



SORBISENSE

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Passive sampling technology for effective groundwater monitoring

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CityChlor: Workshop on-site research and monitoring for chlorinated solvents in urban areas.

Utrecht, the Netherlands. March 2011



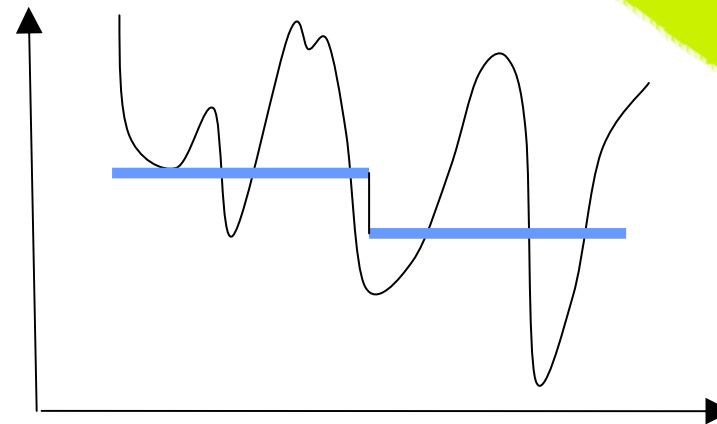
Content

- Introduction to passive sampling
- Application areas
- Technology, how it works
- User value
- Cases, references.



Introduction

- Groundwater sampling primarily occurs with traditional pumping techniques ("spot samples")
- Passive samplers have emerged since the 1990's and have found widespread use in the US.
- Still marginally used in Europe.
- Major argument for using passive samplers is continuous sampling rather than discrete "snap shots"





Application areas

- **Groundwater**
- Surface water
- Wastewater





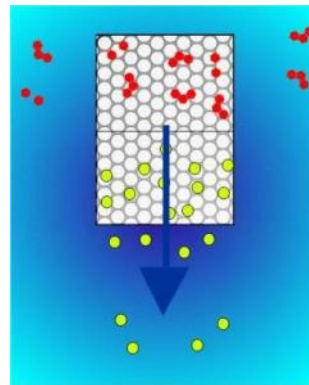
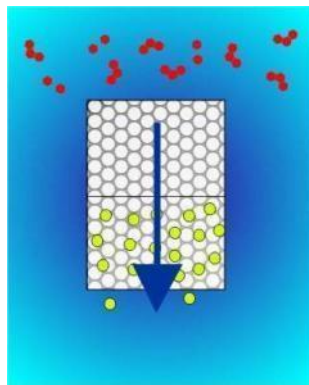
Groundwater applications

- **Groundwater**
 - 3D plume characterization
 - Monitoring performance of remediation activities
 - Monitoring natural attenuation
 - Compliance monitoring
 - "Stable end situation"



Sorbisense method: technology (1)

SorbiCell – how it works



- Pressure gradients creates advective flow through SorbiCell
- Solid phase polymer adsorbs compounds to be measured
- Tracer salt is leached in proportion to water volume
- Analysis in laboratory (GC-MS, LC-MS, etc.)
- Concentration C derived from:
$$C = M * Ks / (m_0 - m_t)$$

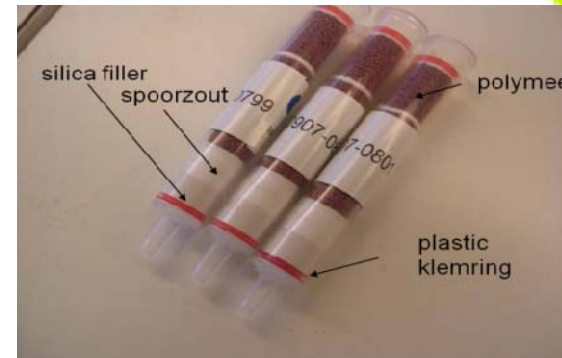
De Jonge and Rothenberg; Pat. WO03098167



Sorbisense method – technology (2)

SorbiCell types – different solute groups

- VOC: 55 VOC
(halogenated, aromatics,
degradation products)
- Oil, PAH, pesticides
- Heavy metals
- Nutrients, MNA parameters



