Désorption thermique in situ et C3: vers une dépollution durable et complète

In Situ Thermal Desorption & C3 Technologies: Towards Sustainable and Complete Remediation

TPSTECH

SURF
SUSTAINABLE REMEDIATION FORUM

Agenda

- Introduction
- ISTD/C3 technologies: Comment?/*How?*
- Quelques exemples – *Some examples*
- *Sustainability scoring*
- Conclusions

TPS TECH: Who We Are

+ Technology & Innovation in Thermal Desorption & Vapor Collection

- TPS TECH first started business operations in 1989 (Adelanto, CA)
- GEO (part of TPS TECH) invented C3 technology in 1994 – started operations in 1996 in Irvine, CA
- 20+ years experience in thermal desorption, vapor collection and in situ remediation
- > 8 million tons treated by thermal desorption
- > 130 on site and in situ thermal desorption /C3 projects completed
- > 1,300,000 gallons of VOCs treated/extracted from in situ zones
- US, EU, AU and PCT patents, plus numerous pending patents

TPS TECH – Who we are

+ **Experts and Advisors**
  - 70 employees – 3 offices (US and Europe) – 2 laboratories – 1 R&D center

+ **Licensees/partners worldwide**
  - In France:
    - GTS
    - Eiffage (Boutté)
    - ORTEC (OGD)
    - ICF (pending)
    - Biogenie (pending)

ISTD/C3

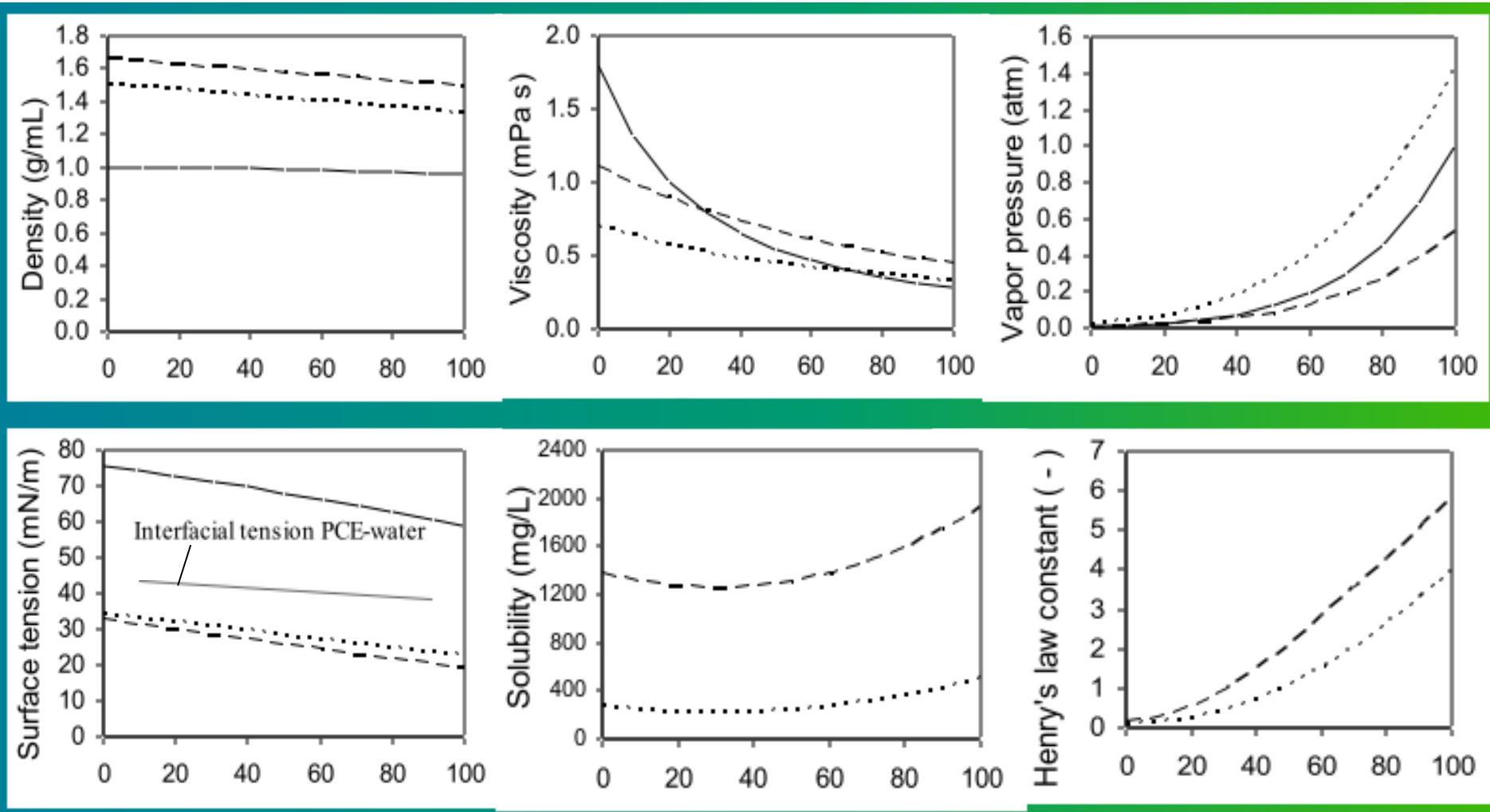
How? Comment?

Why Thermal Works

Heat causes the following to happen:

- **Vapor pressure of organic materials increase**
- **Viscosity of separate phase liquids decrease**
- **Sorption coefficients of dissolved phase compounds decrease**
- **Diffusion rates increase**
- **Solubility increases**
- **Rates of abiotic degradation increase**
- **Rates of Hydrolysis increase**
- **Pyrolysis also takes place**
- **Oxidation occurs at superheating temperatures**

Why Thermal Works



Thermal Properties of Soil

Flux heat conduction: $\dot{q} = -\lambda \frac{\partial T}{\partial x}$

Soil	Thermal conductivity (λ) [W/mK]	Permeability [m2]
Clay (dry)	0.6	10^{-16}-10^{-20}
Water saturated clay	1.4	
Sand	0.5	10^{-10}-10^{-12}
Water saturated sand	2.3	
Gravel (dry)	0.4	10^{-7}-10^{-9}
Water saturated gravel	1.7	

ISTD/C3

+ **ISTD:**
  - Extract contaminants from soil by transfer to the vapor phase and collecting vapors at the surface

+ **C3:**
  - Treat the surface-vapors and condense all contaminants to a recyclable product

ISTD + C3 = recycling contaminant

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How It Works

Closed-loop in-situ thermal conduction heating system;

