



Applied Cryogenics in Life Sciences: The Case of Whole Body Cryotherapy Chamber

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Introduction

Essential Small Molecules...



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Our playground

From production to application

Essential Small Molecules are involved along the entire value chain

Production



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Feedstock

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Storage



8 scientific & technological expertises



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Cryogenics & WBC



What is WBC ?

« Medical treatment using cold at very low temperatures »

Source: IIR Dictionary of Refrigeration



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What is a Cryo-Sauna and Pain Points?



Individual Cabin - Partial Body Cryotherapy





Cold Burn



Source: EIGA

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Figure 1: Example of oxygen concentrations measured in a properly designed and operated open cryo cabin.

What is a WBC Chamber ?





Example of a 2-chamber device for 2-3 persons

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Objective & Scope

- Technological Evaluation
 - Cryosauna (CS) vs Cryo-chamber (CC)

Methodology

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- Experimental tests on liquid N₂ (LIN) consumption
- Data analysis
- Comparative specific LIN consumption in operations

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N₂ Properties

N₂ Practical Data: direct vs indirect injection Δ(Enthalpy) @ -110°C





N₂ Practical Data: Temperature Sensitivity

ΔH _{LIN} (kJ/kg) @ T (°C) (*)	INDIRECT (CC) (**)	DIRECT (CS)	Gap (%)
-110	258.0	268.5	-4.1
-130	237.0	247.5	-4.4

* From LIN @ eq. @ 3 bar abs ** Heat Exchanger Pinch = 10°C

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Experimental Tests



Characteristics of Cryo-Chamber (CC)

Pre-Chamber	ain Chamber		
	Inner Dimensions	Main chamber	Pre-Chamber
	Height (m)	2.05	2.05
	Length (m)	1.70	1.15
	Width (m)	1.15	0.94
	Inner Volume (m ³)	4.01	2.22
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LIN Consumptions in Pull-Down (P-D)

Test Nr	LIN Consumption (kg)	P-D Duration (min)	Initial ambient T (°C)
1	101	50	17
2	101	63	25
3	86	52	27
4	85	51	27
Average	93	54	24
Std Deviation	9	6	5

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LIN Consumptions in Steady-State (S-S)

Test Nr	Total LIN Consumption (kg)	Duration (min)	LIN Consumption (kg/h)
А	108	145	45
В	54	114	28
С	65	78	50
D	85	51	58
E	62	96	39
F	108	136	48
G	100	218	28
Average			42
	Std Deviation		11
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Temperature Set Points

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N₂ Consumptions: CS vs CC

Assumptions

Parameter	Cryo-Sauna	Cryo-Chamber
LIN consumption (kg)	6 kg (P-D) + 6 kg/session (average value from literature)	93 kg (P-D) + 42 kg/h (S-S) (test data)
Person / session	1	2
Session duration (min)	3	3
Stand-by between 2 sessions (min)	3	3
Operation duration (h)	8	8

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Specific LIN Consumption Per Patient - Working Day Basis

Liquid N2 Specific Consumption (kg / patient): Cryo-Sauna (CS) & Cryo-Chamber (CC) / 8-hour operations



● Consump. / patient CS 🔺 Consump. / patient CC

Conclusions & Takeaways

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Conclusions & Takeaways

1. N₂ properties very close in **INDIRECT** equipment vs. DIRECT

- 2. Cryo-Chambers using liquid N_2 are good candidates for Whole Body Cryotherapy vs. Cryo-Saunas
 - ➤ Safety
 - Competitive in CAPEX and OPEX
 - > Whole = Head in cold environment

3. LIN in WBC can offer flexibility in temperature requirements



For further information

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