

DEFROSTING "A LA CARTE" BY LUTETIA

MASSAGERS / TUMBLERS

Name		Type									
		0	1	2	3	4	40	400	5	6	7
Frozen meat capacity	(kg)	60	220	450	750	1.000	1.200	1.500	2.200	3.300	3.800
	(lb)	125	500	1.000	1.450	2.200	2.650	3.300	4.900	7.300	8.400
Floor area	(m²)	1,34	2,69	3,41	4,19	4,85	6,00	7,10	8,13	10,39	10,65
	(ft²)	14,4	28,9	36,7	45,1	52,2	64,6	76,4	87,5	111,9	114,6
Power excluding generator	(kW)	1,6	3,5	3,5	5,9	5,9	7,0	7,0	7,0	10,2	10,2
Indicative daily flow											
8 cycles of 2 hours (small IQF products)	(kg)	480	1 760	3 600	6 000	8 000	9 600	12 000	17 600	26 400	30 400
	(lb)	1 050	3 900	7 900	13 200	17 600	21 200	26 500	38 800	58 200	67 000
4 cycles of 4 hours (large IQF products)	(kg)	240	880	1 800	3 000	4 000	4 800	6 000	8 800	13 200	15 200
	(lb)	550	1 900	4 000	6 600	8 800	10 600	13 200	19 400	29 100	33 500
4 cycles of 5 hours (small blocks)	(kg)	240	880	1 800	3 000	4 000	4 800	6 000	8 800	13 200	15 200
	(lb)	550	1 900	4 000	6 600	8 800	10 600	13 200	19 400	29 100	33 500
1 cycle of 12 hours (large blocks)	(kg)	60	220	450	750	1 000	1 200	1 500	2 200	3 300	3 800
	(lb)	150	500	1 000	1 700	2 200	2 600	3 300	4 900	7 300	8 400

CHAMBERS

Name				Number of trolleys													
				Single chambers									Double chambers				
				1	2	3	4	5	6	7	8	10	1+1	2+2	3+3	4+4	5+5
Frozen meat capacity(kg)	IQF	Small	(kg)	75	150	225	300	375	450	525	600	750	150	300	450	600	750
			(lb)	165	331	496	661	827	992	1 157	1 323	1 653	331	661	992	1 323	1 653
		Large	(kg)	250	500	750	1 000	1 250	1 500	1 750	2 000	2 500	500	1 000	1 500	2 000	2 500
			(lb)	551	1 102	1 653	2 205	2 756	3 307	3 858	4 409	5 512	1 102	2 205	3 307	4 409	5 512
	Blocks	Small	(kg)	300	600	900	1 200	1 500	1 800	2 100	2 400	3 000	600	1 200	1 800	2 400	3 000
			(lb)	661	1 323	1 984	2 646	3 307	3 968	4 630	5 291	6 614	1 323	2 646	3 968	5 291	6 614
		Large	(kg)	500	1 000	1 500	2 000	2 500	3 000	3 500	4 000	5 000	1 000	2 000	3 000	4 000	5 000
			(lb)	1 102	2 205	3 307	4 409	5 512	6 614	7 716	8 818	11 023	2 205	4 409	6 614	8 818	11 023
Floor area			(m²)	2,04	3,69	5,34	6,99	8,64	10,29	11,94	13,59	16,89	4,08	7,38	10,68	13,98	17,28
			(ft²)	22,0	39,7	57,5	75,2	93,0	110,8	128,5	146,3	181,8	43,9	79,4	115,0	150,5	186,0
Electrical power excl. heat			(kW)	4	7	10	13	16	19	22	25	31	7	13	19	25	31
Steam heat power			(kg/h)	15	25	30	40	50	60	80	90	100	25	40	60	80	100
			(lb/h)	33	55	66	88	110	132	176	198	220	55	88	132	176	220
Indicative daily flow																	
8 cycles of 2 hours			(kg)	600	1 200	1 800	2 400	3 000	3 600	4 200	4 800	6 000	1 200	2 400	3 600	4 800	6 000
(small IQF products)			(lb)	1 300	2 600	4 000	5 300	6 600	7 900	9 300	10 600	13 200	2 600	5 300	7 900	10 600	13 200
4 cycles of 5 hours			(kg)	300	600	900	1 200	1 500	1 800	2 100	2 400	3 000	600	1 200	1 800	2 400	3 000
(large IQF products))			(lb)	650	1 300	2 000	2 600	3 300	4 000	4 600	5 300	6 600	1 300	2 600	4 000	5 300	6 600
3 cycles of 6 hours			(kg)	225	450	675	900	1 125	1 350	1 575	1 800	2 250	450	900	1 350	1 800	2 250
(small blocks)			(lb)	500	1 000	1 500	2 000	2 500	3 000	3 500	4 000	5 000	1 000	2 000	3 000	4 000	5 000
1 cycle of 14 hours			(kg)	75	150	225	300	375	450	525	600	750	150	300	450	600	750
(large blocks)			(lb)	150	350	500	650	850	1 000	1 200	1 300	1 700	350	650	1 000	1 300	1 700

