



**Restoring PFAS-contaminated soils
to their pristine state : thermal
treatment of source zones and
pathways to full-scale
remediation with Krysalis®**

Intersoil Barcelona 2026

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Technologies

08/10/2026

DOC-001967

The PFAS Analytical Challenge

10,000+

PFAS compounds known across regulatory lists, industry uses and transformation products

4-100

molecules typically covered by standard laboratory panels

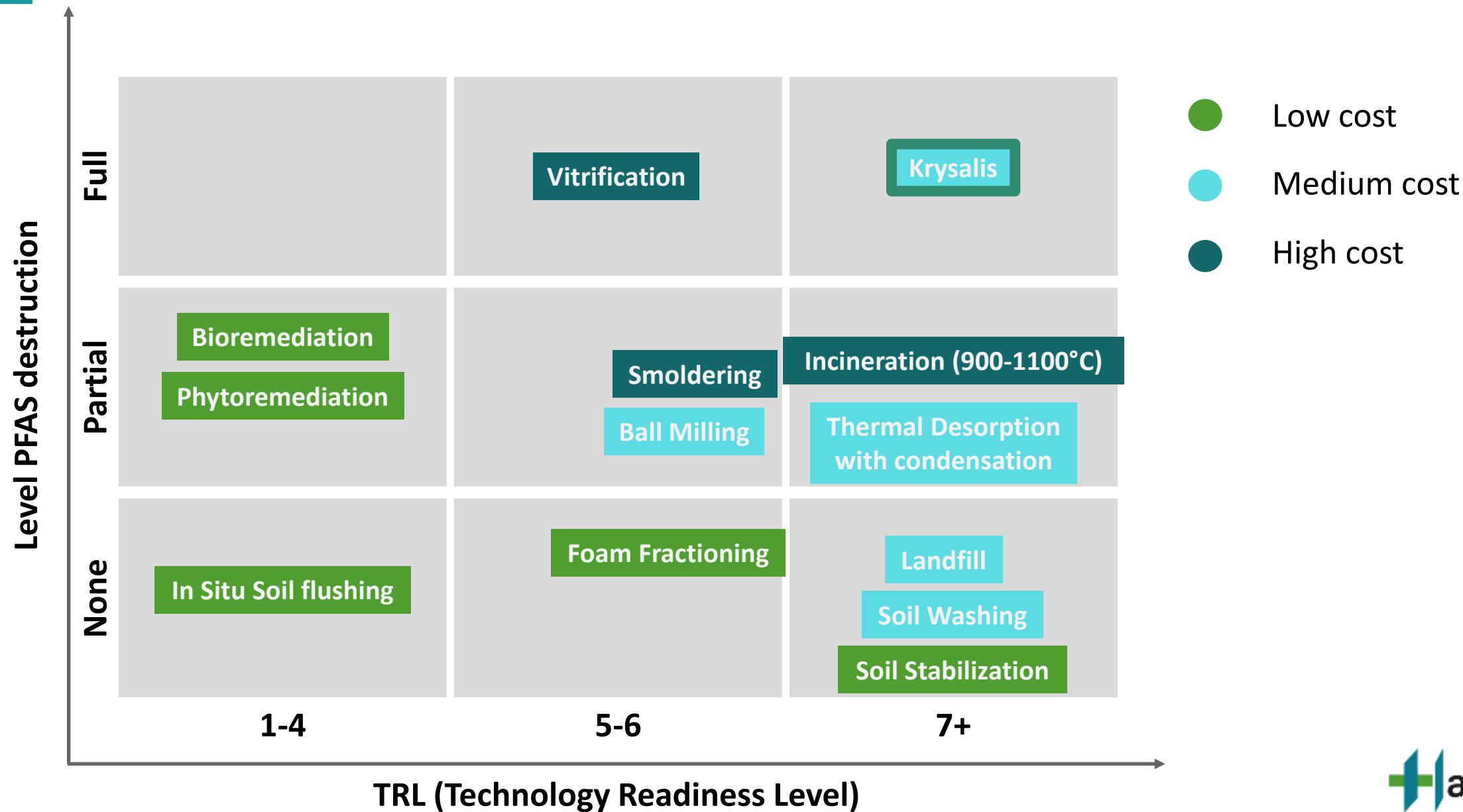
99.99%

DRE on 22 target molecules — proves nothing about the other 9,978+ compounds

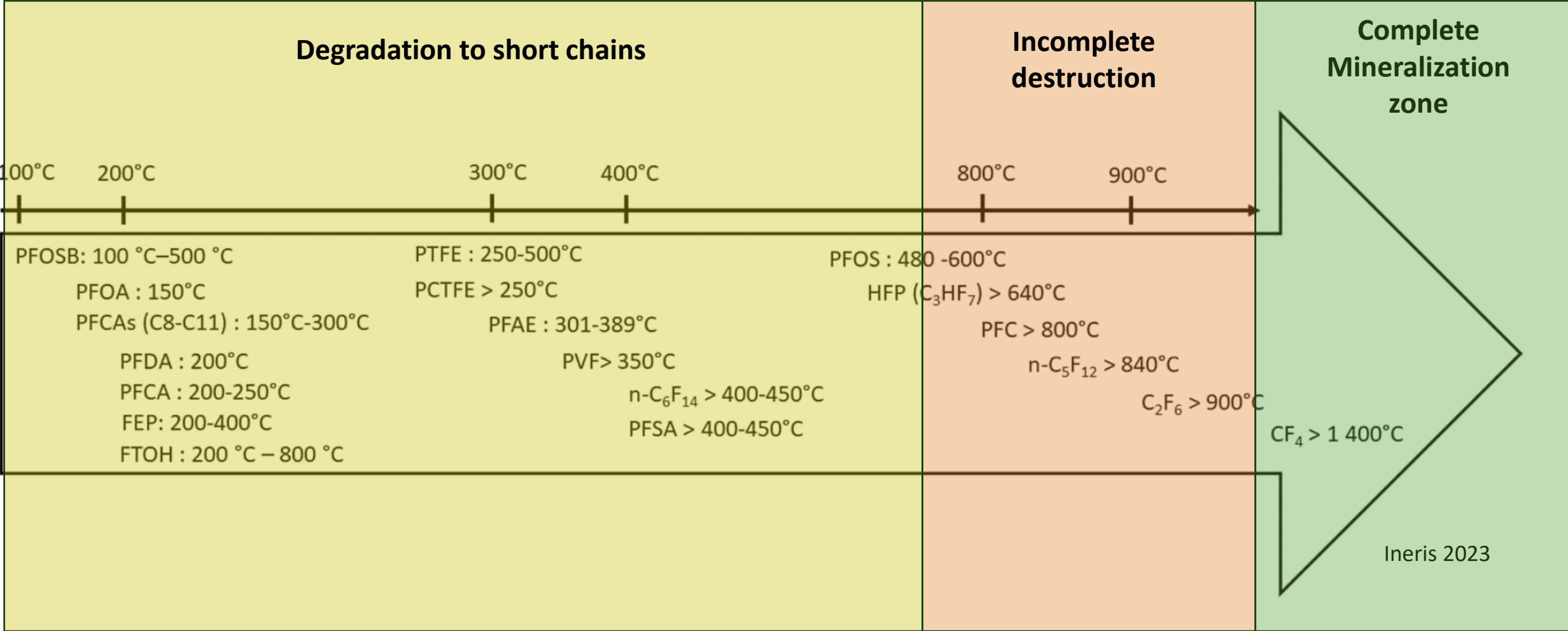
Short-chain and ultra-short-chain PFAS (TFA, CF_4 , C_2F_6) are among the most mobile, most persistent and least regulated — yet the most likely transformation products

State of the Art: PFAS Soil Treatment Technologies

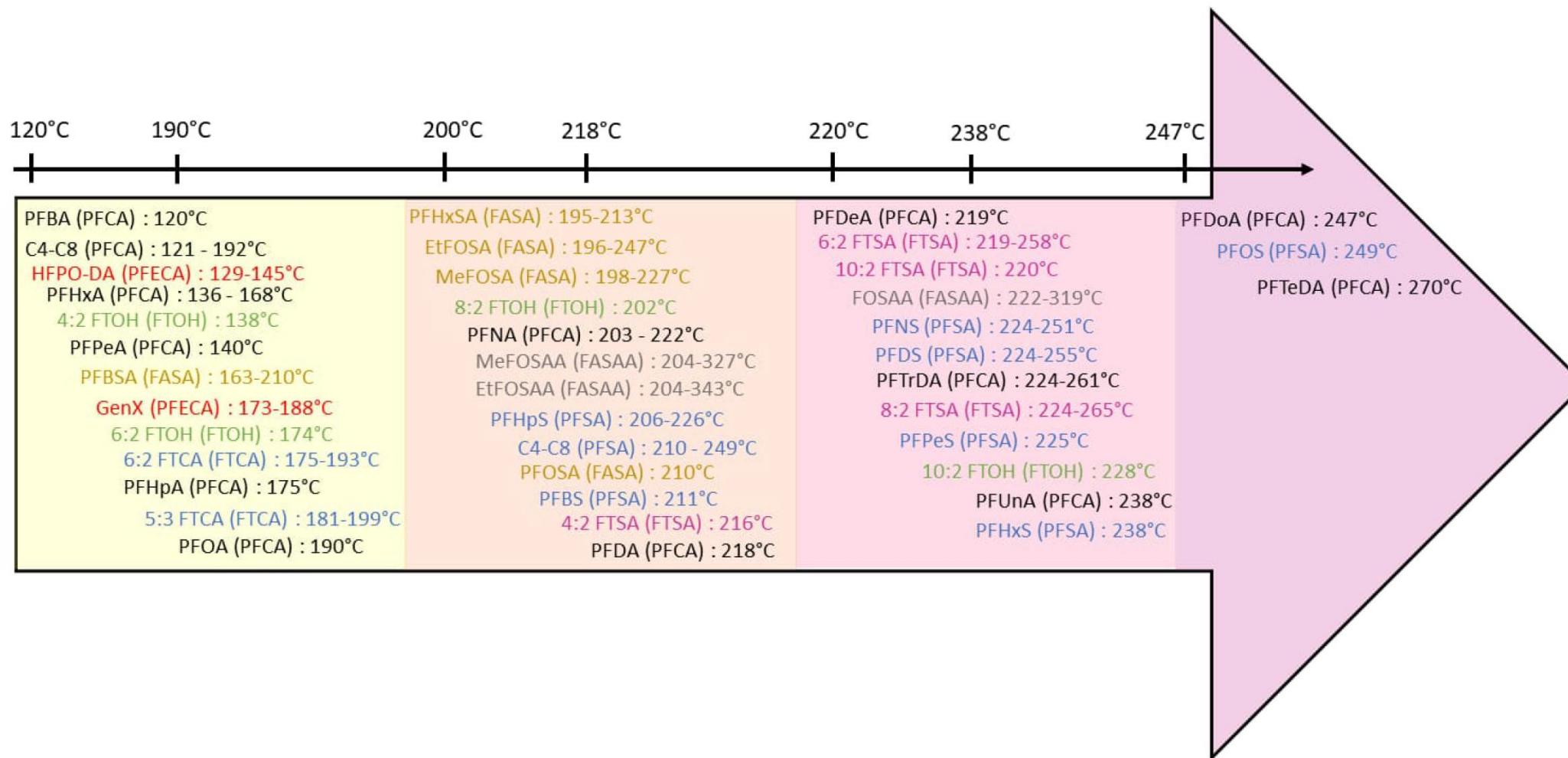
Haemers Technologies property & confidential information



