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DE CATALUNYA
BARCELONATECH

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

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9th WASCON 2015 Resource Efficiency in Construction

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ÁRIDO SIDERÚRGICO EN CAPAS DE SUB-BASE Y DE FORMA EN PLATAFORMAS FERROVIARIAS (ASICAP)

Steel slag aggregates in sub-ballast layers for railway platforms

Fonds



Construction Companies



Recycling Companies



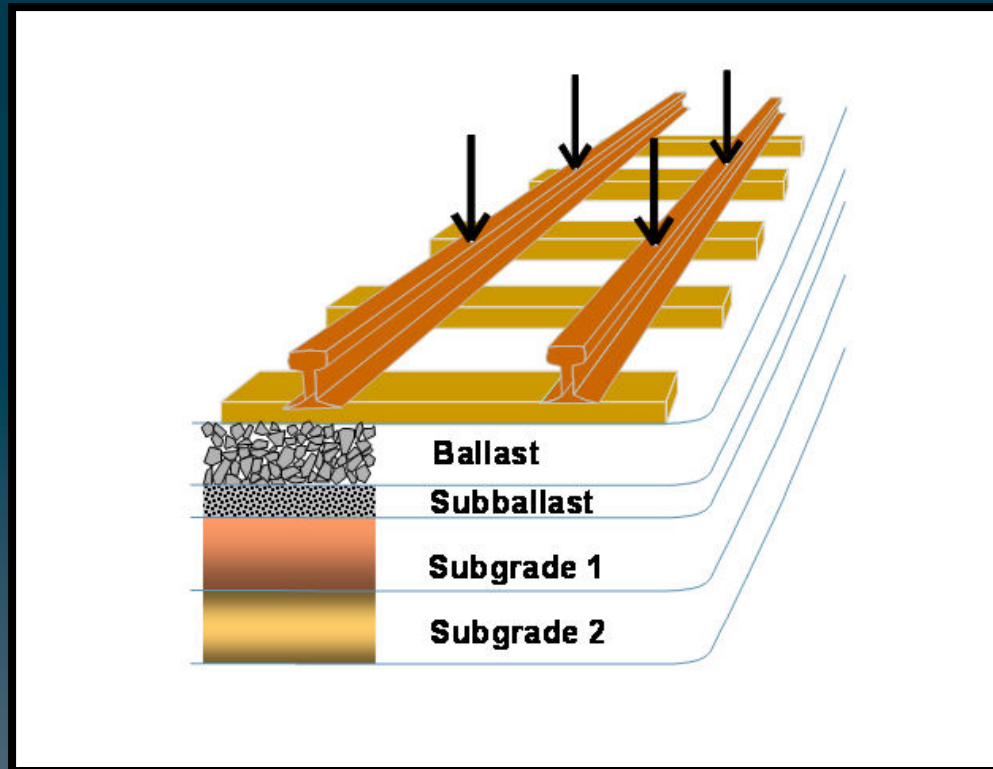
Research Institutes



OBJECTIVE

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)

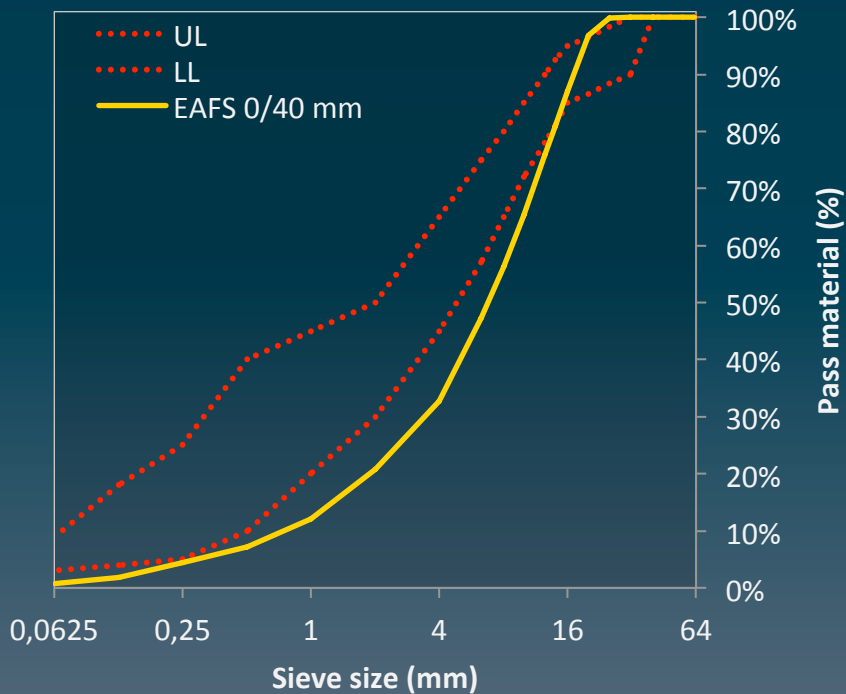
Railway Structure



(railwaysubstructure.org)