Whatever your requirements, we have the defrosting system suited to your production



DEFROSTING

CHALLENGES, TECHNOLOGIES AND SOLUTIONS



PRECISION, PERFORMANCE & PROFIT



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THE CHALLENGES OF DEFROSTING

MACRO-ECONOMIC CHALLENGES

According to the "World frozen food market. Opportunities and forecasts, 2014-2020" report by the Research & Markets Institute, frozen food will represent a 306-billion-dollar market in 2020, **progressing** by 4.1 % over 5 years. Moreover, in response to the **growing demand** for **rapid** defrosting giving total control over the **quality** and the **safety** of foods, LUTETIA has developed various **patented accelerated defrosting procedures** to address the growth in use of frozen raw materials.

MICRO-ECONOMIC CHALLENGES

- ⇒ **Rationalisation** of production (ex. seasonality) and **suppleness** of work in accordance with orders (e.g. speed / "just in time")
- ⇒ Industrial productivity
 - **Yield**,
 - **Speed**,
 - **Reduced footprint**,
 - Maximum **versatility**
- ⇒ Reduced costs
 - **Energy** consumption
 - **Water** consumption

⇒ A defrosting system should be fast, productive and versatile

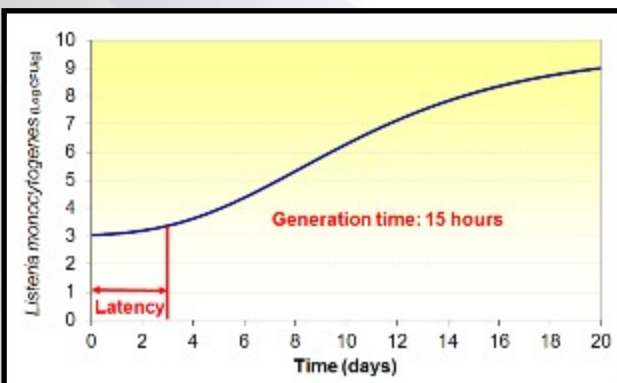
ENVIRONMENTAL CHALLENGES

- ⇒ Reduced environmental impact
 - **Energy** consumption
 - **Water** consumption

⇒ A defrosting system should be understated and clean

FOOD SAFETY CHALLENGES

In Europe, Regulation (CE) n° 852/2004 of 29 April 2004 and in France, the Order of 21 December 2009 no longer impose any particular defrosting technique but requires the implementation of a **hazard analysis**. Freezing does not kill bacteria. It simply stops their development. During defrosting, bacteria pass from their **latency phase** during which their metabolism recovers. At the end of this latency phase, bacteria development recommences. Therefore, at 4 °C under aerobic conditions, the latency phase of *Listeria monocytogenes* lasts around 3 days, knowing that Greer and Murray (1991) have shown that the latency phase of *Listeria monocytogenes* is even shorter in the case of defrosting.



Growth of *Listeria monocytogenes* with latency phase obtained with the Pathogen Modeling Program, according to the model by Buchanan et al. (1989) and Buchanan and Philips (1990).
Conditions: T = 4°C - pH = 6 - Aerobic conditions - [NaCl] = 5 g/kg - [NaNO₂] = 0 mg/kg - Initial load: 3 CFU/mL

⇒ Defrosting should be fast in order to avoid pathogens leaving the latency phase.

