Haemers® technologies

Scaling up of Dioxin Contaminated Soil Thermal Desorption Treatment:

Laboratory tests and pilot conception at Bien Hoa Airbase, Vietnam

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Avec le soutien de la Wallonie

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Our Company

We invent and develop Thermal Desorption Technologies

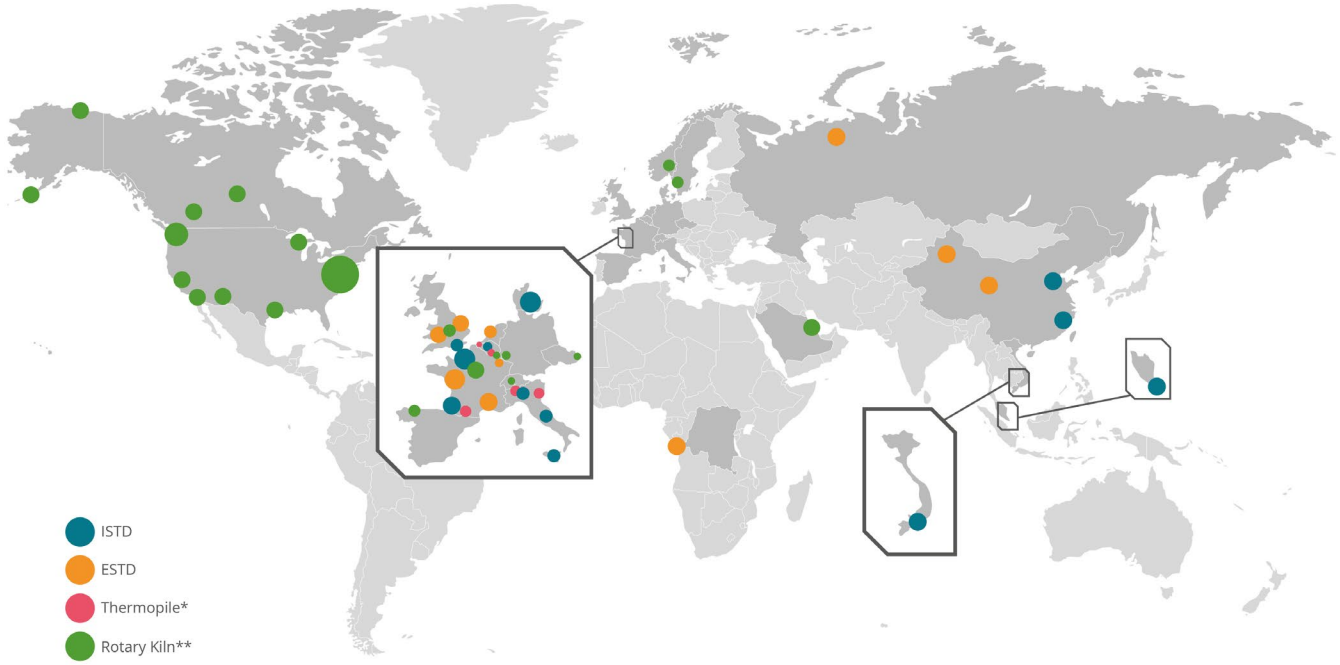
25+ Years in Business

Based in Brussels

Own Smart Burners manufacturing facility

Own Lab and R&D facility

Worldwide operations through our local partners:



Our diverse team:

60
PEOPLE

17
COUNTRIES OF ORIGIN

78%

22%

Introduction

US – Vietnam War

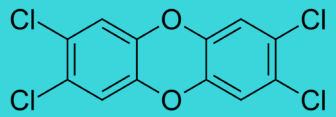
Agent Orange

2,4 – dichlorophenoxyacetic acid

2,4,5 – trichlorophenoxyacetic

⇩

2,3,7,8 – Tetrachlorodibenzo-p-dioxin (2,3,7,8 – TCDD)



Bien Hoa Airbase

- 98 000 barrels Agent Orange
- 45 000 barrels Agent White
- 16 000 barrels Agent Blue