Sub-ballast Requirements

Size distribution



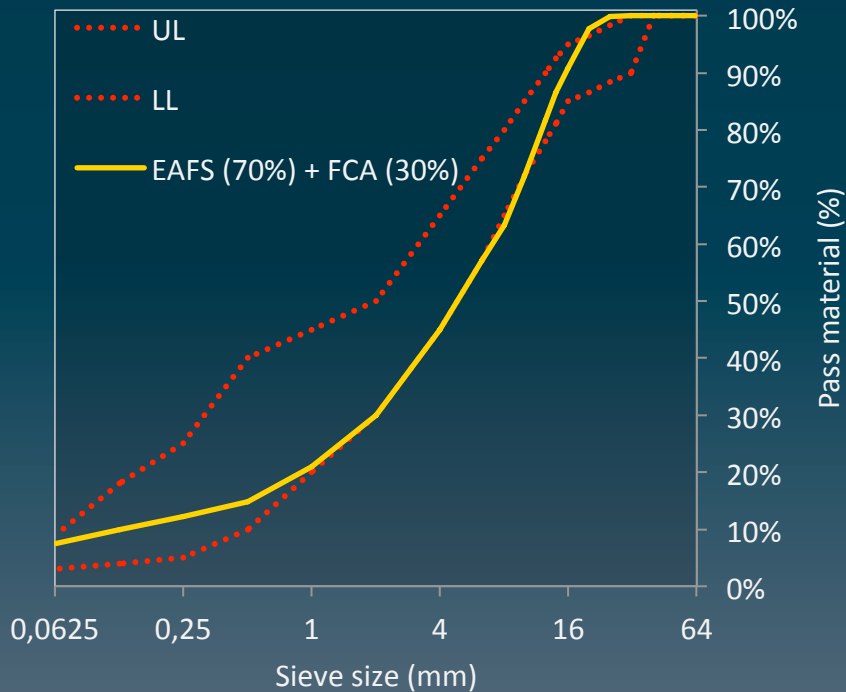
Water permeability

Limit $WP \leq 10^{-6}$ 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 (%)

	EAFS 0/40 mm	FCA 0/16 mm
LOI	---	45,17
Fe ₂ O ₃	38,98	0,76
CaO	21,68	31,00
SiO ₂	11,65	2,59
Al ₂ O ₃	8,27	0,79
ZnO	4,86	---
MnO	4,59	0,07
SO ₃	3,76	0,13
MgO	2,75	19,35
Cr ₂ O ₃	1,88	---

