Sustainable Approach in Contaminated Soil Management: Lessons Learned From 20 Years of Practice

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October 16, 2009
Agenda

1. Introduction
2. Trends in Site Remediation
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   b) Québec
   c) Alberta
3. Sustainable Development (SD)
4. Remediation Approaches vs. SD
5. SD at Work
6. Summary
Introduction

- **Reduce**: Reduce waste or the need to recycle by not creating it in the first place.
- **Reuse**: Reuse materials before recycling or discarding.
- **Recycle**: Transform material into another usable material.
- **Treatment**: Reduce volume or toxicity.
- **Disposal**: Store or bury waste.

The diagram outlines a hierarchy of waste management strategies: reduce, reuse, recycle, treatment, and disposal.
Introduction

Evolution of the Thinking About Waste and Cleanup

- **1960**: Birth of Wastes
- **1990**: Intensive Treatments
  - Dig Pump Bury Burn
- **2020**: Maturity
  - Recycle Reuse Transform Biodegrade
  - Sustainable Methods

**vertical axis**: Birth, Maturity, Growth, Discarded Wastes
Trends in Site Remediation – General

1. Regulations and incentives are put in place to promote treatment and beneficial reuse
2. Direct landfill of contaminated soil is more and more restricted
3. More and more options are available to manage contaminated sites
1985: Hazardous Waste Regulation is adopted

1988: The Contaminated Land Rehabilitation Policy
    Dutch derived generic criteria (A, B, C)
    First “contaminated soils only” landfill sites

1991: Petroleum Products Law and Regulation
    UST replacement 10 year plan: led to first soil treatment facilities

1998: Soil Protection and Contaminated Sites Rehabilitation Policy
    Favor soil decontamination vs. landfill disposal
    Dictate beneficial reuse of decontaminated soil

2005: Quebec Regulation with Respect to Landfilling and Incineration of Residual Materials
    Contaminated soil must be treated before being landfilled
Trends in Site Remediation – Québec

Incentives:

   $113 million to favour rehabilitation/reutilization of urban contaminated sites

2007-2010: Climat-Sol Government Program
   $50 million to favour decontamination and implementing green buildings (GHG reduction)

Landfill taxes reinvested in recycling/treatment
Trends in Site Remediation – Québec

The graph shows the trend in site remediation in Québec, with the quantity of treated soil and landfilled soil from 1991 to 2005. The data is sourced from MDDEP.

- **Treated soil** (blue line)
- **Landfilled soil** (red line)

The graph indicates a significant increase in treated soil starting around 2001, whereas the trend for landfilled soil shows a peak around the same time and then a decline.
The ministry of environment (MDDEP) has clearly manifested its preference for treatment over landfill disposal or containment and its willingness to act to foster it:

a) Soil is a resource and not a waste

b) If a technology exists, treatment should be favoured
   An extensive soil treatment facility network is there to support

c) Petroleum product must be treated (vs. risk analysis)

d) Treated soil may be reused as daily cover/final capping in a municipal landfill
Trends in Site Remediation – Québec

Future

a) Diversify reuse of decontaminated soil ( revegetation of degraded sites, sound/visual barrier, etc.)

b) Implementation of a sustainable approach in site remediation (on-site, in situ, etc.)
1. ERCB regulates upstream Oil & Gas waste management
2. AENV regulates downstream Oil & Gas and other waste (municipal, industrial, etc.) management
   Primary goal: reduce waste disposal at landfills
Outcomes seen:
   a) Improved resource conservation and waste minimization
   b) Integrated resource recovery and waste management systems
   c) Protection of air, land, water, and human health
Trends in Site Remediation – Alberta

1. Contaminated soil is, by weight, Alberta’s single largest waste stream

2. Landfill disposal remains the main solution for soil remediation
   More than 3M tons of contaminated soil per year

3. On site soil treatment is in its growing phase
   a) Cost
   b) Sustainability
Trends in Site Remediation – Alberta

Incentives:

1. The Alberta Petroleum Tank Site Remediation Program

2. Additional funds available to decontaminate orphan upstream Oil & Gas sites
Trends in Site Remediation

Lessons learned from trend in site remediation:

1. Cash is King/Queen!
2. Time is the essence of business
3. Appropriate incentives and regulation are the main drivers for site remediation and promoting treatment
4. Environmental business is selling environmental compliance not decontamination
   - Regulation should integrate concept of sustainability
Sustainable Development (SD)

SD was defined in the 1987 “Brundtland Report” as:

“development that meets the needs of the present without compromising the ability of future generations to meet their own needs”

Sustainable Development (SD)
Sustainable Development (SD)

**Environment**
- Impacts on air/water/soil/ecology
- Intrusiveness
- Resource use and waste

**Economics**
- Costs and economic benefits (direct and indirect)
- Liability
- Employment / human capital
- Life span and “project risks”
- Flexibility

**Social**
- Community involvement and community satisfaction
- Human Health
- Ethical and equity considerations
- Impacts on neighbourhoods or regions
- Fit with planning and policy strategies and initiatives
- Uncertainty and evidence
SD in Site Remediation

1. There is no consensus on:
   a) How to best define a “unit of remediation”
   b) Parameters to use and the weight to give to each of them

2. SD studies in site remediation give variable results

3. Trend in integrating sustainability evaluation in remediation

White paper published (Summer 2009 Remediation Journal)
Sustainable Remediation Forum (SuRF)
(www.sustainableremediation.org)
1. Consensus on “sustainable remediation”: “remedies whose net benefit on human health and the environment is maximized through the judicious use of limited resources”

2. Sustainable remediation:
   a) Minimize/eliminate energy or natural resources consumption
   b) Reduce/eliminate releases to the environment: especially to the air
   c) Harness or mimic a natural process
   d) Promote reuse or recycling of land or undesirable materials
   e) Permanently destroy contaminants

Need energy input
SD in Site Remediation - Bioremediation

\[ C_nH_{2n} + 1.5n \, O_2 \rightarrow n \, CO_2 + n \, H_2O + \text{Energy} \]

- Nutrients (e.g. organic residues)
- Microbes
- Microbial biomass
- Humification in soil (C sequestration)

Contaminant = carbon and energy sources
SD in Site Remediation - Bioremediation
# SD in Site Remediation

## Landfill vs. On-site Bioremediation vs. MNA

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<thead>
<tr>
<th></th>
<th>Landfill Disposal</th>
<th>On-site Bioremediation</th>
<th>Monitored Natural Attenuation</th>
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<tbody>
<tr>
<td>Minimize energy or natural resources</td>
<td>+</td>
<td>+++</td>
<td>++++</td>
</tr>
<tr>
<td>Minimize releases to the environment</td>
<td>short term: ++++</td>
<td>++++</td>
<td>-</td>
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<tr>
<td></td>
<td>long term: ???</td>
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<tr>
<td>Harness or mimic a natural process</td>
<td>-</td>
<td>++++</td>
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SD in Site Remediation

Lessons learned from sustainable remediation

1. Sustainability is more than “carbon footprint” only
2. Sustainability may generate cost savings
3. Need more robust framework to efficiently implement sustainability concept as decision-making
4. On-site bio-destruction of the contaminant is in line with sustainability
SD at Work
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Conclusions

1. Appropriate regulatory frameworks and incentives are necessary to promote sustainable remediation
   Cost and time frame are not the only bottom lines
2. Technological solutions/innovations are there to implement and support sustainable approach in site remediation
3. Sustainable site remediation is trending upward but requires increased promotion and support from stakeholders
Questions ?