Co-located vapor extraction and heating wells;

Treatment temperatures from **~100°C** to **>400°C**

Vapor Recycling:

- as fuel
- as liquid product

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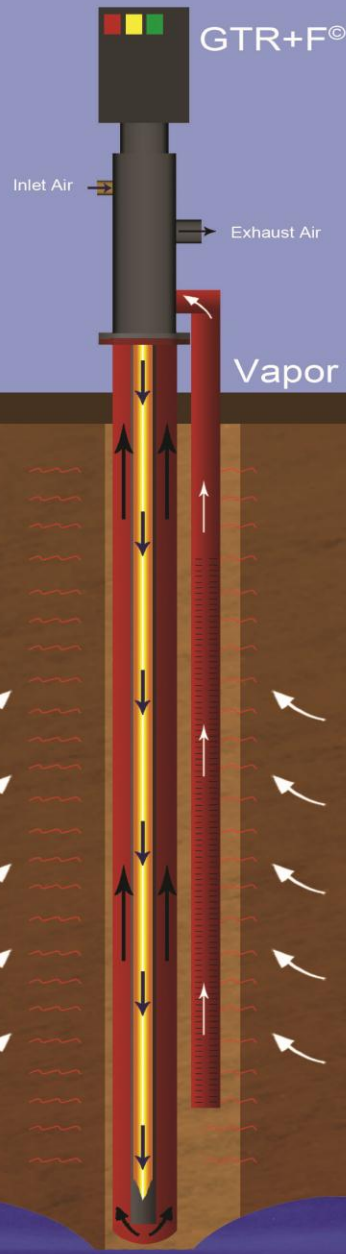
In-Situ Thermal Desorption by TPS TECH AMERICA

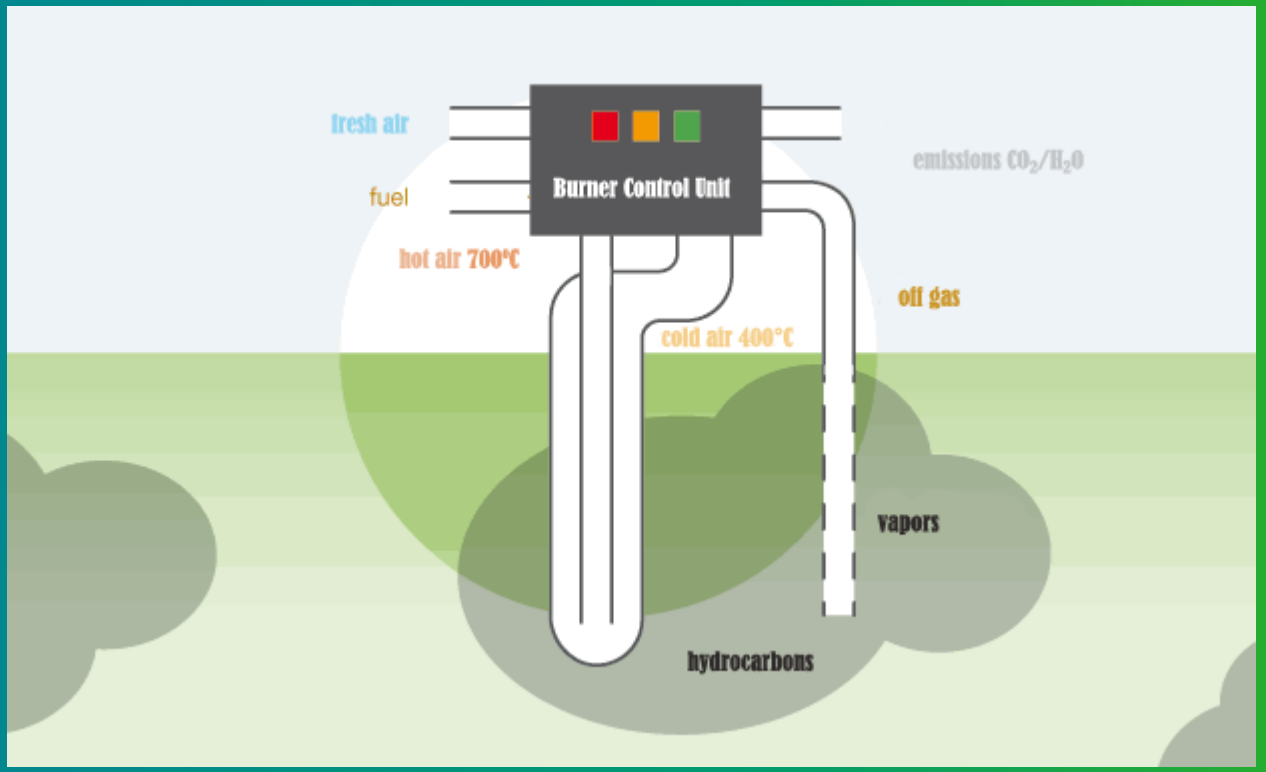


More information at:
www.tpstech.com

How GTR© Works

+ Propane or natural gas is used to heat the air circulating within the pipes
+ Soil is heated indirectly through conduction
+ Vaporized contaminants are collected from extraction wells and routed to heaters as a supplemental fuel source (contaminants can also be routed to a vapor treatment system)

How it works: GTR© (Gas-Thermal-Remediation)