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

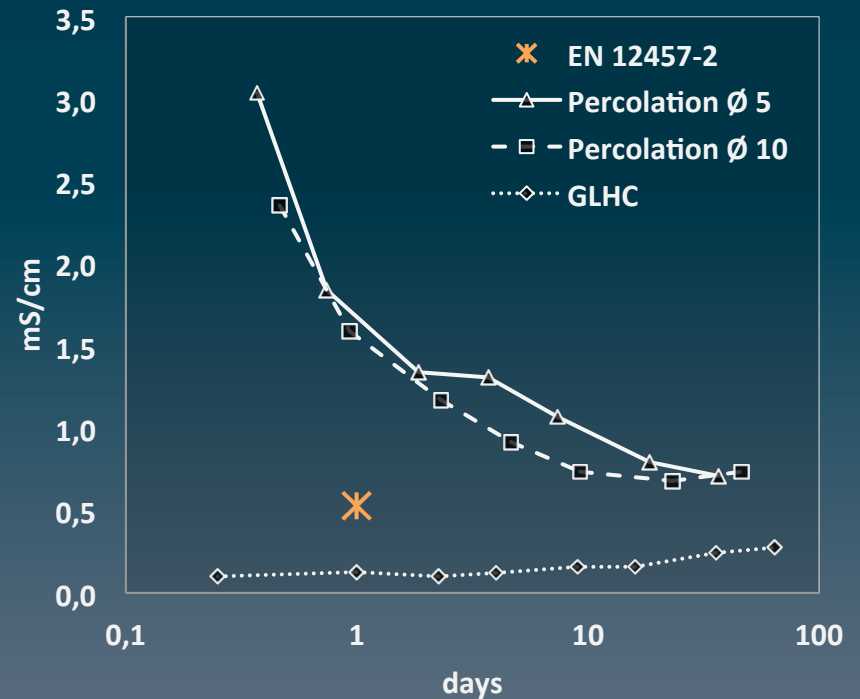
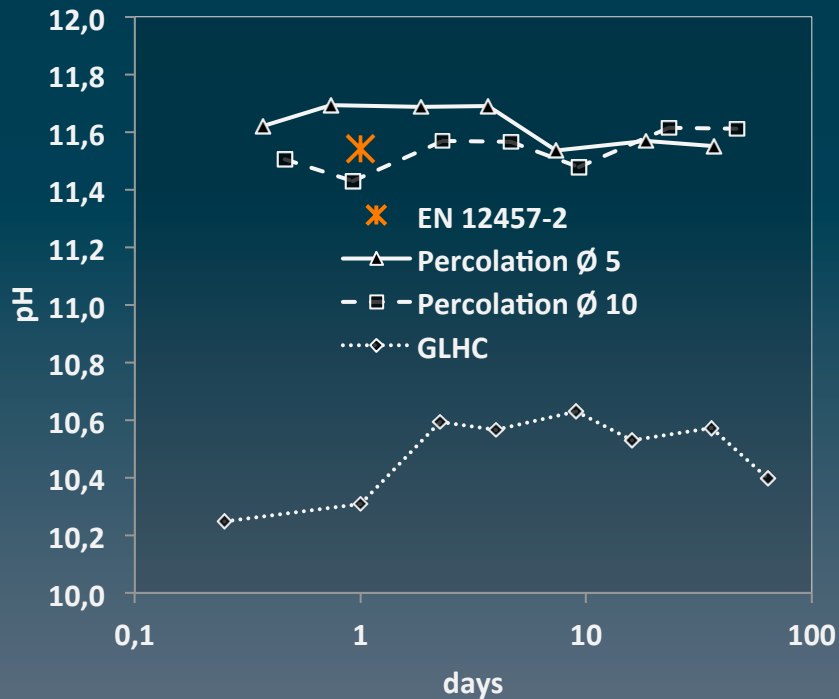
Percolation with and without size reduction (CEN/TS 14405)

Granular low hydraulic conductivity (GLHC) (CEN/TS 16637-2)