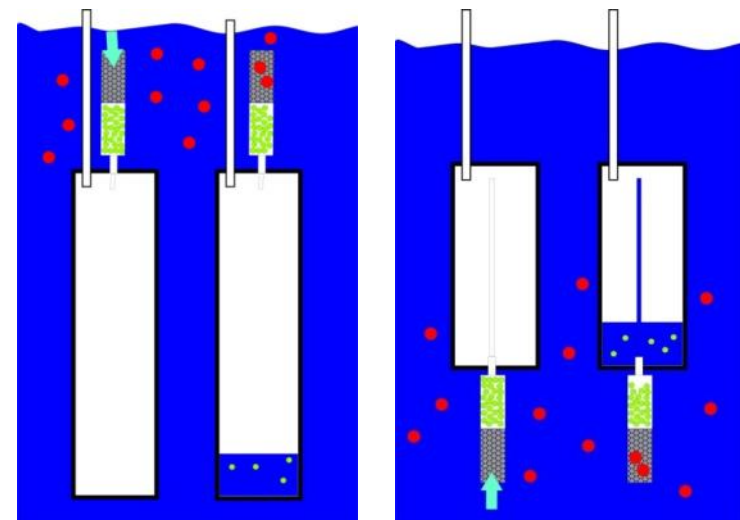


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Sorbisense method- technology

Mounting in groundwater wells

- SorbiCell is clipped onto the GWS unit (various sizes) and mounted at the depth of the well screen
- Hydrostatic water pressure fills the GWS unit, water inflow occurs through SorbiCell cartridge
- Air is pressed out through air-hose
- Sampling interval 1 day 3 - months
- Sampling from 0,5 - 100 m depth
- Precision capillaries for flow control





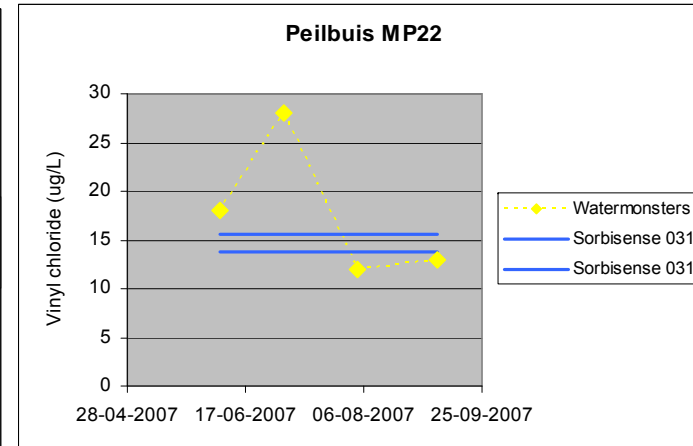
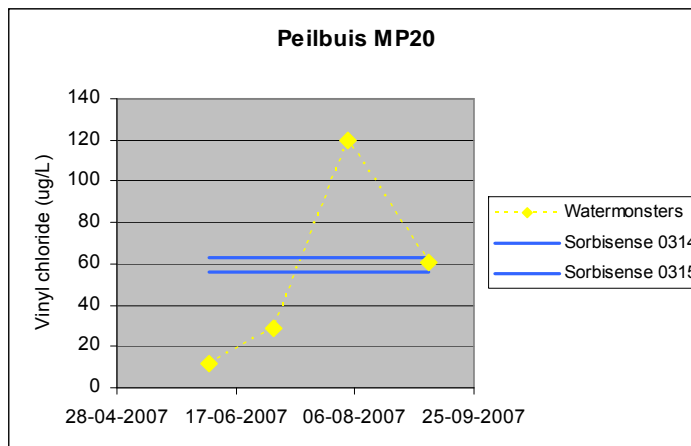
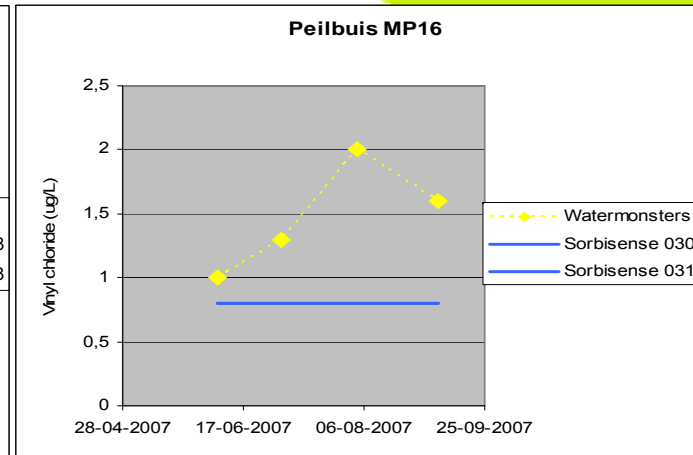
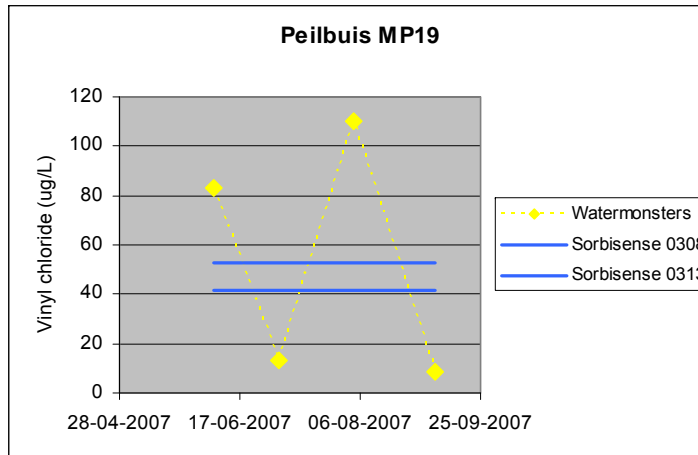
Sorbisense method- user value