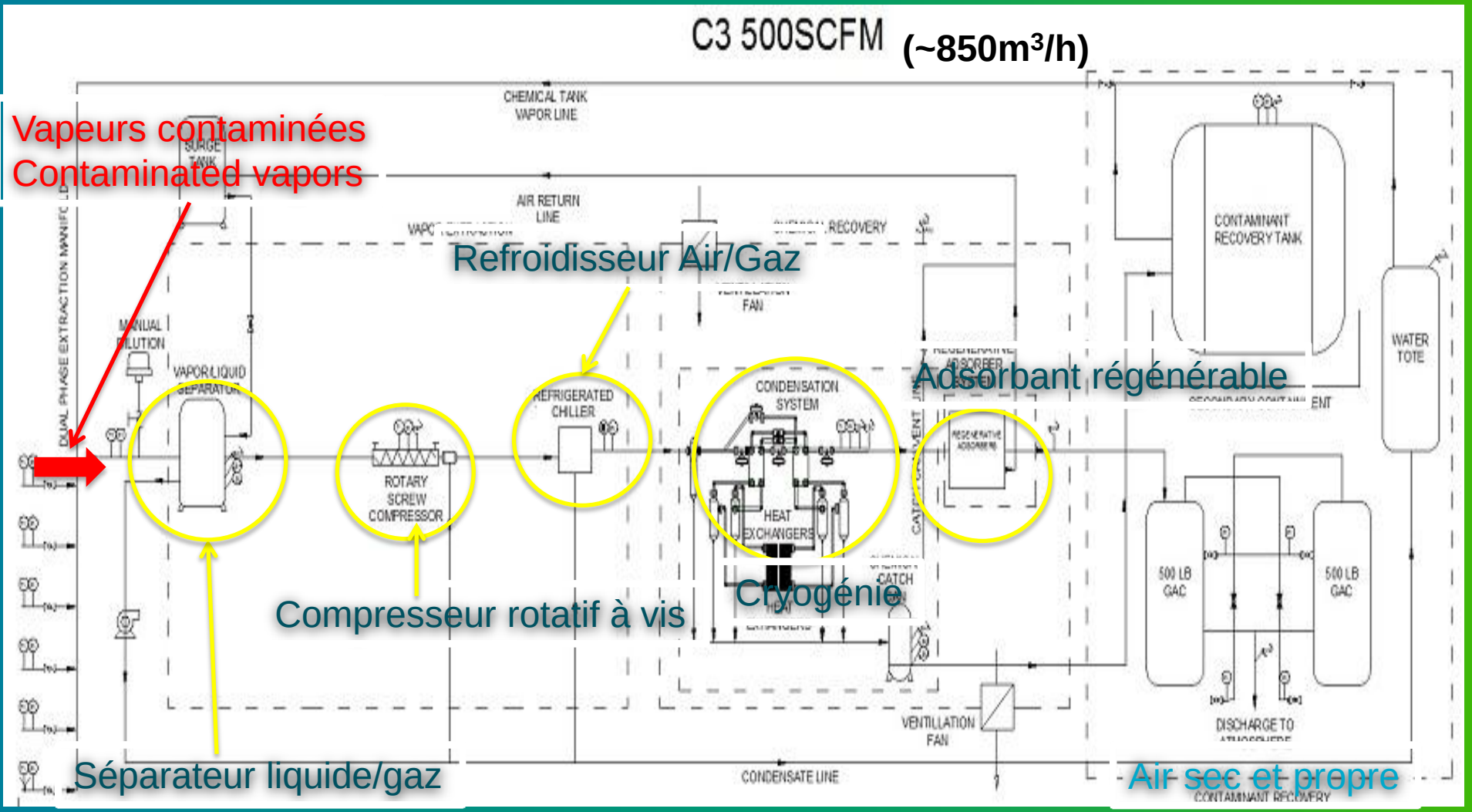
Above animation is of GTR+F (+fuel) installation;
Chlorinated applications use separate SVE/DPE wells and/or trenches.

Unique Attributes of Gas·Thermal·Remediation

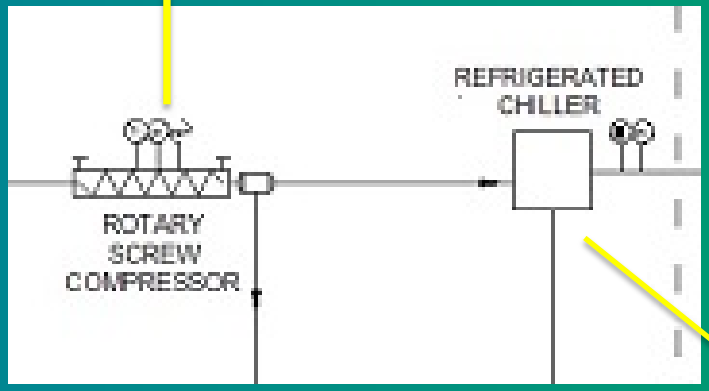
Chlorinated Solvent Treatment March 2012

1. **Scalable**
   - Can be applied to very large and very small projects
   - From 300 m^3 to over 100,000 m^3
2. **Vertical Control**
   - Target heat to different depths
3. **Pollution → Energy**
   - Can utilize off-gas as supplemental fuel when appropriate
4. **No Electricity Required**
   - Small generator can power any project electrical demands (i.e. vapor treatment)

C3: Process Description du procédé

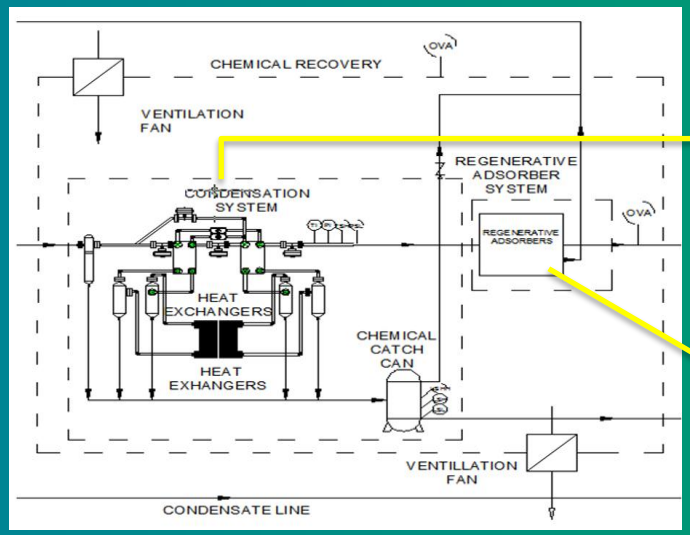


C3: étape 1



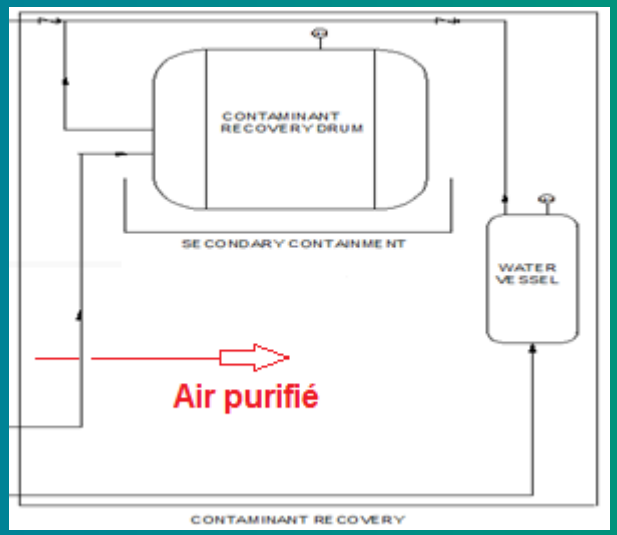
- ***Vapeur est comprimée à P>10 bars***
- ***Flux de vapeur sous pression est pré-conditionnée pour le refroidissement et la condensation cryogénique***