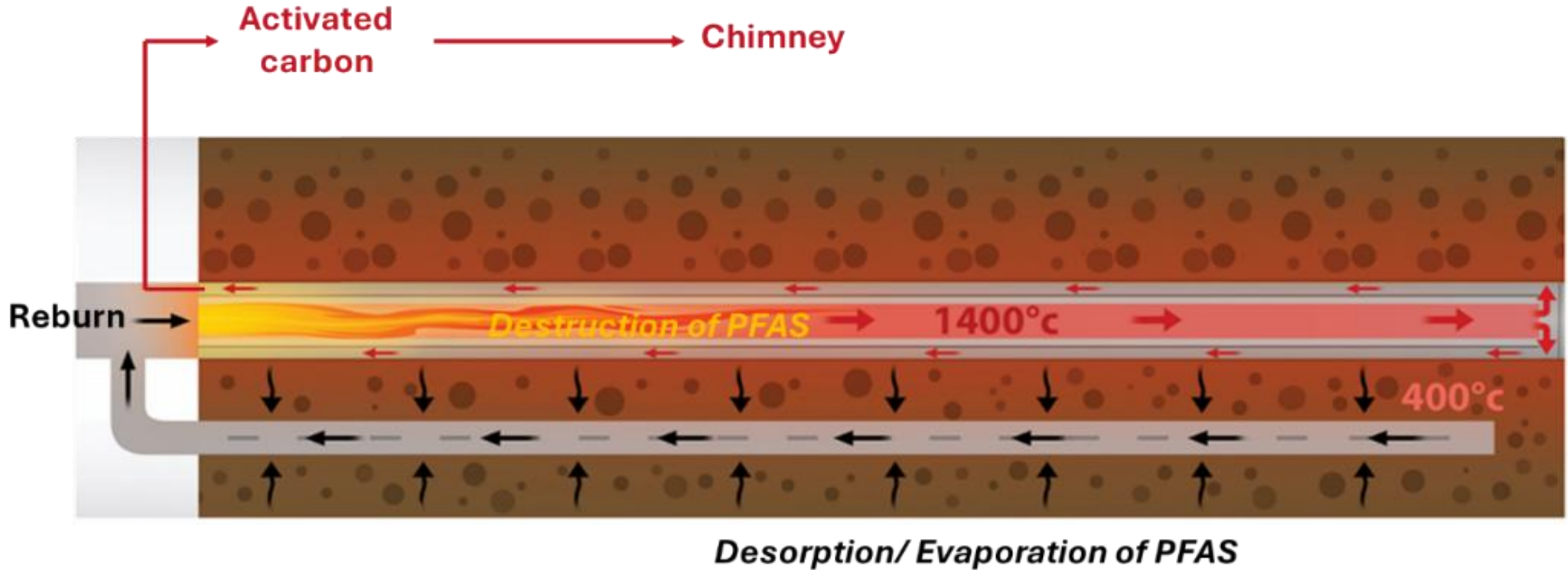
Known 1: Complete Mineralization Requires >1,400°C



