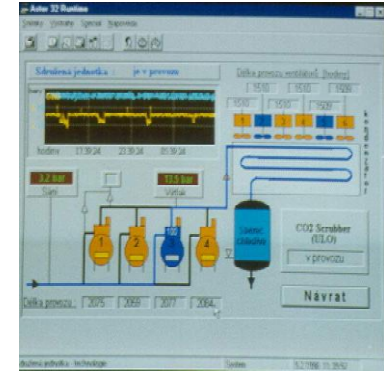
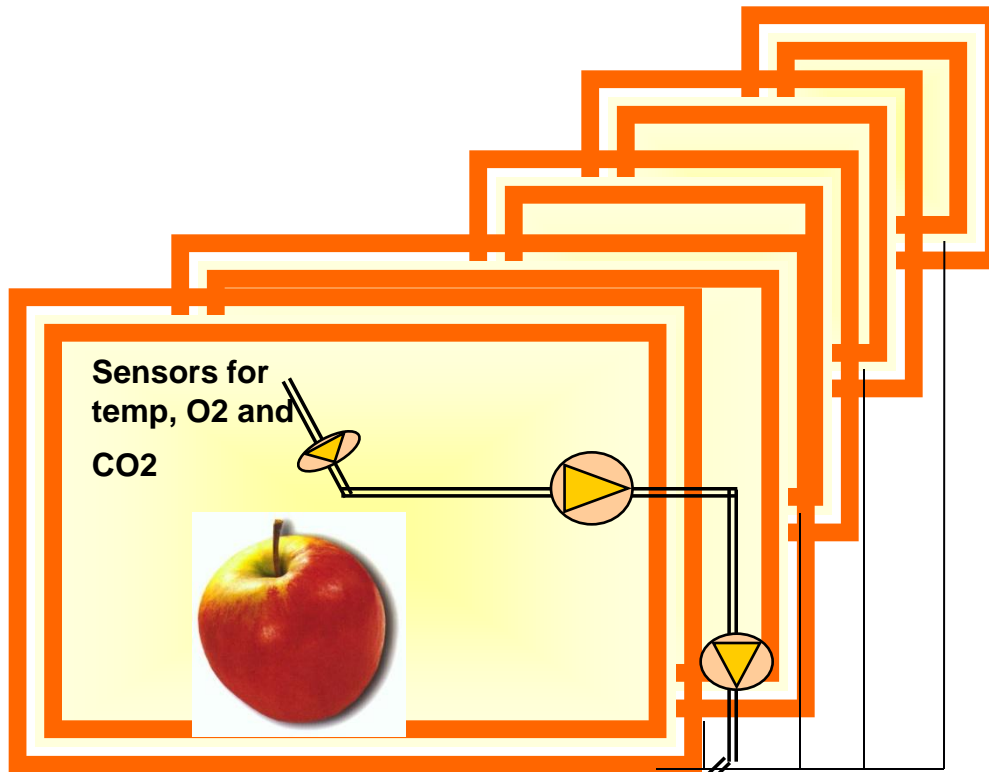


cooling



Automatic control system

The relevant storage conditions for each individual chamber are entered into the PLC.



The PLC will automatically stop and start all the machines in order to maintain the pre-determined storage conditions for each individual chamber

The computer visualization programme will provide historical logs of sensor readings (storage conditions) and of machine working hours and machine behaviour.

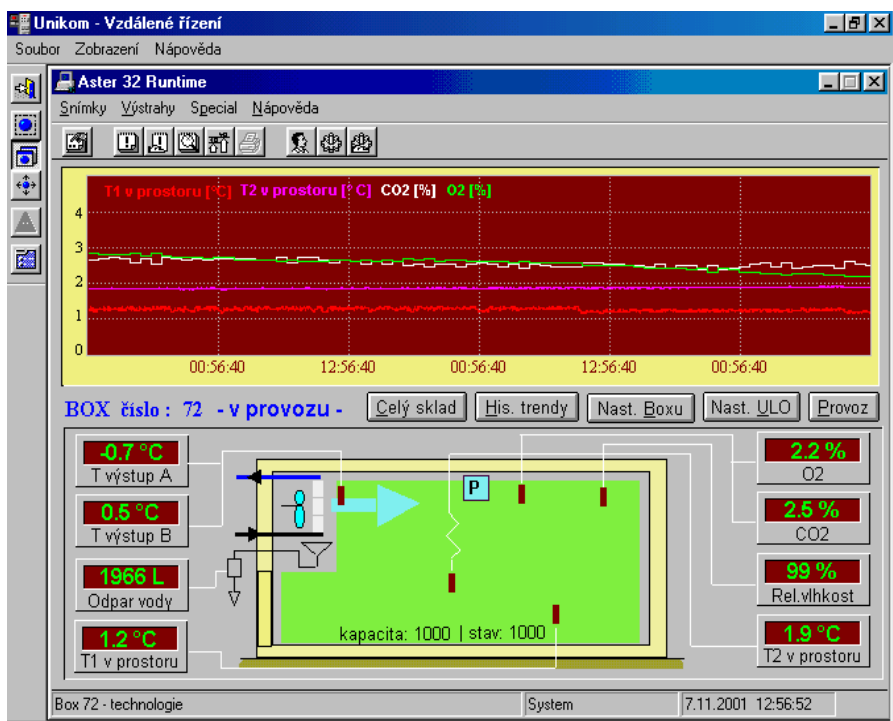
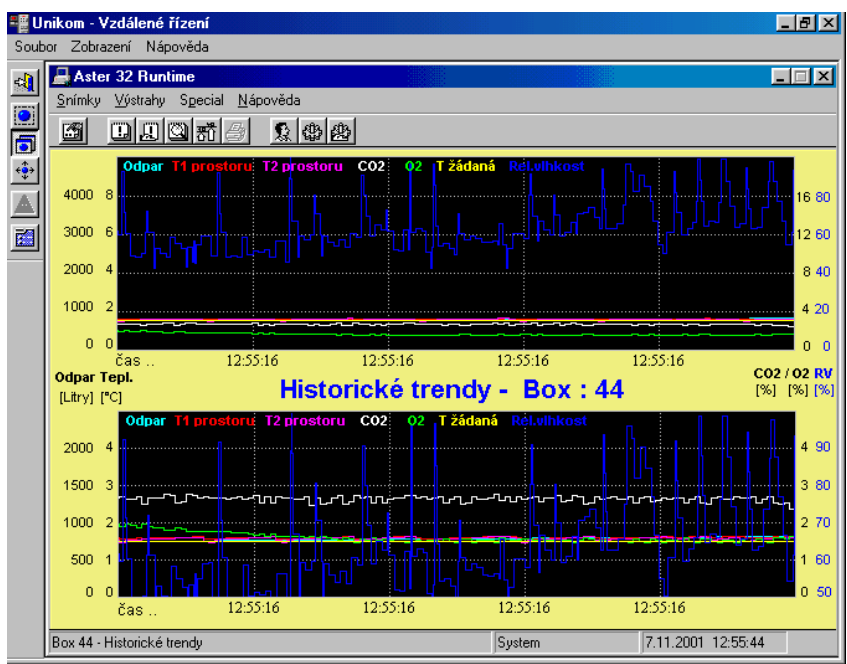
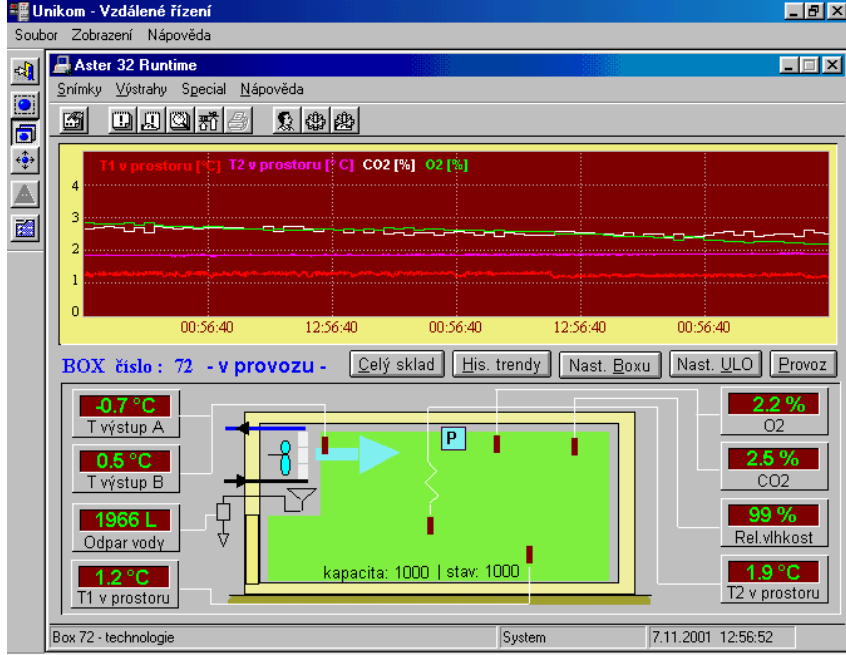
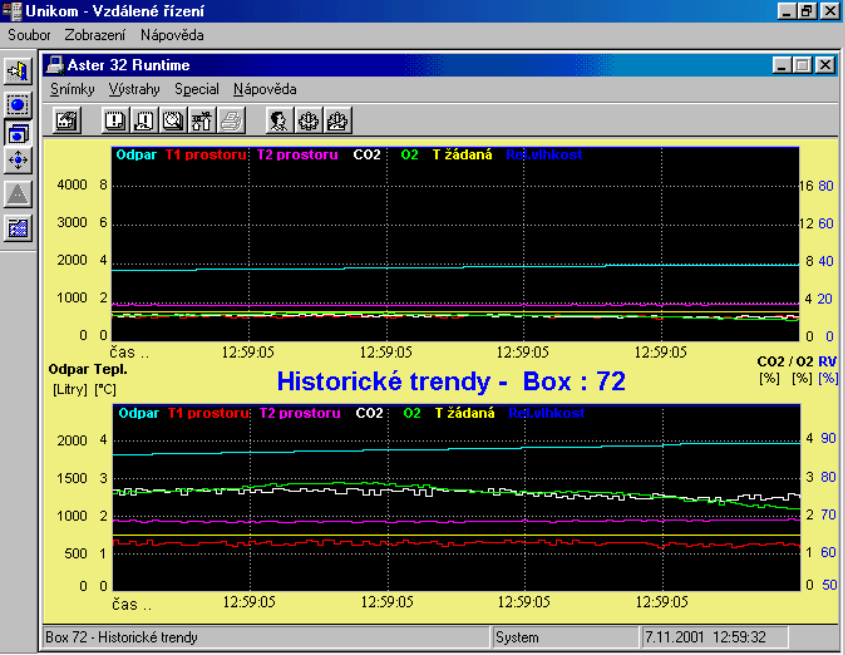
O₂+CO₂+C₂H₄
+H₂O+ethanol
analysis