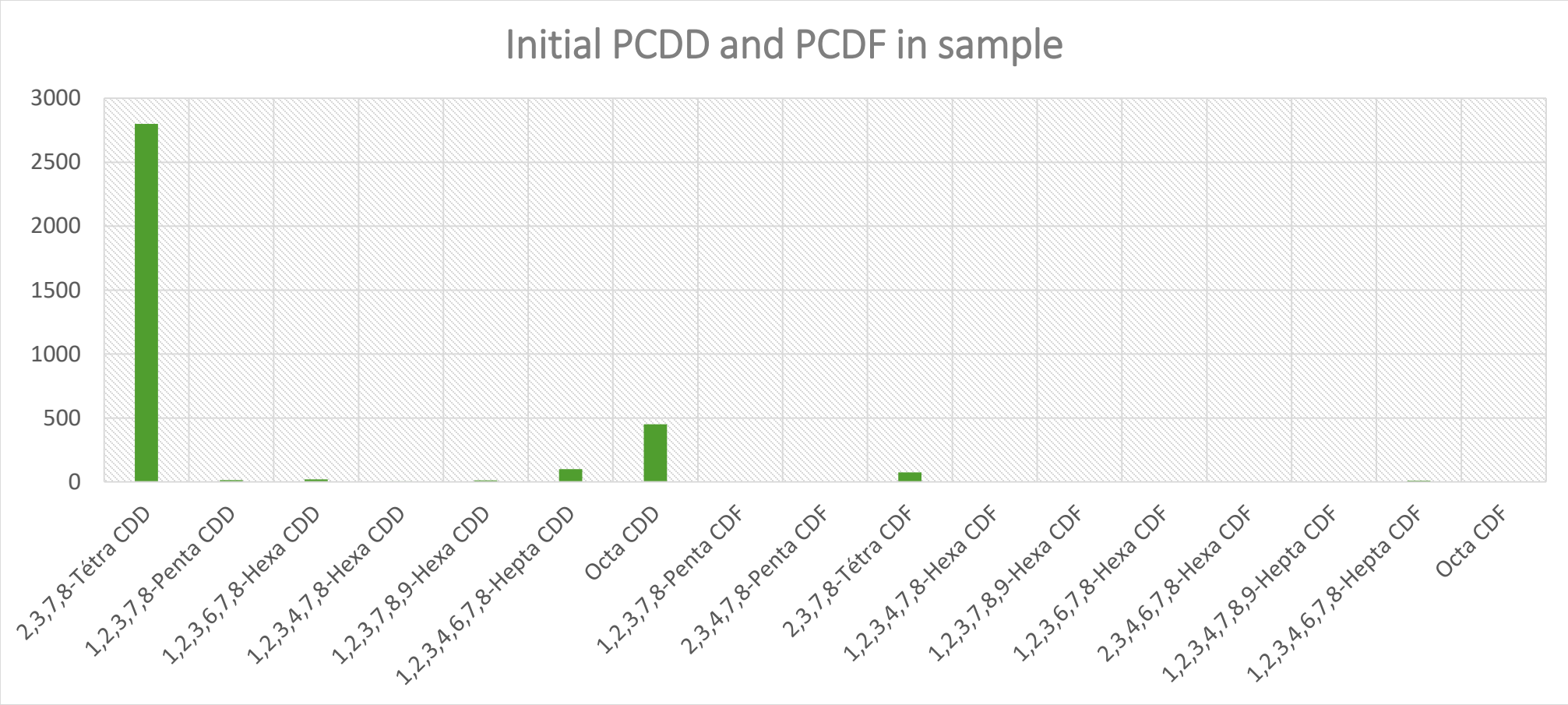
Operation Ranch Hand

Bien Hoa Airbase

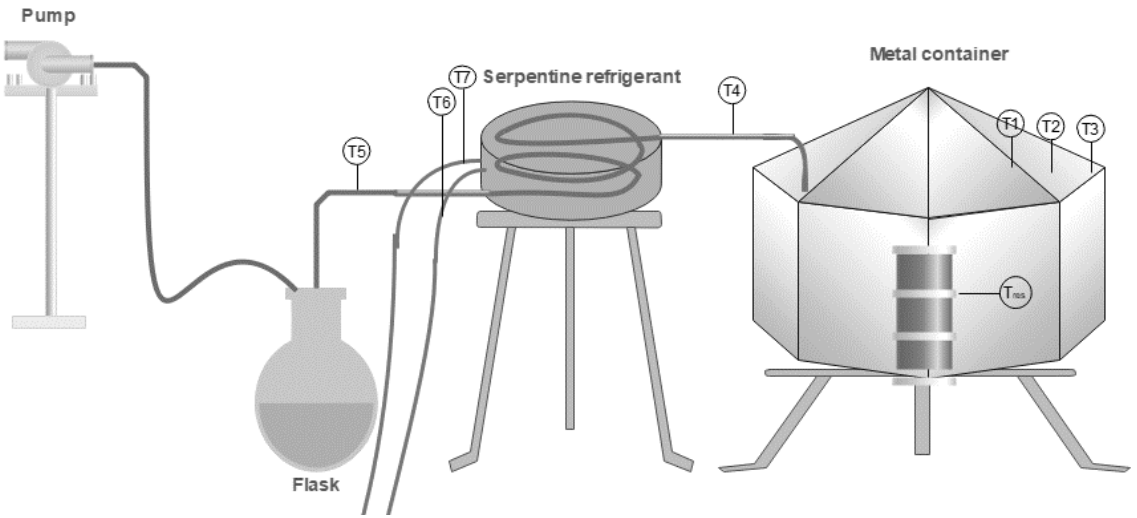
495 300 m³ of dioxin-contaminated soils

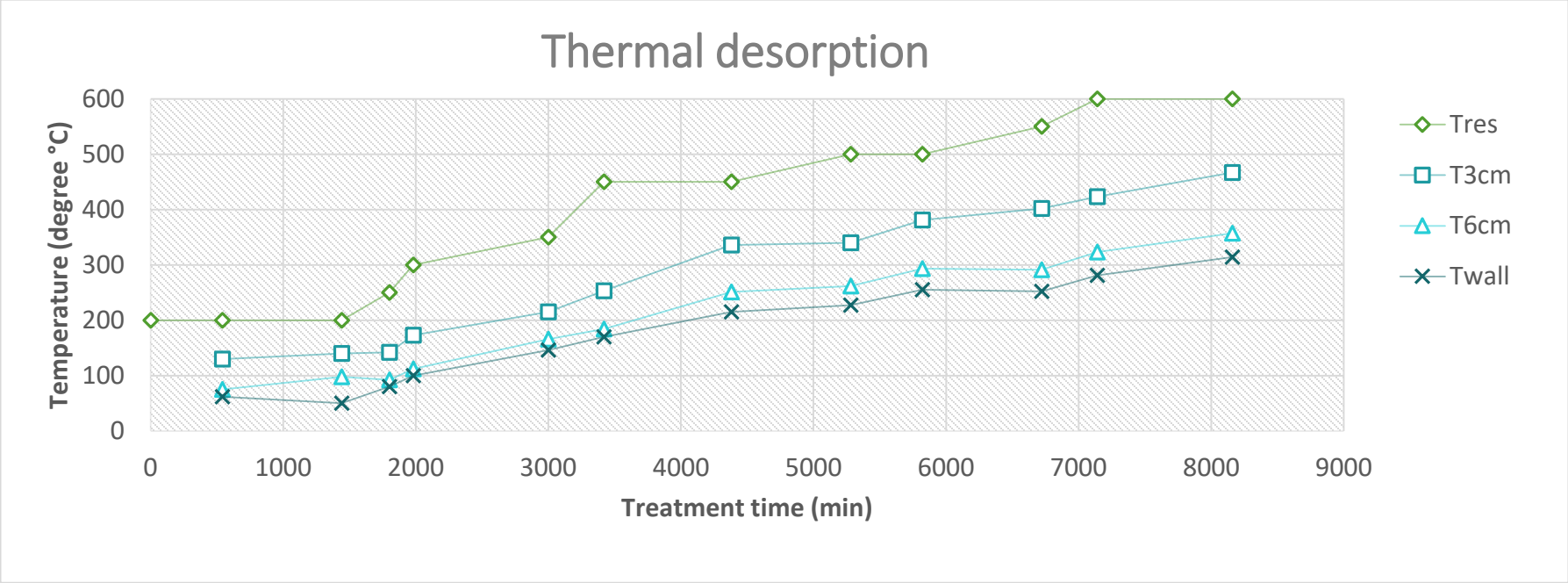
Laboratory Tests

Initial Concentrations



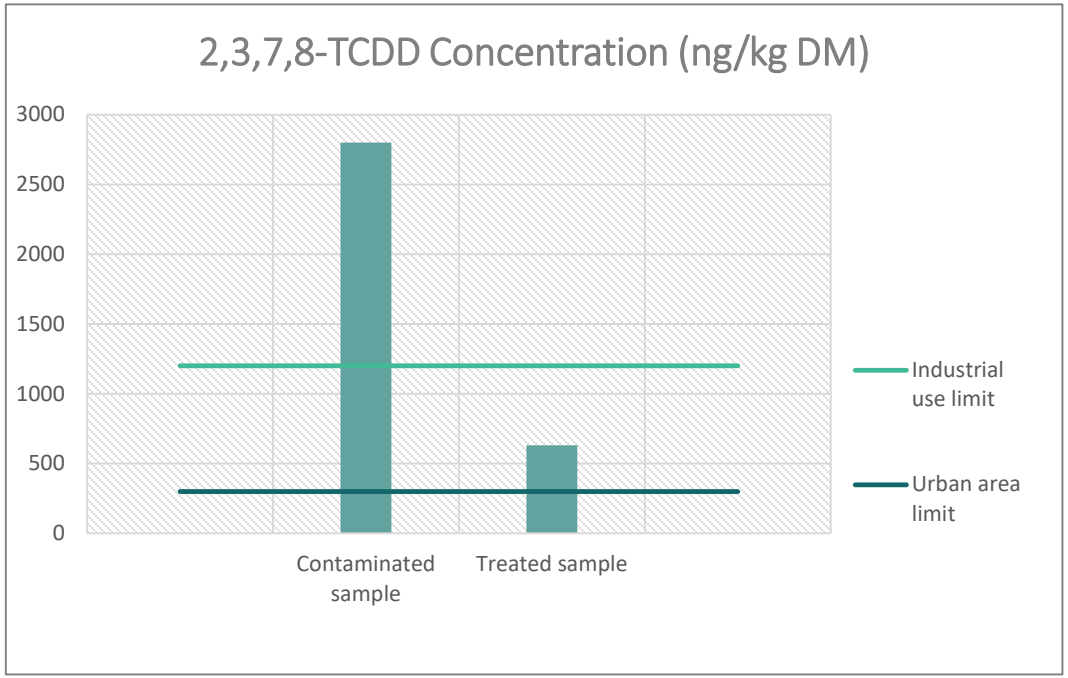
Lab Scale Thermal Treatment





Lab Tests Results

	Contaminated sample	Treated sample	Unit
Dry matter	94,9	99,7	% (dry matter mass)
2,3,7,8-Tétra CDD	2800	630	ng/kg $_{DM}$
1,2,3,7,8-PentaCDD	14	84	ng/kg $_{DM}$