LUTETIA

Convective transfer coefficient	
Coolant fluid	h (W.m ⁻² .K ⁻¹)
Air in natural convection	5 à 25
Air in forced convection	20 à 300
Water in forced convection	300 à 6 000
Boiling water	3 000 à 60 000
Water steam in condensation	6 000 à 120 000

Heat conductivity	
Product	λ (W.m ⁻¹ .K ⁻¹)
Air at 20 °C / saturated steam	0,0256 / 0,0373
Water at 20 / 0 °C	0,599 / 0,553
Ice at -20 °C / 0 °C	2,43 / 2,22
Stainless steel	15
Animal fat at 25 °C	0,152 à 0,190
Fish at 4 °C	0,502 à 0,577
Meat at 4 °C	0,412 à 0,523

Pressure (mbar)	Condensation temperature of steam (°C)	Steam latent heat of condensation (J.kg ⁻¹)
5	-2,4	2 835 000
10	7,0	2 485 000
25	20,8	2 452 000
50	32,9	2 424 000
100	45,8	2 393 000
164	55,0	2 371 000
200	60,1	2 358 000
300	69,1	2 336 000
400	75,9	2 319 000
500	81,3	2 305 000
1000	99,6	2 258 000

Buchanan, R.L., Stahl, H.G. et Whiting, R.C. (1989). Effects and interactions of temperature, pH, atmosphere, sodium chloride, and sodium nitrite on the growth of *Listeria monocytogenes*. *Journal of Food Protection*, 52 (12), 844-851.

Buchanan, R.L. et Phillips, J.G. (1990). Response surface model for predicting the effects of temperature, pH, sodium chloride content, sodium nitrite concentration, and atmosphere on the growth of *Listeria monocytogenes*. *Journal of Food Protection*, 53 (5), 370-376.

Greer, G.G. et Murray, A.C. (1991). Freezing effects on quality, bacteriology and retail-case life of pork. *Journal of Food Science*, 56 (4), 891-894.

QUALITY CHALLENGES

During freezing, ice crystals form in the membranes.

- ⇒ Losses during defrosting
 - Water (loss of water holding capacity)
 - Too slow ⇒ **recrystallization** phenomena
 - Too fast ⇒ The matrix cannot **reabsorb** all of the **exudate**
 - Molecules of technological or nutritional interest
 - Sarcoplasmic **proteins** and amino acids
 - Heme **iron**
 - **Enzymes** (colour stability) and **metmyoglobin**
 - Pro-oxidant molecules
- ⇒ Increased **diffusion** coefficient of ingredients (e.g. salt)

⇒ Poorly managed defrosting reduces efficiency and technological and nutritional qualities..

PHYSICAL BASES FOR APPLICATIONS

Planck's Law - Estimating defrosting time (t in s)

$$t = \frac{e \cdot \rho \cdot L}{\Delta T} \left(\frac{e}{8\lambda} + \frac{1}{2h} \right)$$

Food density (ρ in kg.m⁻³)

Food thickness (e in m)

Latent heat of water fusion (L = 330 000 J.kg⁻¹)

Convective transfer coefficient (h in W.m⁻².K⁻¹)

Difference in temperature between the frozen food and the ambience (ΔT in °C)

Heat conductivity of the food (λ in W.m⁻¹.K⁻¹)

Energy approach to defrosting

$$\text{Energy (J)} = m \cdot C_p \cdot \Delta T + L \cdot m$$

Heat Requirement: Sensible 15 % Latent 85 %

Reduction in thickness of products

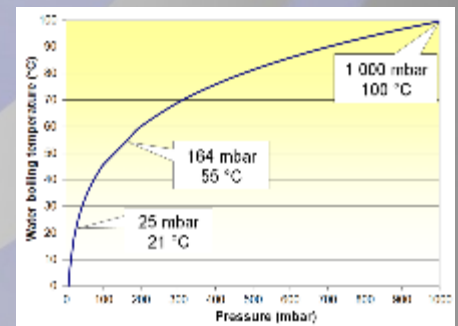
- Working as **hot** as possible
 - Food safety constraints
 - Quality constraints (e.g. melting fat)

Optimise **heat transfer**

- **Double-jacket** (conduction transfers)
- **Cooling fluid(s)** (convection transfers)

Steam injection under reduced pressure for low temperature condensing without cooking the surface of the product (55 °C for meat) and whilst maintaining latent condensation heat transfer to the product.

⇒ Defrosting is accelerated with the help of the above parameters.



YOUR DEFROSTING TESTS

Ideas? Projects?