Automatic control
by PLC

Detection / check on
refrigerant

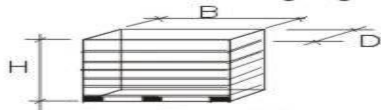


9. automatic analysis and
control system

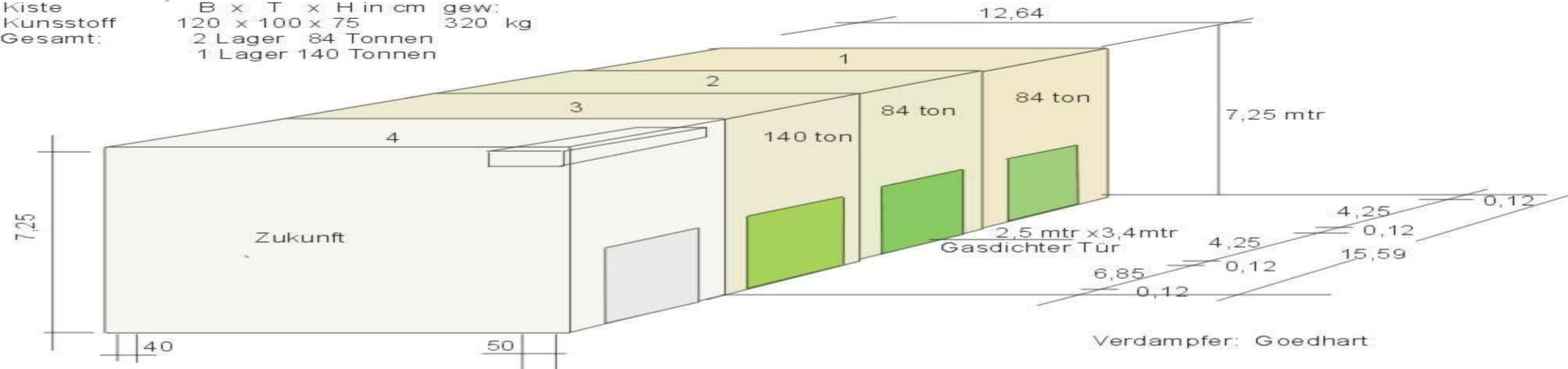


Angebot: Prizvodnja I Prodja Jabuka
 Stan
 Virovitica Croatia
 Donja Zelina
 3 Lager gesamt 308 Tonnen

Renkum 10-2-2003
 PUR Isolierpanelen
 Farbton RAL9002
 43kg/m³ Beidseitig LL(Leicht Liniert)
 beidseitig verzinkt 25µPolyester
 Dach 140mm = 192m²
 Wände 120mm = 506m²