1,2,3,7,8,9-Hexa CDD	13	27	ng/kg $_{DM}$
1,2,3,6,7,8-HexaCDD	20	42	ng/kg $_{DM}$
1,2,3,4,7,8 -Hexa CDD	3,5	7,5	ng/kg $_{DM}$
1,2,3,4,7,8,9-Hepta CDD	99	46	ng/kg $_{DM}$
Octa CDD	450	200	ng/kg $_{DM}$
1,2,3,7,8 Penta CDF	1,7	3,2	ng/kg $_{DM}$
2,3,4,7,8-Penta CDF	1,2	2,8	ng/kg $_{DM}$
2,3,7,8-Tétra CDF	75	28	ng/kg $_{DM}$
1,2,3,7,8,9 - Hexa CDF	<1,0	<1,0	ng/kg $_{DM}$
2,3,4,6,7,8 - Hexa CDF	2,3	1,9	ng/kg $_{DM}$
1,2,3,4,7,8 Hexa CDF	1,5	2,0	ng/kg $_{DM}$
1,2,3,6,7,8 Hexa CDF	<1,0	1,4	ng/kg $_{DM}$
1,2,3,4,7,8,9 -Hepta CDF	<5,0	<5,0	ng/kg $_{DM}$
1,2,3,4,6,7,8 -Hepta CDF	9,4	<5,0	ng/kg $_{DM}$
Octa CDF	<10	<10	ng/kg $_{DM}$
I-TEQ-PCDD/F-OTAN/CCMS (lower limit)	2820	685	ng/kg $_{DM}$
I-TEQ-PCDD/F-OMS 1998 (lower limit)	2830	727	ng/kg $_{DM}$
I-TEQ-PCDD/F-OMS 2005 (lower limit)	2830	726	ng/kg $_{DM}$
I-TEQ-PCDD/F-OTAN/CCMS (upper limit)	2820	685	ng/kg $_{DM}$
I-TEQ-PCDD/F-OMS 1998 (upper limit)	2830	727	ng/kg $_{DM}$
I-TEQ-PCDD/F-OMS 2005 (upper limit)	2830	727	ng/kg $_{DM}$