Known 2: PFAS Volatilization Above 350°C



Krysalis: 400°C to Release — 1,400°C to Destroy



Field Demonstration: Korsør, Denmark



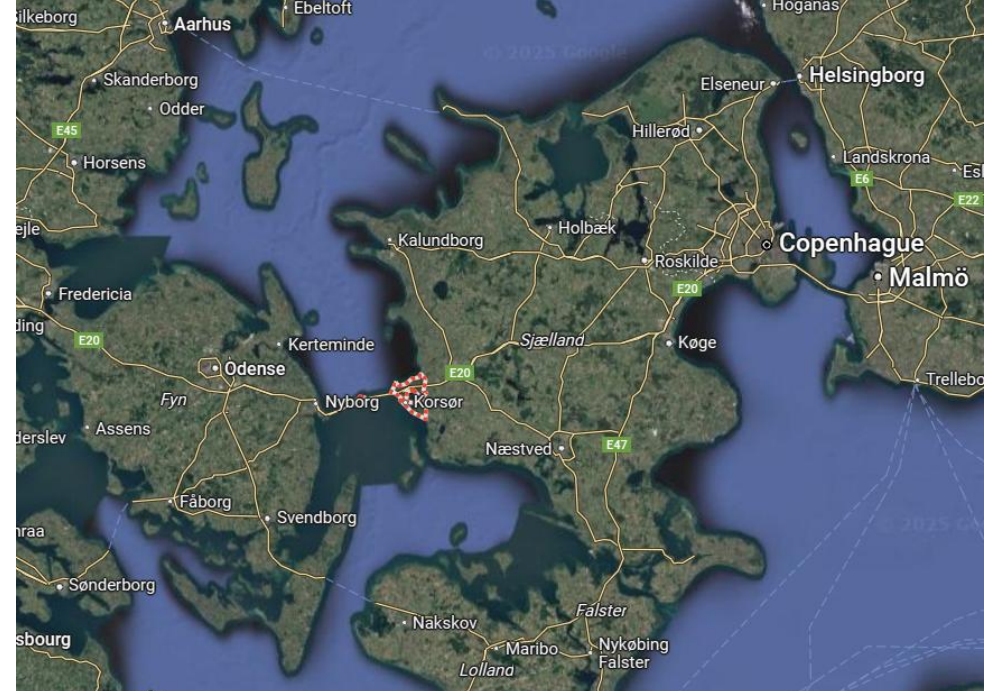
Demo scale
2 batches – 32t each

PFOS/PFOA/PFH_xS/PFNA
200 – 1100 µg/kg

Containerized treatment
(excavated soil)

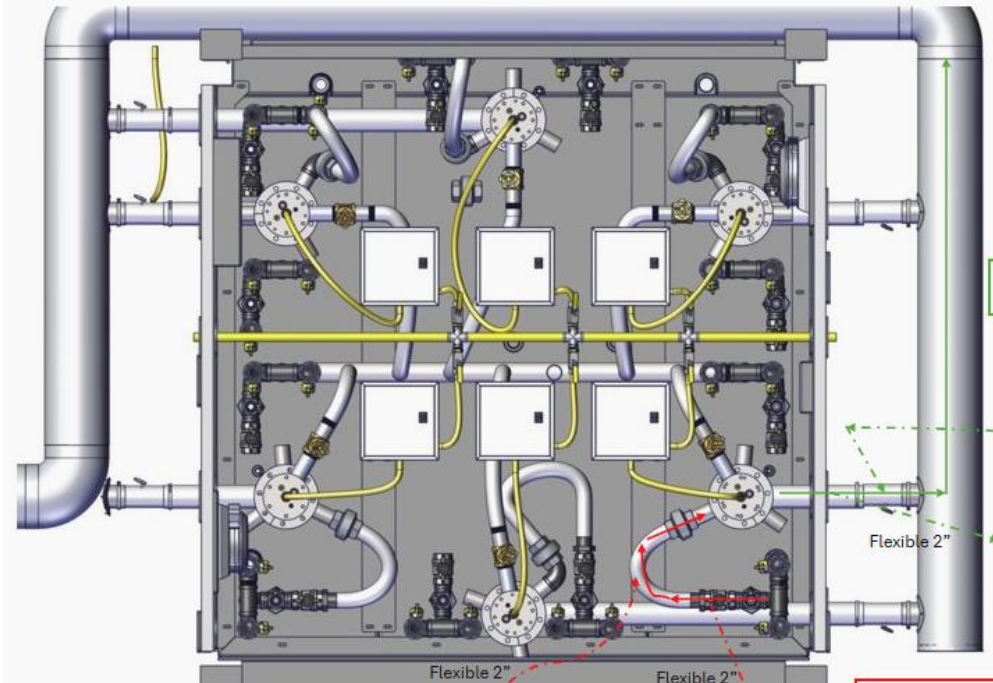
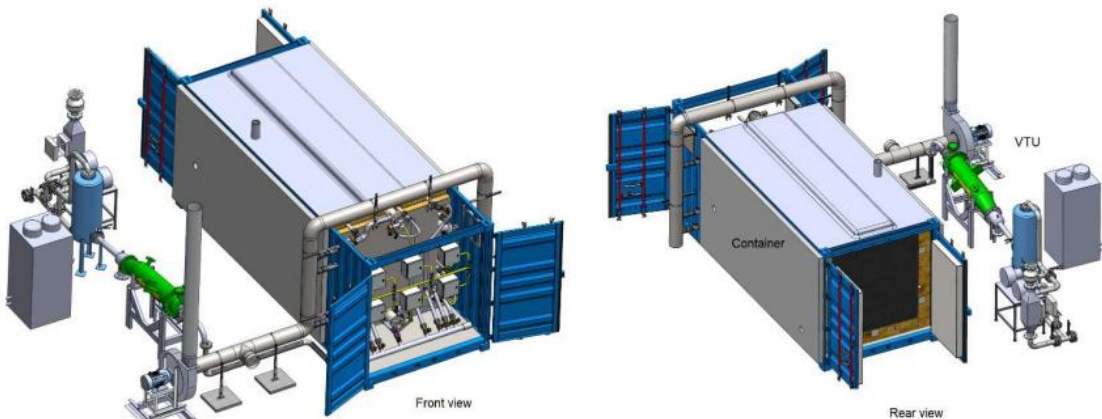
Objectives :
PFAS in soil: nd
No PFAS in vapors
No short chains