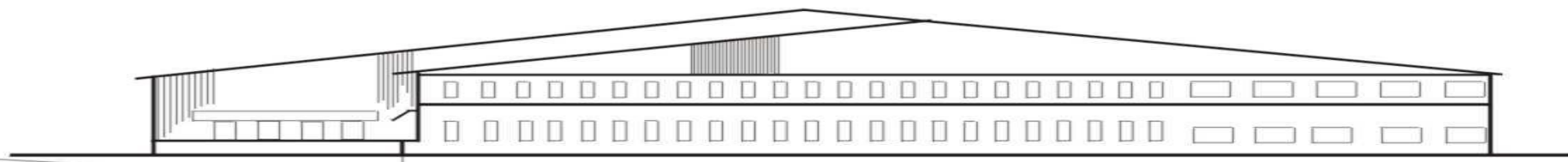
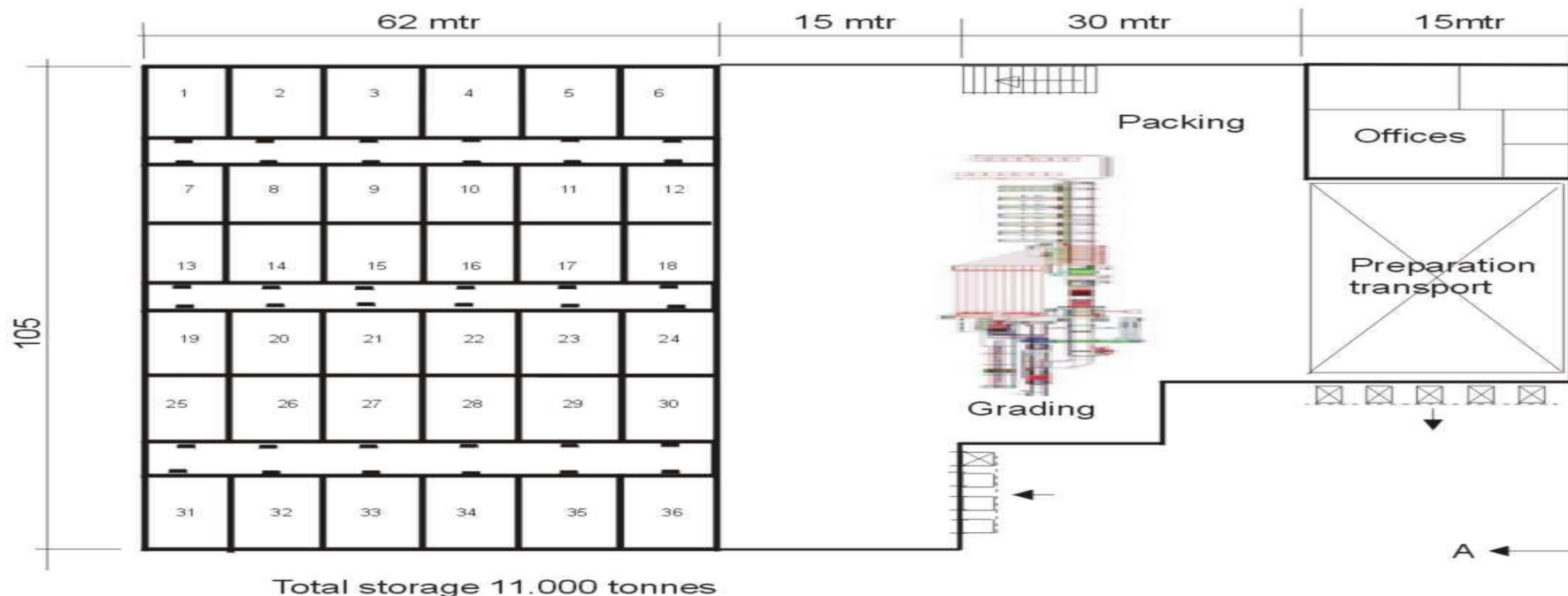
Kiste Kunststoff
 Gesamt: B x T x H in cm gew: 120 x 100 x 75 320 kg
 2 Lager 84 Tonnen
 1 Lager 140 Tonnen



Compressor Bitzer LH 114/4v-10.2y=2x20= 40 kW -5°C 32°C
 4 Stufen je 10kW
 E Aufnahme max 2x8,14 kW = 16,28kW Verflüssiger 2x28,29kW

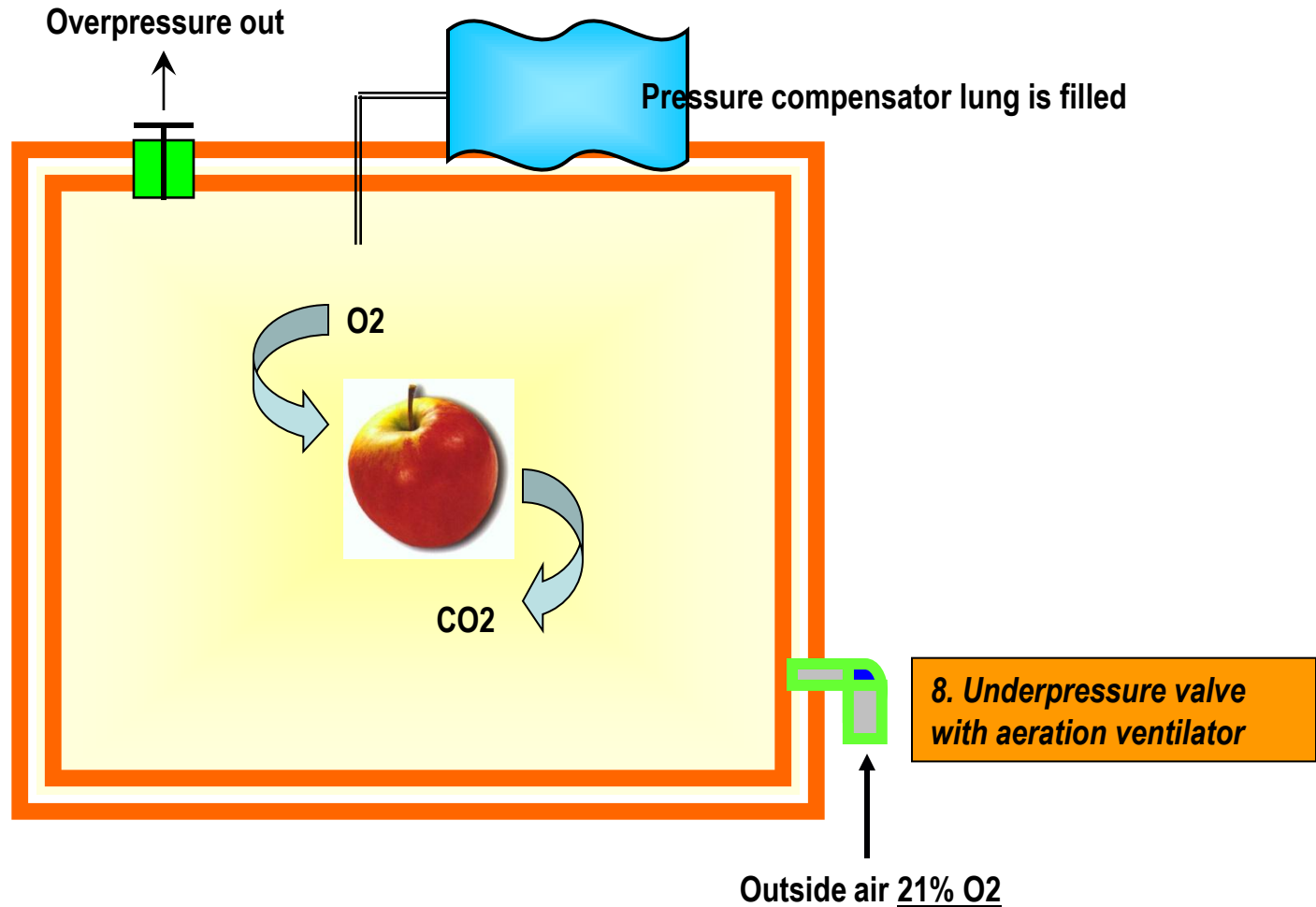
2xVCI 64457 20kW 177m²-7mm / R404a/109m²/168kg Ventilator 3x 450mm x 270W 21000m³/st
 1x VCI 85457 30kW 295m² 3x 450mmx270W 2800m³St





View AA

- 8 Because the fruit is transforming O₂ into CO₂, O₂ levels can become too low. The ULO system will compensate by blowing outside air into the chamber.





