Refrigerated containers:

Potential problems and how to avoid them

IUMI Webinar - 7 September 2022

Refrigerated containers

Potential problems and how to avoid them

Using refrigerated containers means transporting perishable cargo…

What is a perishable cargo ?

> *A cargo can be declared perishable as far as his own composition is conveying him an unstable evolution despite being preserved (or stored) in a stable environnent.*
>
> *By definition, almost all foodstuff (but not only) are perishable as they are suffering internal midification which are physical, chemical, biological, microbiological and organloeptic during storage (transport being considered as a step of the storage)*
>
> *Therefor, perishability is being influenced by both external factors and own inherent factors …*

Refrigerated containers are designed to provide a certain level of control on the product evolution

To determine the potential problem related to refrigarated container implies to first have a correct approach of the source of the potential problem : the commodity …

Refrigerated containers

Potential problems and how to avoid them

(a) Perishable commodities
- a1. « How does it work » ?
- a2. What temperature imply ? (P.S.L.)
- a3. Rules

(b) Temperatures
- b1. « What does it mean» ?
- b2. How to monitor /how to trace ?

(c) Refrigerated containers (and not only refrigerated)
- c1. « How does it work » ?
- c2. What are available equipments on the market ?
- c3. Rules

(d) Transport steps for reefer containers

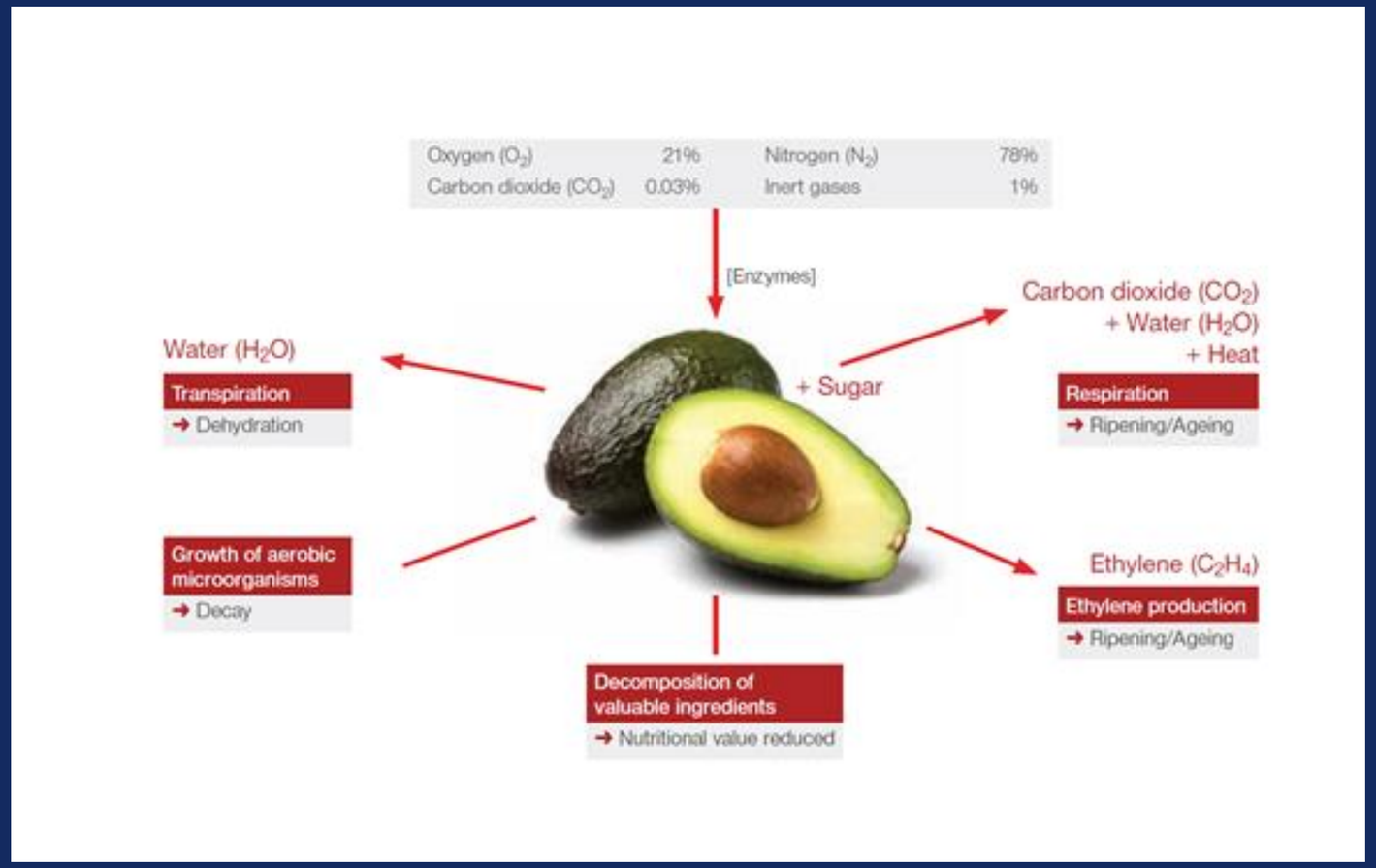
Refrigerated containers

Potential problems and how to avoid them

(a) Perishable commodities

- a1. « How does it work » ?
- a2. What temperature imply ? (P.S.L.)
- a3. Rules

Perishable commodity : a “little nuclear power station”…



✖ In post Harvest / ‘in recent death’ no external source of combustible

⬇

Under perfusion of its own reserves

=

PSL (Potentiel Life Storage)

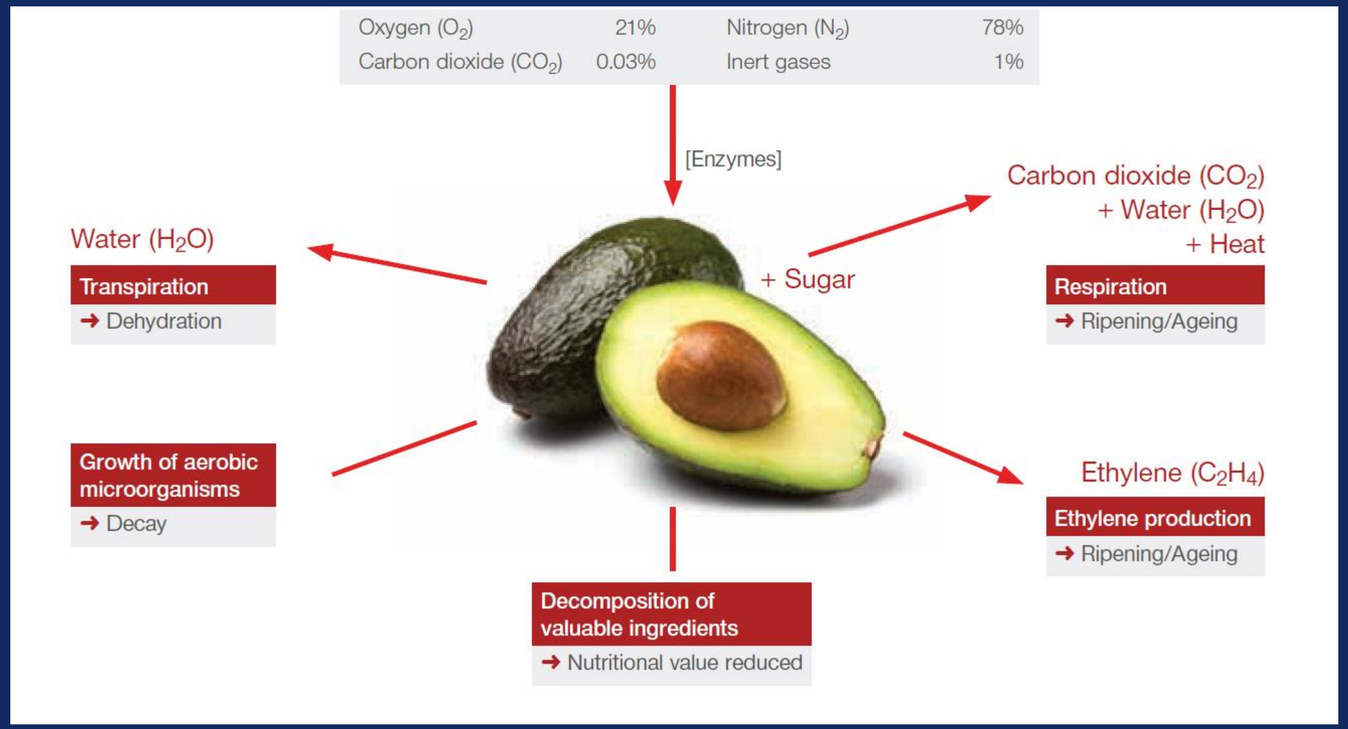
or ’Shelf life’

⬆

In pre harvest/’in life’

Feeding with External Combustible : carbohydrates and others

The target : to reduce the combustion of the reserve to its minimum and necessary level to increase the PSL to its maximum level…



Hass Cultivar

Without controlled temperature :

Abt 7 days

with optimal controlled temperature :

Abt. 28 days

With optimal controlled temperature + CA :

Abt. 40 to 45 days

- Temperature : controllable factor during transport = temp. setting on refrig. cont.
- Air humidity: controllable factor (in limited extend) during transport
- Gaz (CO_2 & C_2H_4): controllable factor during transport = ventilation
- Oxygen and Carbon Dioxyde : controllable factor during transport = CA/MA or vaccuum packing

The first risk of transport is not the transport itself….

(ruled)

PSL

Potential Life Storage

=

BBD

Best Before Date

or

UBD

Use By Date

or = «nothing – no date » (non ruled)

Versus duration of logistics operation (or duration of Post Harvest Time)

Rules or not ruled – low risk or high risk….

Defined by science (only) <> Defined by rules (and also by science)

PSL

Raw commodities
and raw Fruits & Vegetables

Base of preservation duration : days to years

Also non ruled

- Wine and alcohols,
- Vinegar
- Salt
- Sugar
- Bakery products (fresh bread etc)
  by definition consummed within 24 jours)
- Confectionnary being manufactrated
  almost only with sugar
- Chewing gums

BBD

Processed product from vegetal or animal origins

Base of preservation duration : year

Negative controlled temperature

& other preserving methods
(drying, sterilizing, caning…)

UBD

Base of preservation duration : days, weeks or months

Positive controlled temperature

(high water content)

The key factor explaining the difference…

Low food safety risk

In term of healh security/microbiological issues

⇓

PSL

Moderate to high food safety risk

In term of healh security/microbiological issues

⇓

BBD

UBD

Potential Storage Life

Non ruled

This issue is science
& technic

Ruled

B.B.D.

Example D.D.M.
Date de Durabilité Minimale
formerly D.L.U.O.