- Time-averaged concentration values: more reliable results with dynamic/pulsed concentrations
- Easy and precise vertical delineation of the plume
- Saves time (no pre-pumping)
- No waste water pumped to the surface
- No service, power, maintenance
- Better logistics; preservation of the sample

- Better decisions: save total project costs!



User value (3) - time averaged concentrations





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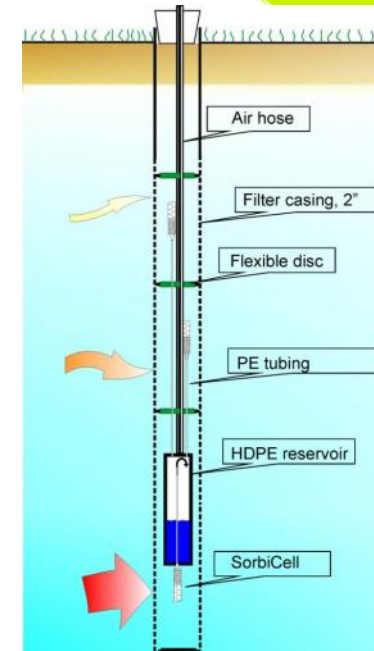
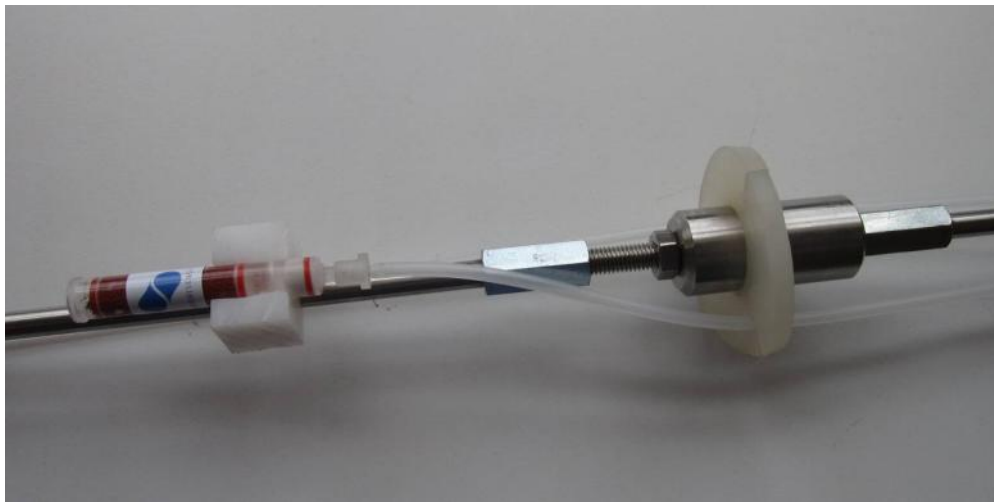
User value (4) - Plume delineation in 3D

- Customer: Copenhagen Regional authorities
- Consultant: Grontmij Carl Bro
- VOCl contamination
- Sampling period: 2 weeks
- 2 reference samples with regular groundwater samples
- Short filter screens (single level) for horizontal mapping
- Longer filter screens with multi-level sampling for vertical delineation of plume



User value (5)