Smart Burners™

Smart Burners™

/1 Conduction Soil Heating

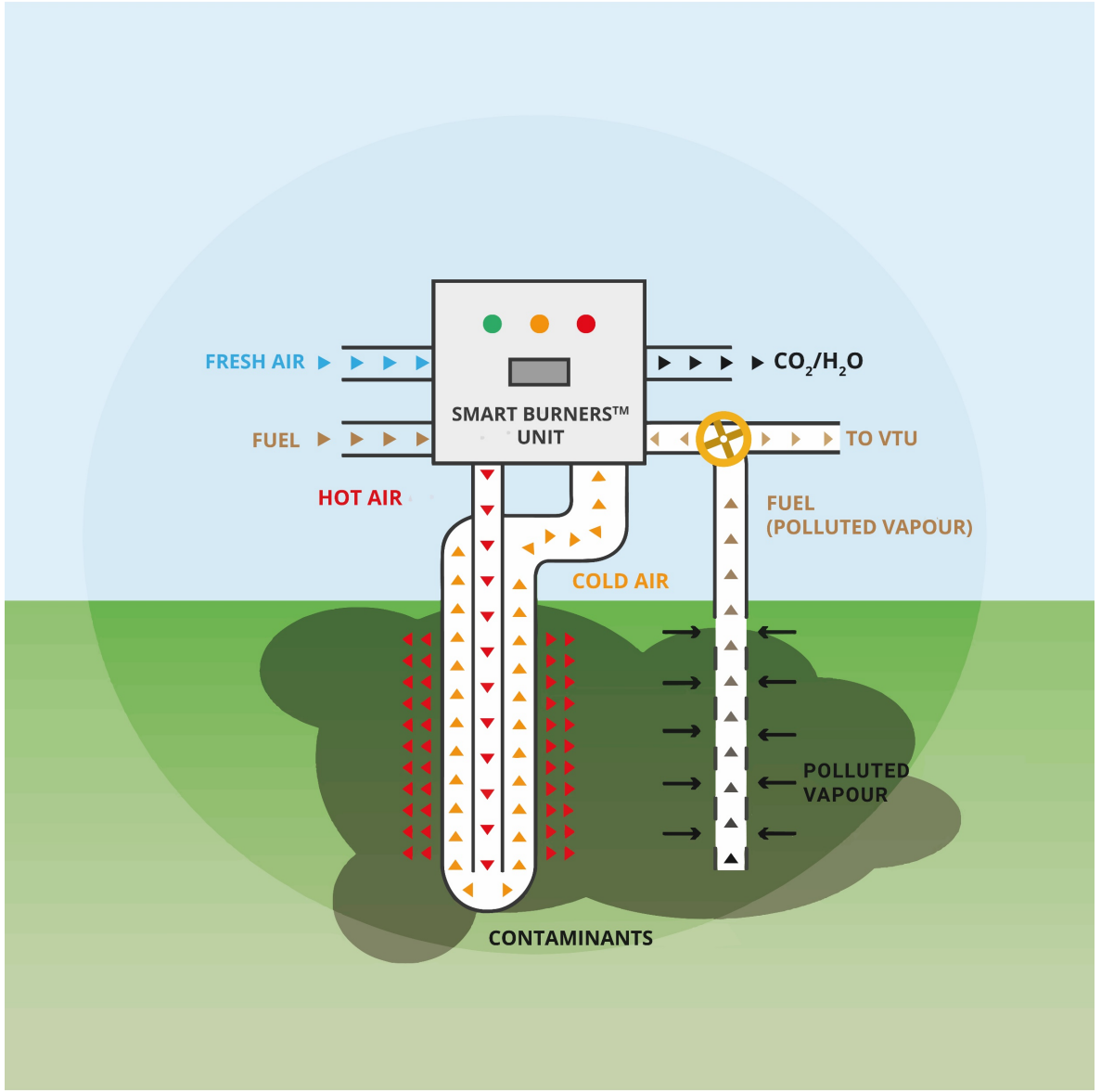
Energy Injection (Smart Burners) into the soil