Rule UE n°1169/2011
Non imperative caracter

If the date is passed
Under certain circumstances
B.B.D. can be extended
Consumption, storage and transport
are possible

U.B.D

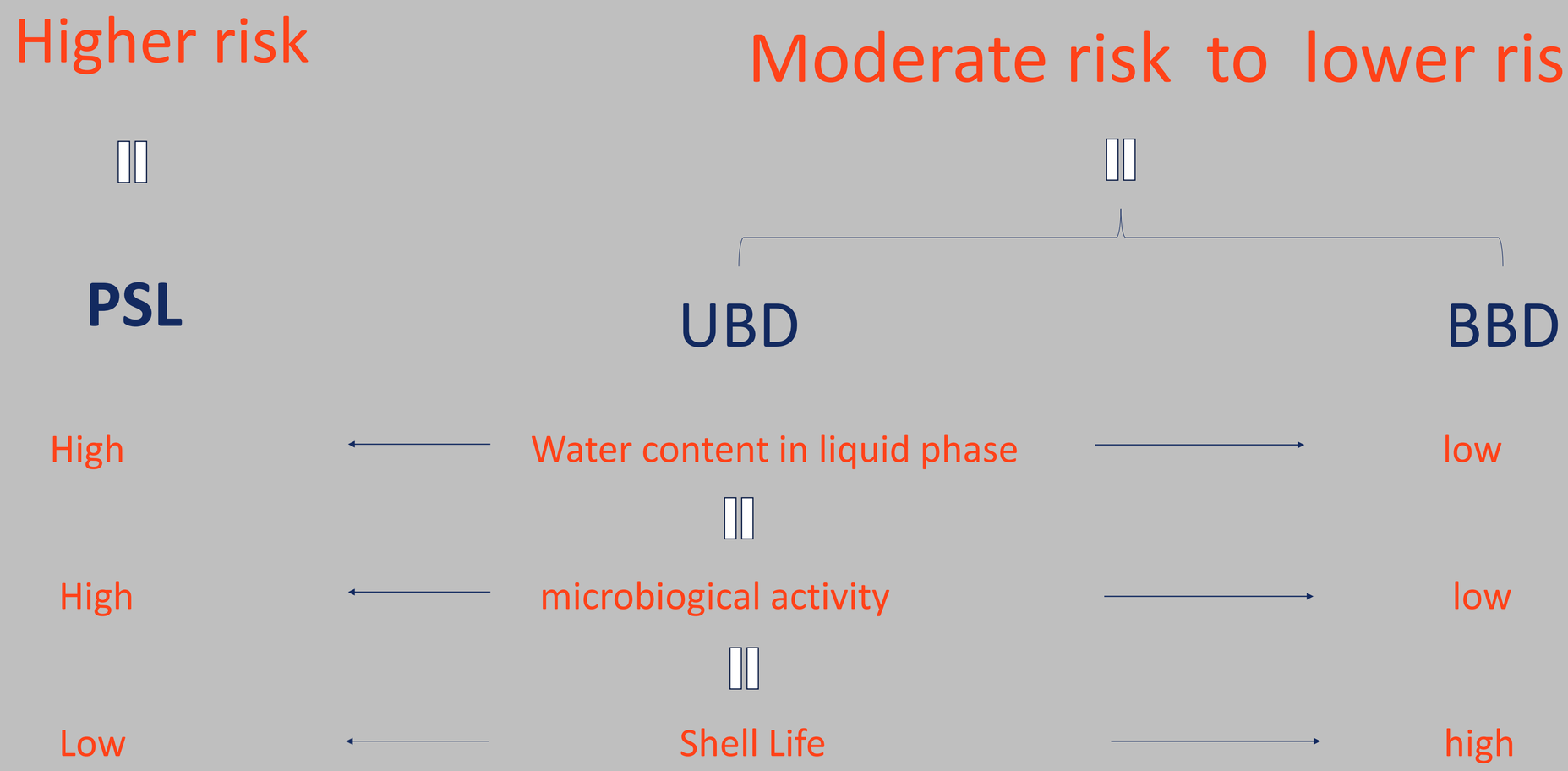
Example DLC
Date Limite de Consommation

« *À consommer jusqu'au…* »

Rule UE n°1169/2011
Imperative caracter

If the date is passed
Forbidden consumption
Forbidden storage
Forbidden transport

Risks – what are the basic technical explanation….



A quick method to determine a risk factor scale for a transport underwriter (for refrigerated cargo) ….

Higher risk

Moderate risk to lower risk

More precaution/prevention → moderate → Lowest (in some cases with precaution)

Mostly concerning fruit and vegetables

Control of temperature is the first and main “technical device”
to optimize the PSL since harvest (or slaughtering for “raw caracasses”)

Some examples

PSL :
the “risky” class
(except wine and alcohols)

The situation :

(1) correct temperature instruction is the duty of the shipper (except some cases – example PPECB South Africa)

The complication :

(2) To apply the lowest possible temperature avoiding chilling injury (cold damage)

(3) Each specie have its own temperature optimum

(4) For each specie, optimum temperature (and PSL) can vary depending on origin, cultivar, harvesting stage (example bananas depending on origin : 3 to 5 weeks at same temperature depending on origin or avocadoes 4 to 5,5°C for same origin depending on harvesting stage/oil content at harvest time) > Subsequently : what is the history of the commodity between harvest and shipment, precooling,…)

Nota about precooling : precooling have a significant impact on the PSL and it almost always applied in the export industry except for some specific species such as bananas. Then the rule is max 24 hours between harvest and first cooling in container.

Some examples

PSL : the “risky” class (except wine and alcohols)

Classification of products according to the degree of perishability

Highly perishable		Very perishable		Perishable		Less perishable	
Vegetables	Fruits	Vegetables	Fruits	Vegetables	Fruits	Vegetables	Fruits
Lettuce Batavia Curly Escarole Oak Leaf Lollo Rossa Chioggia Iceberg Lamb’s lettuce Watercress Dandelion Carot bunch Onion bunch Radish bunch Turnip bunch Very fine and thin green bea Aromatic plants Mushrooms Broccoli Spinach Peas Mini vegetables	Strawberry Cherry Rasberry Currant Cassis Blackberry Blueberry	Endive Asparagus Fresh garlic Aubergine Zucchini Fresh carrot Celery banch Brussels sprouts Mangetout bean Parsley Leek Chard Cardoon Pickle Bean Sweet corn Rhubarb	Apricot Peach Nectarine Plum Mirabelle plum Fresh Fig Melon Apple AC Summer pear Thin-skinned grape Banana Avocado Mango Passion fruit Guava Papaya Mangosteen Rambouton Sapodilla Carambola	Artichokes Cauliflower Cucumber Tomato Pepper Pepper Fennel Fresh potatoes Washed potatoes	Early apple Autumn Pear Muskmelon Watermelon Thicked-skinned grape Clementine Mandarin Lime Pineapple Khaki Kiwi Lychee Nashi	Red beetroot Winter carrot Celeriac White cabbage Turnip Rutabaga Salsify Squash Pumpkin Garlic Onion Shallot Unwashed potatoes Ginger Sweet potatoes	Regular cold apple Winter pear Orange Lemon Pomelo Almond Quince Grenade Nut Coconut

Some examples

PSL : the “risky” class (except wine and alcohols)

Conditions of refrigerated transport of fruits

Species	Minimum temperature recommended (°C)	Relative humidty (%)	Species	Minimum temperature recommended (°C)	Relative humidity (%)
Apricot	0	90	Olive	7	85
Almond	0	60	Orange	4	85
Pineapple	8	85	Papaya	10	85
Avocado	4,5 à 5,5	85	Grapefruit (beginning of the season)	12	85
Banana	13	85			
Cassis	0	90	Grapefruit	5	85
Cherry	0	90	Apple	1	90
Clementine	4	85	Pear	0	90
Lime	4	85	Plum	0	90
Green lime	8	85	Peach	0	90
Quince	0	90	Rambutan	12	85
Cherrimoya	12	85	Grape	0	90
Datte	0	75	Sapodilla	12	85
Fig	0	85	Melon charentais	8	80
Strawberry	0	90	Muckmelon	6	80
Passion fruit	12	90			
Raspberry	0	90			
Guava	10	85			
Pomegranate	5	90			
Currant	0	90			
Khaki/sharon	2	90			
Kiwi	0	90			
Lime	8	85			
Lychee	0 / 2	90			
Mandarin	4	85			
Mango	8 / 10	85			
Mangoustan	12	85			
Blackberry	0	90			
Blueberry	0	90			
Nashi	0	90			
Nectarine	0	90			
Hazelnut	0	70			
Nut	0	65			
Coconut	0	80			
Coconut (transit)	14	80			

Conditions for refrigerated transport of vegetables

Species	Minimum temperature recommended (°C)	Relative humidity (%)	Species	Minimum temperature recommended (°C)	Relative humidity (%)
Dry Garlic	-1/0	70	Turnip	0	95
Artichoke	0	90	Green onion	0	90
Asparagus	1	90	Dry onion	0	70
Aubergine	7	90	Parsley	0	95
Batavia	0	95	Peas ou mangetout	0	95
Beetroot	0	90	Leek	0	95
Red beetroot	0	95	Pepper	7	95
Brocoli	0	90	Sweet potatoes	12	85
Carrot	0	95	Watermelon	8	85
Bunch celery	0	90	Potatoes	8	90
Celeriac	0	95	Pumpkin	10	70
Chayot	7	85	Radish	0	95
Mushroom	0	95	Rhubarb	0	95
Curly chicory, escarole	0	95	Rutabaga	0	95
Cabbage	0	95	Salsify	0	90
Brussels sproute	0	90	Escarole	0	95
Cauliflower	0	90	Green tomato	10	90
Cucumber	8	90	Red tomato	8	90
Squash	10	70			
Zucchini	5	90			
Pickle	8	90			
Cress	0	95			
Endive	0	95			
Spinach	0	95			
Fennel	0	95			
Curly salad	0	95			
Ginger	12	85			
Green bean	7	90			
Lettuce	0	95			
Sweet corn	0	95			
Charentais melon	8	80			
Muskmelon	6	80			

Some examples

PSL :
the “risky” class (except wine and alcohols)