Environmental Impact Study

Results

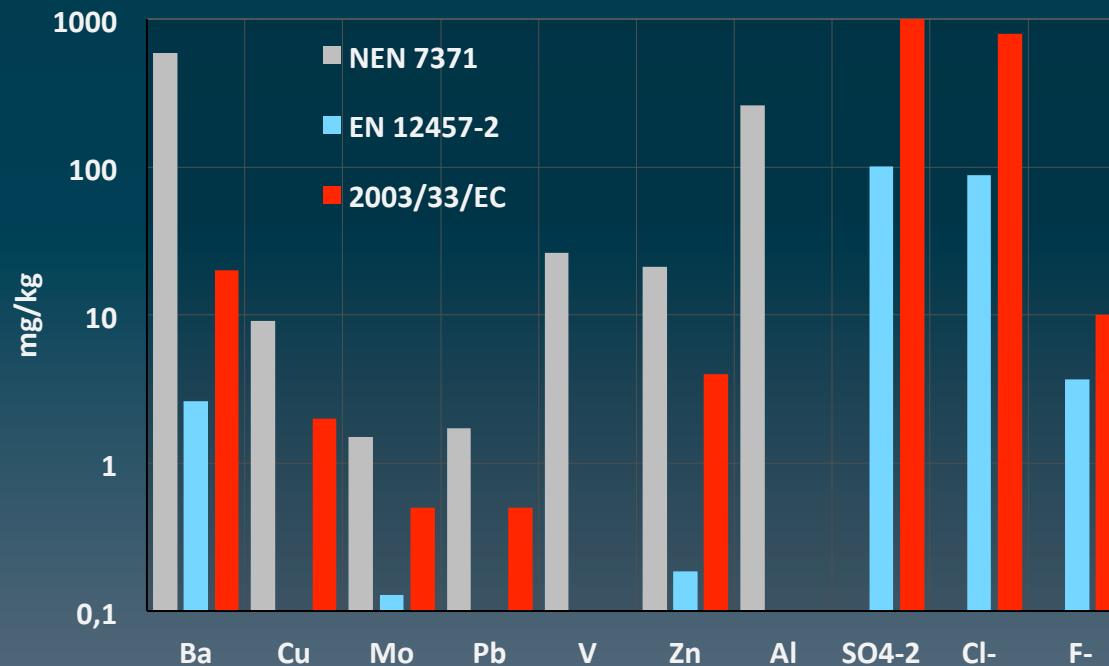
pH and electrical conductivity



Environmental Impact Study

Results

Release of constituents in Compliance and Maximum Availability test

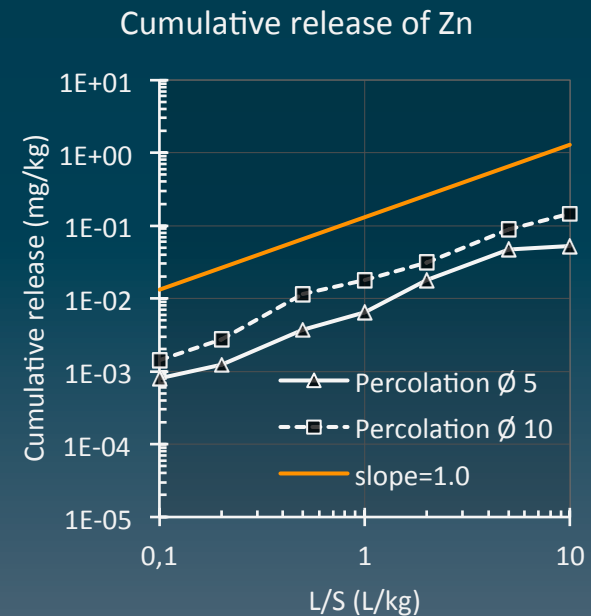
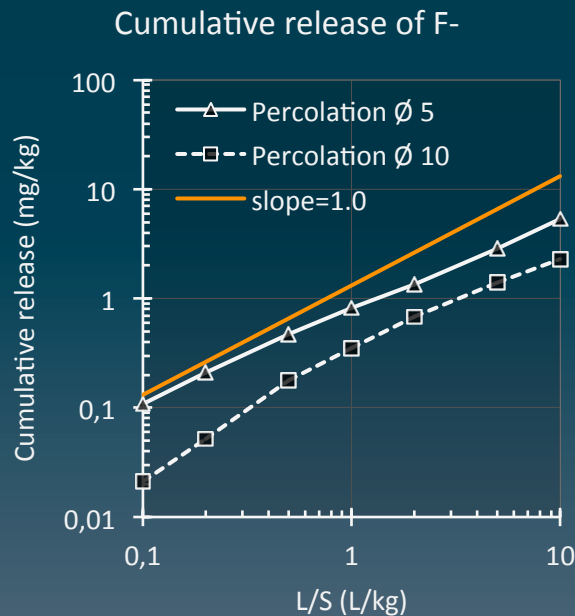
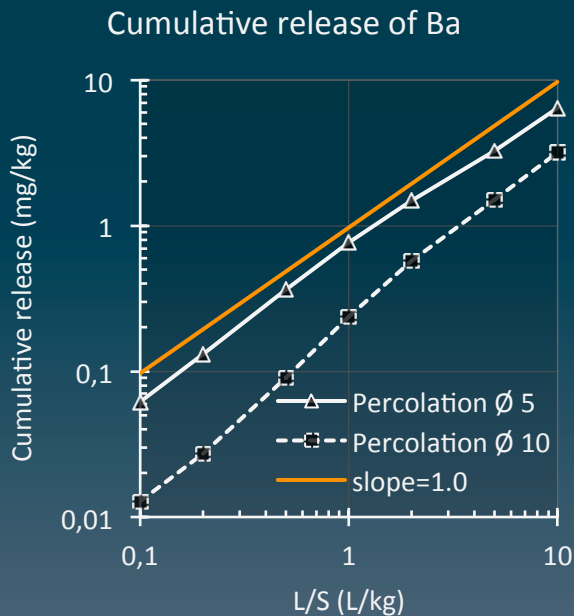