Reasons for criteria

- Equal sizes.
- Uniform colors.
- Selected weight for packing.

Maximum ULO storage times



Elstar

cooling : 3 months
ULO: 9 months



Gala

cooling: 3 months
ULO: 9 months



Conference

cooling: 5 months
ULO: 10 months



Golden Delicious

cooling : 3 months
ULO: 10 months



cherry

cooling : 2 weeks
ULO: 8 weeks



Orange

cooling: 1 month
ULO: 3 months



Idared

Cooling: 3 months
ULO : 10 months



Kiwi

cooling: 3 months
ULO: 7 months



Red berry

cooling: 2 weeks
ULO: 14 weeks



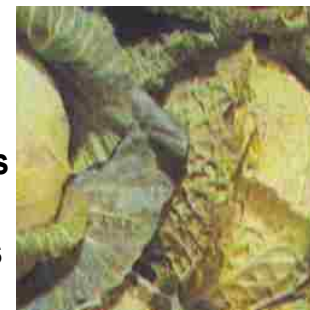
Jonagold

Cooling : 3 months
ULO: 11 months



Lily

Cooling: 3 months
ULO: 7 months



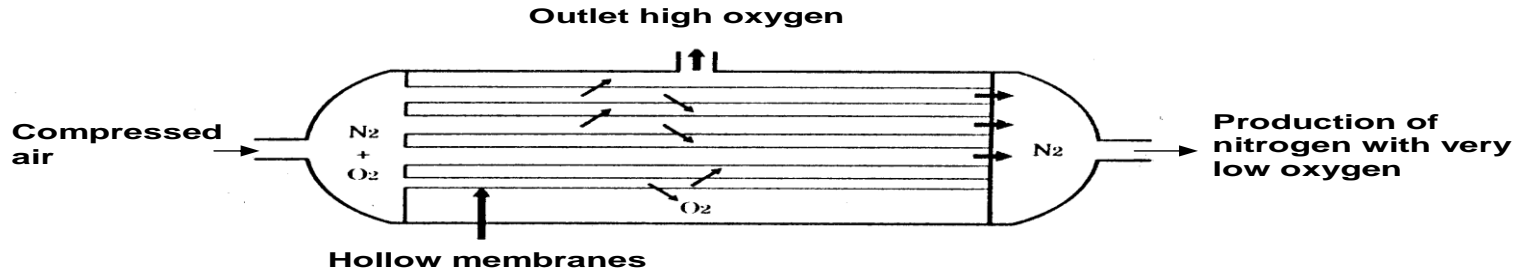
Cabbage

Cooling : 2 months
ULO: 6 months

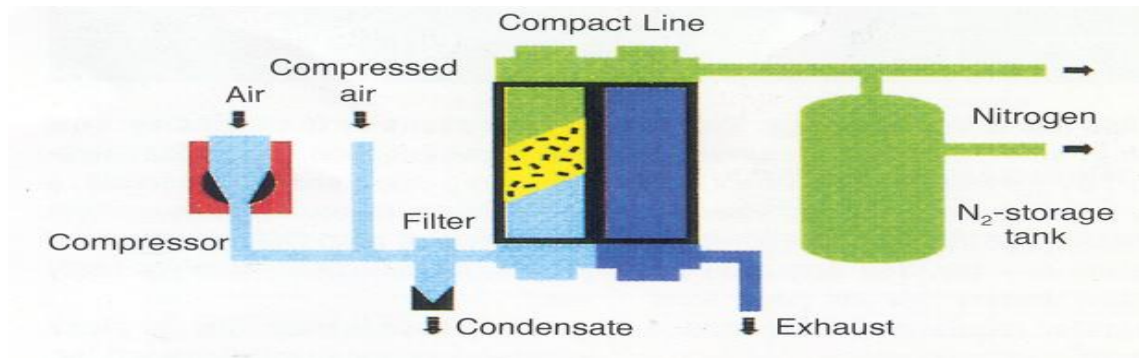
cooling = normal cold storage without atmosphere control

PRODUCTION-SYSTEM OF NITROGEN

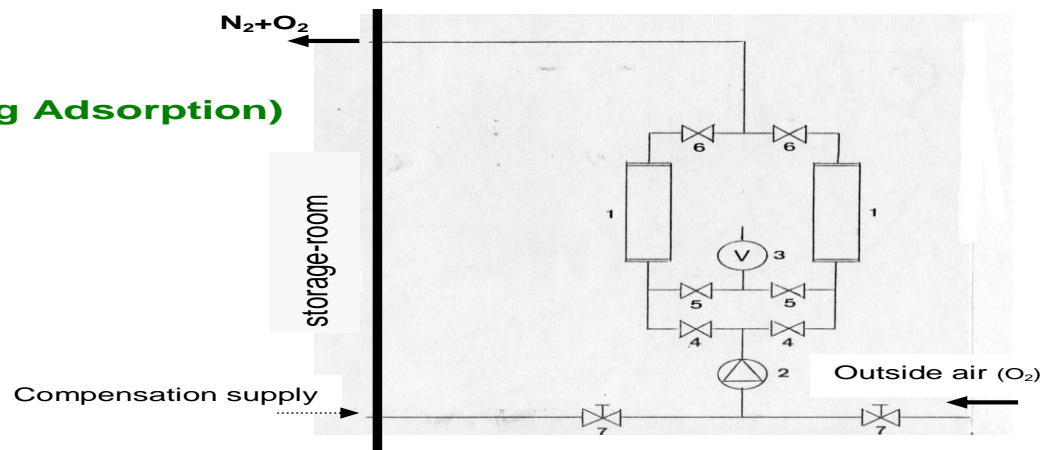
NITROGEN-SEPARATOR With hollow membranes



NITROGEN-GENERATOR P.S.A.-type (Pressure Swing Adsorption)



NITROGEN-GENERATOR V.S.A.-type (Vacuum Swing Adsorption)



Schematic survey of the components for ULO storage

1. Cooling machines (compressors, condensers, evaporators)
2. Storage chambers made of polyurethane insulation panels
3. Storage chambers 100% gastight !!
4. gastight doors 100% gastight !!
5. CO₂ adsorber und O₂ remover with connection conduits and open/close valves to each chamber, and chamber sensors.
6. Double
6. **Automatic analysis and control system** : The cold store manager enters into the PLC the minimum and maximum values for temperature, and for O₂ and CO₂ levels, for each individual chamber the temperature sensors and gas sensors in each chamber feed information to a **programmable logic control** (PLC) about the .. On the basis The PLC then controls sensors sensorsa automatic analysis of the actual storage conditions in each chamber, and automatic control of all machines, in order to maintain the levels of temperature, and CO₂ and O₂ concentrations between the pre-set minimum and maximum values (**the storage conditions**), in each individual chamber. (Including automatic defrosting of evaporators).
7. **Computer visualization and control.**
 - visualization of all machines working, and of of all storage conditions, and historical logs of all