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Container Design

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Sample #	Sample location	Dybde/placering	Resultater modtaget	PFAS 22	Top Assay PFAS 35	EOF	Non target
6	Center line - 1 m from burners, ½ meter below roof	0,5 meter under top	n.d.	n.d.			
7	Center line - 2 m from burners, ½ meter below roof	0,5 meter under top	n.d.	n.d.			
8	Center line - 3 m from burners, ½ meter below roof	0,5 meter under top	0,27 µg/kg PFAS4				
9	Center line - ½ meter from back end of container, ½ meter below roof	0,5 meter under top	3,6 µg/kg PFOS				
19	Mix sample off 6, 10 and 16 (3 * 1/3)	0,5 meter under top	n.d.	n.d.			
22	Mix sample off 6, 10 and 16 (3 * 1/3)	0,5 meter under top	n.d.		n.d.		
1	Cold point - 1 m from burners	Midt container ved rør	n.d.	n.d.			
2	Cold point - 2 m from burners	Midt container ved rør	n.d.	n.d.			
3	Cold point - 3 m from burners	Midt container ved rør	n.d.	n.d.			
4	Cold point - ½ meter from container end near burners	Midt container ved rør	n.d.	n.d.			
5	Cold point - ½ meter from back end of container	Midt container ved rør	0,14 µg/kg PFOS				
20	Cold point - 2 m from burners	Midt container ved rør	n.d.		n.d.		
21	Cold point - 3 m from burners	Midt container ved rør	n.d.		n.d.		
23	Cold point - 2 m from burners	Midt container ved rør	n.d.			n.d.	
24	Cold point - 3 m from burners	Midt container ved rør	n.d.			n.d.	
25	Cold point - 2 m from burners	Midt container ved rør					n.d.
26	Cold point - 3 m from burners	Midt container ved rør					n.d.
13	Halfway between cold point and container side, 1 meter from burner end	Midt container	n.d.	n.d.			
14	Halfway between cold point and container side, 2 meter from burner end	Midt container	n.d.	n.d.			
15	Halfway between cold point and container side, 3 meter from burner end	Midt container	n.d.	n.d.			
27	Halfway between cold point and container side, 2 meter from burner end	Midt container					n.d.
28	Halfway between cold point and container side, 3 meter from burner end	Midt container					n.d.
10	Center line - 1 m from burners, ½ meter above floor	0,5 meter over gulv	n.d.	n.d.			
11	Center line - 2 m from burners, ½ meter above floor	0,5 meter over gulv	n.d.	n.d.			
12	Center line - 3 m from burners, ½ meter above floor	0,5 meter over gulv	n.d.	n.d.			
16	Next to heater pipe 4, 1 meter from burner	Ved brænder 4	n.d.	n.d.			
17	Next to heater pipe 4, 2 meter from burner	Ved brænder 4	n.d.	n.d.			
18	Next to heater pipe 4, 3 meter from burner	Ved brænder 4	n.d.	n.d.			

Soil leachates

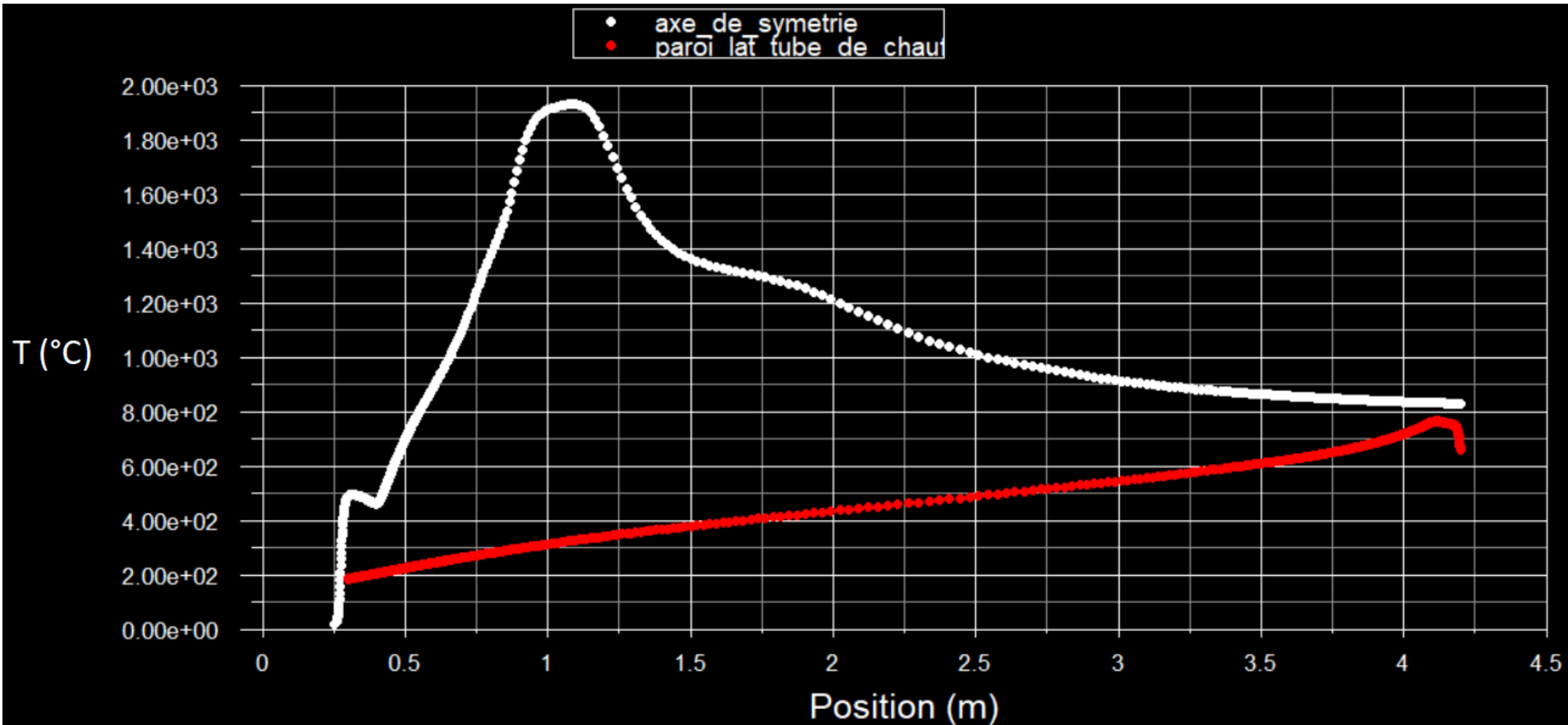
Compound	Unit	Before treatment	After treatment
PFOS	ng/l	7,300	1.7
PFHxS	ng/l	3,100	1.4
6:2 FTS	ng/l	3,900	2.2
PFOA	ng/l	380	1.1
Sum PFOA+PFOS+PFNA+PFHxS	ng/l	11,000	4.2
Sum of 22 PFAS (DK BEK nr 1023)	ng/l	17,000	11

