

Thermal Wells – a Time and Energy Saving Module to Extend the Applicability of Soil Vapour Extraction

Intersol 2005:
5th International Conference-Exhibition on Soils, Sediments and Water
21. April 2005

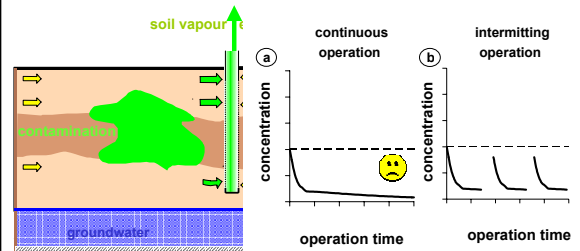
U. Hiester, A. Färber, H.-P. Koschitzky



Bundesministerium
für Bildung
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revitalisation concepts for
sites and urban areas

Soil Vapour Extraction (SVE)



after Altenbockum et al. 1997

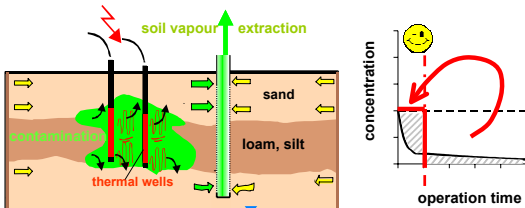


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THERIS = SVE + Thermal Wells



- Goal**
- NAPL (Liquid) \Rightarrow gaseous phase
 - increase of gaseous conductivity

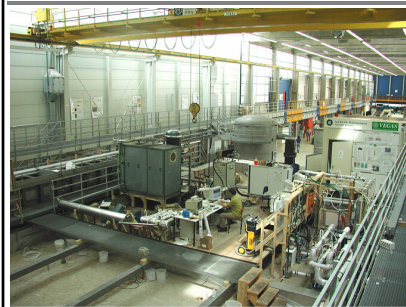


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Thermal Well Applications



large-scale
remediation
experiment

field site
remediation



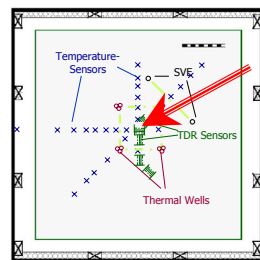
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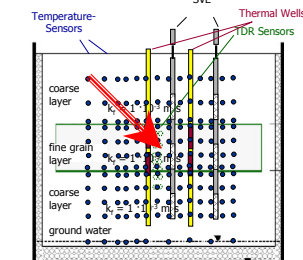
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VEGAS – Large-scale Container - Experimental Set-up and Measurement Equipment-

Top View:



Side View:

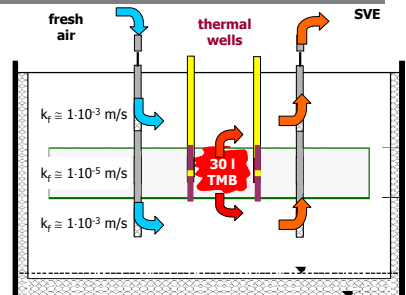


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Sketch of Contaminant Extraction

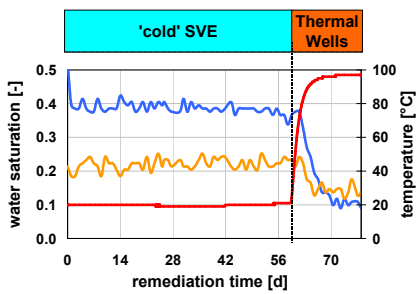


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Temperature and Saturation Development



