AGGREGATES FROM ELECTRIC ARC FURNACE SLAG AS MATERIAL FOR SUB-BALLAST LAYER, ENVIRONMENTAL CONSIDERATIONS

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Steel slag aggregates in sub-ballast layers for railway platforms
The aim of this investigation is to assess the environmental impact of the use of blend material (electric arc furnace slag + fine calcareous aggregates) in subballast layers (railway).
Railway Structure

Ballast
Subballast
Subgrade 1
Subgrade 2

(railwaysubstructure.org)
Sub-ballast Requirements

Size distribution

Water permeability

Limit WP ≤ 10^{-6} m/s

EAFS 0/40 mm WP > 10^{-6} m/s
Sub-ballast Requirements

Size distribution

Water permeability

Limit WP \( \leq 10^{-6} \text{ m/s} \)

EAFS 0/40 mm (70%)

+ 

Fine calcareous aggregate 0/16 mm (30%)

\[ WP = 4,0 \times 10^{-6} \text{ m/s} \]

EAFS (70%) + FCA (30%) = AM
# Materials Characterization

## Chemical composition (%)

<table>
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<tr>
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<th>EAFS 0/40 mm</th>
<th>FCA 0/16 mm</th>
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<tr>
<td>LOI</td>
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<td>45,17</td>
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<tr>
<td>Fe₂O₃</td>
<td>38,98</td>
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<td>CaO</td>
<td>21,68</td>
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<td>SiO₂</td>
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<td>Al₂O₃</td>
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<td>ZnO</td>
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<td>MnO</td>
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<td>SO₃</td>
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<td>MgO</td>
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<td>Cr₂O₃</td>
<td>1,88</td>
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</table>

## Mineralogical composition

- **EAFS 0/40 mm**
  - Wuestite
  - Gehlenite
  - Magnetite
  - CalciumSilicate
  - Lime
  - Portlandite
  - Brucite

- **Fine calcareous aggregate 0/16 mm**
  - Calcite
  - Dolomite
  - Quartz
Environmental Impact Study

Leaching test

The maximum availability test (NEN 7371)
Compliance test (EN 12457-2)

Characterization test
- Percolation with and without size reduction (CEN/TS 14405)
- Granular low hydraulic conductivity (GLHC) (CEN/TS 16637-2)
Environmental Impact Study

Results

pH and electrical conductivity
Environmental Impact Study

Results

Release of constituents in Compliance and Maximum Availability test

Legal limit defined in the Directive 2003/33/EC for inert material
Environmental Impact Study

Results

Percolation (< 4 mm and < 25 mm)

Cumulative release of Ba

Cumulative release of F-

Cumulative release of Zn

Main mechanism for the release is dissolution
Environmental Impact Study

Results

Percolation (< 4 mm and < 25 mm)

Main mechanism for the release is wash out
Environmental Impact Study

Results

GLHC

Slope Up 0.65 = dissolution
Slope between 0.35 and 0.65 = diffusion
Slope lower 0.35 = washing or depletion

Analysis following the procedure of Annex B, from CEN/TS 166637:2014
Conclusions

In accordance with Decision 2003/33/CE the aggregates mixture (AM) could be considered as a waste at inert landfill.

Percolation and GLHC tests can be applied to the mixture. The pH value has been mainly constant along the test.
The release mechanism is specific to each species and differs between the executed tests.

It has been confirmed that the maximum particle size has an influence on the release quantity for percolation tests.
Thank You For Your Attention

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