Sum of 22 PFAS: 17,000 → 11 ng/l (>99.9% reduction). Values shown are the compounds most relevant to the DK BEK nr 1023 (29/06/2023) sum limits; the full 22-compound dataset (Eurofins, ISO/IEC 17025) is available in the downloadable technical report.

OTM45-OTM50 – XAD sampling



The Role of Temp/H in Complete Mineralization



Vapors — Confirmation Complete Mineralization

Before reburn (entering the burners)

- Sum PFAS-22: 480 ng/L
- Sum PFAS (TOP Assay): 2,200 ng/L
- Short-chain PFAS confirmed present:
 - PFBA: 68 ng/L
 - PFHxA: 110 ng/L
 - 6:2 FTS: 200 ng/L

Field gene detection Perfluorooctane sulfonic acid (PFOS)	%	**	13
Field gene detection Perfluorooctanoic acid (PFOA)	%	**	9.4
Field gene discovery Perfluorobutanoic acid (PFBA)	%	**	7.2

After reburn (post-combustion stack)

- PFAS-22 / PFAS-35: **non-detect**
- TOP Assay / EOF: **non-detect**
- CF₄ (tetrafluoromethane): **non-detect**
- TFA (trifluoroacetic acid): **non-detect**
- C₂F₆, C₂F₄, hexafluoropropylene, FC-C318, FC-C1418, vinyl fluoride, chlorotrifluoroethane: all non-detect

Tetrafluoromethane

ND H

15

1.5 ppb v/v

Treated Soil: Ready for Immediate Reuse

Biodiversity
(plants, roots)

Structure and texture
(grains intact)