	Temperature during transport (°C)	Ethylene	Relative Humidity (%)	PSL (days)	Point of freezing (°C)	Air inlet (m³/hour)	Odour
Garlic	0	-/-	70	180	-0,8	30	+apple, pear, citrus
Pineapple	8 - 9	-/-	90	14-28	-1,1	15	+Avocado
Artichokes	0	-/-	90	20	-1,2	0	
Asparagus	0 - 0,6	-/+	90	14	-0,6	20	
Avocado	4,5 – 5.5	+/+	90	14-28	-0,3	40	
Banana	13	+/+	90	21-24	-0,8	30	
Broccoli	0 – 0,5	-/+	90	14	-0,6	30	+apple, pear, citrus
Carrot	0	-/-	90	180	-1,4	20	+apple, pear, citrus
Celery	0	-/-	90	28	-0,5	20	+apple, pear, citrus
Cherry	-0,6 – 0	-/-	90	14	-1,7	0	
Cabbage	0 – 1,1	-/+	90	24	-0,9	20	+apple, pear, citrus
Cauliflower	0	-/+	90	28	-1,9	20	+apple, pear, citrus
Lemon	Variable	-/-	90	30-120	-1,4	15	
Clementine	2 - 4	-/-	90	7-50	-0,8	15	
Ginger	12,8		75	30-90	-0,8	15	
Honey melon	7,2 – 10	+/-	90	16-20	-0,8	30	
Kiwi	0	+/+	90	60-90	-0,8	20	
Lettuce	0 – 0,6	-/+	90	14-21	-0,2	20	
Lychee	0 - 1	-/-	90	21-35	-0,5	15	
Mango	8 -10	+/+	90	14-21	-0,9	40	
Cantaloup Melon	3	+/-	90	10-14	-1,2	30	
Turnip	0,6	-/+	90	10-14	-0,27	0	
Oinon	-0.5 – 1,1	-/-	60	270	-0,8	15	Grape, fig
Oranges	variable	-/-	90	35-90	-0,8	15	Fruits
Grapefruit	Variable	-/-	90	28-120	-1,1	15	Fruits
Papaya	10	+/+	90	14-21	-0,8	30	
Peach / nectarines	0	+/+	90	14-28	-0,8	40	
Pear	0	+/+	90	60-180	-1,44	40	
Leek	0	-/-	90	40	-0,7	15	+apple, pear, citrus
Potatoes	6-8	-/-	90	60-150	-0,8	15	+apple, pear, citrus
Apple	0 - 2,2	+/+	90	90-240	-1,5	40	
Plum	0	+/+	90	20	-0,8	15	
Grape	-0,5 – 0	-/-	90	120	-2,2	15	
Rutabaga	0		90	60-120	-0,8	0	
Tomato	8-12	+/+	85	40	-0,5	15	
Watermelon	7,2 – 10	+/-	90	16-20	-0,6	30	

Mostly concerning fruit and vegetables

Control of ventilation is the second“technical device”
to optimize the PSL since harvest (or slaughtering for “raw caracasses”)

Some examples

PSL :
the “risky” class (except wine and alcohols)

The situation :

(1) Correct ventilation instruction is the duty of the shipper > Renewal of fresh air to avoid accumulation of Carbon dioxid and Ethylen is an important issue (except the case of controlled atmosphere)

(2) Permanent and adequate ventilation (number of volume per hour is a critical point for some high metabolism rate category such as climacteric fruits)

The complication :

(3) Higher shall be the air renewal, more difficult might be the “reduction time”

(4) CA is implying addition class of risks such as suffocation etc…

Mostly concerning chilled processed products

Control of temperature is the first and main “technical device”

To optimize the PSL since processing

The situation :

(1) correct temperature instruction is the duty of the manufacturer (and therefore the shipper) (except some cases for which the temperature is defined by regulation) The producer is responsible to define the Life Storage (not “potential” anymore) based on aging test.

The complication :

(2) To apply the lowest possible temperature avoiding freezing injury

(3) Each family of product have its own temperature optimum (mostly depending on it composition) but in general below 4°C (critical level as regards as 2/4°C is the critical limit for pathogen germs development)

(4) Vacuum packed products enable a shell life multiplied by 5 to 10 the shell life compared to non vacuum products but this require an extremely precise, regular and accurate temperatures control (usually between -1,5 and -0,5°C) with a very limited tolerance in term of deviation.

UBD :
the “intermediate” risk class

Preservation area : days to months

European regulation

Nature of the foodstuffs	Storage temperature during storage or transport	Storage temperature in direct delivery or collective catering establishments
Cut/Minced meats	*	+2°C
Offal of domestic ungulates and ungulate game (farmed or wild)	*	+3°C
Meat preparations	*	+4°C
Mechanically separated meats	*	+2°C
Poultry meat (including small feathered farmed game), lagomorphs (including small hairy farmed game), ratites and small wild game	*	+4°C
Domestic ungulates meat, hoofed game meat	*	+7°C for the whole carcasses and wholesale pieces +4°C for the cutting pieces
Fresh fish products, defrost unprocessed fish products, cooked and chilled crustacean and mollusc products	* (1)	+2°C
Packed fresh fish products	* (1)	* (1)
Egg products apart from UHT products	+4°C	+4°C
Raw milk intended for the consumption as is	+4°C	+4°C
Pasteurized milk	Temperature defined under the responsibility of the manufacturer or packer	Temperature defined under the responsibility of the manufacturer or packer
Ripened cheeses	Temperature defined under the responsibility of the manufacturer or packer	Temperature defined under the responsibility of the manufacturer or packer
Other highly perishable foodstuffs	Temperature defined under the responsibility of the manufacturer or packer	+4°C
Other perishable foodstuffs	Temperature defined under the responsibility of the manufacturer or packer	+8°C
Culinary preparations made in advance	+3°C	+3°C

Nota - The lower storage limit for refrigerated foodstuffs must be at the starting freezing temperature specific to each product category
(*) See the temperatures of the regulation (EC) No. 853/2004
(1) Temperature of the melting ice: 0 to +2°C

Chinese Regulation

According to standard GB/T 24616-2009 for Packing, Labelling, Transport and Storage of refrigerated products in logistics:

- Foodstuffs must maintain a core temperature below 8°C and above the freezing point during the logistics process and keep their original quality and coldness.
- At least 15 cm space between the cargo and the roof of the container
- During transport, the temperature inside the container must be checked to maintain the temperature required for refrigerated foodstuffs
- During stuffing / discharge operations, the increase in temperature product must not exceed 3°C
- Thermal records must be saved for more than 1 year by the carrier

UBD : the “intermediate” risk class

Some examples

Mostly concerning frozen processed products

Control of temperature is the only “technical device”

To optimize the PSL since processing

The situation :

(1) correct temperature instruction is the duty of the shipper based on applicable regulation

The complication :

(2) Frozen or quick frozen.

(3) IQF (Individually Quick Frozen) or in block

(4) Thermal inertia- “defreezing point” is varying depending on composition of the product > ice creams, IQF frozen fruits etc… are more sensible that meat in blocks etc…

BBD :
The “low risk” class

Preservation area : years (usually 2)

European regulation

Nature of the foodstuffs	Storage temperature during storage or transport	Storage temperature in direct delivery or collective catering establishments
Ice creams	-18°C	-18°C
Frozen minced meats and meat preparations	*	-18°C
Frozen fish products	*	-18°C
Frozen whole fishes in brine intended for the manufacture of canned food	*	-9°C
Other frozen foodstuffs	-12°C	-12°C
Nota - The temperature mentioned is the maximum temperature of the foodstuff without lower limit (*) See the temperatures of the regulation (EC) No. 853/2004		

BBD :
the “low risk” class

Some examples

Chinese regulation

According to standard GB/T 24617-2009 for Packing, Labelling, Transport and Storage of frozen products in logistics:

- Foodstuffs transported, stored and marketed with a temperature below -18°C
- Pre-cooling operated before stuffing of the containers for transport below -10°C or below an agreed temperature
- During stuffing / discharge operations, checking of the product temperature, not be higher than -12°C
- At least 10 cm space between the cargo and the door of the container, 25 cm space between the cargo and the roof
- Temperature of the container to be kept below -18°C during transport, tolerance to -15°C. To be returned at -18°C quickly after each stuffing/discharge operation.
- Thermal records must be saved for more than 1 year by the carrier

Refrigerated containers

Potential problems and how to avoid them

(b) Temperatures

- b1. « What does it mean» ?
- b2. How to monitor /how to trace ?

Temperatures : different stories…

Is the market underwriting temperature deviation or the consequences of temperature deviation ?
(temperature deviation does not necessiraly have an impact on the product depending on circonstances)
What is the wording of your policies ?

Set point

The set point is the temperature the shipper request the carrier to set the refrigerating unit

It is not

- The temperature that the carrier commit himself to keep in the cargo itself
- *Exactly* the temperature of the air supplied from the refrigerating unit

Supply (or delivered) air temperature

This is air temperature delivered at the T floor in the front of the container (temperature of air at the evaporator exit).

It is

- The temperature that the carrier commit himself to deliver to the cargo compartment of the container (more or less)

Return air temperature

This is air temperature return to from the cargo compartment of the container to the refrigerating unit.

It is

- The temperature of the air after passing through the cargo compartment. Its level is impacted by heat tranfers through the container walls, massic heat of the cargo et eventually metabolic heat of the cargo. Its level is necessarily higher than supply air temperature

Temperatures : different stories…

Is the market underwriting temperature deviation or the consequences of temperature deviation ?
(temperature deviation soes not necessiraly have an impact on the product depending on circonstances)
What is the wording of your policies ?

Regulatory temperature
This is the core product temperature

It is not
- The air temperature

The consequence is often confused with the reason …

The shipping company is technically liable to the consequence, not neccessarily to the result…

The mean (the refrigerating container) is often the root cause of the consequence but not only…

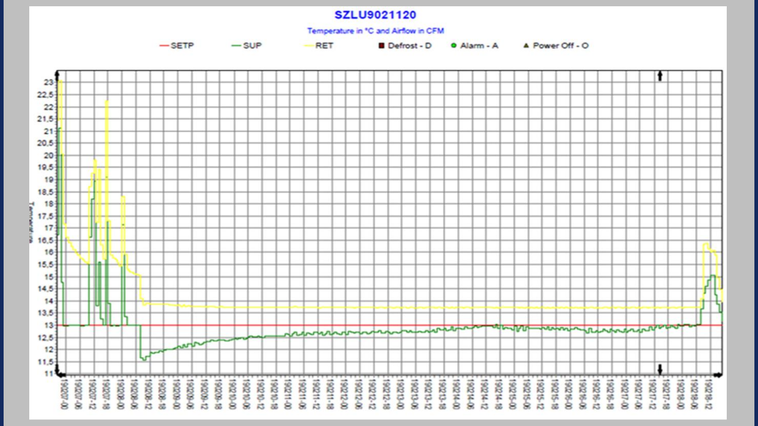
Temperatures tracking…

Except USDA graded container, the measured value is the air temperature, not the core temperature

Data logger (temperature) – carrier

Recorded data :

- Set point
- Supply air
- Return air
- Core (if USDA graded container)
- others : stoppages, RH, fan speed,…)



