

A field study using steel industry slags in a landfill cover construction

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Introduction

The need for cover materials for landfill closure and the search for applications to reuse slags from steel industry (15.2 Mio tones yearly in Europe) resulted in a project testing steel making slags as construction material in a landfill cover.

Research question

Does a landfill cover with steel slags in the liner fulfill the technical, legal and environmental requirements?

Material & Methods

Three types of electric arc furnace slag (EAFS 1, 2, 4) and one ladle slag (LS) originating from Uddeholm Tooling AB in Sweden are tested in a top cover of a landfill for municipal solid waste, situated in Hagfors, Sweden.

Ten lysimeters are placed below the liner for leachate collection.

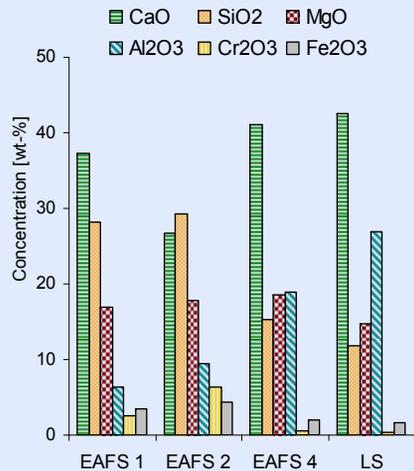


Figure 1.

Chemical composition of EAF and ladle slags

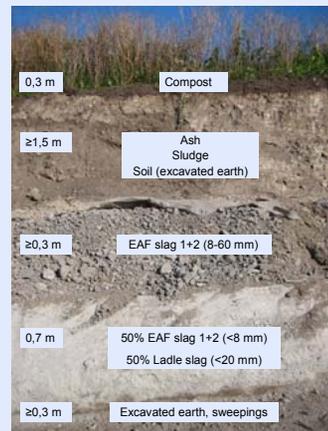


Figure 2.

Cover design of test area 1 with liner consisting of steel slags

Results

On average, 28 l/m² percolated through the cover per year (Fig. 3).

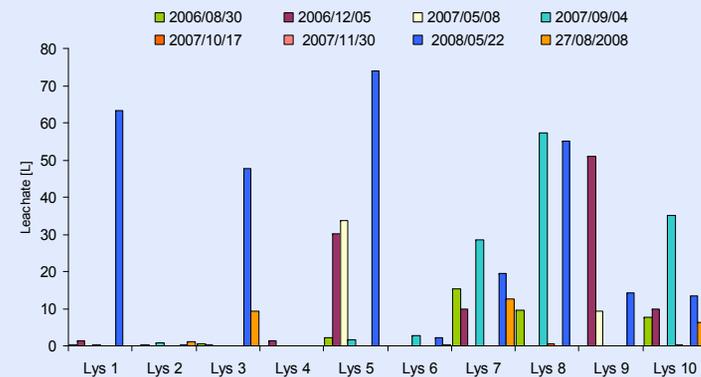


Figure 3.

Leachate amount collected in ten lysimeters below test area 1 for different sampling periods

The leachate (Fig. 4, 5) is characterized by high pH, high amounts of Ca, salts as Na and low amounts of heavy metals as Fe, Mo, Cr and Cu.

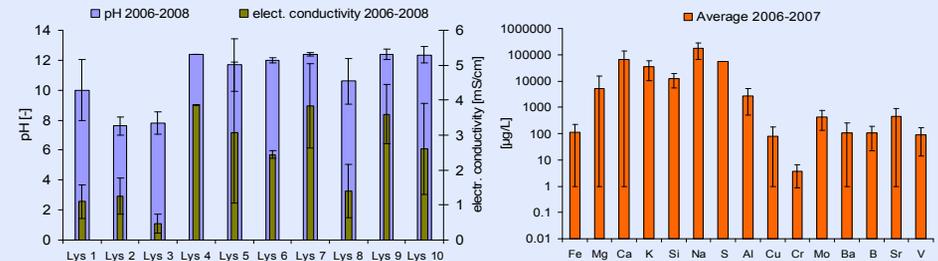


Figure 4.

Average pH and electrical conductivity

Figure 5.

Average leachate concentrations over ten lysimeters

Conclusion

The construction fulfills the Swedish legal requirements for permeability of 50 l/m² per year for a top cover for non-hazardous landfills. The high buffer capacity of the liner material provides additional safety and contributes to the long-term stability.