Nutrient cycling

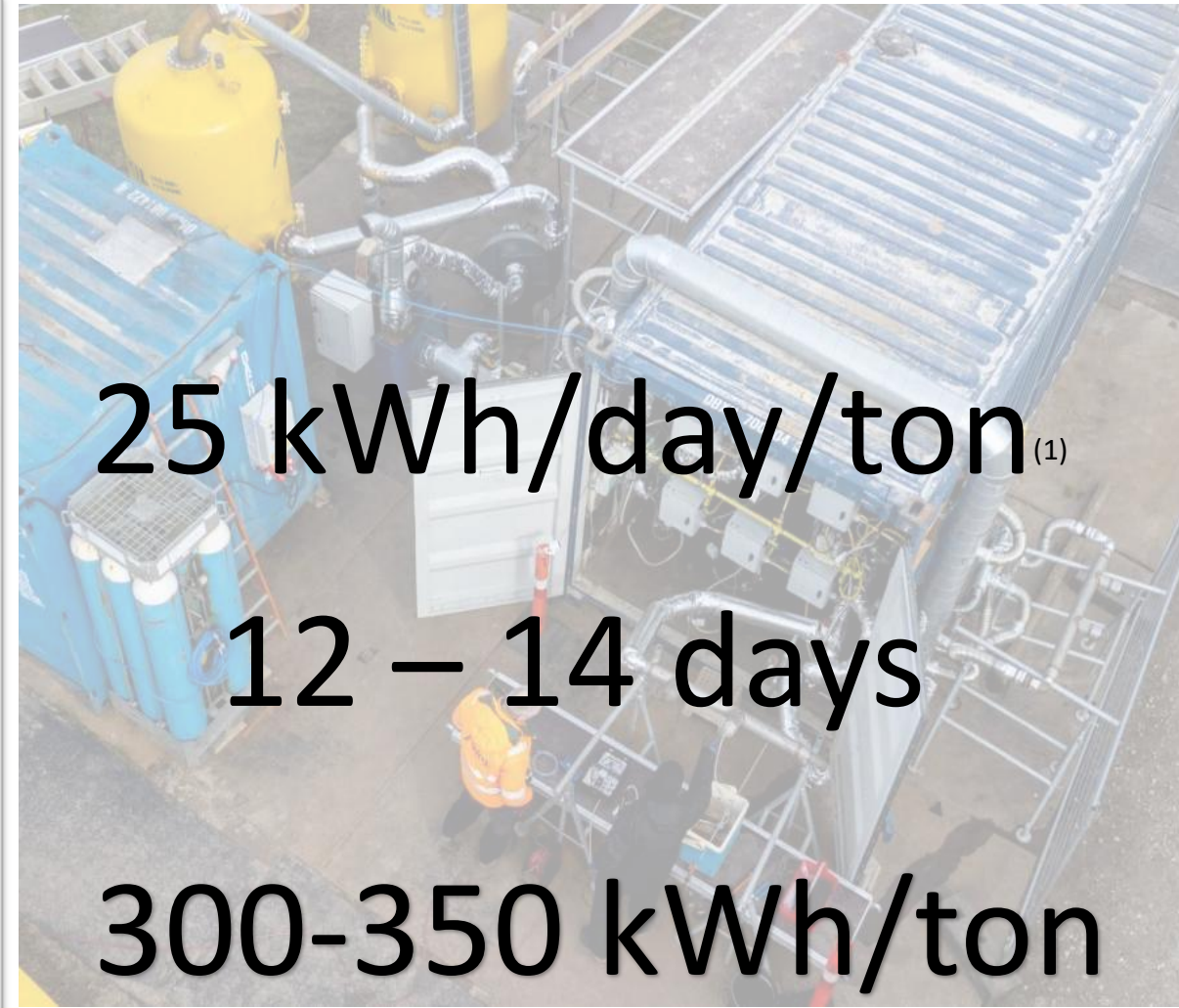
Carbon storage

Energy Consumption

Lower power, longer duration

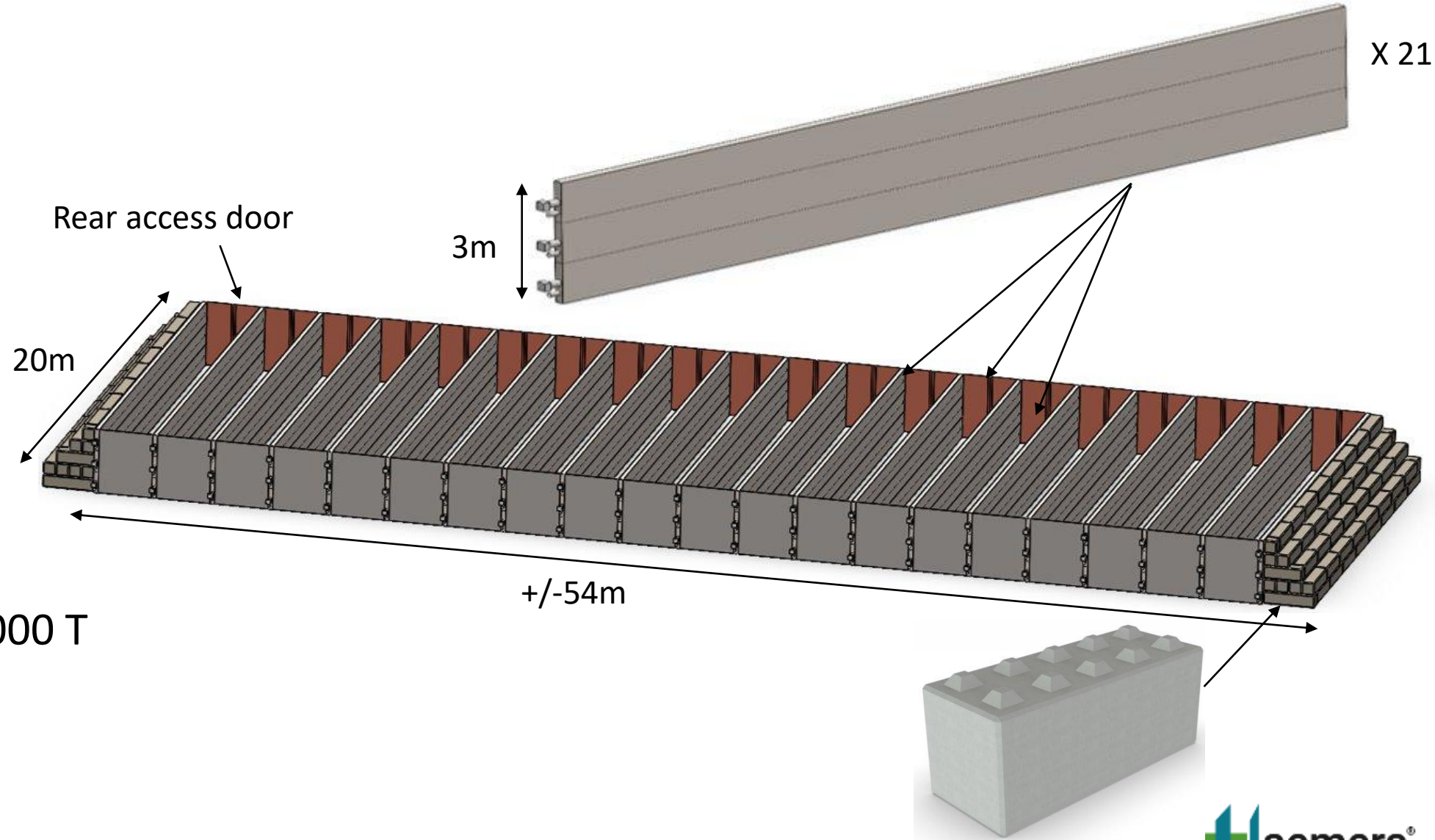


Higher power, shorter duration



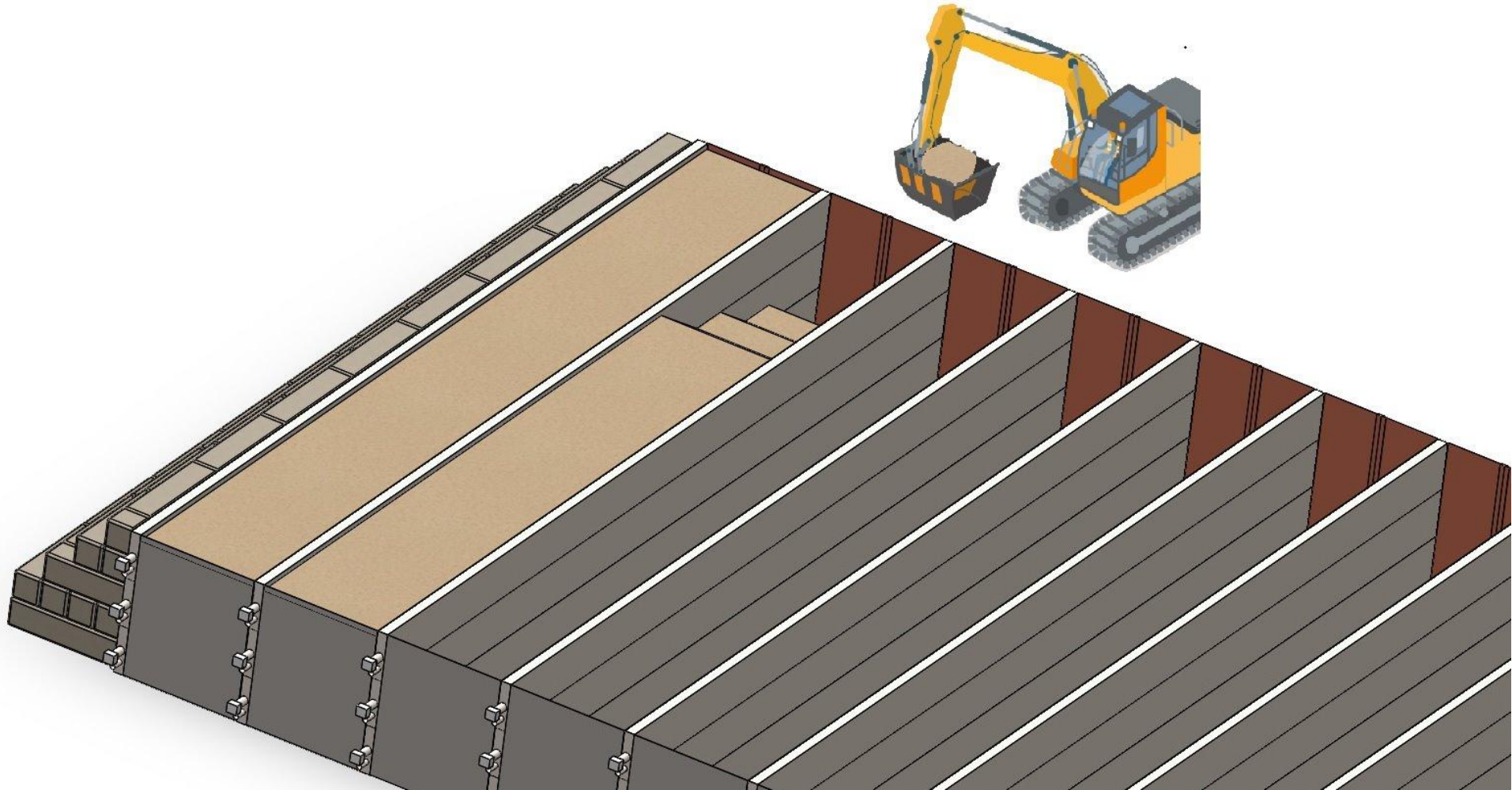
Both scenarios are the same Krysalis system operated at different power/duration settings — not a comparison with a competing technology. (1) Includes one-off demo-specific equipment overhead; see technical annex for the corrected figure.

Modular full scale application : on site



- 5000 T → 80,000 T

Modular full scale application : on site



Summary

Krysalis is a thermal separation technology, followed by a destruction step at high temperature (min 1400°C)

Soil keeps its functions

Energy consumption is reasonable

Technology is scalable

Want to know more?



Download our technical report for
detailed data and insights



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