- Vertical delineation of plume with ML sampler

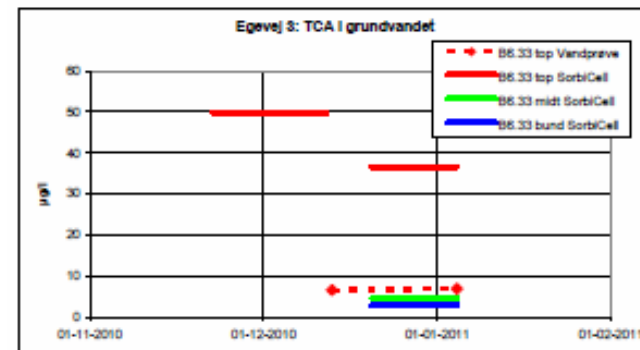
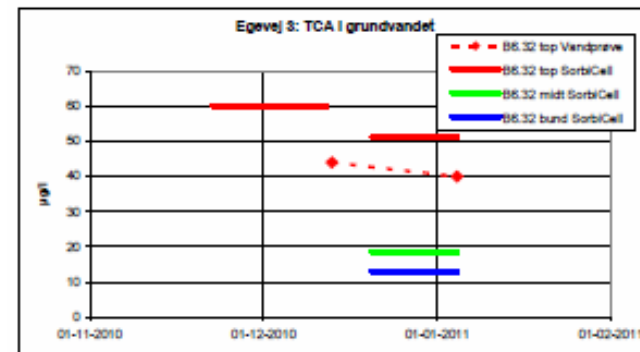
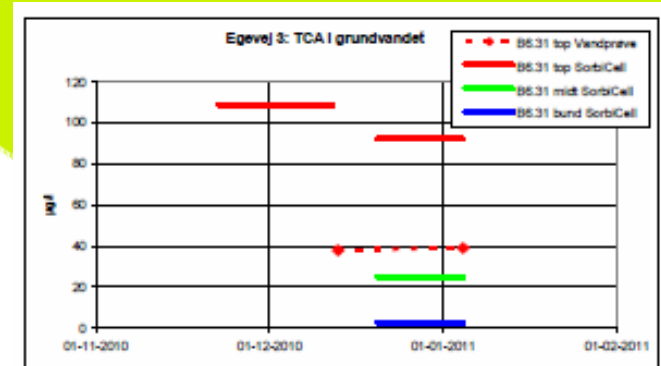


Make optimal use of longer well screens



User value (6) - vertical delineation

- Long wells are "problematic" and mostly useful for screening purpose only
- Nevertheless: many have been placed throughout Europe.
- Level specific groundwater sampling: expensive with regular methods
- Sorbisense Multilevel System is easily applicable: 30 min placements
- Gives precise information on vertical concentration gradients.





User value (7) - time saving

VANDPRØVETAGNING

Pre-pumpning: 75 min. (60-90)

Sagsnavn Sorbicell
 Lokalitet: Egevej 3, Skuldelev
 Sagsnr: 30.8030.01

Initialer: JMP
 Dato: 14-dec-10

Boring nr.: B6-11 Pejlepunkt (MP): kant filter, placering: m o/u terræn MP, kote (husk x): DNN DVR90
 Bundpejling: 20 m u.t. Bundpejling: m u. MP
 Pumpe type: Mp-1 Prøvetagn. st.: Start, kl.:
 Pumpens placering: 2 m over bund Filtersætning: m u.t. - m u.t. Filtersætning: m.u.MP - m.u.MP

Tidspkt. (kl.)	Pejling (m.u.MP)	Konduktivitet (µS/cm)	ilt (mg/L)	ilt (%)	Temp. (°C)	Pumpeydelse (L/min)	Prøveudtagning	Bemærkninger (fx prøve id)
13.30		1404	7,39	4,27	10,5	10 L/ 94 sek	?	brungrumset
13.45		1404	7,42	4,44	10,4	10 L/ 94 sek	?	klart
14.00		1405	7,43	4,54	10,6	10 L/ 94 sek	?	klart
14.30		1403	7,44	4,62	10,5	10 L/ 94 sek	?	klart
14.35	17,62	1407	7,43	4,69	10,5	10 L/ 94 sek	?	klart
14.40	17,62	1403	7,43	4,7	10,5	10 L/ 94 sek	?	klart
14.45	17,62	1403	7,43	4,81	10,5	10 L/ 94 sek	?	klart
							?	
							?	
							?	
							?	