/2 Vapor Extraction

Vapor recovery by suction

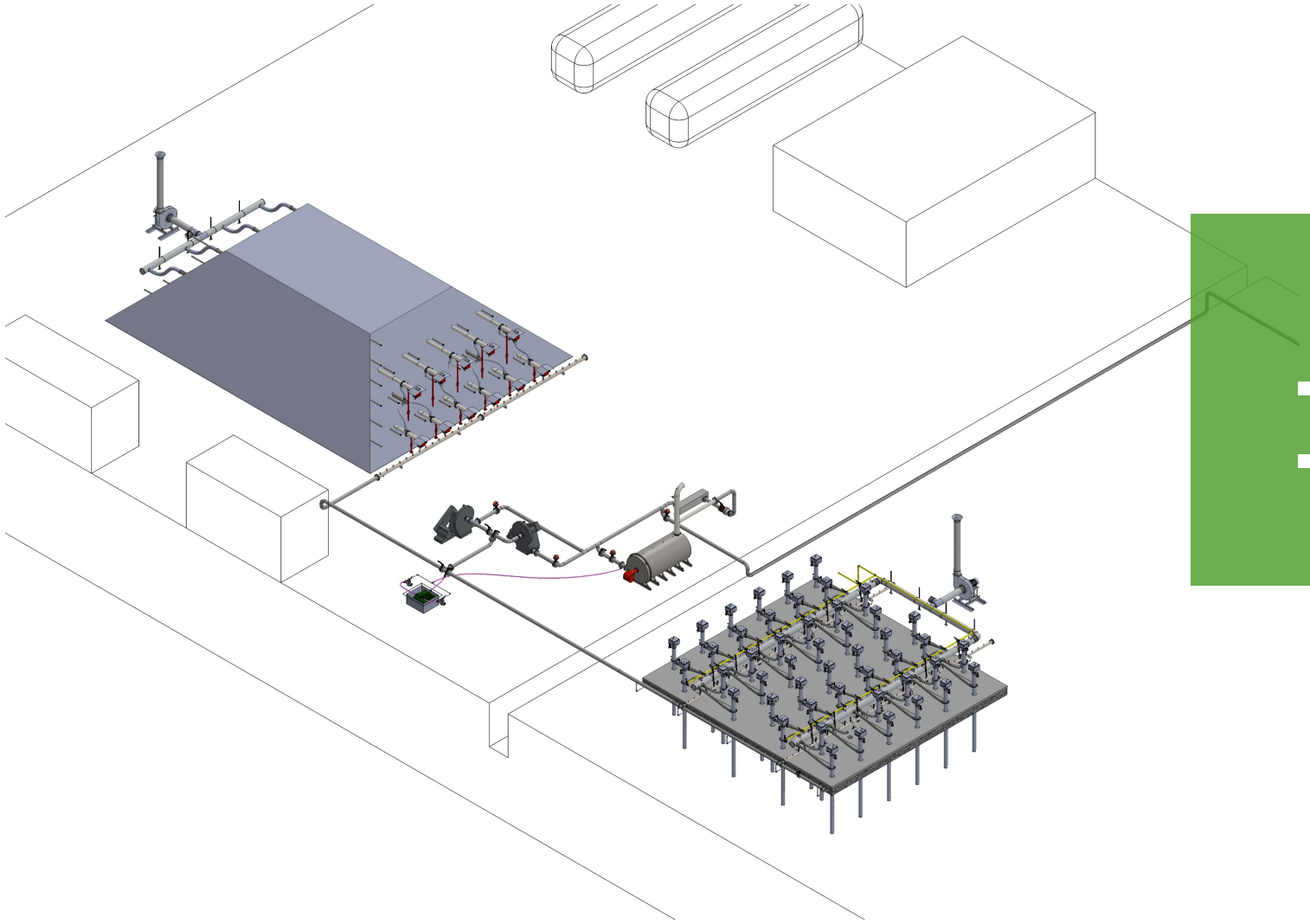
/3 Vapor Treatment

Condensation, Activated Carbon, Thermal Oxidizer, …



Pilot Design