C3: étape 2



- ***Les vapeurs sont réfrodies par cryogénie jusqu'à T ≤ -35°C***
- ***Les contaminants sont condensés en phase séparée***
- ***L'air est ensuite traité par adsorption régénérative***

C3: étape 3



- ***L'air traité quitte C3 avec des concentrations en contaminant <1 ppmv (produits de pétrole)***
- ***Le condensat est récupéré, séparé puis envoyé vers un centre de recyclage***
- ***Pas de génération de déchet***

COC Discrimination
Three Levels of Treatment

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Level of Heating & Contaminant	Target Treatment Temperature (°C)	Heating Well Spacing (m)	Desiccation of Zone?	Range of Costs (all inclusive) ($/m³)
1. VOCs: Gentle Heating (BTEX, CVOCs)	<100	4 – 8	No	40-200
2. VOCs (CVOCs, PAHs)	>100	3 – 6	Depends	60-300
3. SVOCs (PCBs, dioxins)	>200	1.5 – 3	Yes	150-500

In-Situ Thermal Desorption Applications

+ Contaminants Treated:
  - All VOCs and SVOCs
  - LNAPL and DNAPL
  - PAHs
  - Long chain Hydrocarbons
  - Tar
  - Mercury
  - Dioxins
  - Pesticides, Fertilizers and POPs
  - PCBs

Some examples

Unimproved Site: Urban Area (Paris, France)

- Former MGP Site
- No Electricity
- BTEX and PAHs
- February 2012
- 64 Heating Wells
- Rapid Schedule
- PBR Contract
- Propane-based

Unimproved Site: ISTR Operations (Propane)

Propane→Heat
Propane→Electricity

Phase One: Benzene Treatment; Phase Two: Separate PAH Treatment Area

ISTR Mobilized in Less Than One Month

Target Treatment Temperature Reached in Three Weeks

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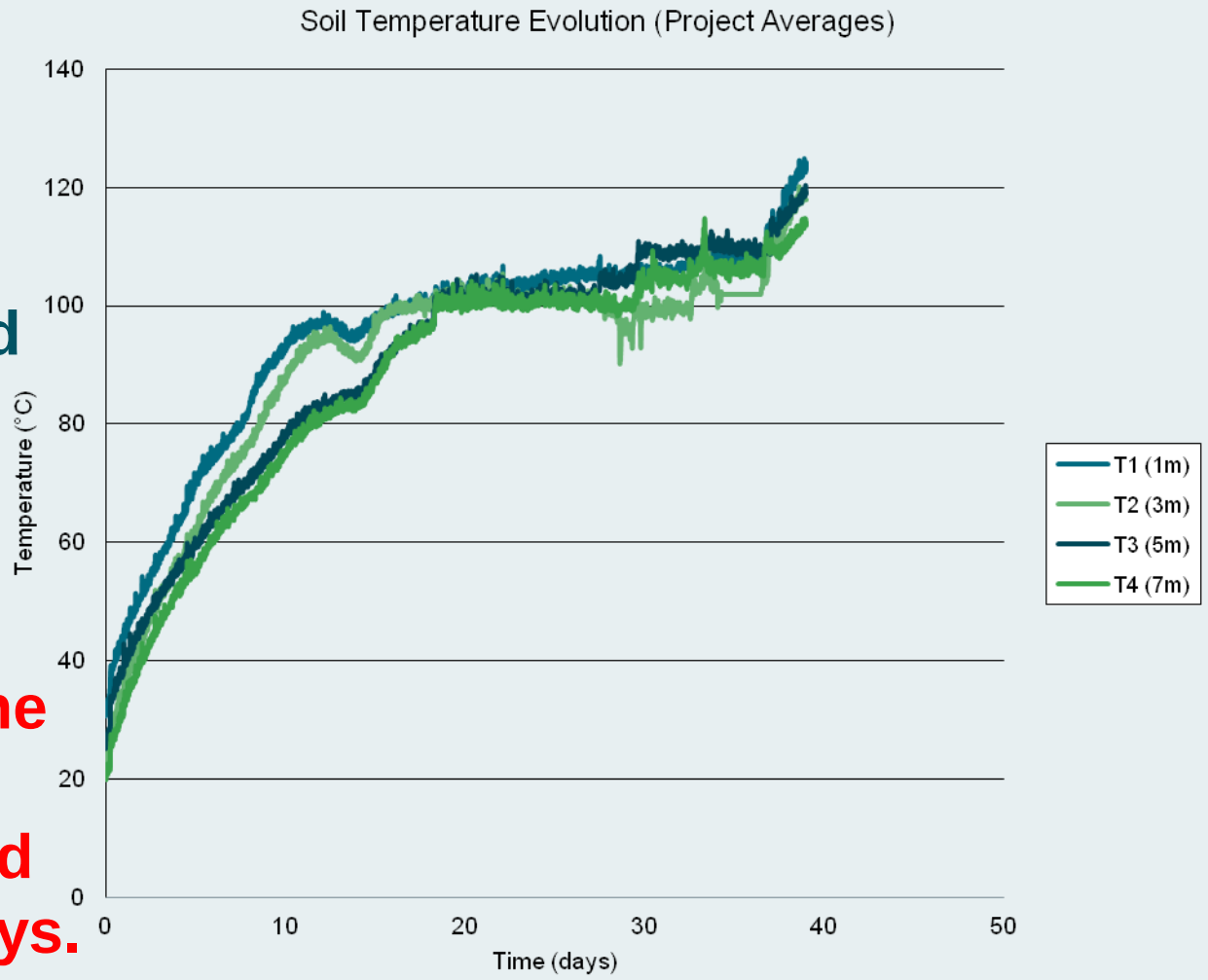
Case Study Temperature Profile – Target Constituent: Benzene

Project completed within 39 days;

Energy applied into subsurface soil varied from 700 to 2,000 watts per m. depth of heating well;