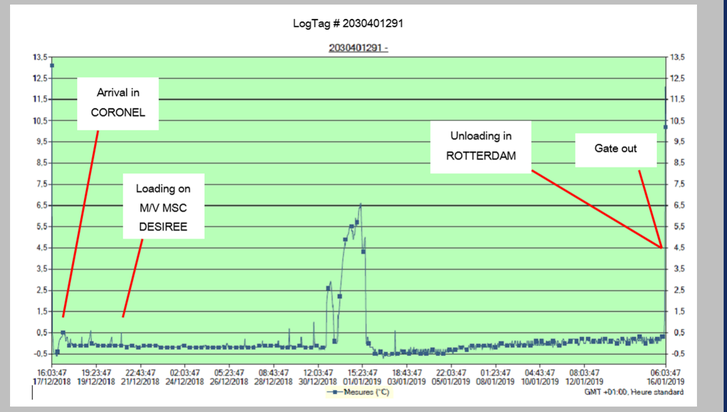
Problematic : Often unavailable to merchant - shipping company often refuse to provide it in the survey phase as this is « shipping company property »

Solution : Data logger data disclosure have to be part of the terms of freight booking contract

Temperature recorder – merchant

Recorded data :

- Ambiant air in the container (which is an intermediate value between sypply and return which level can vary depending on loacation of the recorder – exemple on a carton of climacteric fruit – metabolic heat)
- Core temperature if device is adapted



Problematic : Often disputed by the shipping company due to a lack or treacability and not being the supply air temperature (not being totally relevant of the contractual temperature) – it needs specific interpretation

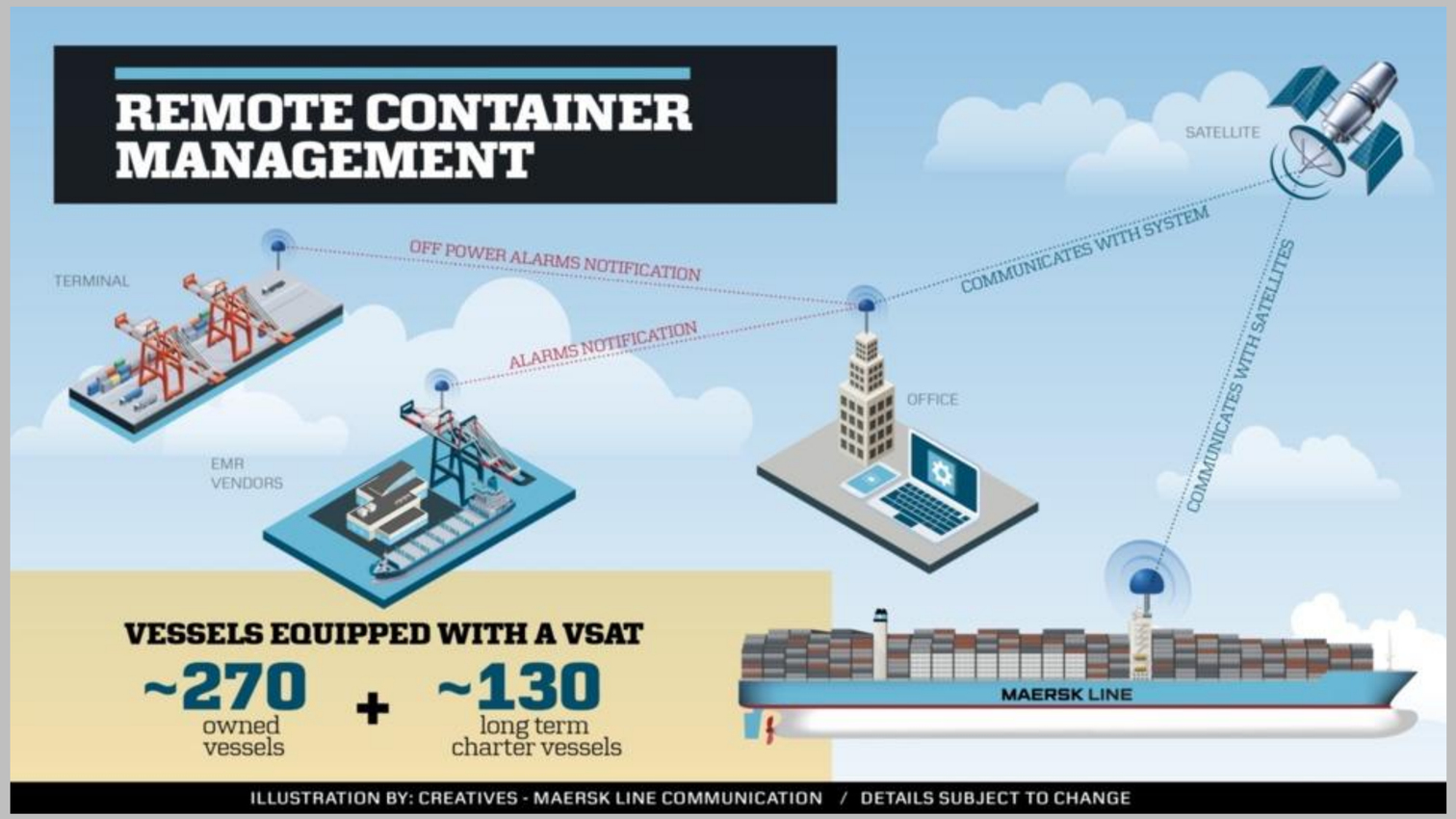
Solution : to notify the serial number of the devices on the B.L. and to install two devices : one at the bottom of a front palett (supply air) and one on the top of one of the back palett (immediate anormal event reading warning when opening the doors of the container > LOP)

Specialised surveyors…

“on transport tracking systems”

Recent years evolution…

Example RCM (Remote Management Control) for Maersk or SMART for CMA CGM etc…



Connected containers…

Shipping companies are offering this additionnal service enable to track the location of the container, the temperature, the RH and sometimes the gas content

Launched in 2018 by Maersk and 2022 by CMA CGM (for reefer)

As for example, more than 270 000 reefer containers are equipped for Maerk

Datas in real time…

Refrigerated containers

Potential problems and how to avoid them

(c) Refrigerated containers (and not only refrigerated)

- c1. « How does it work » ?
- c2. What are available equipement on the market ?
- c3. Rules

Refrigerated transport : “the box”

Two main principles

Insulation

Isothermal Coefficient
Should be less than 0,4 W m² °K

To limit the heat transfer through walls (conduction, convection and radiation)

Cold (or heat) production

Refrigerating unit (Carrier, Thermoking, Daikin,…)

Refrigerated transport : “the box”

Two important issues

adequate
setting of
parameters
&
optmized airflow

Refrigerated transport : “the box”

The regulated parameters

= shipper instruction

= shipping company setting

Temperature

The instruction (set point) is related to supply air temperature

The instruction does not imply an obligation for the carrier to guarantee the return air temperature or the core product temperature as other factors can influence as specific heat (temperature of the cargo at loading), metabolic heat (heat produced by the cargo), deficient stowage (air by pass), etc… > obligation of mean

Ventilation

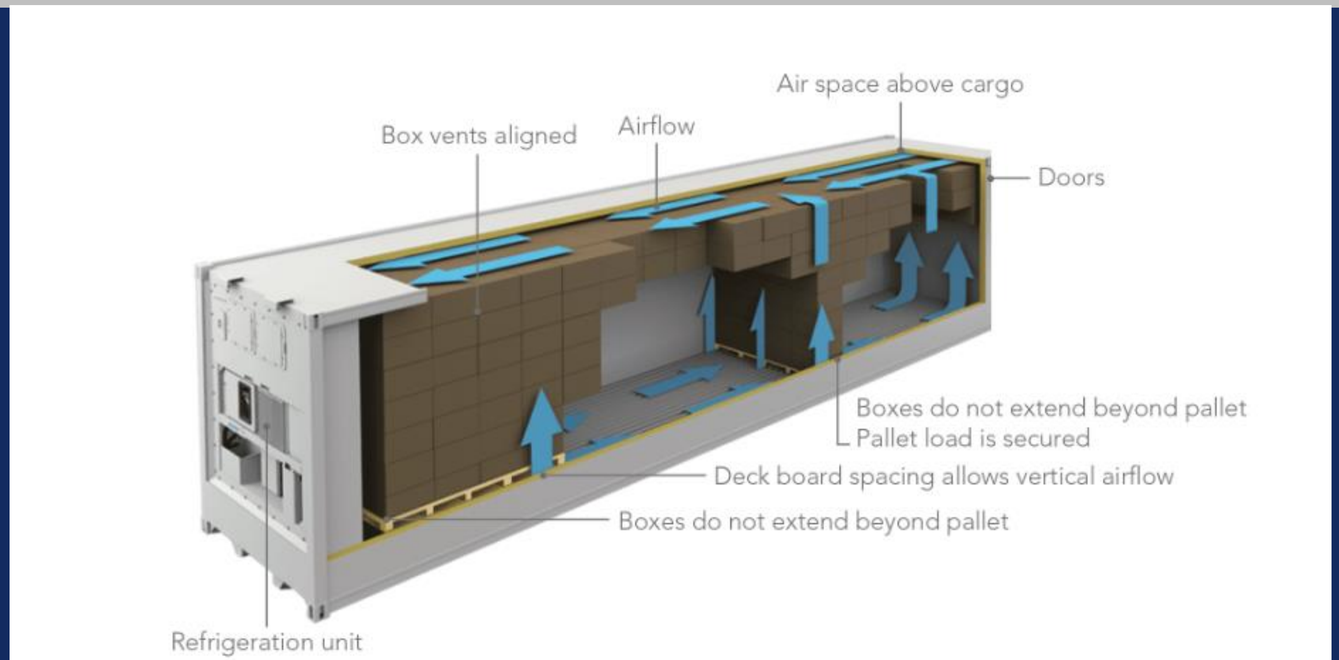
The instruction “air renewal” (cfh or cmh)

Gaz composition

The instruction for O2 and CO2 content is related the of the proportion of those gas to maintain in the container during the voyage > obligation of result

Note. A difference have to be done between controlled atmosphere and modified atmosphere system which also allows a “certain Relative Humidity control”

Refrigerated transport : “the box”



Airflow : from bottom (from cold compartment through the T floor surrounding and in vertical ascension in the load and return by the top)