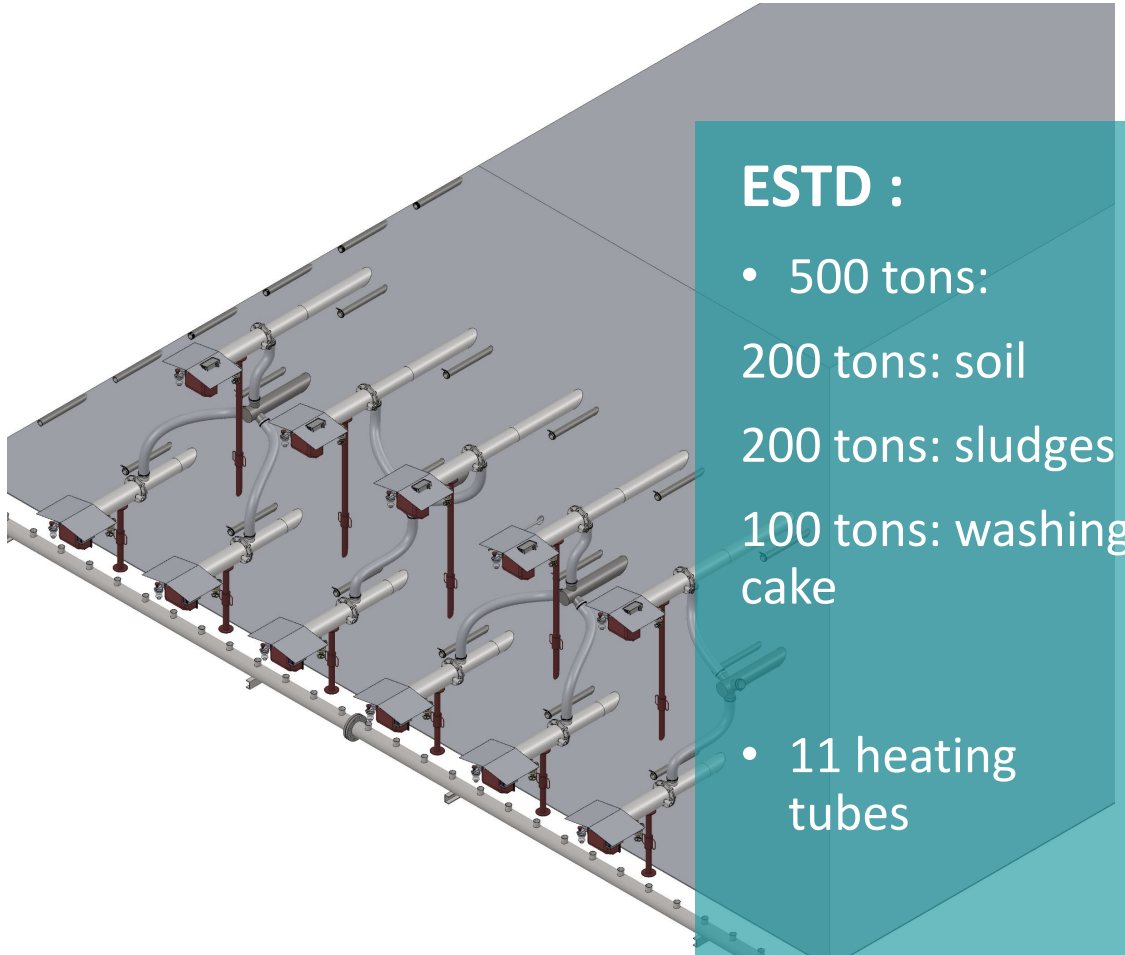
Pilot Design



Treatment objectives

- Industrial use: 1.200 ppt
- Urban area: 300 ppt

Pilot Design



ESTD :

- 500 tons:

200 tons: soil

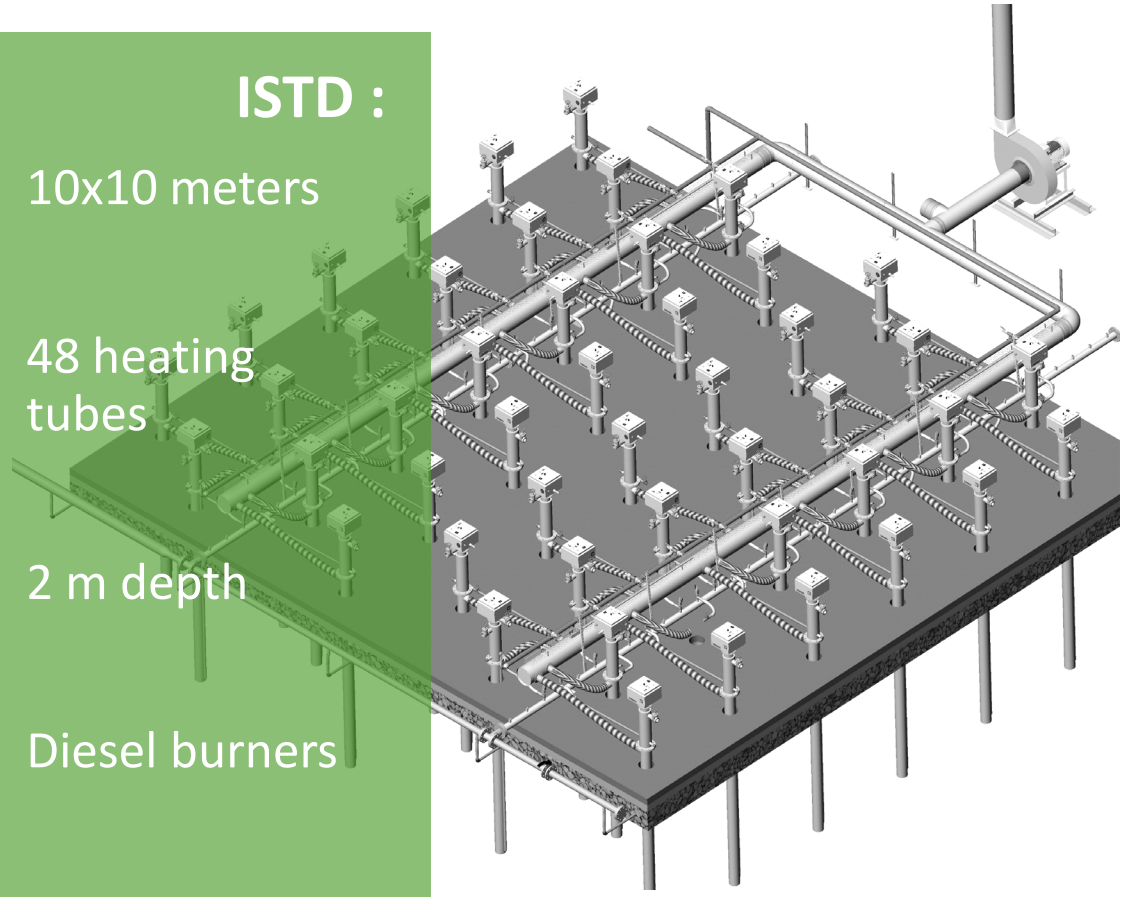
200 tons: sludges

100 tons: washing cake

- 11 heating tubes
- Diesel Burners

ISTD :

- 10x10 meters
- 48 heating tubes
- 2 m depth
- Diesel burners



Vapor Treatment

Vapor Treatment

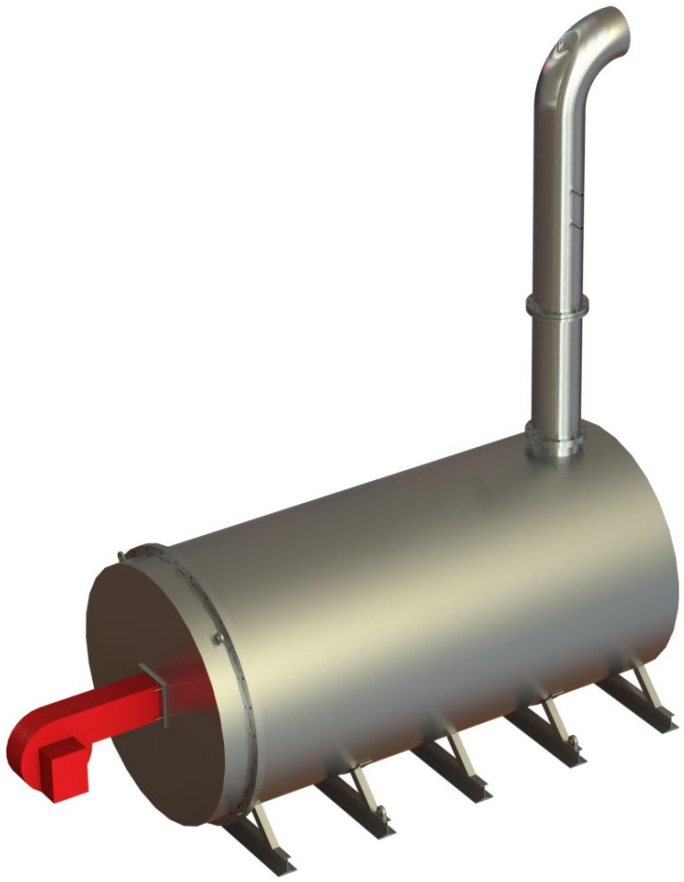
Thermal Oxidation

+ No waste
+ PCDD/PCDF destruction
- High energy consumption

Condensation and Adsorption (Activated Carbon)

+ Low energy consumption
- Liquid and solid waste
- Post treatment

Vapor Treatment



Thermal Oxidation

- Temperature: min. 1100°C (1200°C)
- Oxygen content: min. 6% (10%)
- Residence time: min. 1s (2s)
- High turbulence (Re>>2500)
- Fast cooling

➔ Complete destruction of all dioxins

Conclusions

Conclusions

Pilot Project Design

ISTD 200m³

ESTD 500 tons

VTU: Thermal Oxidizer

Laboratory Tests

TD is effective for dioxins/furans remediation

Target Temperature: 350°C

Haemers® technologies

Thank you for your attention!

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