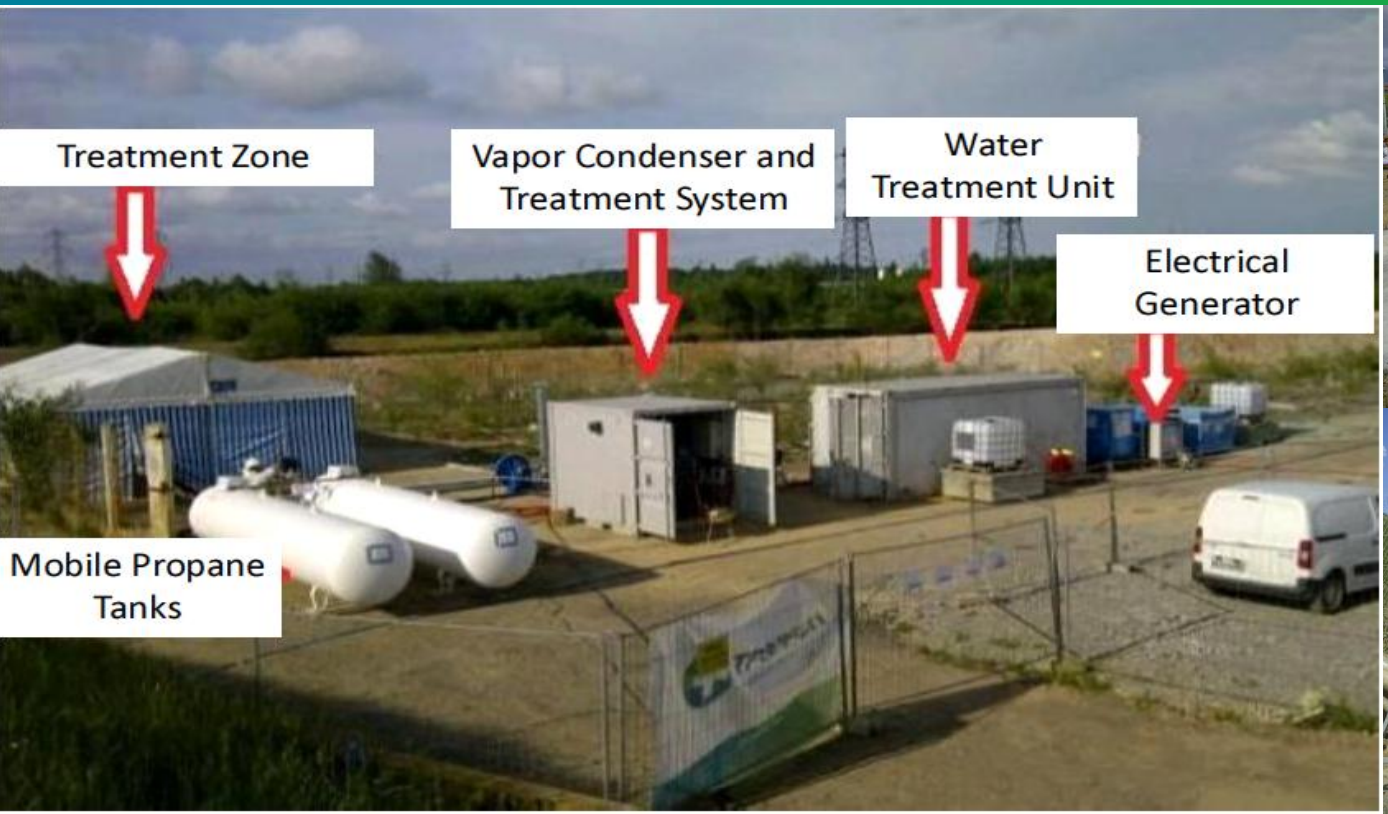
Final goal of benzene < 20 mg/kg met … to reach < 1 mg/kg would take < 5 additional days.



Case Study Temperature Profile – Target Constituent: Benzene

Remote Site: Pilot Test for Multinational Mining Co.

+ Nearest electrical source was ~ 4,000 m
+ Cost to bring 3,000 amps 3ph to site was ~ $1,600,000.00
+ Pilot Test: $150,000 budget
+ Full Scale: $ 1,400,000 with performance guarantee
+ Propane accounted for 28% of budget



Remote Site: ISTR of PCBs

- 250° C target treatment temperature
- TTT duration: 72 hours
- CEM ambient air and emissions monitoring (reason for tent)
- Full Scale project in construction
- PBR stipulation amounts to 99% mass removal or greater (below residual guidelines for PCBs)

Pilot Test for Ford Motor Co. (Chlorinated Solvents)

