

HOListic Management of Brownfield REgeneration (HOMBRE)

Integrated strategies for Brownfield
regeneration: treatment of subsoil and alkaline
residues by the combined Ecogrout-carbonation
process

Wouter van der Star, Dianne den Hamer, Deltares
Oriana Capobianco, Giulia Costa, Renato Baciocchi,
University of Rome “Tor Vergata”

In cooperation with:



www.cabernet.org.uk



www.greenland-project.eu



www.timbre-project.eu



www.dais.unive.it/~glocom

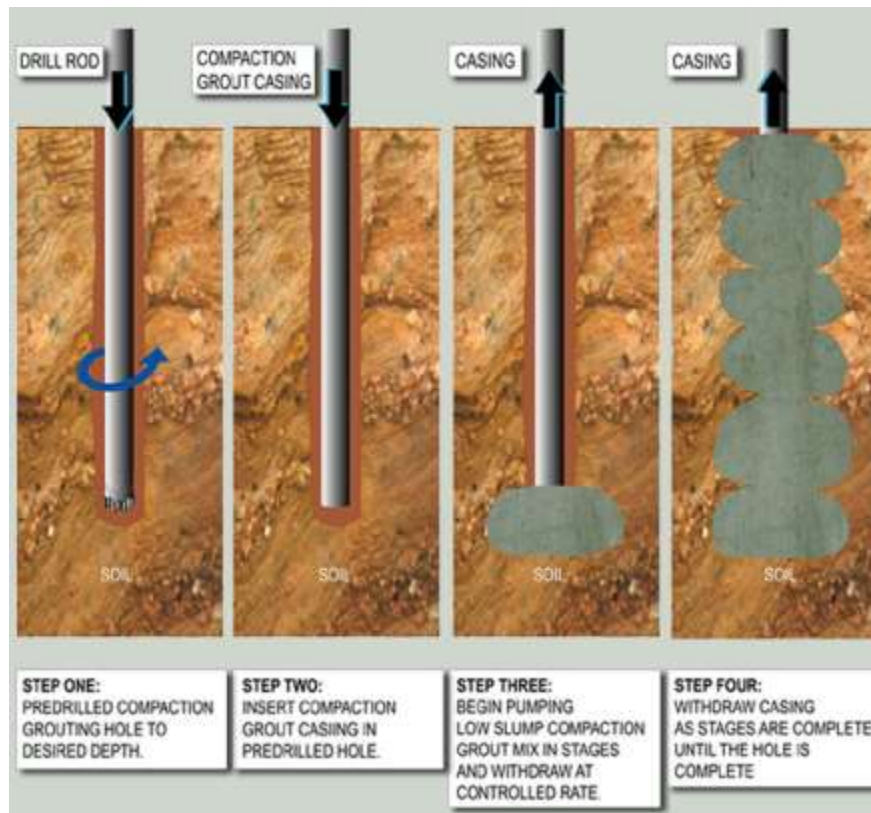


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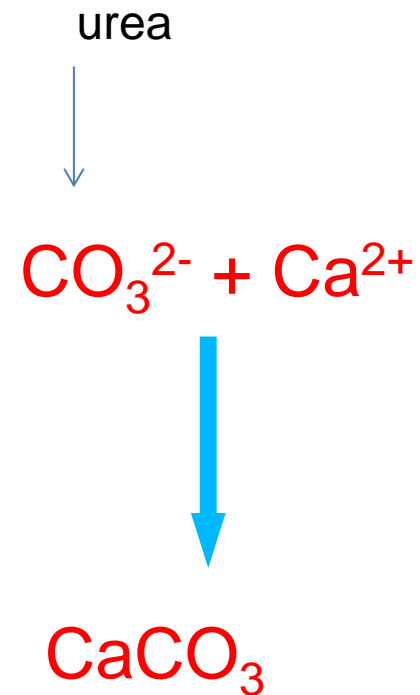
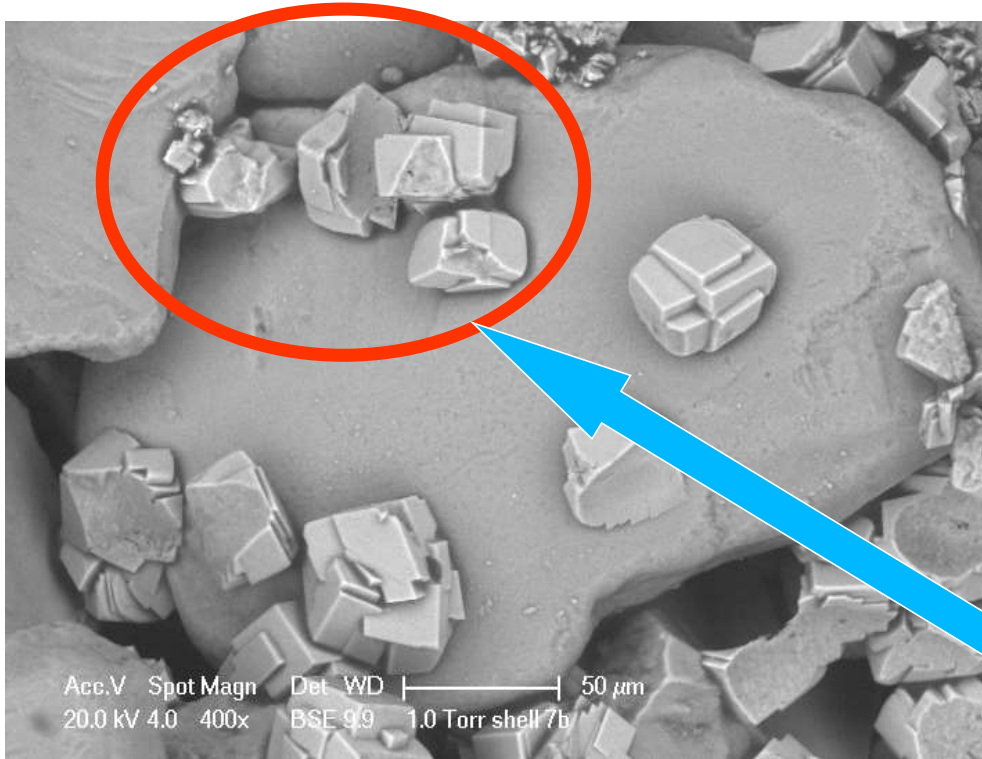