ULO storage conditions for apples

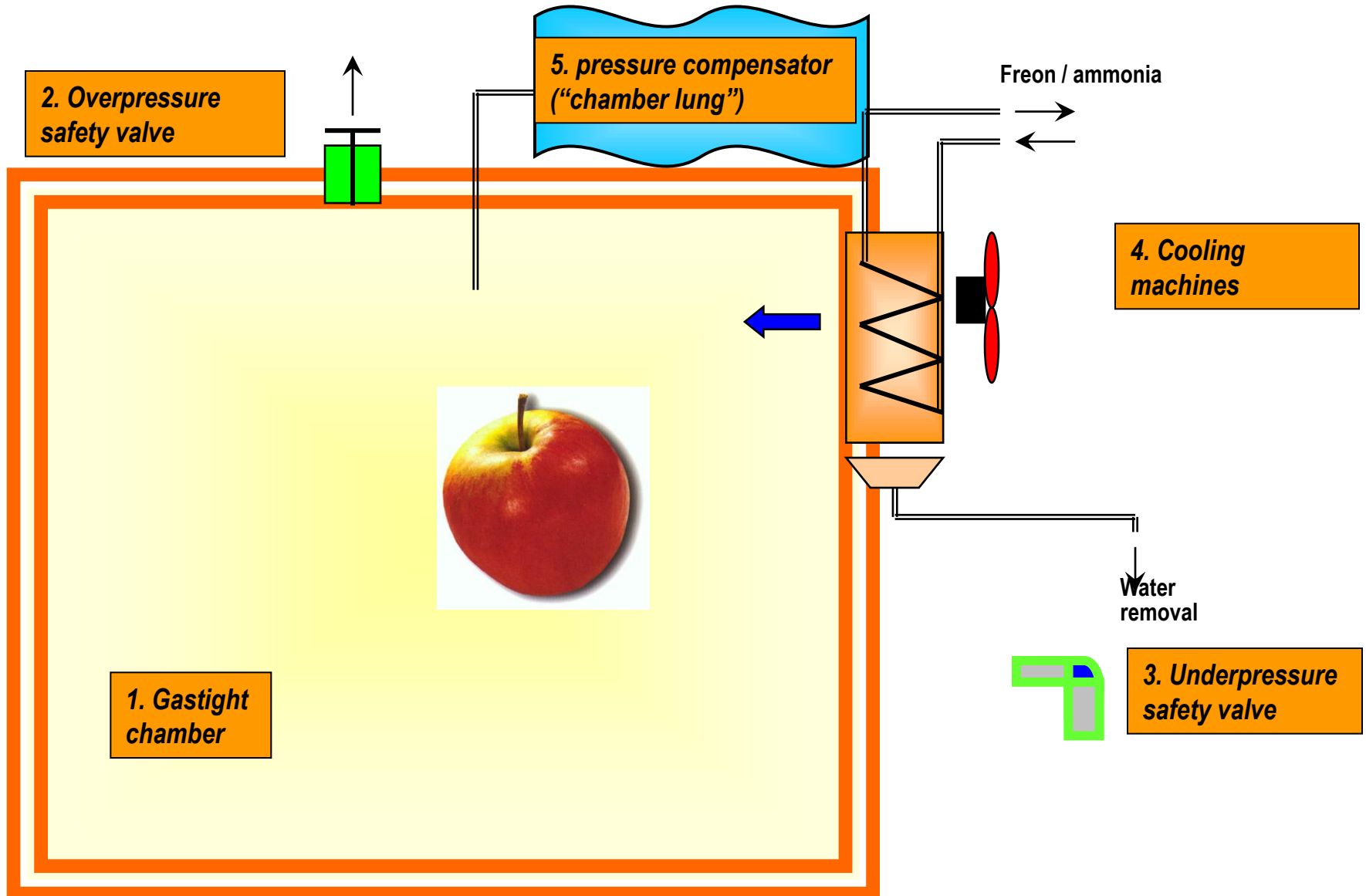
- **Oxygen level (O₂) : 1,2 % - 1,5%** (depending on variety).
(the fruit will consume O₂ by respiring).
- **Carbon dioxide level : 0,8% - 3%** (depending on variety).
(the fruit will produce CO₂ by respiring)

CO₂ removal : with a CO₂ adsorber

ULO storage conditions : a complicated balance :

- O₂ level too low : THE FRUIT WILL SUFFOCATE AND ROT
- O₂ level too high : THE FRUIT WILL RESPIRE TOO STRONGLY, AND WILL RIPEN TOO QUICKLY
- CO₂ level too low : THE FRUIT WILL RESPIRE TOO STRONGLY, AND WILL RIPEN TOO QUICKLY.
- CO₂ level too low : “CO₂ DAMAGE” (BROWN SPOTS)

ULO Essentialia



ULO – einige Teile



Druckausgleichslunge



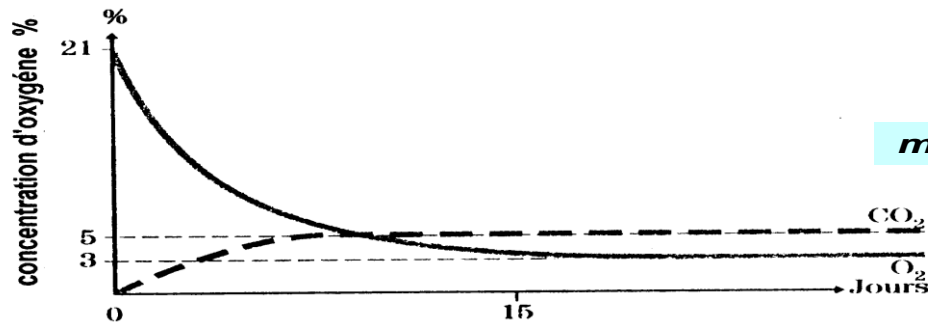
Lüftungsventilator



Doppelventile

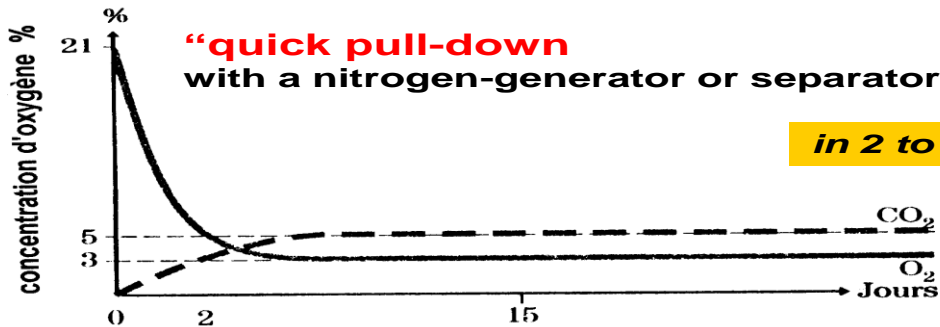
EXPLOITATION-START OF THE STORAGE UNDER CONTROLLED ATMOSPHERE U.L.O.