ISTT Pilot Test Saturated and Unsaturated Zones

3 GTR Heaters

6 Heating Wells

1 LNAPL Extraction Well

Underneath Building

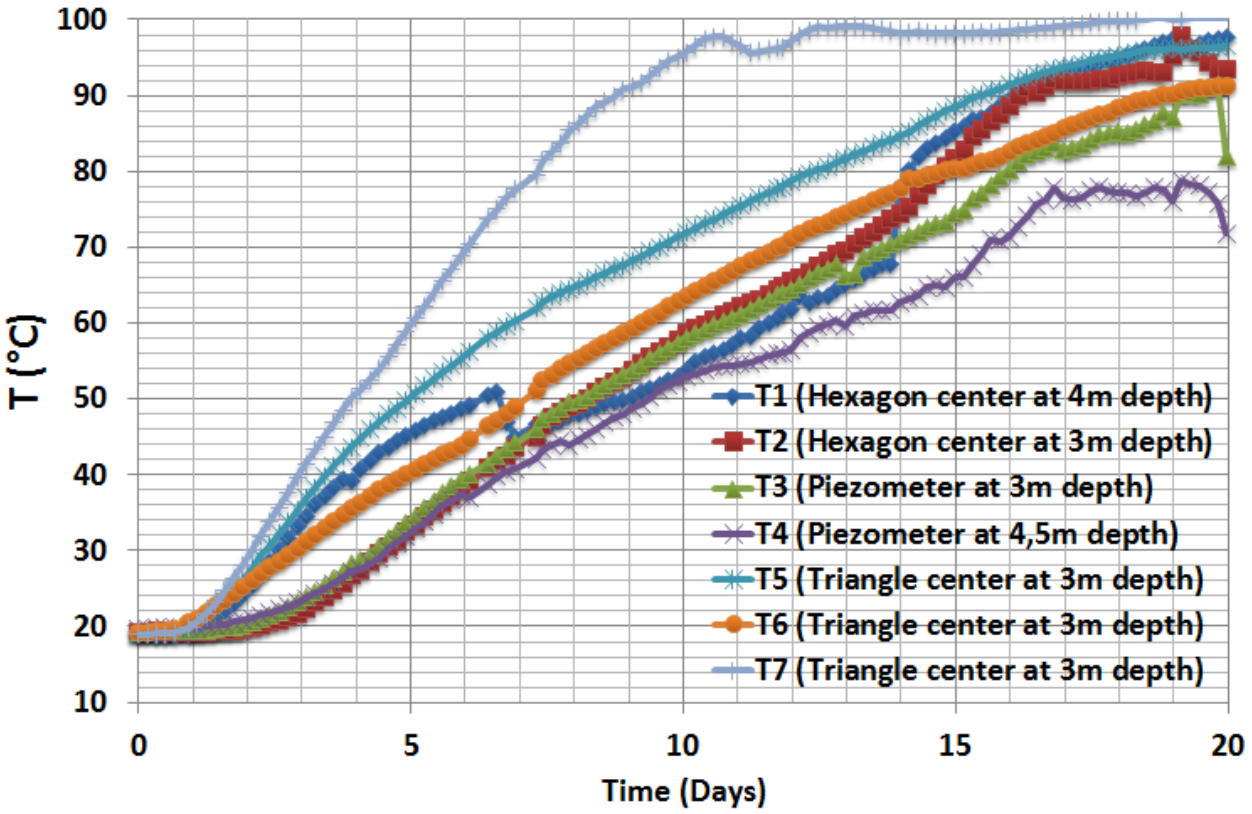
March 2012

Pilot Test LNAPL/CVOC Thermal Treatment

Results:

CVOC desorption target temperature achieved within 20 days

LNAPL extraction rates increase by 15x



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Full Scale LNAPL/CVOC Thermal Treatment

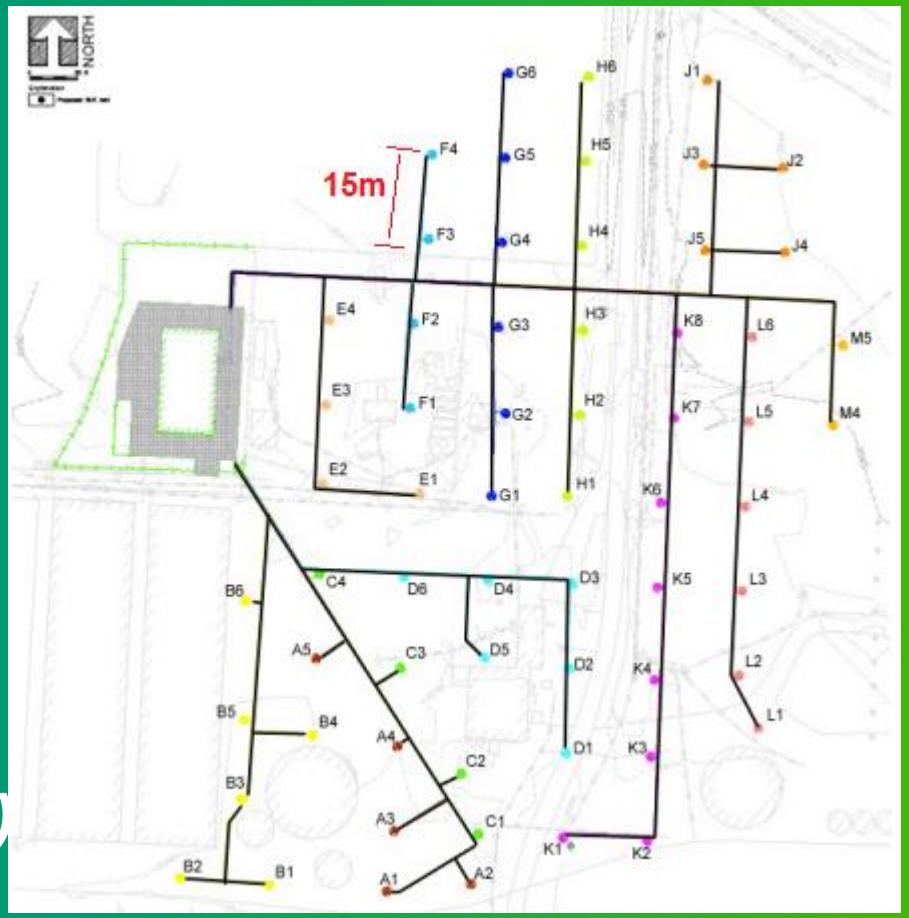
Full Scale ISTD and LNAPL Extraction

CVOC desorption

LNAPL extraction

Site Levelland, Texas USA

+ *Ancienne raffinerie (arrêt en 1953)*
+ *Pollution : HCT*
+ *Site de 26 Hectares (sable)*
+ *Profondeur de la nappe 46m*
+ *Zone de traitement: 1,6 Hectares*
+ *62 puits d'extraction (2 profondeurs)*
+ *2 ans de traitement par SVE et C3 (3400m³/h)*