Soil strengthening, a little history

- Classical soil strengthening



Liquid grouting



Scale up

- Classical soil strengthening



5 cm

1D



1 m



1 m³

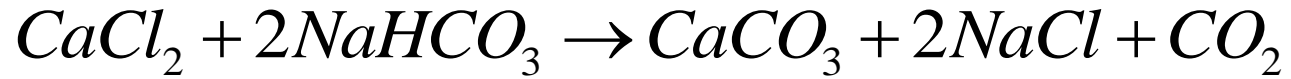
2D



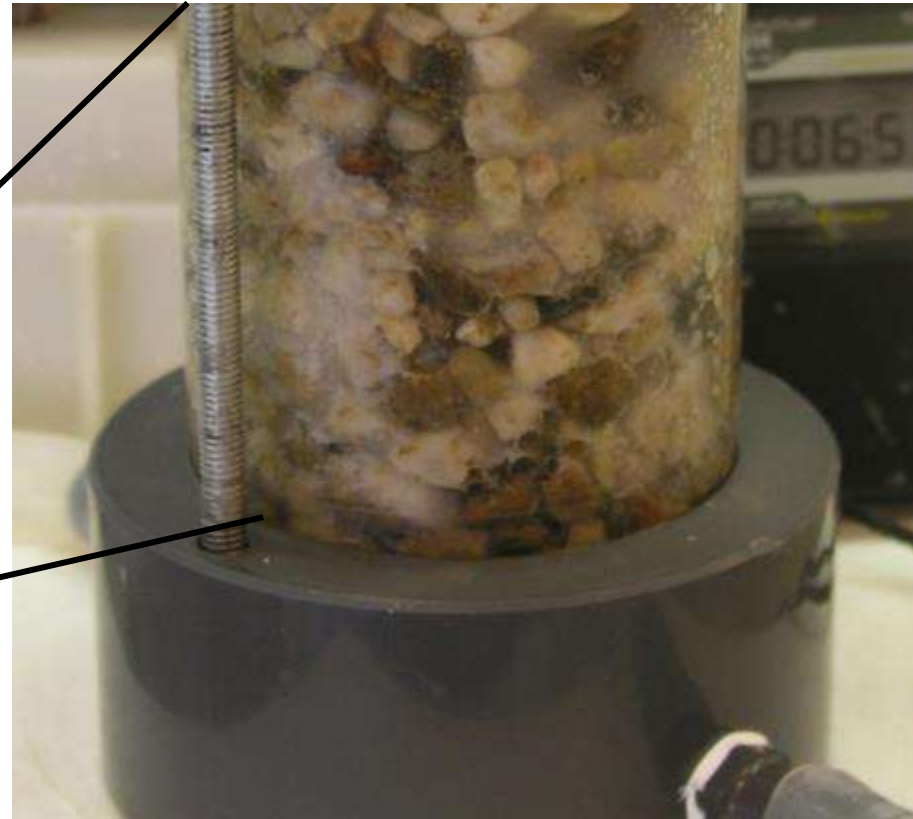
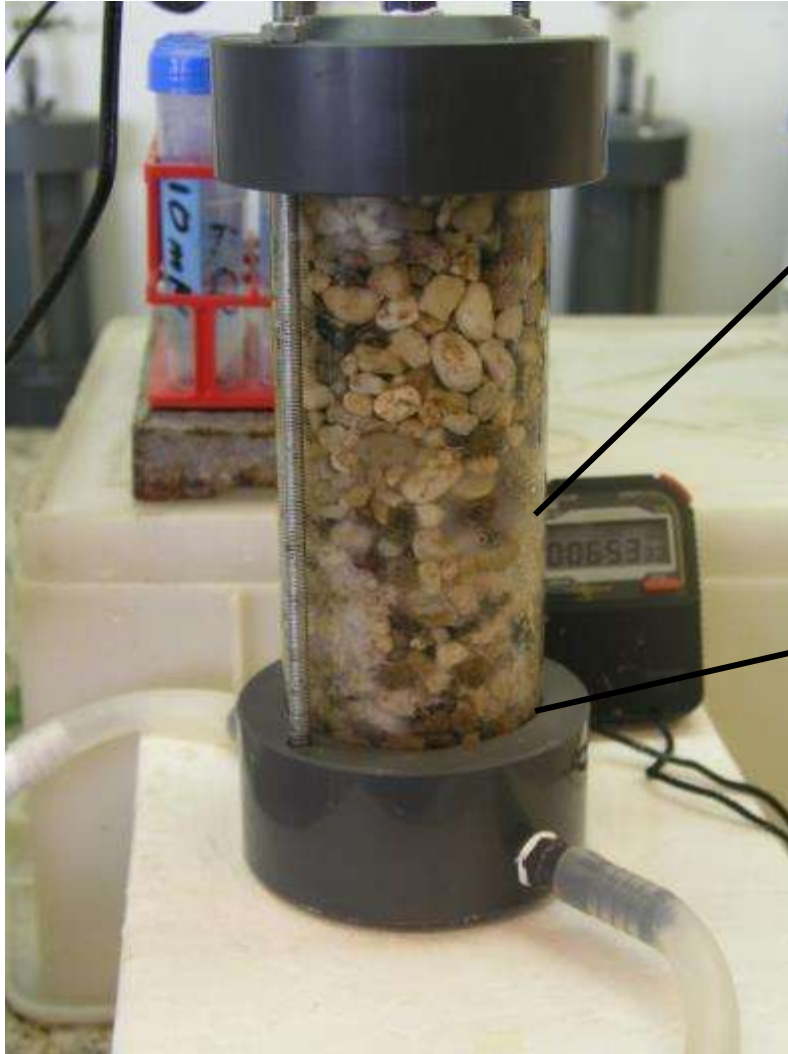
43 m³