PULL-DOWN = reducing of the oxygen-concentration in the storage room



gen by the product

more than 15 days !



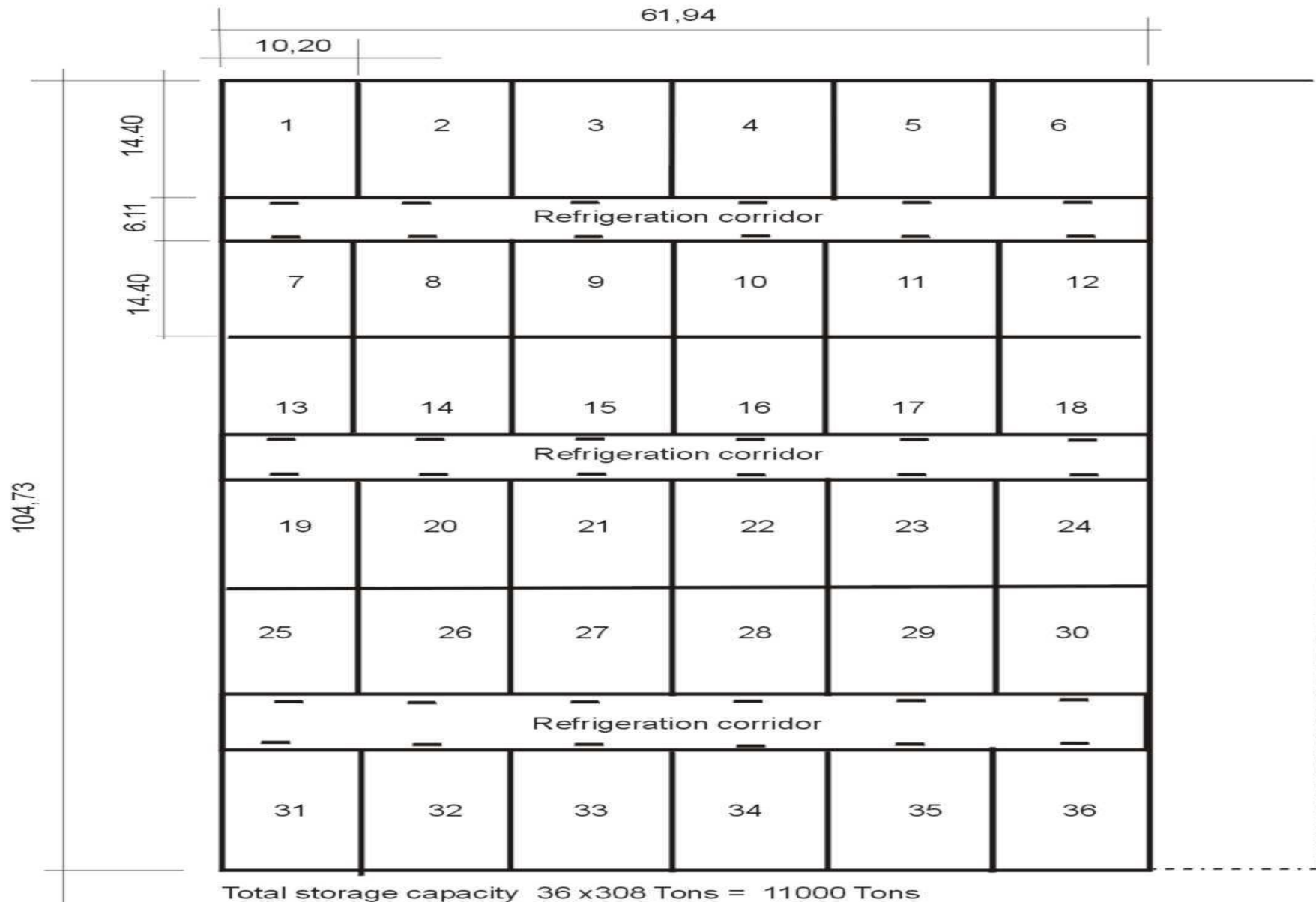
"quick pull-down"
with a nitrogen-generator or separator

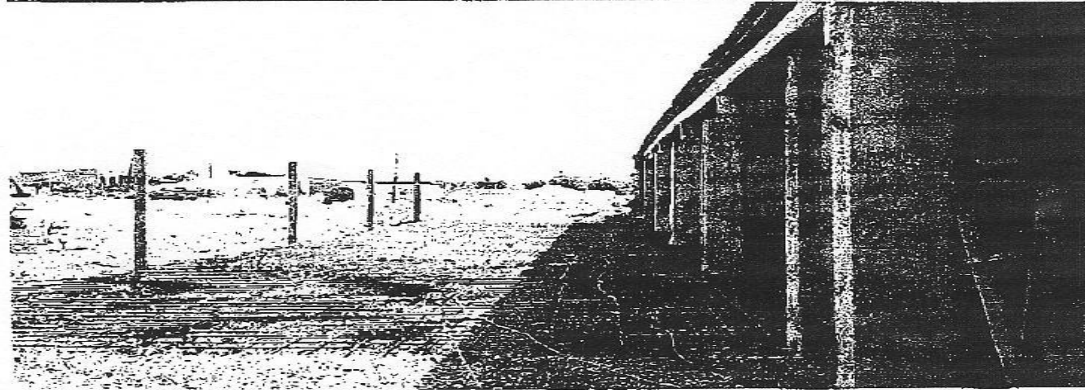
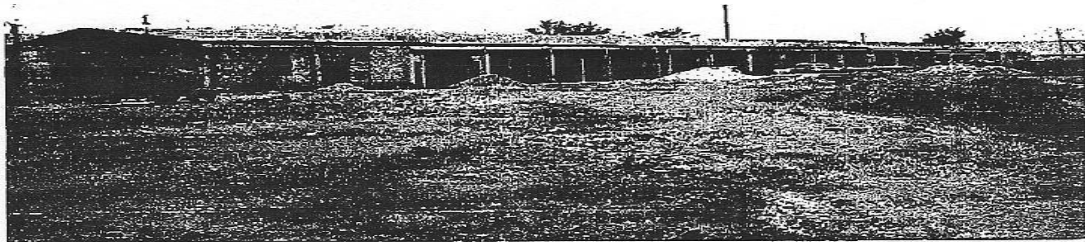
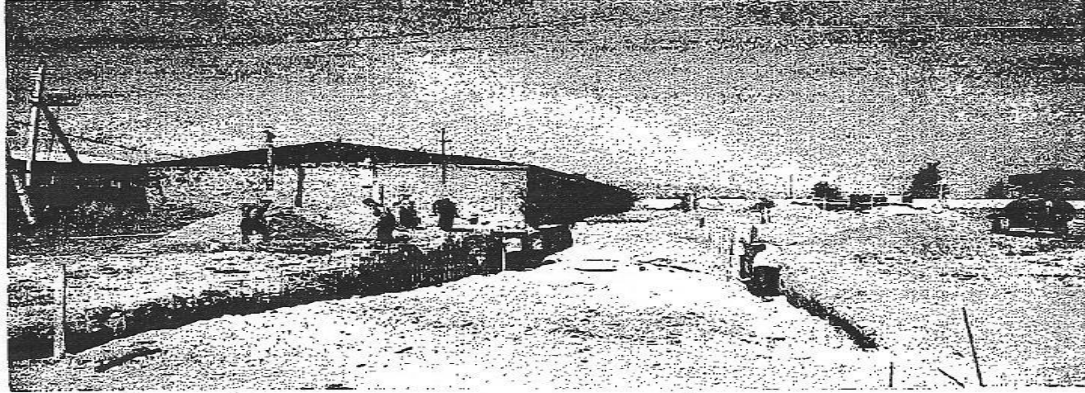
in 2 to 3 days !