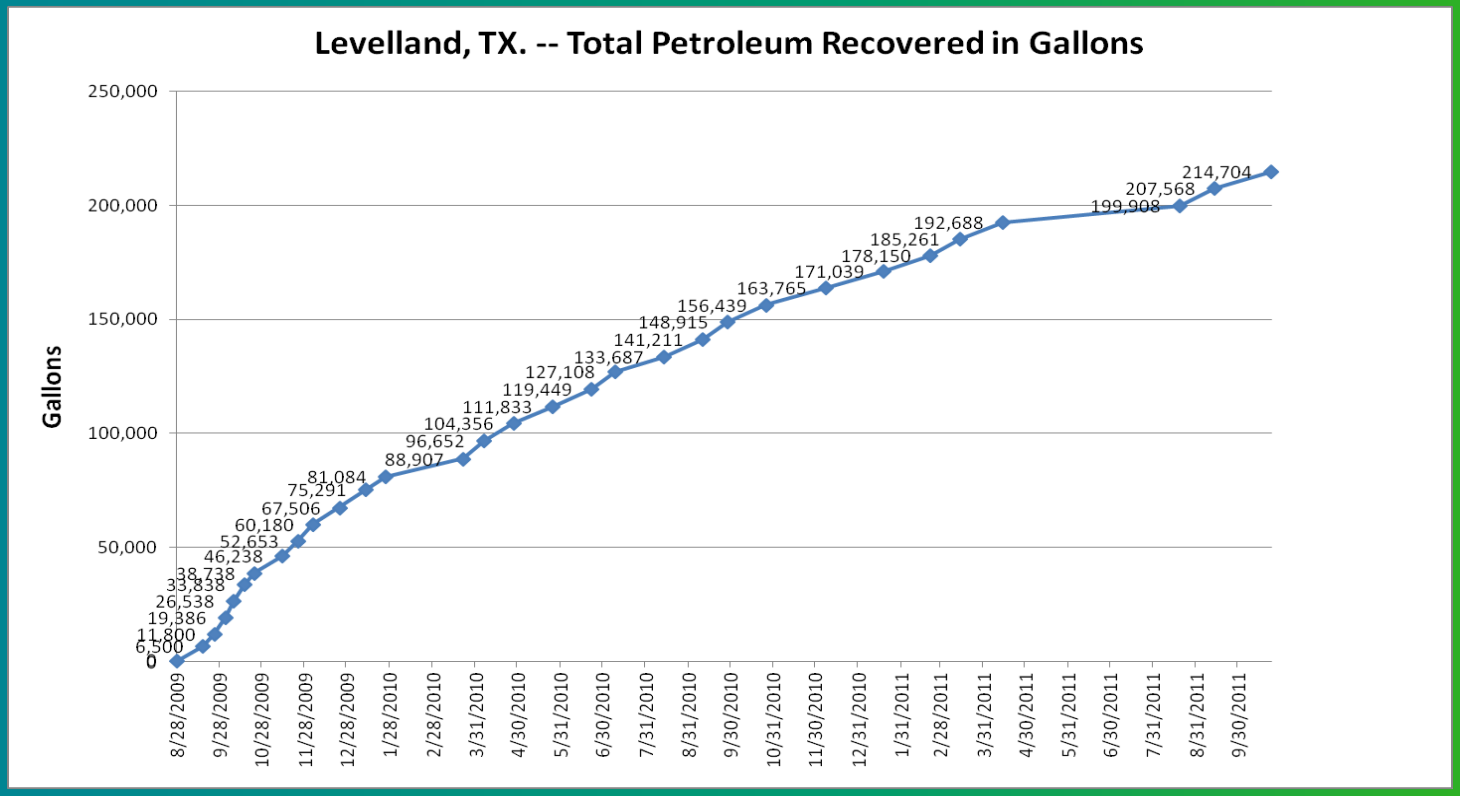


Site Levelland, Texas USA

Installation du traitement sur site (C3)

Site Levelland, Texas USA

+812m³ de produits pétroliers sont récupérés



Site Levelland, Texas USA

+ Env. 450€/m³ de valeur brute pour le recyclage

+ Le carburant est régénérée hors site

+ Plus de 95% de carburant récupéré est régénérée en essences commercialisables (<5% de perte en re-raffinage)

+ 77% de la consommation électrique est récupérée après régénération des produits

Sous bâtiments existants

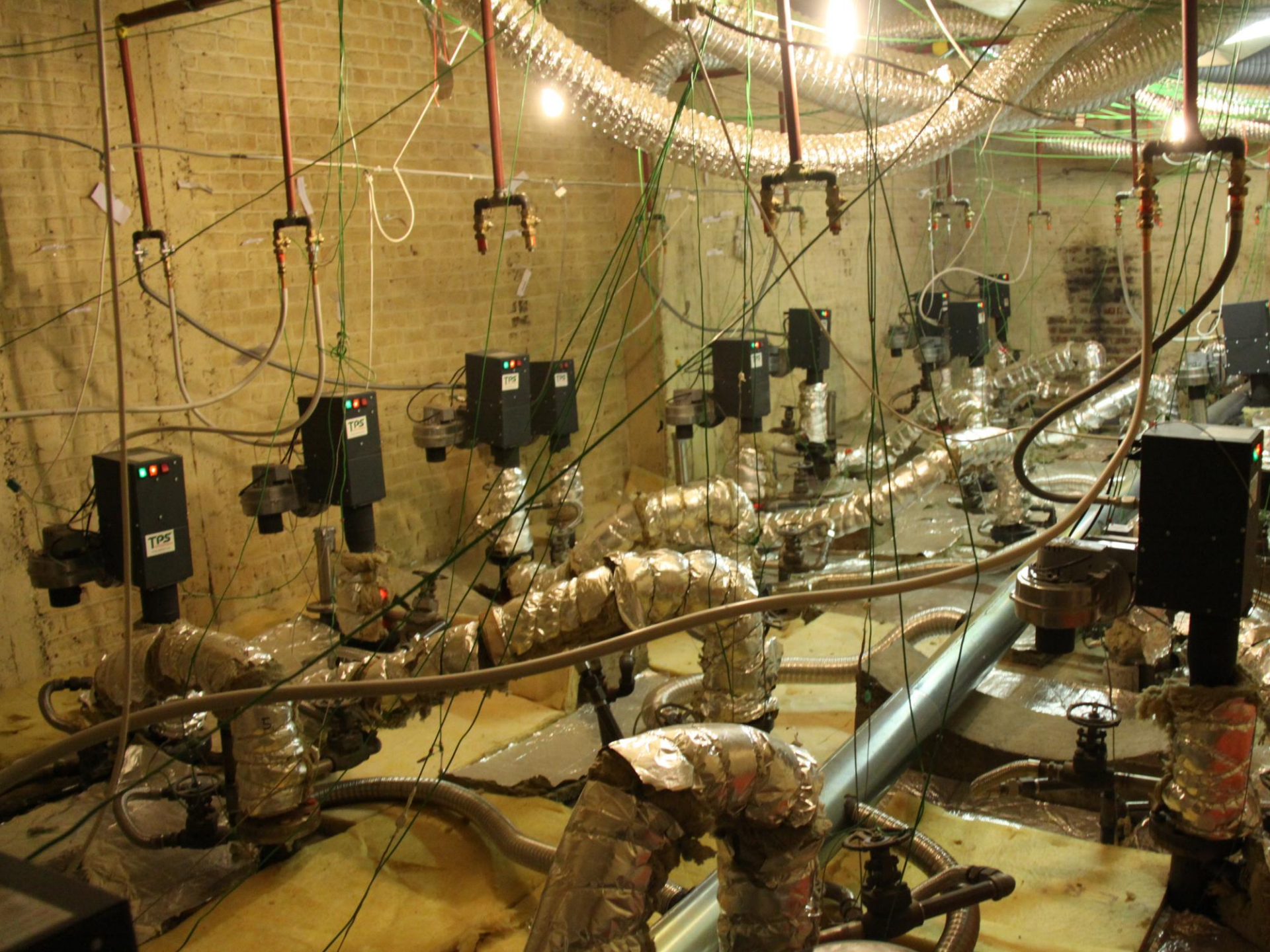
Under existing buildings


29


Rue de Courcelles, Paris, Île-de-France, France
sse approximative
COURCELLES AUTOMOBILE
TOTAL
Lubrifiants
crea
Casa Diva
Date de la prise de vue : février 2009


Avenue Minerve, Forest, Bruxelles, Belgique
Adresse approximative
A
Avenue Minerve