Forpumpningsberegninger ved 5 x filtervolumen:

Pejling, vandspejl: m.u.MP - Pejling, filterbund: m.u.MP ? vandsøjle (h): m
 Diam. filter (x) mm = m Filtervolumen, (π × (D/2)² × h): π × (/ 2)² × h = m³ = L · 5 x filtervol. = liter
 Flow (Q): L/min
 Pumpe tid for 5 x filtervolumen (5 × filtervolumen) / Q : L / L / min = min

Nødvendigt værktøj til borings-adgang: Boring: unbracoskrue ? lås ? (Nøgle nr./lås nr.:)
 Boringsslutning:



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User value (8) - time saving

- No pre-pumping; hence no problems with low-yield wells
- Typical installation time for mounting of groundwater units: 10-15 minutes
- Deep well mounting under 15 minutes!
- Nr. of field visits can be reduced





Documentation & references

- An extensive list of documentation/ references, here among:
 - DK: Copenhagen authorities and waterworks (VOCI, pesticides)
 - Grontmij Carl Bro
 - DK: DHI/ETV validerings project (VOCs)
 - NL: SKB project
 - Lab accreditations (Alcontrol NL)
- International developments



Sorbisense A/S



It is legal to use us 😊
Quick ordering via Eijkelkamp
Enabling services with lab analyses
NL office soon to be established

Contact us at:

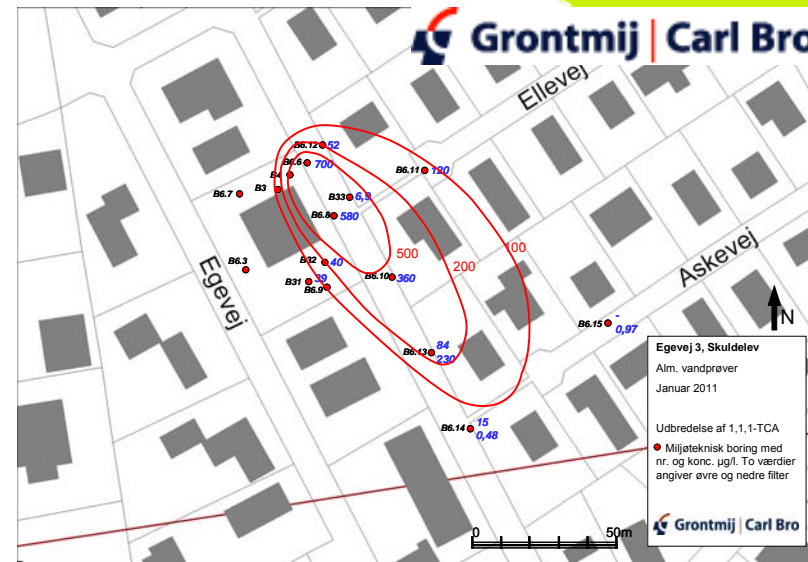
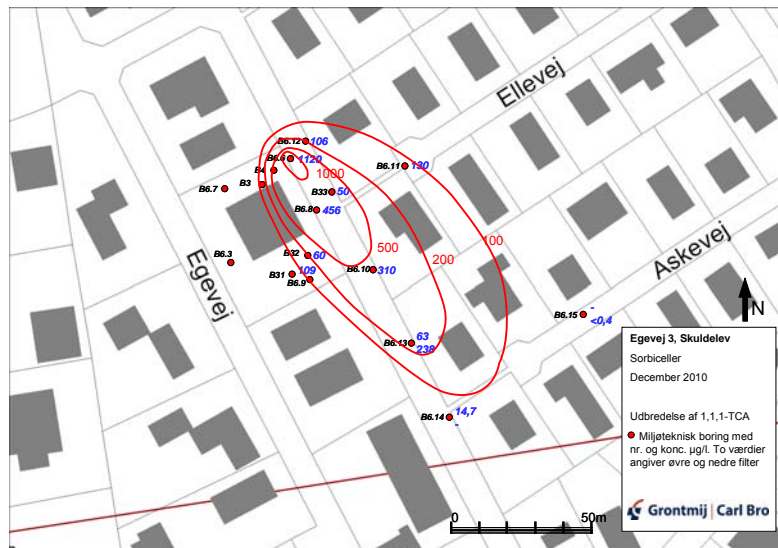
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User value (5) - horizontal delineation of VOCI plume



Almost identical results with SorbiCells (left) and regular water samples (right)