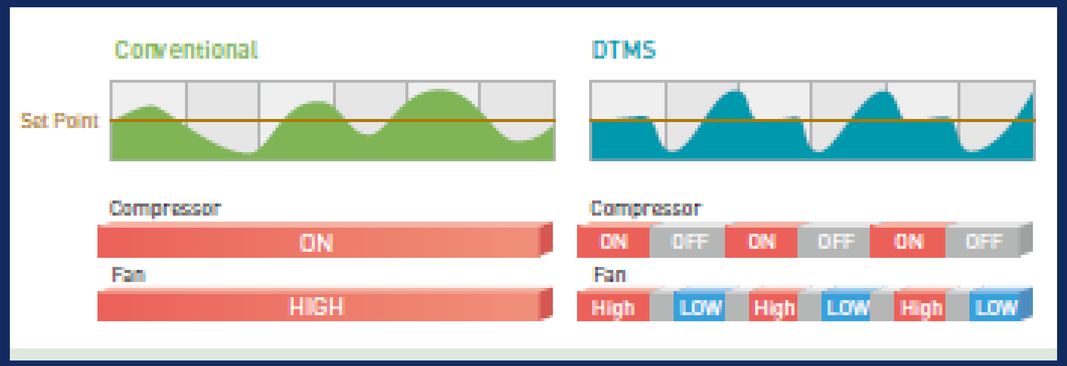
In the past : continuous mode (continuous ventilation) involving from 80 to 100 volumes per hour
and thick walls (better isothermal factor) with lining airflow conducts in interior lateral panels

In recent times: saving energy mode (discontinuous ventilation) involving from 50 to 80 volumes per hour
and thin walls (lower isothermal factor) without lining airflow conducts in interior lateral panels

Refrigerated transport : “the box”

Focus on « saving energy modes » which were imposed by merchants

What is being sold by carriers

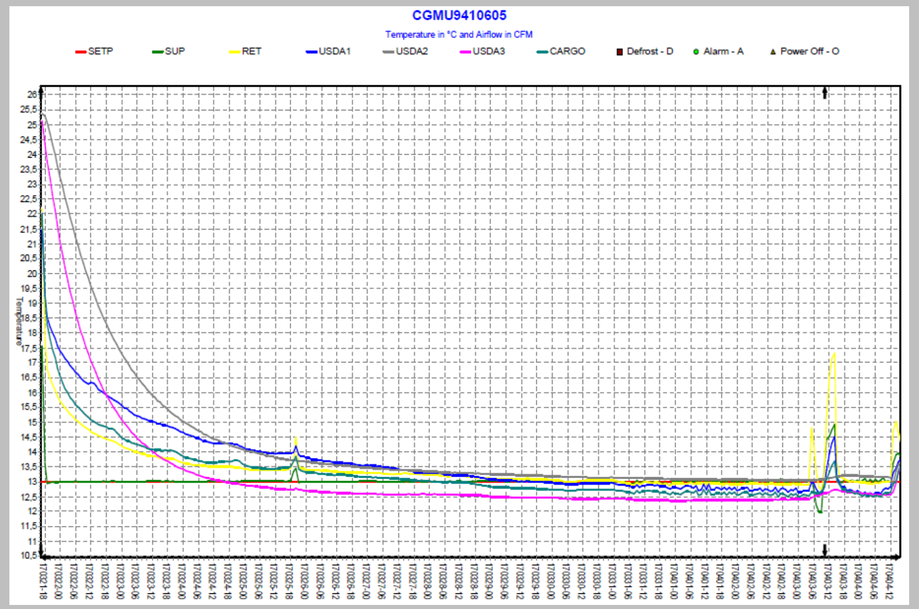


QUEST sytem for CARRIER
DTMS system for DAIKIN

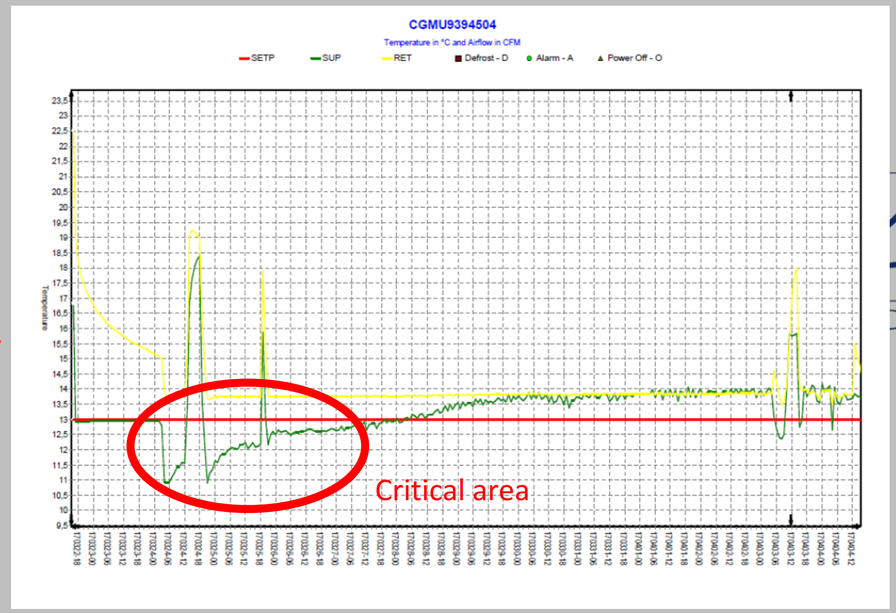
A category apart…
THERMOKING had recently developped new more accurate systems (+/-0,25°C for chilled) : CFF (including AFAM+), MAGNUM and SUPERFREEZE (down to -70°C)

Let’s be more accurate about what’s really happen and not always being said (CL Surveys testing with Quest)

Conventional



Saving Energy



Refrigerated transport : “the box”

Focus on « saving energy modes » which were imposed by merchants

Testing results on bananas container with Quest Carrier (CL Surveys testing)

Container	Survey date	Acknowledged number of boxes	Boxes with ripe fruits discarded on stripping	Part of the boxes with ripe fruits in the boxes remaining after sorting
XXXX 941 060/5	04/04/2017	1118	5	0%
YYYY 826 642/2	11/04/2017	1116	3	0%
Subtotal / average QUEST OFF		2234	8	0%
XXXX 939 450/4	04/04/2017	1117	9	4%
YYYY 904 881/8	11/04/2017	1117	5	4%
Subtotal / average QUEST		2234	14	4%

Container	Survey date	Temperature of the fruits pigmentation 1-2* (°C)		
		Minimum	Maximum	Average
XXXX 941 060/5	04/04/2017	13,2	14,8	13,9
YYYY 826 642/2	11/04/2017	13,3	14,7	13,7
Subtotal / average QUEST OFF		13,2	14,8	13,8
XXXX 939 450/4	04/04/2017	14,0	16,4	14,9
YYYY 904 881/8	11/04/2017	14,1	16,6	14,8
Subtotal / average QUEST		14,0	16,6	14,9

Container	Survey date	Operating mode ventilation		Air renewal (m3/h)	
				Flap graduation announcement	Average measure
XXXX 941 060/5	04/04/2017	Normal – continuous		75	84,0
YYYY 826 642/2	11/04/2017			90	89,0
Average QUEST OFF				82,5	86,5
XXXX 939 450/4	04/04/2017	Alternation normal or low after start of cooling	Normal	Over 75, evaluated at 85	83,3
			Low		53,1
YYYY 904 881/8	11/04/2017		Normal	Over 75, evaluated at 85	92,2
			Low		51,3
Average QUEST – normal ventilation				Evaluated at 85	87,8
Average QUEST – low ventilation					52,2

The consequences…

- Gain on energy saving
- No significant gain about reduction period
- Unfavourable situation in term of ambiant temperature in the container
- Risk of chilling or freezing injuries in certain situation
- Risk for sensible products (with low defrosting point)

→ Saving energy mode is an aggravating factor of risk for PSL and UBD classes, specificalle for exothermic commodities (example fruits or soft cheeses) or evensi for BBD sensible products (example : vacines or low defrosting point commodities such as ice cream, IQF fruits, IQF fish filets,…)

Controlled Atmosphere & Modified Atmosphere

Control
(or modification) of
Oxygen rate
&
Cabon dioxide rate

Target

- In addition to temperature control, CA consist in modyfying the oxygen rate (decreasing) and Carbon dioxide rate (increasing) as per particular ratio depending on fruits/vegetables to slow down respiratory activity and therefor to slow down the use of the reserve (notably carbohydrates) and increase the PSL

  Roughly (to adapt to each fruit and vegetable), it allows to gain X1,5 the PSL of temperature only regime

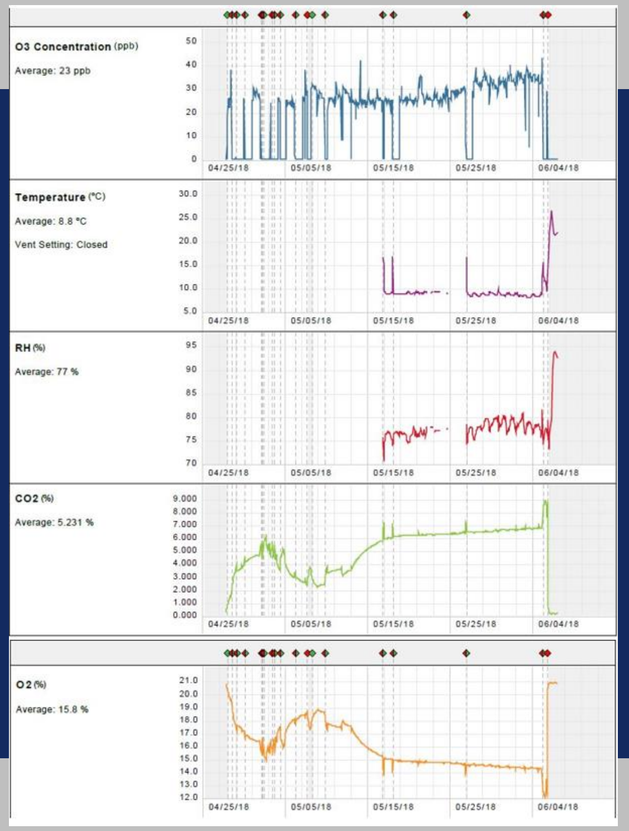
➞ Example : avocados Hass

In the atmosphere : 20,9% oxygen and 0,04% carbon dioxide (and 78% Nitrogen)
In the container : 2 à 5% oxygen and up to 10% carbon dioxide

The « temperature only » PSL is about 28-30 jours whereas it becomes 40-45 days with CA. Origins like Peru or Chili couldreach the EU markets or Far East markets with CA which is not possible with temperature only system.