Legal limit defined in the Directive 2003/33/EC for inert material

Environmental Impact Study

Results

Percolation (< 4 mm and < 25 mm)



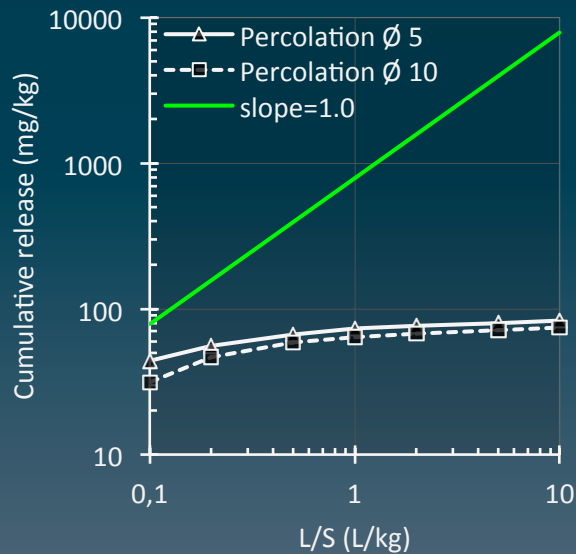
Main mechanism for the release is dissolution

Environmental Impact Study

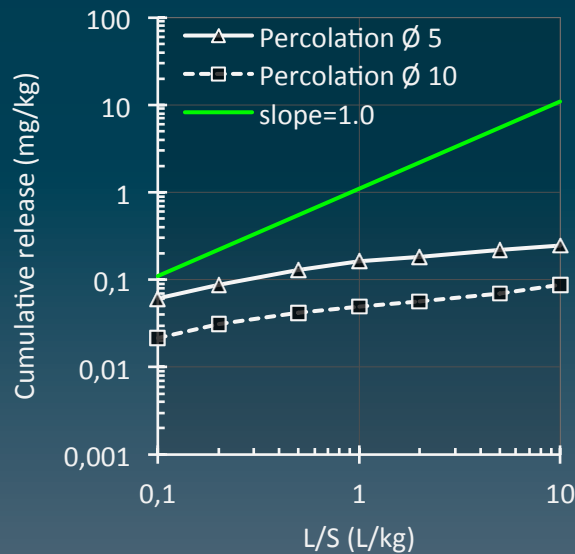
Results

Percolation (< 4 mm and < 25 mm)