Acknowledgement

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Ageing of a steel slag liner in a landfill top cover

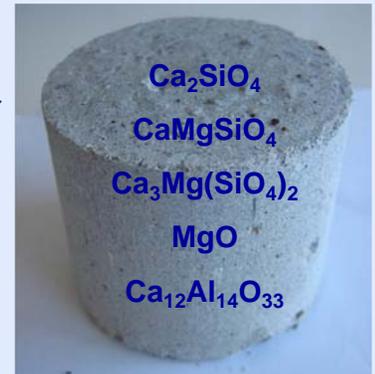
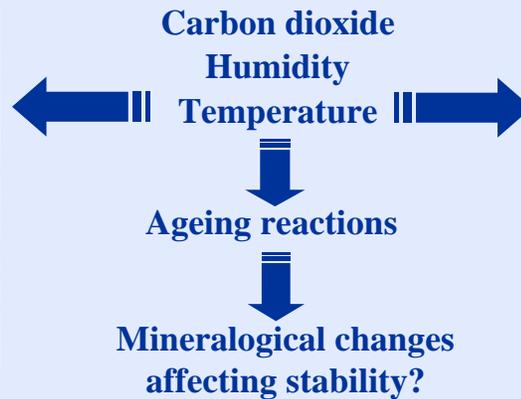


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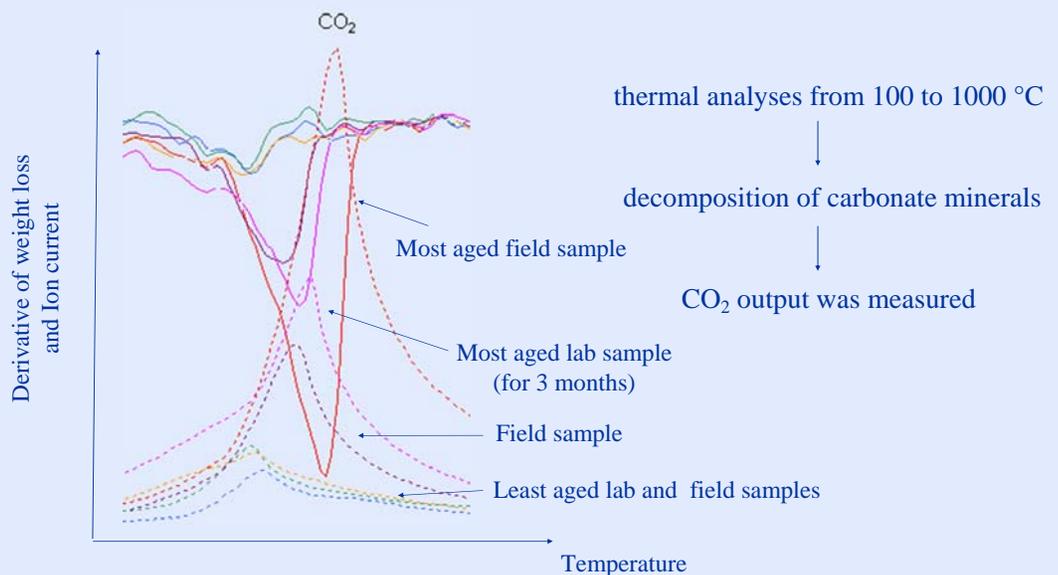
- How does the mineral composition of a steel slag liner change in a landfill top cover?
- What mineral changes are found in a laboratory experiment simulating accelerated ageing?



Landfill top cover with steel slag liner
Requirements: low water infiltration and LFG emissions, chemical and physical long-term stability



Steel slag liner specimen from laboratory experiment



Results and conclusions

- Ageing reactions of the field samples included calcite formation and possibly, changes in calcium-silicate minerals. In the laboratory samples, only calcite formation was observed (X-ray diffraction).
- Ageing reactions were more intensive in the field than under laboratory conditions.
- Reaction with CO₂ was not the only factor responsible for ageing reactions of the calcium-silicate rich steel slag but also varying environmental conditions and processes such as leaching support ageing.
- A slag liner will be stable for a longer time if protected by layers above i.e. not being directly exposed to temperature changes (freezing, thawing, desiccation) and precipitation.
- The studied steel slag mixture contains minerals with low solubility that are stable after construction.
- Predictions of the long-term stability (beyond 50 or more years) need further research.

Acknowledgement

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