Avenue Louise / Rue Defacqz, Bruxelles, Belgique
Adresse approximative
Avenue Louise / Rue Defacqz
Avenue Louise
Avenue Louise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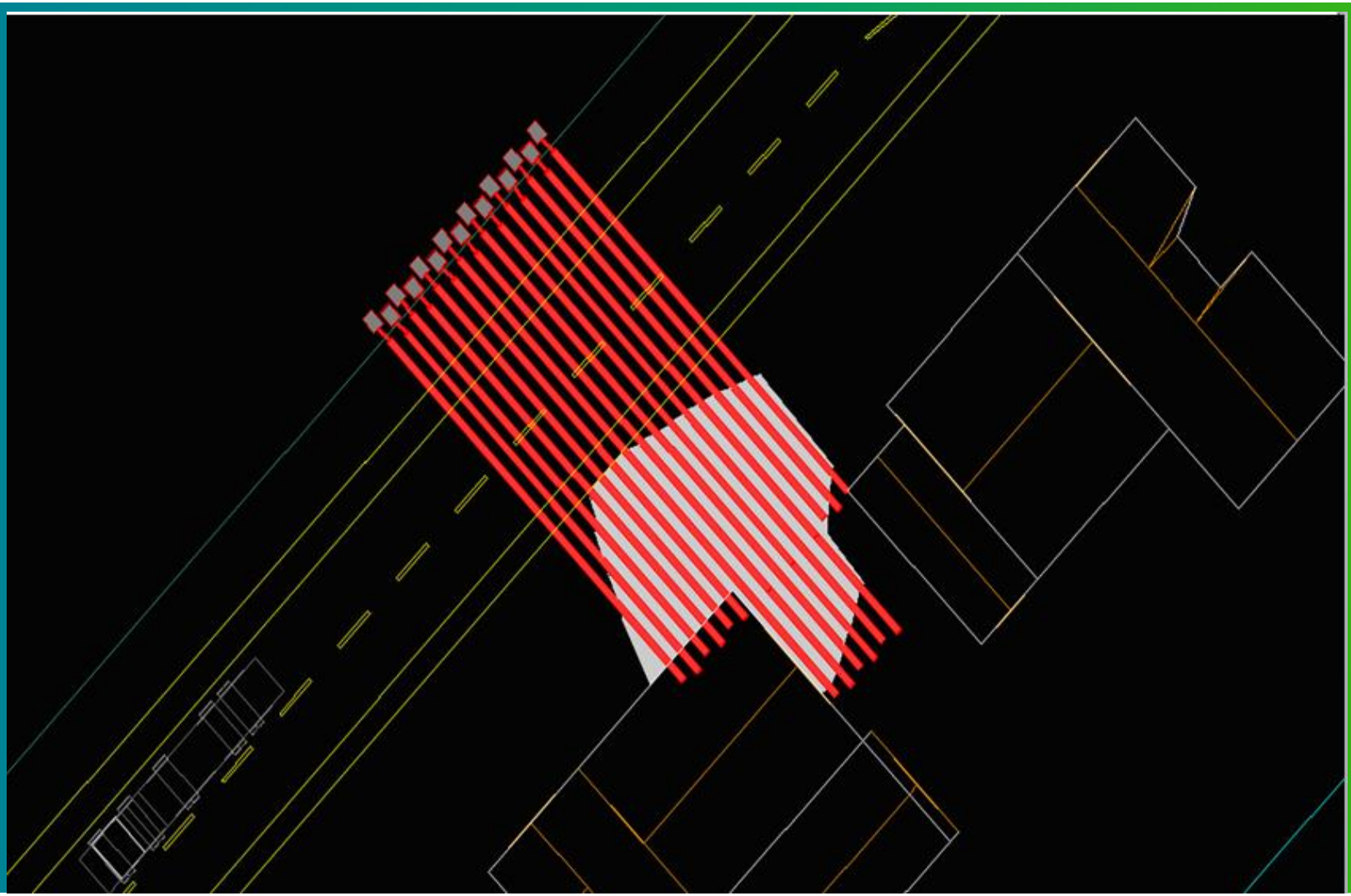
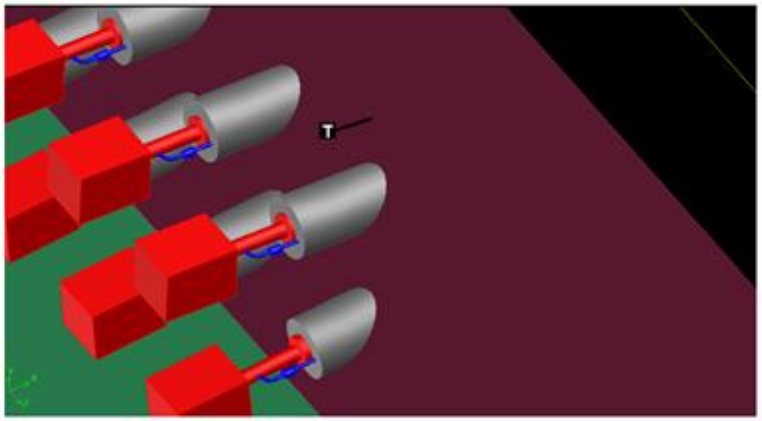
Abdijstraat

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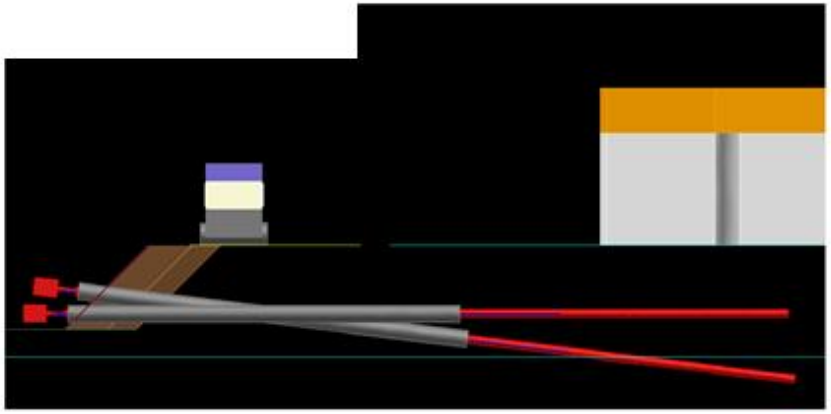


B&B

Remédiation durable

Sustainable Remediation

Sustainability?

Conclusion: Osez comparer!

Thank you!

Jan Haemers – jan.haemers@tpstech.com