Gaseous Permeability

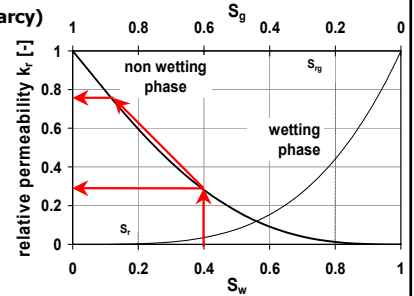
Saturated Zone (Darcy)

$$Q = k_f \cdot I \cdot A$$

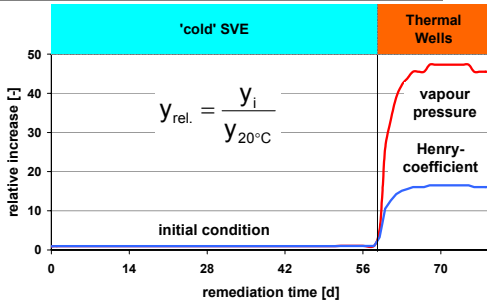
Unsaturated Zone

$$k_{eff} = k_r \cdot k_f$$

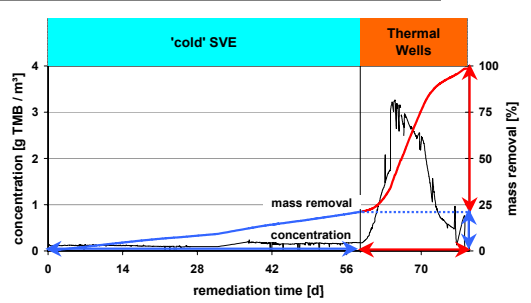
$$Q = k_r \cdot k_f \cdot I \cdot A$$



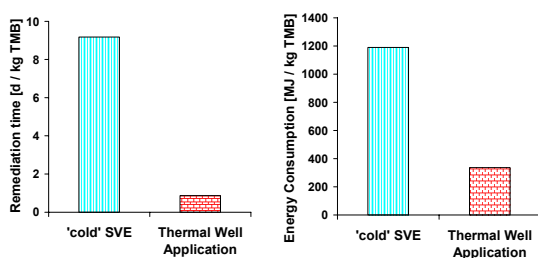
Transfer from Liquid to Gaseous Phase



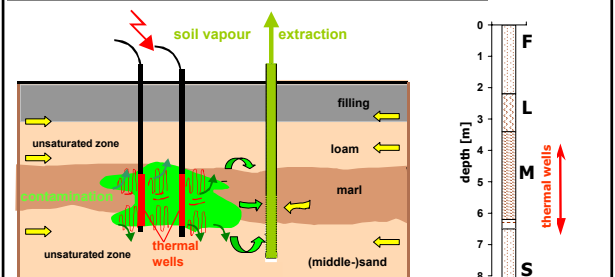
Increase in Contaminant Extraction



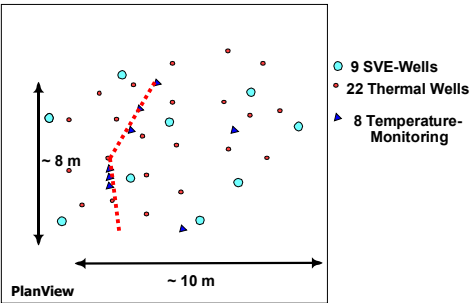
Comparison 'cold' SVE – Thermal Wells



THERIS Application at a PCE Site



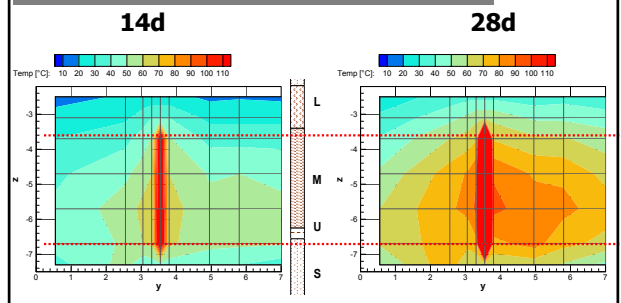
THERIS Installation



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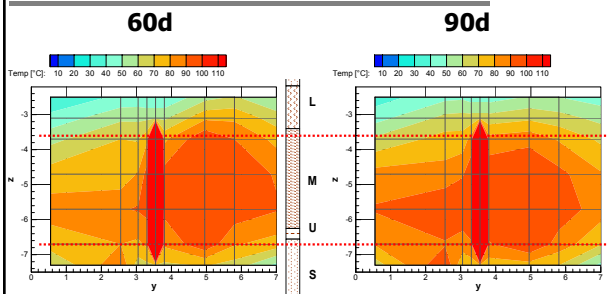
Heat Propagation



