

European perspective in situ and on site soil remediation

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Greensoil Group

General contractor

- In situ and on site soil remediation
- Groundwater treatment
- (Soil) Vapour treatment

Innovation & knowledge driven

- Specialized in biological remediation techniques
- R&D
- Sustainability

Client orientated

- Result driven contracting
- Client-, site specific and tailormade solutions
- International





Greensoil Group: filosophy

- Unique and complete so(i)lutions
- Proven (and) Sustainable
- Cost Efficiency
- International network
- Safety

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Soil & Groundwater remediation in Europe – an overview

Legislative, Geographical & Technical Timeline



Template







Legislative and Geographical timeline

- European countries with soil legislation at different times
 - The Netherlands: Wet bodembescherming (Wbb) , 1 januari 1987
 - Belgium
 - Flanders: 1995
 - Walloon region: 2013
 - Germany: Bundes-Bodenschutzgesetz, 1998
 - Denmark: Contaminated Soil Act No. 370 of June 2, 1999
 - Finland: Government Decree on the Assessment of Soil Contamination and Remediation Needs (Ministry of the Environment, 2007).
 - Italy: Regulation No. 118 adopted on 12 March 2002; "Regulations regarding the Quality of Surface Waters and Groundwaters"
 - Spain: Real Decreto Legislativo 2008 2 por el que se aprueba el texto refundido de la ley de suelo (consolidated text of the Soil Law)
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- 2015: European year of the soil
- Fragmented legislative framework in Europe to date
- Europe
 - 2006: Soil Thematic Strategy: proposal for a Soil Framework Directive
 - 2014: withdrawal proposal Soil Framework Proposal because evaluated countryspecific
 - 7th EAP: land is managed sustainable by 2020 in the Union (including soil protection and remediation contaminated sites)



Templat







Impact of local legislation on soil market (2 cases)

- The Netherlands
 - 1st stage: high ambitions as front runner, legislative framework with strict remedial targets, young but fast growing market...
 - 2nd stage: focus on investigation, development of standard procedures
 - 3rd stage: implementation of mainly conventional techniques (ecxavation and P&T)
 - 4th stage: remediation market development with focus on innovation (due to limitations in conventional techniques)
 - 5th stage: maturing market; realistic target values (risk based remediation introduction)
 - 6th stage: risk based remediation evolves to non remediation (causes: 'easy' remediations are done, complexity and cost increase; saturated market, financial crisis 2008, lobbying,...);
 - 7th stage: again focussing more on remediation driven by drinking water directives (pendular mouvement);
 - Future: evolve to a quality driven, mature market aiming maximum environmental efficiency intergrating all aspects (legislation, techniques, risk mitigation, soil remediation, water preservation).
- Germany
 - Country legislation but regional specific governance and inrepretation
 - Relativey strict and rigid interpretation
 - Development of mature market often delayed by unrealistic target and strict governmental governance



Template







Phasing in Soil & Groundwater Market

- Repeated Phasing in Soil & Groundwater Market
 - Voluntary soil remediation (unbounded, uncomplete)
 - Implementation soil legislation
 - Investigational phase
 - Conventional approach
 - Soil: Excavation off site treatment
 - Groundwater: Hydrogeological approach P&T (barriers), funnel and gate
 - Search for other techniques from remedial (long term) and cost inefficiencies
 - Innovation
 - Maturing of market







Technical Evolution

- Other technique era's
 - Physical era: SVE, MFE, NAPL removal,...
 - Thermal era: six/three phase heating, steam injection,...
 - Chemical era: ISCO, liquid driven (permanganaat, persulfate) of gas driven (perozone),...
 - Biological era: in situ bioremediation, phytoremediation, biological treatment systems (soil, water, air)...
- Each era has added to growing understanding of complexity of soil matters, has shown succes/failure/limitations.
- Each site/contamination needs individual approach, concept and remediation most often combining techniques in terms of cost and effectiveness
- No site remediation is the same as a consequence of influence of different scientific areas (geology, hydrogeology, chemistry, biology, engineering, risk management, project and cost management)





Market study: Global forecast to 2022 (© Market&Markets)

- Growing business worldwide expected
 - Oil and Gas
 - Mining and forestry
 - Construction and Land Develoment
 - Industrial Manufacturing, chemical production
- Market share predicted faster growth for groundwater vs soil



Market study: Global forecast to 2022

(© Market&Markets)

- Highest increase in market share for
 - Bioremediation of soil and groundwater
 - Soil vapour extraction
- Bioremediation technology to hold the largest market size by 2022 for both soil and groundwater remediation
- Increasing demand for sustainability and CO₂ footprint

Sustainability

- Ecological footprint < environmental benefit
- Sustainability:
 - Minimal waste streams
 - Soil
 - Water
 - Air
 - Minimal energy
 - Treatment systems
 - Transport
 - Production costs
 - Minimal use/ maximal re-use natural resources

Cost Efficiency and Sustainalbility

Some European experiences

- <u>Germany</u>: pioneer project to replace P&T system (O&M for >15 years of pumping) in bioremediation system (low aerobic aquifer – project completion in three years)
- <u>Belgium</u>: on site aerobic landfarming projects as innovative approach for off site soil washing/thermal treatment
- <u>Belgium</u>: Soil vapour extraction and P&T in combination with 100% biological treatment of air and groundwater
- <u>Spain</u>: DNAPL removal in combination with anaerobic biodegradation
- France: enhanced anaerobic biodegradation of cVOC cocktail
- <u>The Netherlands/Belgium</u>: from feasibility study to full scale remediation of nion standard compounds (1,4-dioxaan, phtalates,...)
- <u>Finland</u>: mobile soil washing and bioremediation

Conclusions

- Soil & Groundwater is a complex matter
- Needs individual approach (project based)
- Each technique has its pro's and con's and specific area of application
- Combination of techniques most often necessary
- End result to be reached should be a combination of realism, pragmatism, risk management and environmental benefit analysis
- Sometimes soil remediation is driven by other governing actors
- Governance can act as catalyzer towards innovation and maturing of soil market
- Soil remediation is a largely knowledge driven business and especially based on professional experience of people (call it a métier or in Finnish 'Alus')

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Slide 15

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