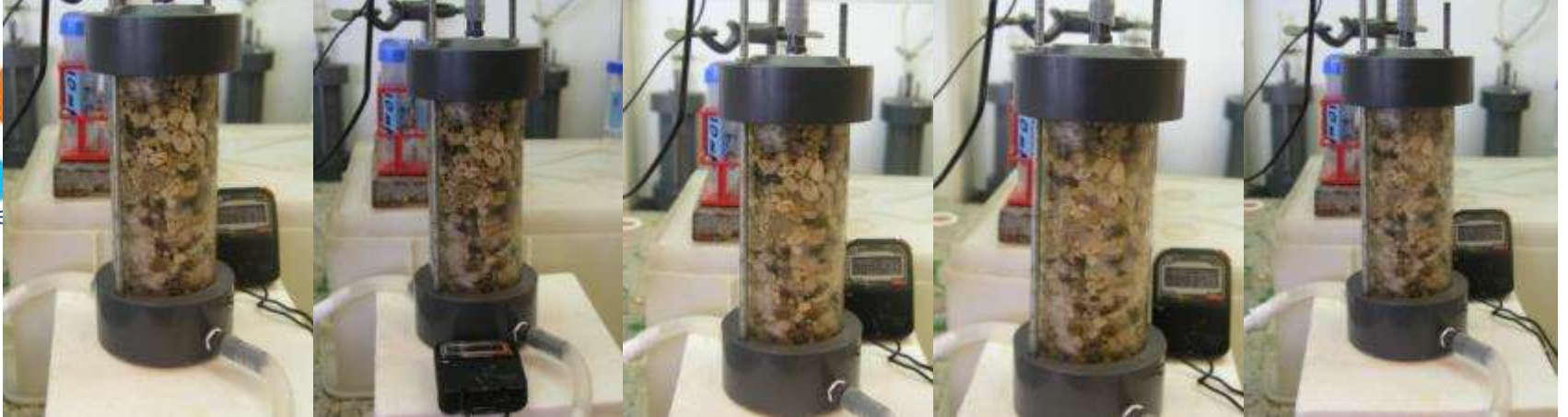
3D

Proof of Principle



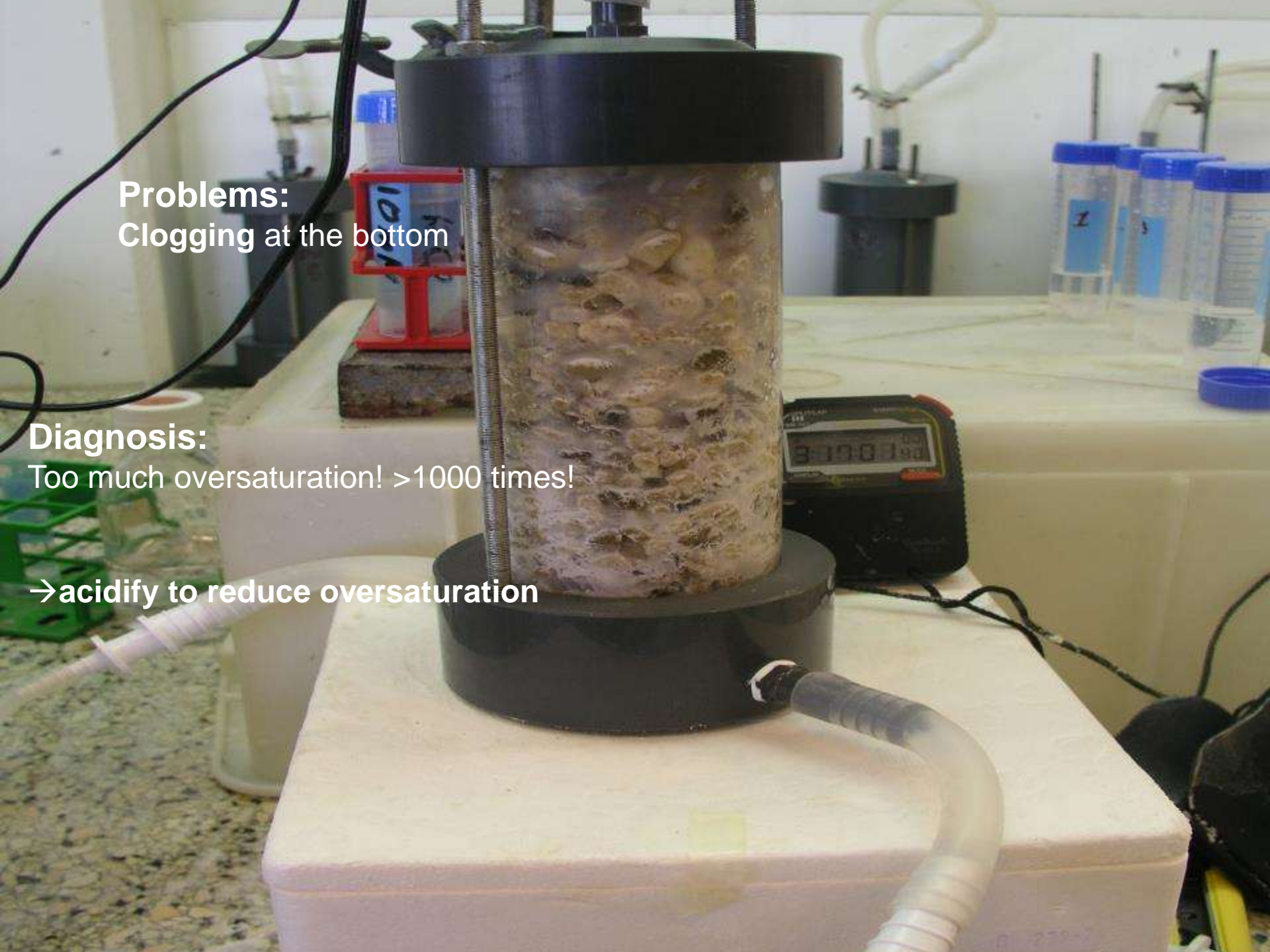
Column experiment





21 oktober





Problems:
Clogging at the bottom

Diagnosis:
Too much oversaturation! >1000 times!

