Shredder residues: A problematic fraction

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Results of work and discussions undertaken by DepoNet
Outline

• Introduction
• Landfilling of SR – feasible?
• Landfill mining of SR
• Future management of SR
Deponering af shredderaffald

Site 1: Farligt affald
Site 2: Farligt affald
Site 3: Farligt affald
Amounts of Shredder residue landfilled at AV Miljø, Odense Nord Miljøcenter og Reno Djurs

2011: 2,028,698 tons were landfilled
1,434,030 tons were landfilled at mono cells
Focus on management of shredder waste


- Until 2012 landfilling of hazardous waste was exempted from tax – Tax will be fully implemented in 2015 (475 kr. per ton)

- Focus on resource recovery: European road map for resource efficiency, (unpublished) national resource strategy and Waste strategy 10
Questions!

- Does the waste meet EU WAC?
- Feasible for landfilling – is final storage quality achievable?
  - Landfill operators must ensure sufficient resources for the aftercare period (CEC 1999)
  - Regulations prescribe the use of 30 years for calculation of the gate fee
- Resource potential?
DepoNet projects

Landfilling of SR

Characterisation
Field experiment

Landfill mining of SR

Resource recovery potential
Landfilling of SR

Questions:
- Can it fulfil WAC?
- How does it behave in a landfill (hydraulic, leaching)?
- Aftercare period?
- Actions to reduce aftercare period?

To fulfil the objectives following experiments were undertaken:
- Laboratory testing
- Lysimeter testing
- Field observations

Ref: Hansen et al. and Hjelmar et al., in Proceedings Sardinia 2011
Field observations from test cells
Meeting acceptance criteria?

Problematic for:
- PCB-total
- TOC
- DOC
L/S development in test cells

Showing preferential flow – not unexpected
Test results vs. field observations

- Similar pattern for:
  - Chloride
  - Mg
  - Na
  - K
  - Cr (total)
  - DOC
  - Ca ?
  - Mn ?
Test results vs. field observations

Decreased leaching in field
- SO4
- Cd
- Co
- Cu
- Hg
- Ni
- Pb
- Zn

Increased leaching
- Fe
- Ba
- As
- V
Conclusion: Lab test vs. field observations

While laboratory experiments were fully oxidised the field conditions were more or less reduced.

Compared to laboratory tests field observations showed that:

• The leaching of Cd, Co, Cu, Hg, Ni, Pb and Zn were significantly lower from the landfill – since these metals most likely are bound as metal sulphides in the landfill

• Fe, As, Ba, V were mobilised under reducing conditions in the landfill

• The leaching from SR landfills most likely takes place from both reduced and oxidised zones

= complicates the estimation of the aftercare period

However with the understanding of the processes controlling leaching in landfills it is possible to obtain a sound basis for estimation of the aftercare period
Aftercare period?

NO METHOD AVAILABLE!

SIMPEL APPROACH:
Estimated based on results from basic characterisation testing and
Criteria for acceptance at source: Criteria defined for infiltration of surface run off and leachate from unit IIa

<table>
<thead>
<tr>
<th>Element</th>
<th>Breakpoint L/S (l/kg)$^1$</th>
<th>Net infiltration 158 mm/år</th>
<th>2009 H = 10 m</th>
<th>Net infiltration 658 mm/år</th>
<th>2010 H = 10 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cd</td>
<td>3,00</td>
<td>100 years</td>
<td></td>
<td>24 years</td>
<td></td>
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<tr>
<td>Cu</td>
<td>3,75</td>
<td>130 years</td>
<td></td>
<td>30 years</td>
<td></td>
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<tr>
<td>Hg</td>
<td>1,17</td>
<td>40 years</td>
<td></td>
<td>9 years</td>
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<tr>
<td>Ni</td>
<td>7,98</td>
<td>270 years</td>
<td></td>
<td>65 years</td>
<td></td>
</tr>
<tr>
<td>Pb</td>
<td>2,42</td>
<td>80 years</td>
<td></td>
<td>20 years</td>
<td></td>
</tr>
<tr>
<td>Zn</td>
<td>11,0</td>
<td>370 years</td>
<td></td>
<td>90 years</td>
<td></td>
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</tbody>
</table>
Remarks

- SR is in many ways a problematic fraction for landfilling with respect to:
  - WAC
  - Hydraulic flow
  - Leaching behavior
  - Gas production

- Many open questions regarding estimation the aftercare period call for a (inter)national guideline

- Future – new strategies for landfilling is needed
Landfill mining of SR

Ref: Hansen et al. in Proceedings Sardinia 2013
Metal, plast og energi

Energi ?

??
Ressource values

Mechanical sorting of > 5 mm fractions:

Metals (Fe, Cu, Al, brass):
6-9 % metals can be recovered from landfilled SR using existing technologies
Corresponding to 86,000 tons or in best case 130,000 tons of metals

Plastic:
8% plastic (> 10 mm) in SR
(large impact on Cl-content in residual)
Positive effects:

• Recovery of metals (and other fractions e.g. Plastic, glass ??)
• Recovery of energy (positive gain to society – but an economically burden to landfill owners)
• LCA showed positive environmental effects
• Regain of Landfill volume

Summary:

• 60-75% (w/w) of landfilled SR is expected to be feasible for material or energy recovery (ca. 1 mio tons)
• 25-40 % may need to be re-landfilled (at least for some time)
Economically assessment

Expenses
1. Excavation
2. Preparation and Sorting
3. Transport to treatment plants
4. Energy recovery (treatment costs and taxes)
5. Re-landfilling of the residual fraction (expenses unclear)

Revenue
6. Sale of materials (METALs, glass?, plastic?)
7. Proceeds from the release of landfill volume
8. Reversal of taxes (?)
9. Reversal of guarantee

Economically feasible ???
Final remarks

SR as we know it today is not feasibel for landfilling
• Contains valuable resource – can be recovered
• Seems difficult to obtain FSQ for landfilled SR

Still a need for landfilling of the fine fraction - at least until we know how to recover the metals

Only one reason that we have landfilled SR until now – MONEY
Future management

- Metal scrap
- Shredder plant
- Shredder waste
- 100% SR Treatment
- Products 80%
- Landfilling Max 30% af SR
- Energy recovery ca. 50-60% af SR

Material recovery Min 10% af SR