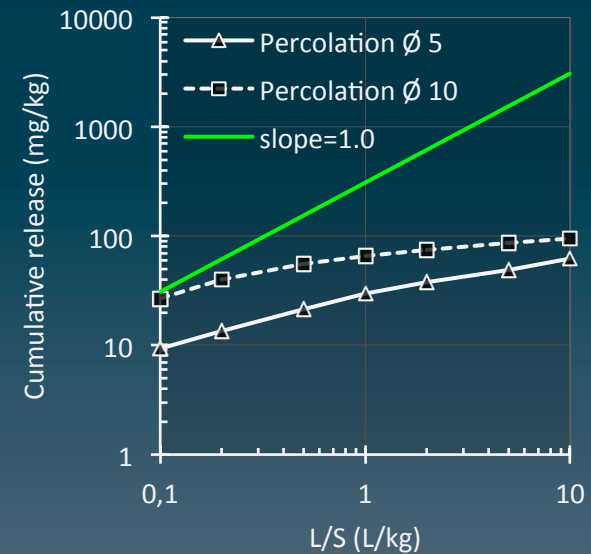
Cumulative release of Cl⁻



Cumulative release of Mo



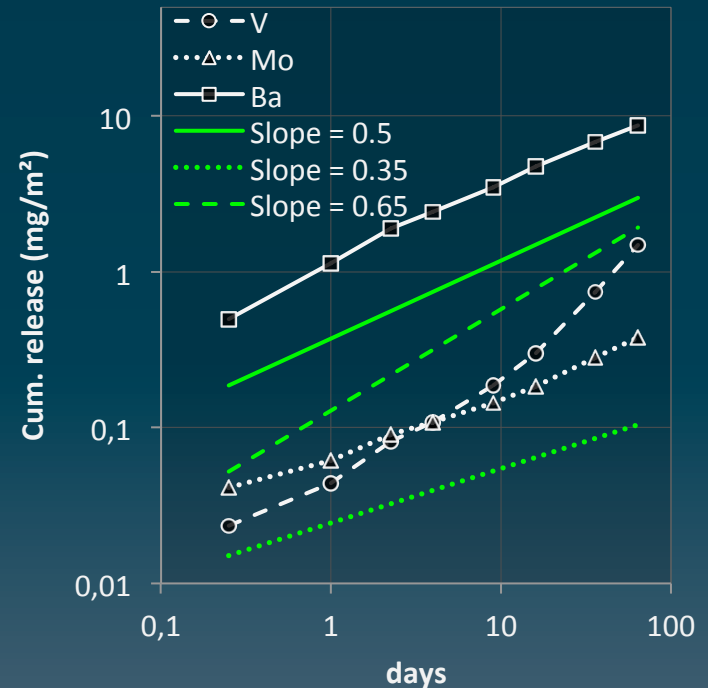
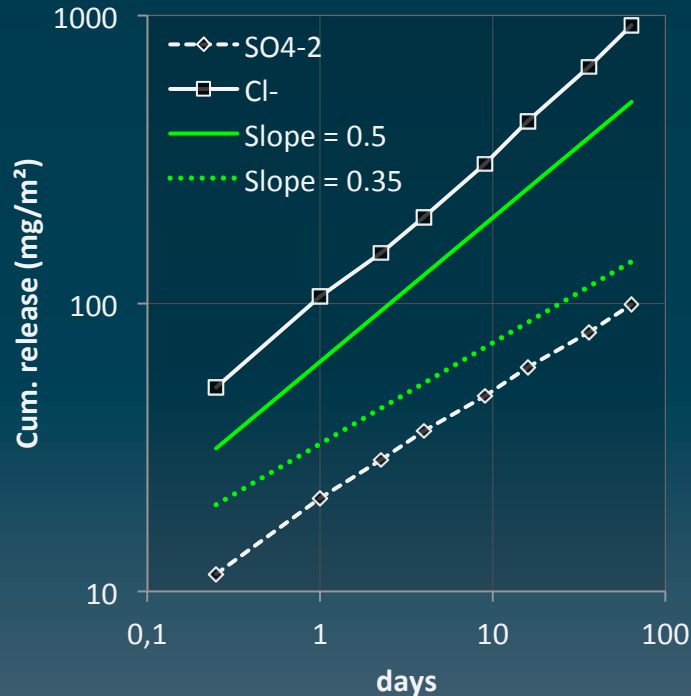
Cumulative release of SO₄²⁻



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

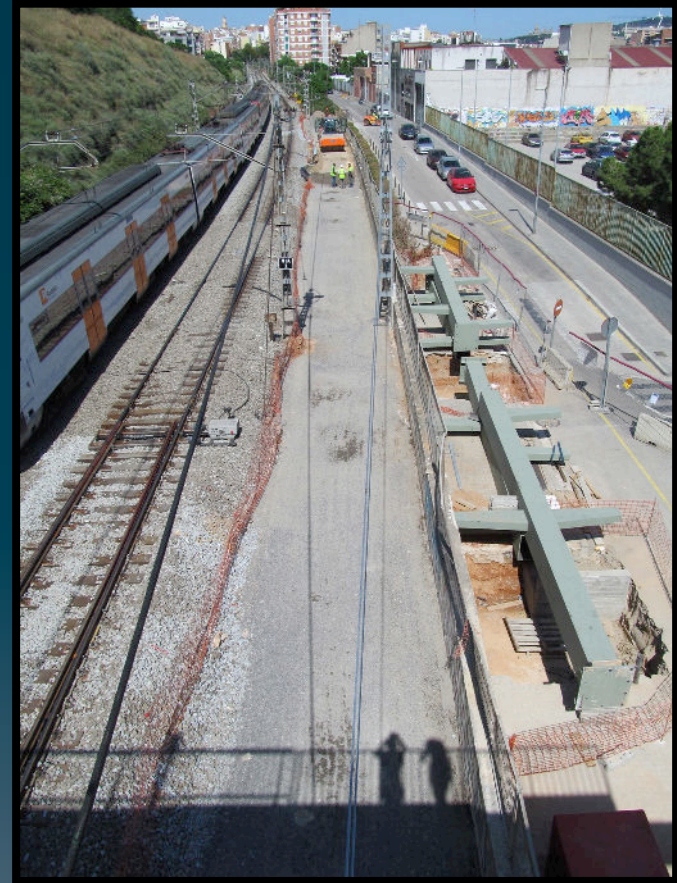
Conclusions

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



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Thank You For Your Attention

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