→acidify to reduce oversaturation

Results of Short Column Tests

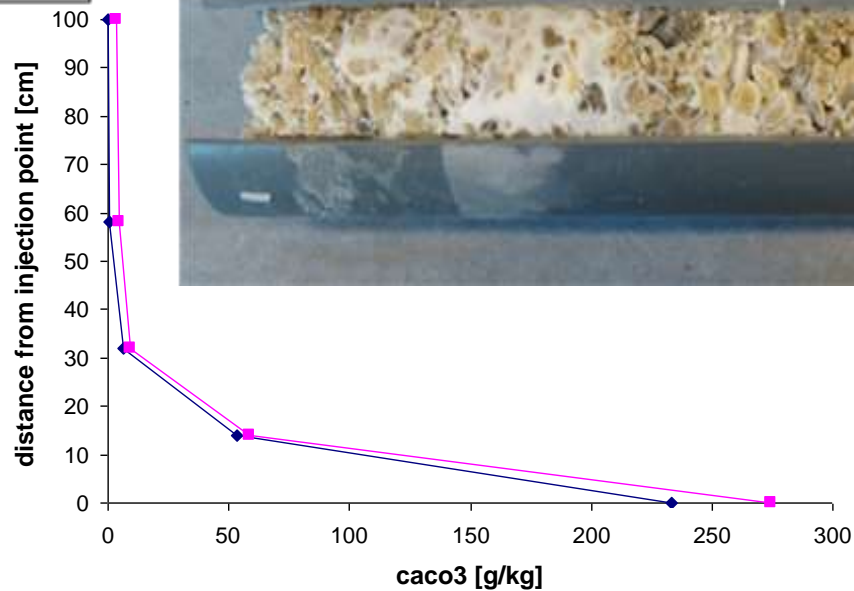


Results Long (1m) Column Tests



Bottom
end

Top
end



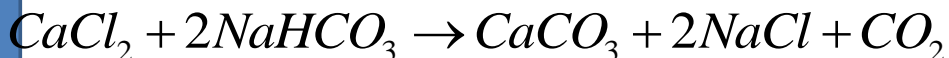
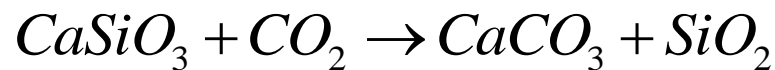
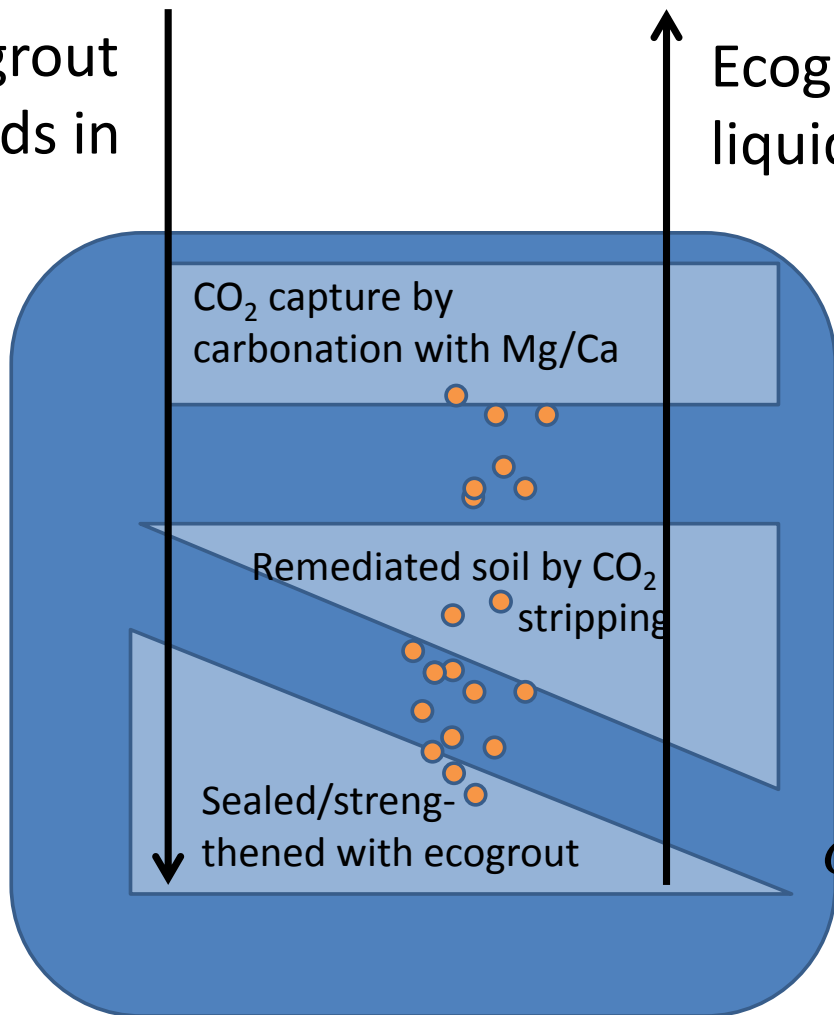
Use in brownfields and function combination?