NITROGEN-GENERATOR







MEASUREMENT OF THE WATER-LOSS

Recupartion of the defrosting-water from the evaporators



Possibility to measure

The water-losing of the product in storage

Possibility to reajust

The processing of the cooling-equipment (particularly the Δ -t of the evaporator) and consequently to control the relative humidity of the storage-room atmosphere

REMARKS

The measurement of defrosting-water works easily with an “electrical” or “hotgas”-system of defrosting



GAS CONCENTRATION

OXYGEN - O₂ IS A "LIVING GAS"

BELOW A CERTAIN CONCENTRATION

The product can be damaged, danger of asphyxiation

- ◆ **APPARITION DE DISEASES AND FERMENTATION**

ABOVE A CERTAIN ADVISED LIMIT

Acceleration of the respiration

- ◆ **REDUCTION OF THE STORAGE TIME**

CARBON DIOXIDE - CO₂ IS A "CONSERVATION GAS"

BUT ABOVE A CERTAIN CONCENTRATION

The product can be damaged

- ◆ **APPARITION OF DISEASES**

ETHYLENE GAS - C₂H₄ IS A "RIPENING GAS"

ABOVE A CERTAIN CONCENTRATION

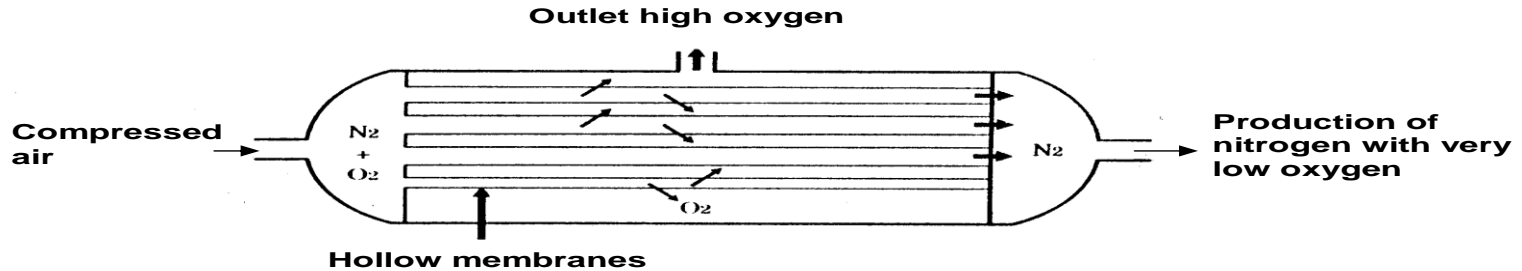
The maturation of the product can be activated

- ◆ **NECESSITY TO STOP THE STORAGE AND TO DISTRIBUTE THE PRODUCT**

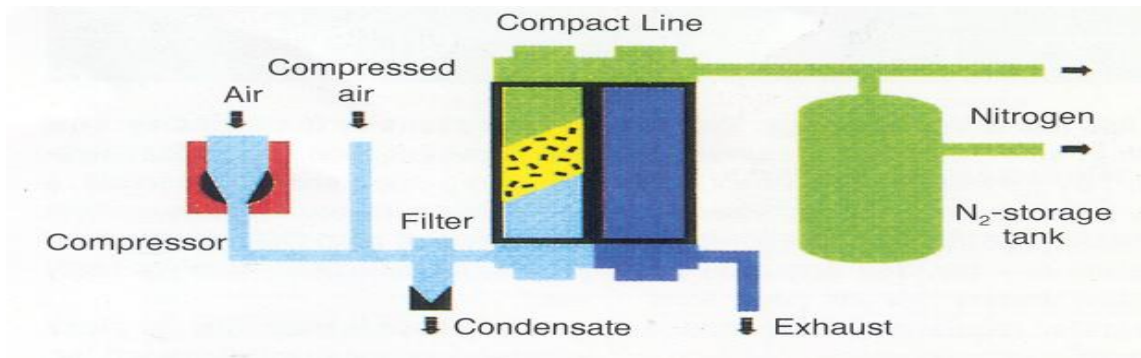


PRODUCTION-SYSTEM OF NITROGEN

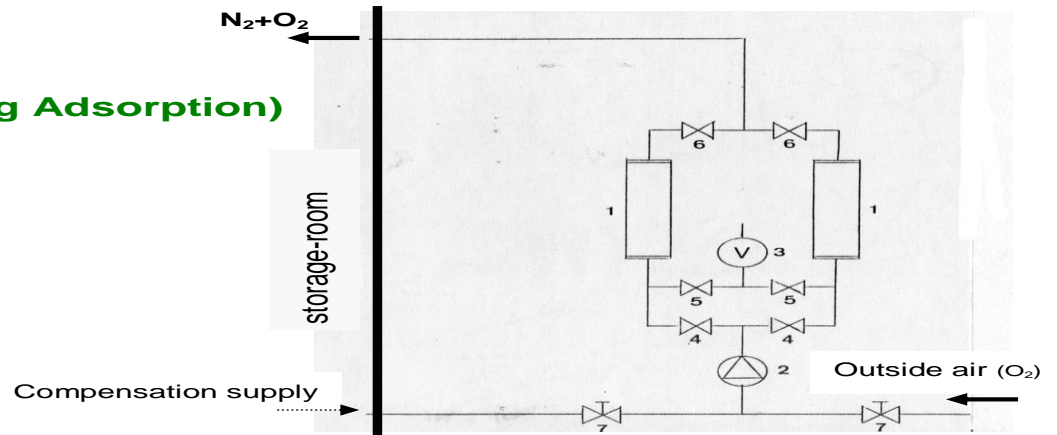
NITROGEN-SEPARATOR With hollow membranes