Come and test them in our technological applications laboratory



STEAM-VACUUM DYNAMIC DEFROSTING

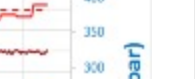
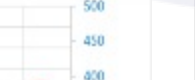
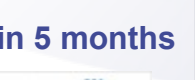
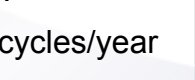
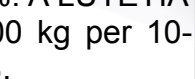
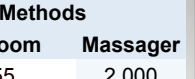
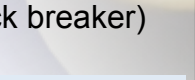
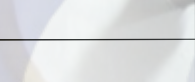
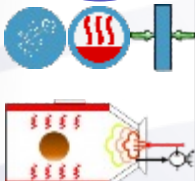
LUTETIA PATENTS n° 92/07091 AND 15/51805

TECHNICAL PRINCIPLE



Steam-vacuum dynamic DEFROSTING

The gradual injection of regulated **steam under vacuum** enables the transfer of latent heat from change of phase of steam to the product in a regular and controlled manner, without cooking the surface. Frozen blocks are gradually separated and uniform temperatures are achieved via **rotation**. Defrosting may be followed by salting and a range of other operations (tenderising, smoking, cooking, cooling, PROactivation, etc.) in a **single operation**.



- With a **double-jacket**, the temperature is managed throughout the process and the addition of steam can be reduced.
- The **block breaker** enables the reduction of the blocks using hydraulic pressure (accelerated defrosting and improved quality).



Steam circuit



Double-jacket



Block breaker



Block conveyor



Unloading hopper

TECHNOLOGY AND PRODUCTS

General duration of defrosting

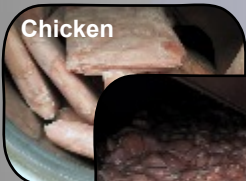
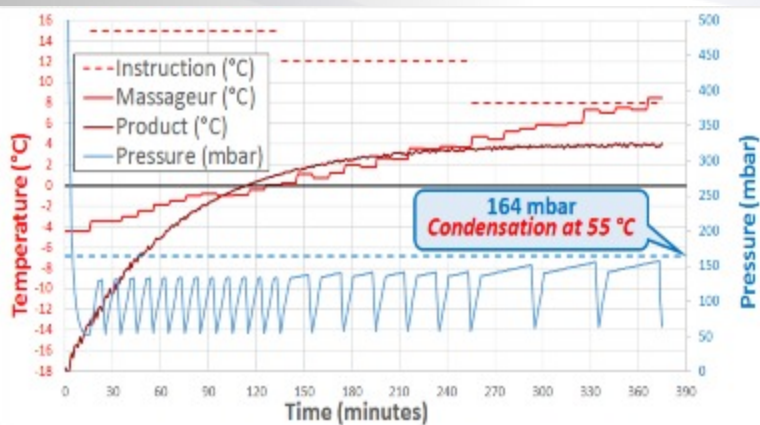
- IQF: 1 to 4 hours
- Blocks: 5 to 12 hours (-30 % with block breaker)

Pay-back example

A manufacturer defrosts 4 tonnes of 15 kg chicken fillet blocks daily. In classic air defrosting, defrosting yield is around 94%. A LUTETIA T5 defrosting massager can process 2 000 kg per 10-hour cycle. Defrosting yield is around 106%.

Materials saving: 255 kg per cycle for 400 cycles/year
102 000 kg/year

⇒ **Equipment is paid for itself within 5 months**



LUTETIA



PROCESS CONTROL



Rev counter



Wireless temperature probe



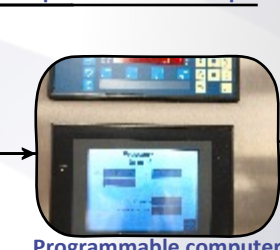
Glycol temperature probe



Vacuum-meter



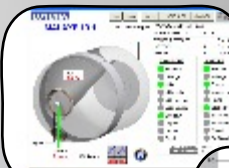
Weigh



Programmable computer



PC Supervision



Visualisation in real time



Centralised information



ADVANTAGES



Cost-effective, improved yield (weight gain of 4 to 8 %) by reabsorption of condensates (steam, proteins, etc.),

Low water use, consumption below 8 % of the weight processed and most often reabsorbed,

Fast, defrosting times reduced from 24/48 hours to 4/ 8 hours,

Respects the integrity of fragile products, in tilted massage or progressive tilting,

Conceived for you as perfectly adapted to your factory, the system being modular and adaptable to your constraints and configuration,

Versatile, for any product, with cumulative operations (salting, tenderising, cooking, smoking, PROactivation, etc.) in the same massager,

Innovative and patented, patents n° 92/07091 and 15/51805,

Safety and health, anaerobic conditions, short defrosting times incompatible with the emergence of bacteria from their latency phase, ease of cleaning, stainless steel tank,

Uniform, through process control, the variety and progressively of heat provision, the mix obtained by rotation and decompacting,

Regular, from one cycle to another, via the management of defrosting conditions and the process control-command.

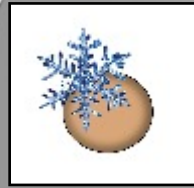
Accumulation of phases: defrosting, salting and smoking of pork bellies.