- How does this work in a 3D environment?
- With different injection locations?
- And in Sand?
- Can we use the “released/produced” CO₂
 - stripping VOC
 - Improve env properties of Alkaline residues

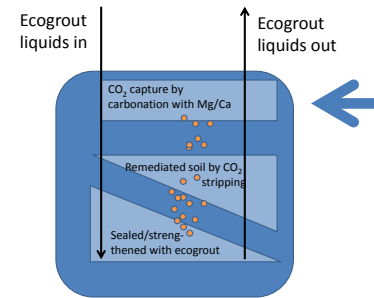
3-step concept

Ecogrout
liquids in

Ecogrout
liquids out



Carbonation: removal of CO₂

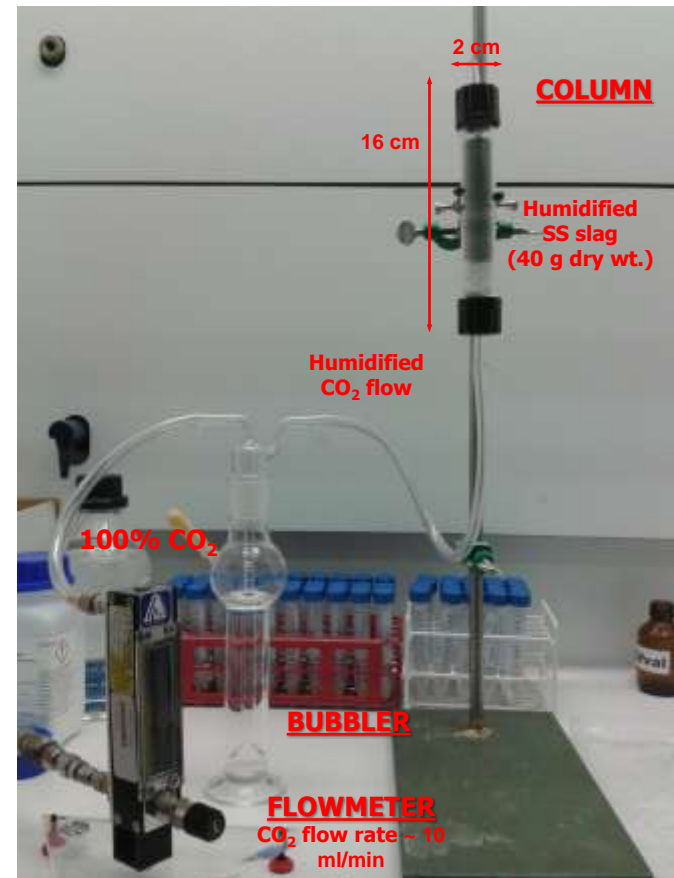
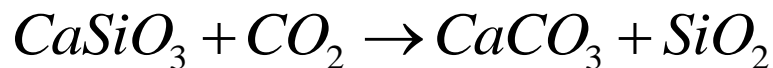


Material:

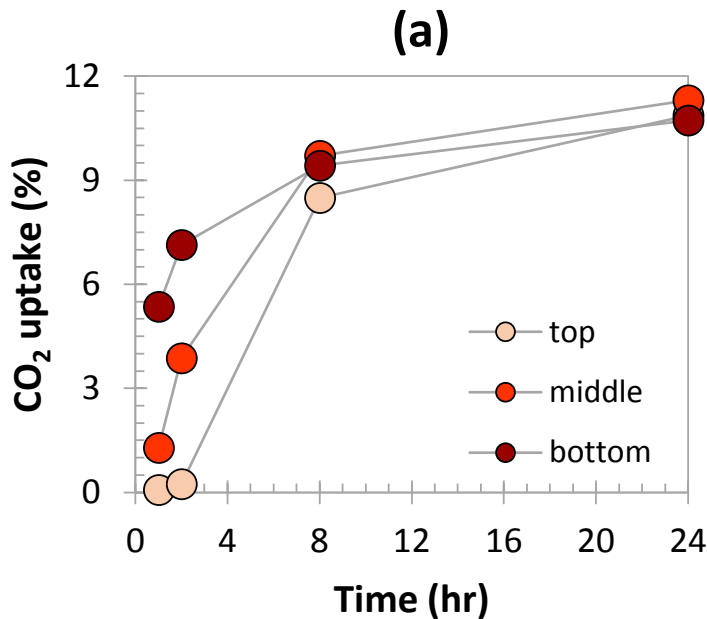
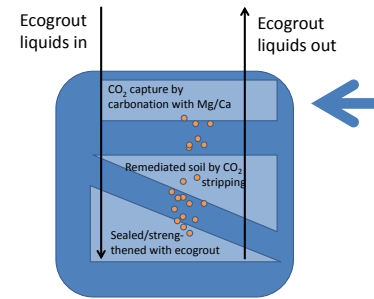
- Steel slag
- Alkaline
- Leaching concern