Controled or modified atmosphere containers

Mostly for fruits



Caution : system being said Controlled atmospghere are sometimes only modified atmosphere systems (which mean less efficient):

- **Ethylen absorbers or blocking agent for Ethylen** : Smartfresh
- **Modified Atmosphere** : Liventus, Purfresh, Maxtend, AFAM+
- **Controled Atmospehere**: Everfresh, Xtendfresh, Starcool CA, Daikin CA etc…

To be known :

- The system is implemented by the shipping company
- In case of claim, it is very difficult to get gas log records

The surveyor must be familiar with fruits
Post harvest diseases and CA disorders to
Identify them

Insulated system in dry container

Adding an insulation wall in dry containers

example : KIT IN DRY of CLIMATAINER

or other systems

Advantage

Cheaper than reefer container and satisfying solution for products sensible to extremely high or extremely low temperature (Example : seeds, wines, mineral water etc…shipped to certain geographic areas)

Limitation of temperature variation in extreme atmospheric temperature condition
but on slowing down the temperature variation

Rules

International

Container are not subjected to ATP Convention as refrigerated trailers are…

http://www.unece.org/fileadmin/DAM/trans/main/wp11/ATP_publication/2017/ATP-2017f_Handbook.pdf

Classes : I (Isolate) – RR (Refrigerant) – FR (Refrigerating) sub classes A to D (depending of ability to maintain to a certain range of temperature inside the trailer under atmospheric temperature of 30°C)
Obligation of agreement to perform the transport (validity 6 years and renewable two times for 3 years max after testing)

Most frequent case: FRC MM/YY (FRC 12/2025 – refrigerated reinforced class C valid until December 2025)

Conclusion : Regulatory risk prevention measure existing for refrigerated trailers does not exist for containers : a 15 years old reefer container can still be in use despite constraints on the structure (loss of Isothermal capacity) are much more important for container compared to trailer > prevention regarding the quality of the bow can only be contractual

Refrigerated containers

Potential problems and how to avoid them

(c) Transport steps for reefer containers

Document	Booking - Etd/Eta - Instruction temp./ventilation/CA	PTI report	Inland transport instruction - Temperature/genset or not	E.I.R. (Equipement Interchanger Receipt)
Operational	P.T.I. (Pre Trip inspection) - Cleaning - Setting parameters temp./ventilation/CA	Stuffing operation - Container taken empy to be delivered to shipper premises to be stuffed - Stuffing – stowage – temperature recorders in cargo (option)	Delivery full to port terminal	
In duty/by	Merchant	Shipping company or subcontractor	Shipper (transport by shipper to subcontracted haulage companyor by shipping company if door/door contract)	Stevedore (subcontracted by shipping company)

Refrigerated containers

Potential problems and how to avoid them

(d) Transport steps for reefer containers

Document	Daily monitoring log.- Incident report	Mate receipt -Reefer log book	*Same document chain*
Operationnal	Positionning of the container to the reefer section (ususally less than 6 hours transfer plugging/unplugging refrig. unit) - Plugging of the refer to energy source - Checking of temp. set point/supply/return/ventilation	Loading and voyage - Container taken empy to be delivered to shipper premises to be stuffed - Stuffing – stowage – temperature recorders in cargo (option)	Operation on Hub port to port of destination and to final delivery
In duty/by	Stevedore (subcontracted by shipping company)	Shipping company	*same types of operators*

PTI (Pre Trip Inspection) : a major tool of prevention

Two goals :

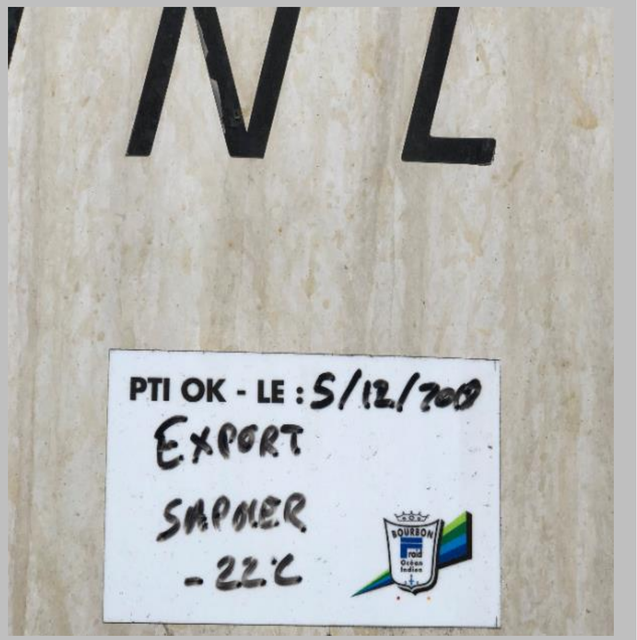
- Control of external and internal condition of the container : integrity of panels, condition of door seals, condition of ventilation deflector, condition of refrigerating unit, screwing, condition of T floor water drain evacuation, condition of evacuation drain from evaporator defrosting water collecting tank,…) > all those are well known root causes of claim
- Setting of temperature, ventilation, defrosting sequences
- Running test of the refrigerating unit

Who :

- Reefer of the shipping company
- Or subcontracted PTI company

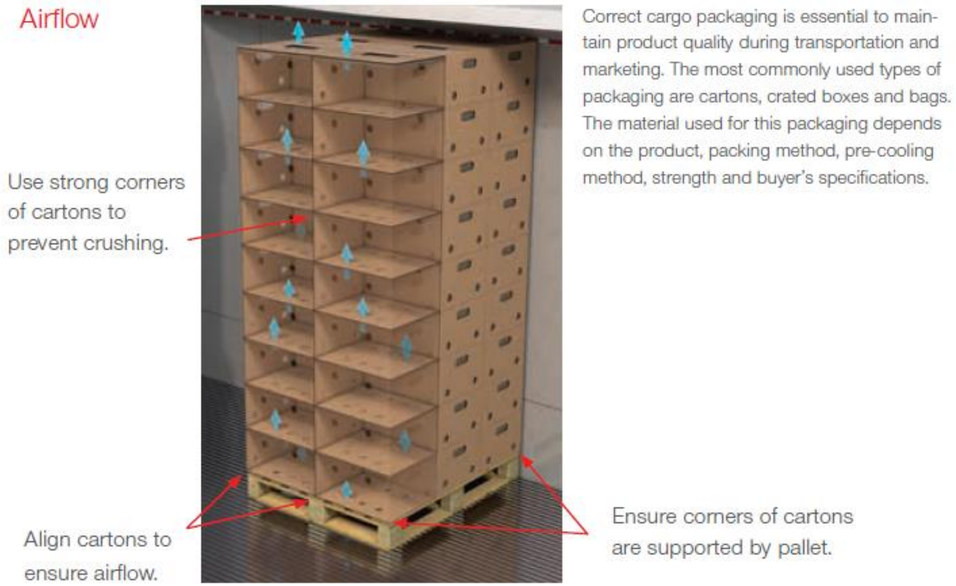
What can be asked (notable for sensible cargo) :

- Reinforced PTI proceed
- Merchant to be provided with PTI report



Stuffing : a possible source of future claim

Correct air circulation in the container is essential

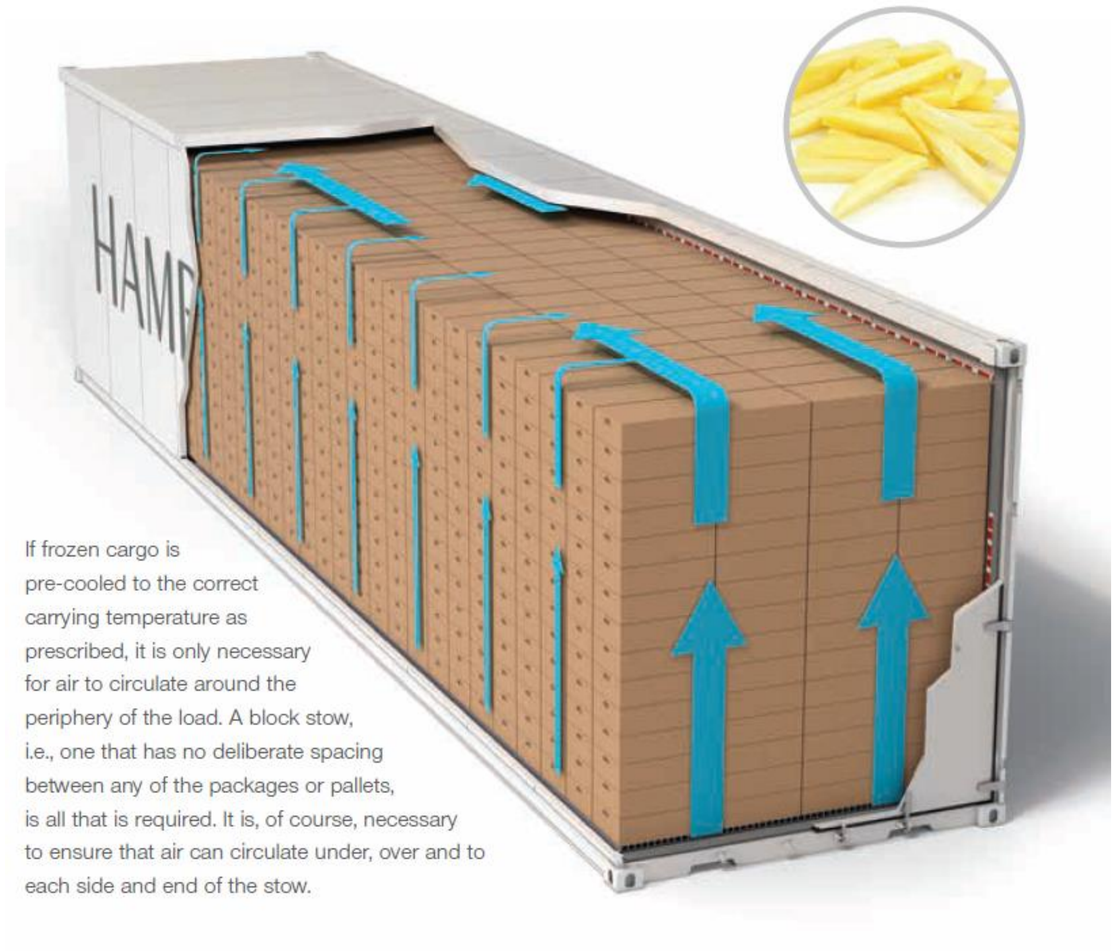


Chilled cargo

Stuffing : a possible source of future claim

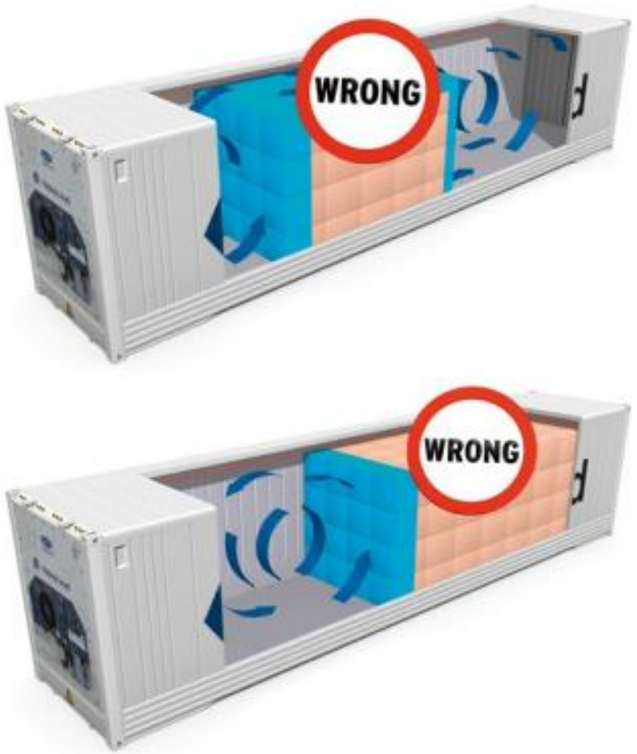
Correct air circulation in the container is essential