FAST DEFROSTING IN COLD CONVECTION

LUTETIA PATENT n° 14/56533

TECHNICAL PRINCIPLES



Fast DEFROSTING in cold convection

Optimises conditions for transfer between the surface of the food and humidity in the air and balances the internal distribution of heat in the food and transfer to the interface. Therefore, surface heating managed and heat provision is optimised for a **faster defrosting** and **optimum food quality and safety**.

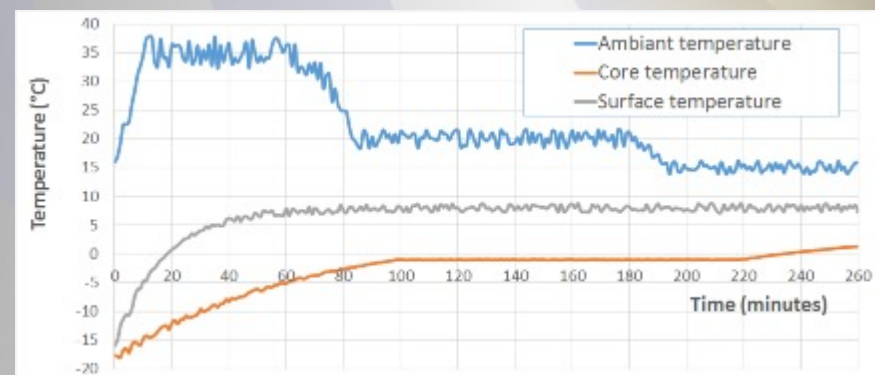
- **High speed air circulation**, which renews the boundary layer and accelerates heat transfer,
- **Regulated heat** provision (air, water, steam) and **cold** provision (air, water),
- Static procedure which **respects** the most **fragile** foods.
- Maintenance of **ambient and surface humidity** by injection of **steam** and **water spraying**, which **reduces drying** and encourages heat transfer.



TECHNOLOGY AND PRODUCTS

General defrosting times

- IQF: 1 to 5 hours
- Blocks: 6 to 14 hours



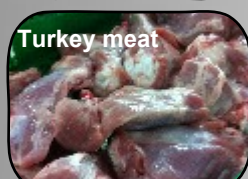
Pay-back example

Every day a manufacturer defrosts 4 tonnes of chicken. In classic air defrosting, the defrosting yield is around 94%. A LUTETIA DGV 4 trolley defrosting chamber can process the daily production in two 2 000 kg cycles. The defrosting yield is around 98%.

Weight (kg)	Methods	
	Cold room	Chamber
Frozen	2 085	2 000
Defrosted	1 960	1 960

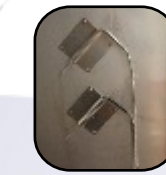
Material gain: 85 kg per cycle over 400 cycles/year
34 000 kg/year

⇒ The equipment is paid for itself within 10 months



LUTETIA

PROCESS CONTROL



Temperature probes (surface and core)



Ambient temperature probe

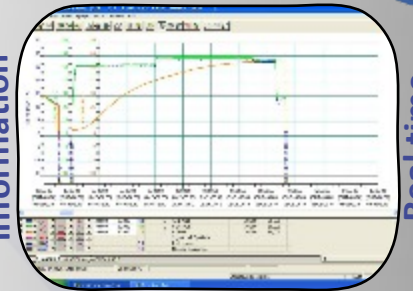


PC Supervision



Programmable computer

Centralised information



Real time visualisation



ADVANTAGES

Profit

Performance

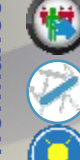
Precision



Cost-effective, improved yield (surface humidity of product maintained), the equipment can be amortised in under 1 year,



Low water consumption, consumption below 10 % of processed weight,



Fast, convection and distribution accelerated for defrosting times 2 to 4 times shorter,



Respects the integrity of fragile products, products remain static throughout defrosting (possible in bags or pouches),



Conceived for you as perfectly adapted to your factory, the system being modular and adaptable to your constraints and your configuration,



Versatile, for all products and all packaging,



Innovative and patented, patent n° 14/56533,



Safe and healthy, reduced risk of cross-contamination, simplified quarantining of batches, short defrosting times incompatible with the emergence of bacteria from their latency phase, dual temperature control at the core and on the surface (tailored surface conditions),



Uniform, through optimised aeraulics,



Regular, from one cycle to another, thanks to the management of defrosting conditions and process control-command.



Example of defrosting of fragile products