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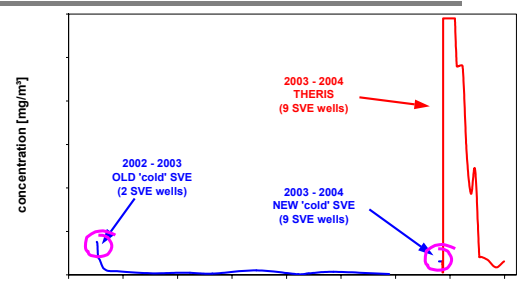
Heat Propagation



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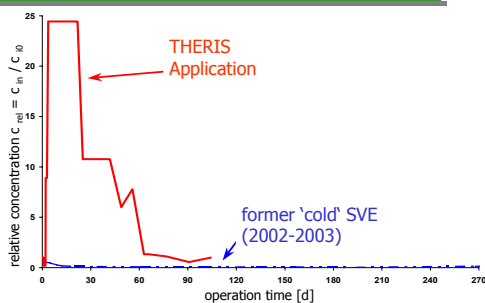
PCE Concentration



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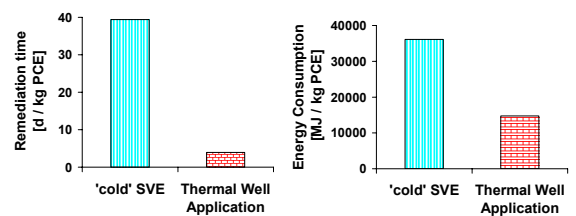
Relative PCE Concentration



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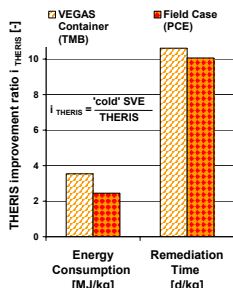
Comparison 'cold' SVE – THERIS



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Result I: Energy and Time



Thermal Wells need:

- 3 times less energy
-> 2/3 of the 'cold' SVE energy consumption can be saved
- 10 times less of remediation time
-> 90% of the 'cold' SVE remediation time can be saved

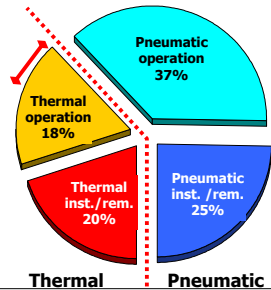


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Result II: Cost Share of Subsystems

6% energy costs for subsurface heating



Thermal

Pneumatic



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Result II: Cost Share of Subsystems

THERIS

Installation / Removal
 $0,20 + 0,25 = 0,45$
Operation $0,18 + 0,37 = 0,55$
1,0

proposed 'cold' SVE

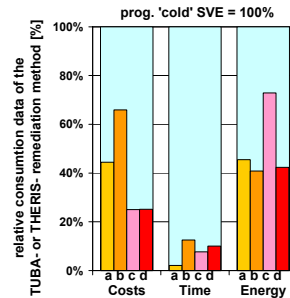
Installation/Removal
 $= 0,25$
Operation $0,37 \times 10 = 3,7$
~ 4,0



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Result III: Technology Comparison



Money, Time and Energy
can be saved by using
TUBA (steam-(air-)injection)
and **THERIS** (Thermal Wells)

Costs for subsurface heating
about **4 – 6 %**
of the project costs

a = TUBA Plauen
b = TUBA Mühlerack
c = TUBA Albstadt
d = THERIS Field-I



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www.vegasinfo.de

Thank you!
Merci beaucoup!

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