Frozen cargo



Stuffing : a possible source of future claim

Correct air circulation in the container is essential



Air short circuit
and/or
air flow reduction/blockage

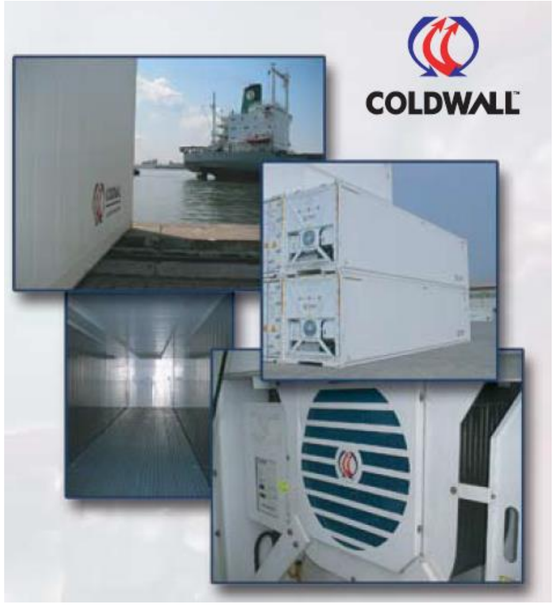
must be avoided

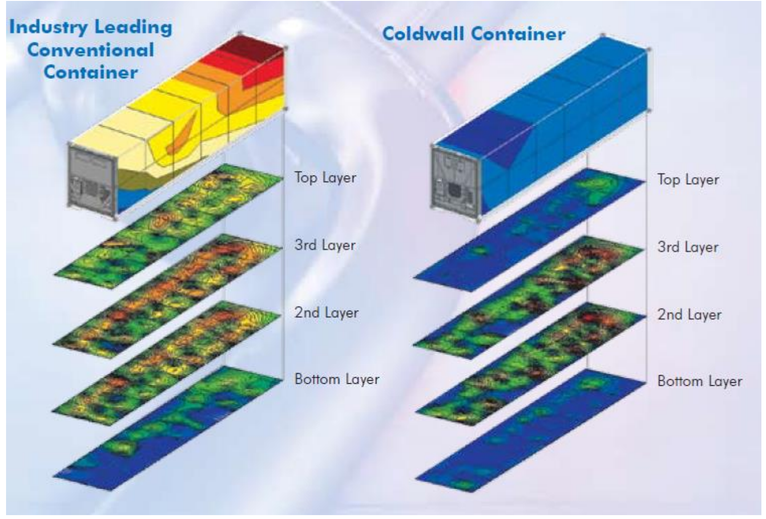
The freight market is not oriented to mitigate the risk but to mitigate the running cost of carriage/carriers

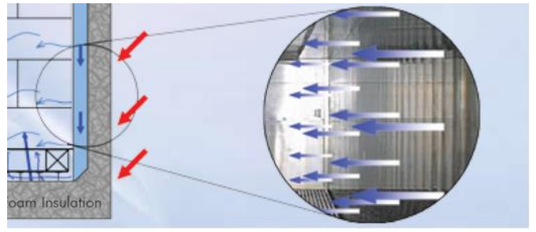
Example : failure of the launch of the system

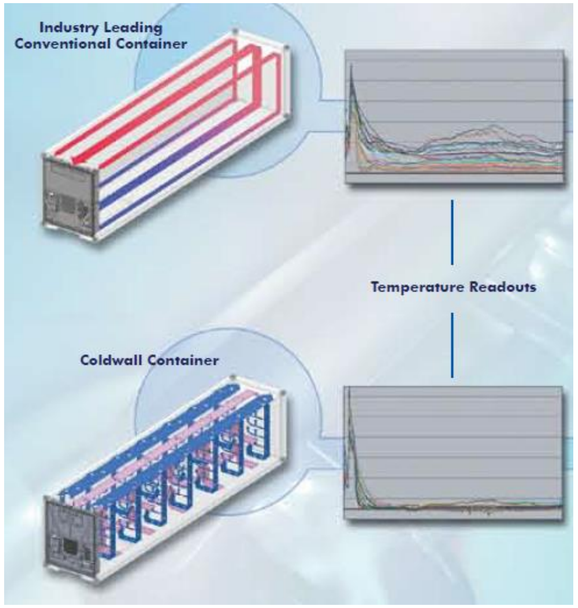
THE NEXT REVOLUTION . . .

(as they called the system) did not occur









PREVENTION for refrigerated cargo by container

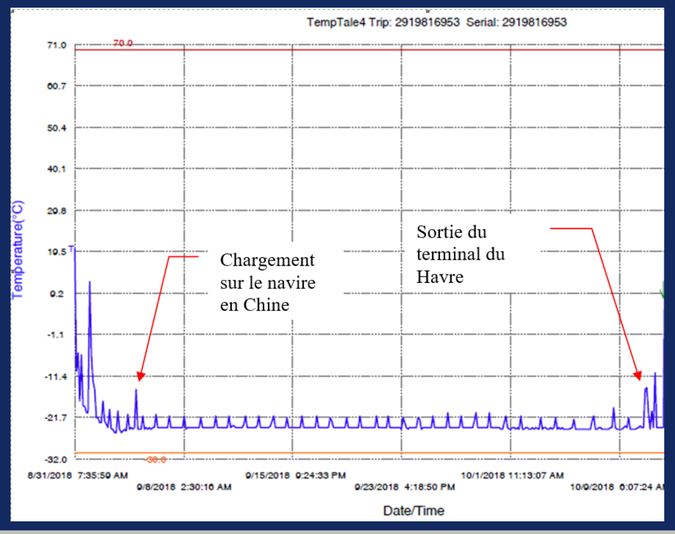
Easy and applicable : The “P P C” rule

P like « Potential storage life »	**P** like « Preparation of the box »	**C** like « Control »
This is the key starting point : if storage + transport does not fit with transit + marketing period, there is no feasible (without claim) transport operation, whatever shall be the logistic organisation or the equipments…	Dedicated instruction : - Set temperature with operationnal security margin (if the regulatory cargo temperature is -18°.C, request -20°C set point (or even -22°C if the product is sensitive (IQF fish filets, ice creams, IQF frozen fruits, if carriage temperature is 2/4°C, request +3°C and not +2/+4°C,… etc…) and evenso continuous mode for sensible products - Request a specific instruction as for delivery date when possible and not only ETA / and (as far as possible) direct transit for « PSL commodities » - Request to be provided with data logger (temperature en gaz) upon Merchant request	Own data recorders : - Implement your own traceability devices - Identify them on transport contract (BL) to convey them a contractual value - Apply for the tracking systems proposed by carriers
PSL product needs almost a « à la carte » prevention plan whereas UBD and BBD products needs normal prevention levels (reinforced in case of sensible products)	Dedicated PTI : - Request to be provided with the PTI report before stuffing - Request a re inforced PTI in case of sensible product	
	Dedicated stuffing : - Merchant pre stuffig inspection of the container - Dedicated stuffing plan depending on product sensitivity	

and overall, control as much as possible the human factor : refrigerated cargo is a specialized matter, thean appoint specialist (forwarder,s inspectors, surveyors, …)

Some stories

Thin container wall effect / stowage plan– fish filets from China to France – cost 98 K€



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Why ?

Due to introduction of thin wall containers + saving energy mode refrig.: pre cooling issue and stowage plan issue

However?

This kind of damages did occur occur with former container generation?

Who is liable ?

Carrier for inadequete equipment or shipper for inadepate instruction/stowage ?

Some stories

Negligence effect / wine from Australia to Netherlands – Cost 58 K€

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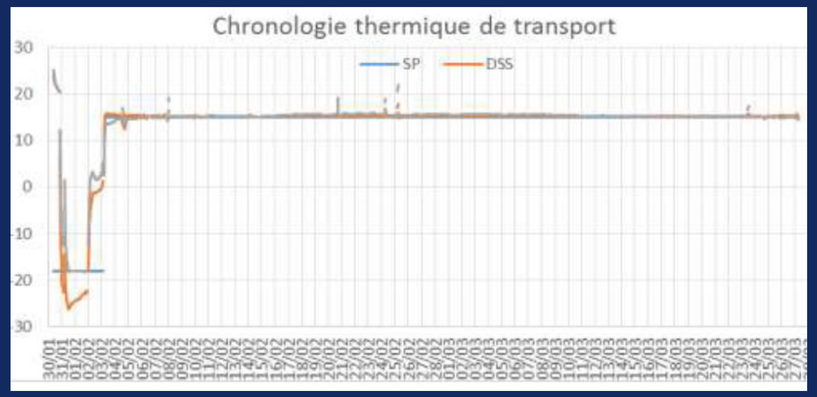

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Why?
Default of PTI

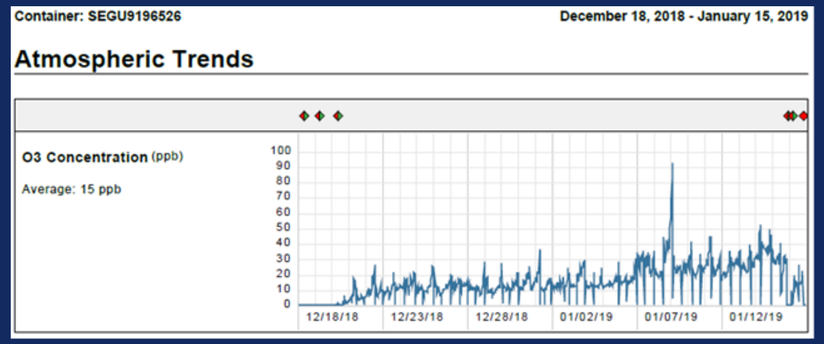
However ?
Which kind of control ?

Who is liable?
Carrier for setting default of shipper for control default ?

