The technical sustainability of in-situ stabilisation/solidification

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http://www.subrim.org.uk
Objectives

• Comparison of technical/environmental sustainability of in-situ stabilisation/solidification and dig & dump

• Identification of potential improvements to currently used remediation methods

• Laboratory and site work to investigate potential improvements
Technical aspects of sustainable remediation

• Future benefits outweigh cost of remediation,

• Environmental impact of implementation is less than the impact of leaving the land untreated,

• Environmental impact of the remediation process itself is minimal and measurable,

• Time-scale over which the environmental consequences occur, and hence inter-generational risk, is part of the decision making process,

• Decision making process includes proper engagement of all stakeholders.
Methods of data analysis

- Multi-criteria analysis (MCA) – compares overall impacts
- Analysis based on 17 sub-criteria

<table>
<thead>
<tr>
<th>Emissions (greenhouse gas)</th>
<th>During</th>
<th>S/S</th>
<th>Landfill</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Onsite -100</td>
<td>Emissions mainly from cement production -26</td>
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<td></td>
<td></td>
<td>Offsite 0</td>
<td>Emissions mainly from transportation/site operations 0</td>
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<tr>
<td></td>
<td>After</td>
<td>Onsite 10</td>
<td>Absorption of CO₂ over time 0</td>
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<td></td>
<td></td>
<td>Offsite 0</td>
<td>Landfill gas emissions -5</td>
</tr>
<tr>
<td>Weights</td>
<td></td>
<td>0.5 on and off site (global importance)</td>
<td></td>
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<tr>
<td>Overall scores</td>
<td>-45</td>
<td>-15.5</td>
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Methods of data analysis

• Examination of individual impacts, including:
  – Effect of contamination on human health
  – Efficient use of land
  – Air pollution/greenhouse gas emissions
  – Change in soil properties
  – Waste
  – Effects on other sites
  – Transportation
  – Use of raw materials
Case study details

• Comparison between S/S and dig & dump
  – Former industrial site
  – Contaminated with hydrocarbons
  – Potential risks to future site users and nearby watercourse
  – Approximately 7000 tonnes contaminated soil
  – Coarse grained material overlying clay layer
Case study details

• S/S:
  – Cement/bentonite grout
  – Barrier wall and hotspot treatment
  – Reduction in groundwater contamination by 98%

• Dig & dump:
  – All contaminated material removed to landfill
  – Replaced with clean fill
Outcome of MCA

• Indicated that S/S would perform better than dig & dump in terms of overall impact

• S/S also had less impact than leaving the land untreated - dig & dump did not.

• Sensitivity analyses generally backed up these conclusions
Immediate impacts

- Major negative impacts of S/S are due to the production of cement (CO$_2$ emission, energy consumption)

- Solidified soil can improve foundation strength
Immediate impacts

• Compared to dig & dump, S/S has:
  - Low impact on other sites
  - Low waste production
  - Relatively efficient use of materials
Long term impacts

Both techniques involve containment:

• S/S:
  – immediate reuse of soil
  – contaminants remain onsite and may escape from solidified mass eventually

• Dig & dump:
  – removes site risk but transports it elsewhere
  – organic contaminants may be degraded in long term
  – soil is not reused efficiently
Investigation into potential improvements

• Use of more environmentally sustainable cements
  – would reduce immediate impacts
  – Currently investigating MgO and low pH cements

• Degradation of organic contaminants over time
  – Exploring potential for biological degradation within solidified mass
Summary

• Immediate impacts for S/S are less onerous overall than for dig & dump

• Limited data availability in some areas

• S/S allows more rapid reuse of the contaminated soil

• Long term – contamination problems may be passed on to future generations