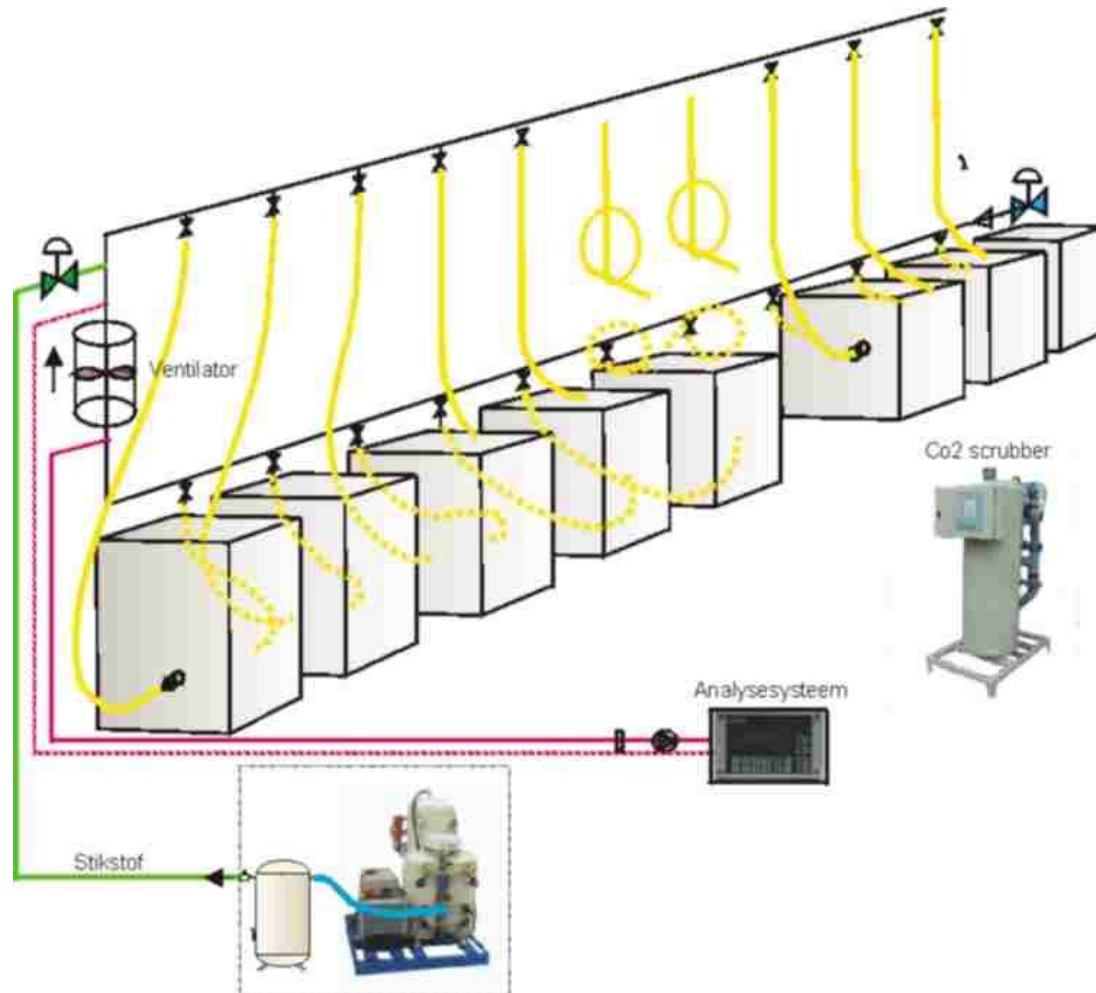


NITROGEN-GENERATOR P.S.A.-type (Pressure Swing Adsorption)

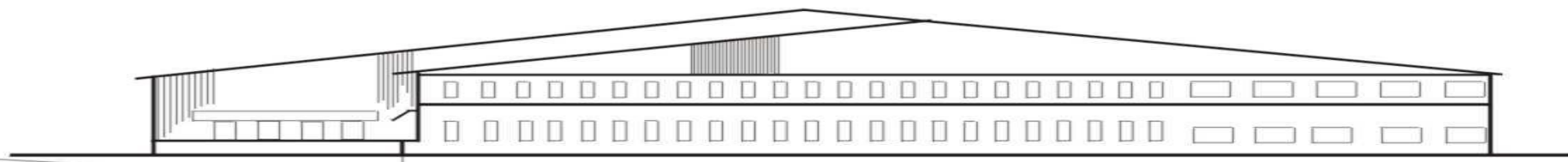
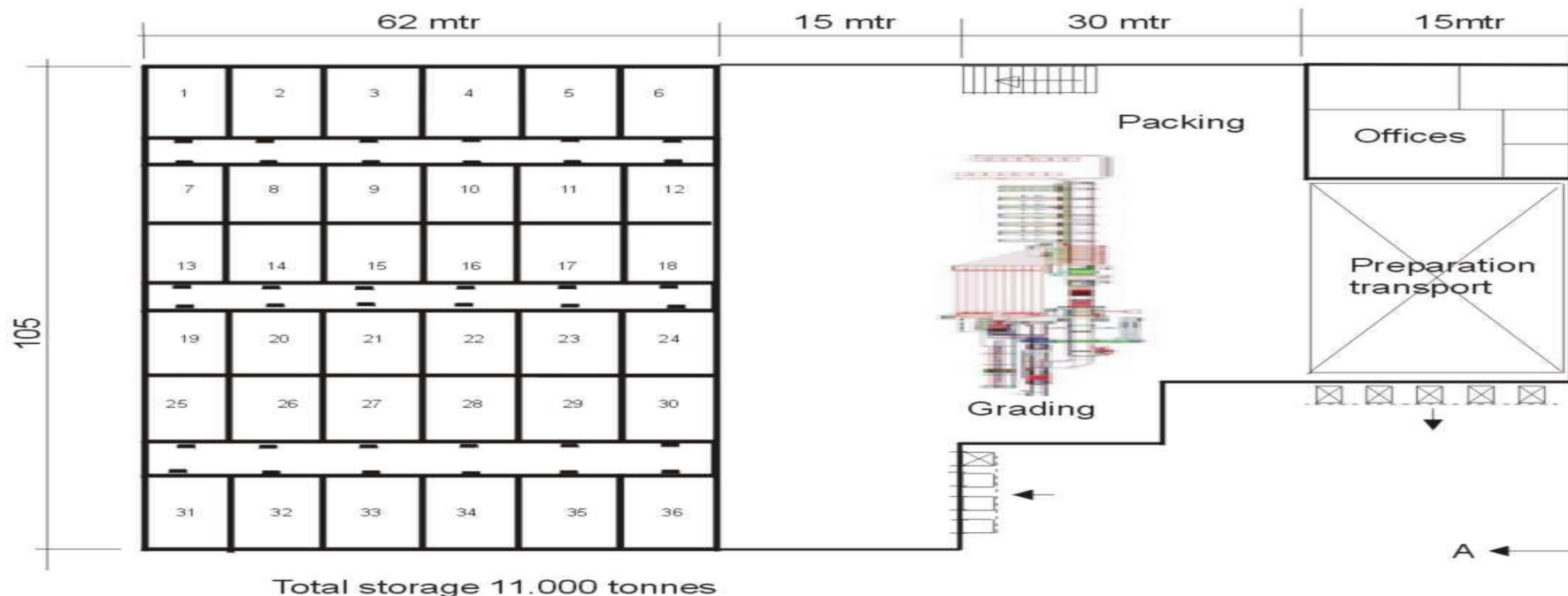


NITROGEN-GENERATOR V.S.A.-type (Vacuum Swing Adsorption)





Dieses neue System bietet Ihnen die Möglichkeit, viele verschiedene Obst- oder Gemüsesorten in einem vorhandenen Kühlraum in verschiedenen ULO-Konditionen zu lagern (jede Palette hat eigene ULO-Konditionen).



View AA