Some stories

6 containers of buleberries from Chile to Netherlands – cost 620 K€

+



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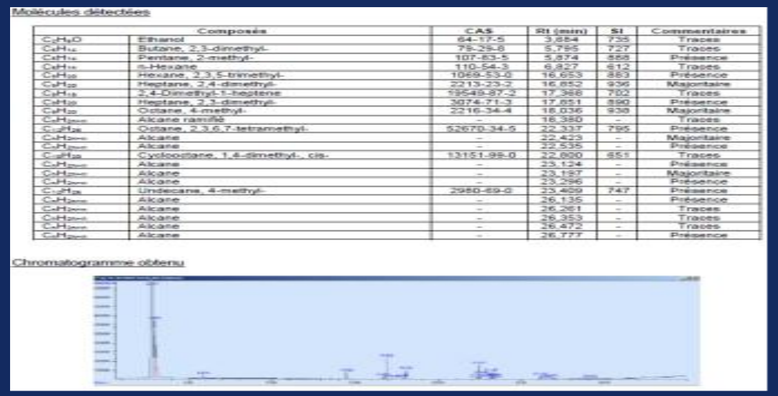

Why ?

Putrid smell at delivery for 6 shipments within 2 moth with Purfresh et PET packaging (fruit inspection before loading – conform package to EU Regulation – no problem with same products other packages and no gas / temperature issue during transport)

However ?

Molecules of package interacted with molecules of Purefresh transport system ?

Who is liable ?

Shipper for packaging defect or shipping company for unadapted AC system ?

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Expertise & Contrôle

IUMI International Union of Marine Insurance

CL Surveys

CL SURVEYS is a consulting and survey firm that has been in business for about 30 years. We operate around three axes:

A **human capital** with the necessary training, experience and specialization to guarantee the upmost technical quality and rigor of our investigations and provide an exploitable value added. Keeping this level of quality is a matter of credibility towards our clients, but also towards the parties our reports will be opposed to.

An **international network** allowing a short and optimal reaction span, no matter the location.

A **24/7 availability and a systematic response** to events of which we have the responsibility.

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- ☐ TRANSPORT SURVEYS, BOTH GENERAL AND SPECIALIZED
  Maritime, shipping and logistics surveys regarding Cargo and public liability, with the recent creation of a pole for Nautical, Hull and Machinery, as well as Pleasure Crafts.

- ☐ AVERAGE AGENCY / INTERNATIONAL DESK
  Pole operated by engineers and professionals with higher education, who not only manage missions abroad but also contribute their technical expertise.

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  Legal protection, risks and assets assessments, preventive analysis

CESAM
Différents experts de CL SURVEYS sont certifiés

IUMI

IN A NEW FIGURES

- Close to **80 collaborators** proper to the group in **9 countries**, and more than 15 specialities as commodities, fruits, automotive, air, chemistry etc.
- **An international department** epresenting **25%** of our services and operated by specialized engineers: the handling of worldwide spot cases and a "master surveyor," horizontal management service, for major corporate customers.
- About **60 000 survey cases** handled since our creation and over **10 000 shipping containers** or equivalent inspected or surveyed every year – a substantial experience to capitalize upon.

OUR DEPARTEMENTS

FOOD AND PERI-SHABLES

Core specialty of the firm at its onset, it still represents more than half of our activity. Agronomy engineers and MSc with superior academic education operate the department.

food@cl-surveys.com

FRUITS

The company's second historical specialty, fruits are a particular specialty which represents more than a quarter of the compasy activity.

fruits@cl-surveys.com

SOFT COMMODITIES

The firm has dealt with major cases of soft commodities, and has a senior specialists cell at its disposal in the event of major damages, ready to leave in a heartbeat to worldwide destinations.

commodities@cl-surveys.com

HARD COMMODITIES

This department comprises chemist engineers and specialised mariners, as well as a former merchant navy officer with experience navigating on tankers. We handle matters related to pollution, weight loss etc...

liquid@cl-surveys.com

REFRIGERATED TRANSPORT

The department is composed of engineers and MSc specialised and trained in matters and challenges regarding the maintaining the cold chain.

refrigerated@cl-surveys.com

LIVESTOCK

It is a core activity of the firm with notable international cases. We provide survey and inspections services for ground, sea or air cases. Specialty in assessing financial valuation according to genetic variability.

livestocks@cl-surveys

LIFE SCIENCE AND PUBLIC HEALTH

Founded in 2006, TERREUM is a sister company of CL SURVEYS specialized in environmental, agricultural, public health and also agro-industrial matters, in P&C, liability and legal protection.

info@terreum.com

CONSUMER GOODS

Department specialized in the management of claims involving consumer goods and the implementation of rapid recovery solutions...

info@cl-surveys.com

OUR DEPARTEMENTS

CHEMISTRY

Organic and synthetic chemistry. This department is operated by specialised chemist engineers.

chemical@cl-surveys.com

INDUTRIAL PACKAGING

A department operated by Arts et Métiers engineers with strong experience experience in industrial packaging) and familiar with the SEI and EUMOS (and other similar organizations) standards.

projects@cl-surveys.com

HEAVY CARGO, INDIVISIBLE OBJECTS AND INDUSTRIAL PROJECT

Department composed of Arts et Métiers engineers and marine officers who manage major machine breakdown cases and master good practices in terms of stowing and lifting..

SUPPLY CHAIN

Composed of engineers, this department deals with all issues relating to the fields of freight transport and logistics.

supplychain@cl-surveys.com

NAUTICAL, HULL AND MACHINERY

This department comprises former navigation professionals - merchant navy officers and engineers and professionals formerly working in classification societies.

marine@cl-surveys.com

AUTOMOBILE / ROAD VEHICLES

Specialty acquired since 2018 with interventions in the context of logistics incidents for large accounts and carriers. The department is centralized by a European and Ministry of Transport approved auto expert.

vehicles@cl-surveys.com

RAILWAY

Department created in 2014. The experts operating in this area have been trained on equipment and infrastructure. They have participated in major derailment cases in particular.

rail@cl-surveys.com

AIR

The department is made up of engineers used to dealing with logistics issues but also with the security of goods in the field of air freight.

air@cl-surveys.com

OUR DEPARTEMENTS

FINANCE AND OPERATING LOSS

Founded in 2018, our Finance department handles business interruption valuation cases and trading losses cases in many areas of agriculture, industry, commerce and services.

loss@cl-surveys.com

THEFTS AND MISAPPROPRIATIONS

Surveys of the conditions surrounding thefts and misappropriations, enhanced by a specialty in the authentication of assets and of values being declared through equipment and merchandise experts and professionals.

vol@cl-surveys.com

INFORMATION TECHNOLOGIES

Department composed of engineers and specialized in the management of computer and electronic goods.

it@cl-surveys.com

ARTS AND MOVES

In early 2015, this department became a branch in its own right, notably following the arrival of a new recruit with a double specialty in damage management and arts expertise.
The department has at its disposal a portfolio of surveyors by area of expertise (manuscripts, porcelain...)

arts@cl-surveys.com

CONTROLEA

CONTROLEA is an independent, certified organization that provides inspection, surveillance and control services:

- SUPER STEWARDSHIP MISSIONS:

Control within the contractual and standardisation framework of all types of products and particularly for specialised sectors:

- Fruits and Vegetables
- Soft Commodities
- Agrofood products (fresh & frozen)
- Livestock
- Liquids (Oils, etc...)
- Hard Commodities
- Vehicles
- Equipment
- Consumer Goods

- STORAGE AND TRANSPORT CONDITIONS

- Pre-loading surveys / Conditions surveys
- Wedging
- Warehouse audits
- Risk assessment
- Nautical studies

- FINANCIAL RISKS

- Monitoring and valorization of stocks or profesional assets in agro-production / agribusiness.

OUR « HUMAN CAPITAL »

Our expertise is technical but at its core lays first and foremost a human, relational and even cultural dimension.
It is a matter of common sense, combined with technique, experience and integrity.

Our Human Capital is the main component of our activity and its value added.
We have successfully trained a number of experts, which is a sign of the dynamism of our methods.

- Over **90% of our experts** achieved a higher education level: **engineers, PhDs, master graduates, navy officers**...

- Over **60%** had professional experience in the **industrial sector** prior to entering our firm: consulting, quality control or logistics..

- Over **50%** of our surveyors have worked with us for **more than 5 years**, and have therefore accumulated a substantial amount of experience to tap into.

.

Our **human capital** is **international**:

- Our national grid relies on 16 local offices spread across France and allows us to cover the entire country in less than two hours. Over **25% of our surveyors have some form of international experience**. Our staff comprises collaborators with professional experience on all continents..

- We also have **a direct international presence in 9 countries** and in the **rest of the world** through our **international department**: international.claims@cl-surveys.com.

FRANCE Head office
Lyons La Forêt
+33.2.32.49.00
info@cl-surveys.com

FRANCE Head office
Paris
+33.1.56.89.80.80
info@cl-surveys.com

RUNGIS
+33.1.46.87.39.30
rungis@cl-surveys.com

LE HAVRE
+33.2.35.41.11.38
lehavre@cl-surveys.com

LILLE
+33.3.20.32.04.50
lille@cl-surveys.com

DUNKERQUE
+33.3.28.21.30.31
dunkerque@cl-surveys.com

ROUEN
+33.2.35.89.16.80
rouen@cl-surveys.com

BREST
+33.2.97.55.99.80
brest@cl-surveys.com

RENNES
+33.2.99.67.01.92
rennes@cl-surveys.com

NANTES
+33.2.40.25.84.29
nantes@cl-surveys.com

TOURS
+33.2.47.72.88.75
centre@cl-surveys.com

BORDEAUX
+33.5.56.12.36.45
bordeaux@cl-surveys.com

TOULOUSE
+33.5.61.54.08.55
toulouse@cl-surveys.com

PERPIGNAN
+33.4.84.25.87.00
perpignan@cl-surveys.com

MARSEILLE
+33.4.91.03.11.27
marseille@cl-surveys.com

ALPES & SUISSE
+33.4.79.28.12.66
suisse-alpes@cl-surveys.com

LYON
+33.4.37.25.57.48
lyon@cl-surveys.com

STRASBOURG
+33.3.88.16.26.35
strasbourg@cl-surveys.com

BELGIUM
+32.3.641.82.00
info@cl-surveys.be

PORTUGAL & SPAIN
+34.910.39.17.06
info@cl-surveys.es

NETHERLANDS
+32.3.641.82.00
info@cl-surveys.nl

GERMANY
+49.151.10.332.837
info@cl-surveys.de

UK
+44.7470.729477
info@cl-surveys.co.uk

NORTH AMERICA
+1.(445).213.3023
northamerica@cl-surveys.com

CARAÏBES
+596.6..96.00.61.06
northamerica@cl-surveys.com

ASIA
+86.21.5860.6668
info@cl-surveys.cn

RUSSIA
+7.812.380.74.04
cl.ru@cl-surveys.com

CAMERROON
+33.1.56.89.80.80
cameroon@cl-surveys.com

SENEGAL
+33.1.89.80.80
senegal@cl-surveys.com

OTHER COUNTRIES
+33.2.32.49.49.00
internationalclaims@cl-surveys.com