Evaluation of:

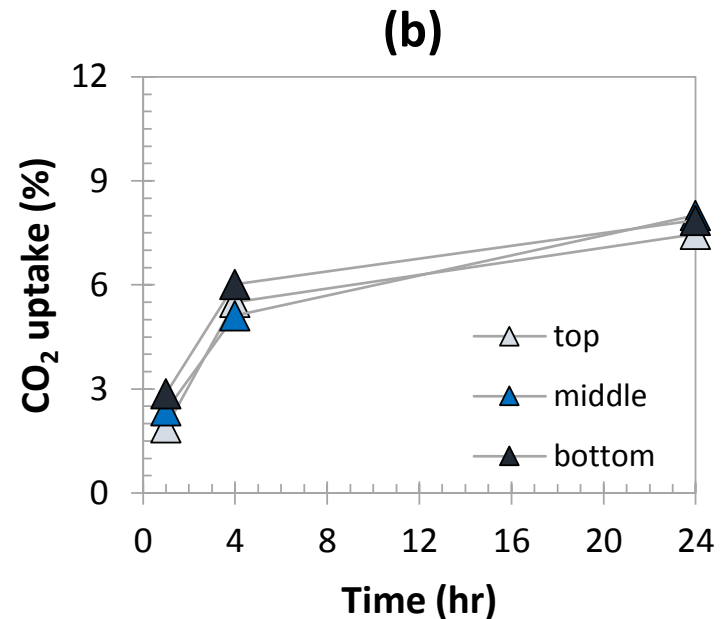
- Particle size
- Residence time
- Liquid/solid ratio
- wetting method



Carbonation: removal of CO₂

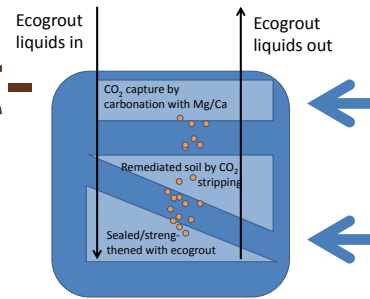


Slag diameter <0.85 mm

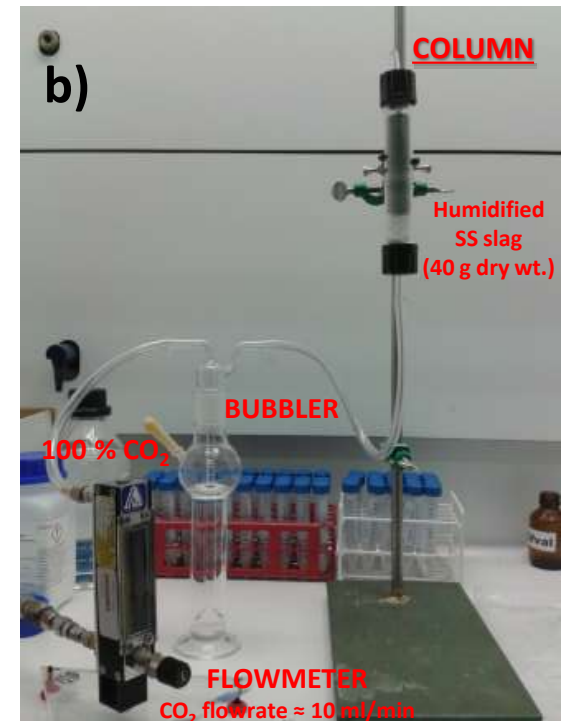
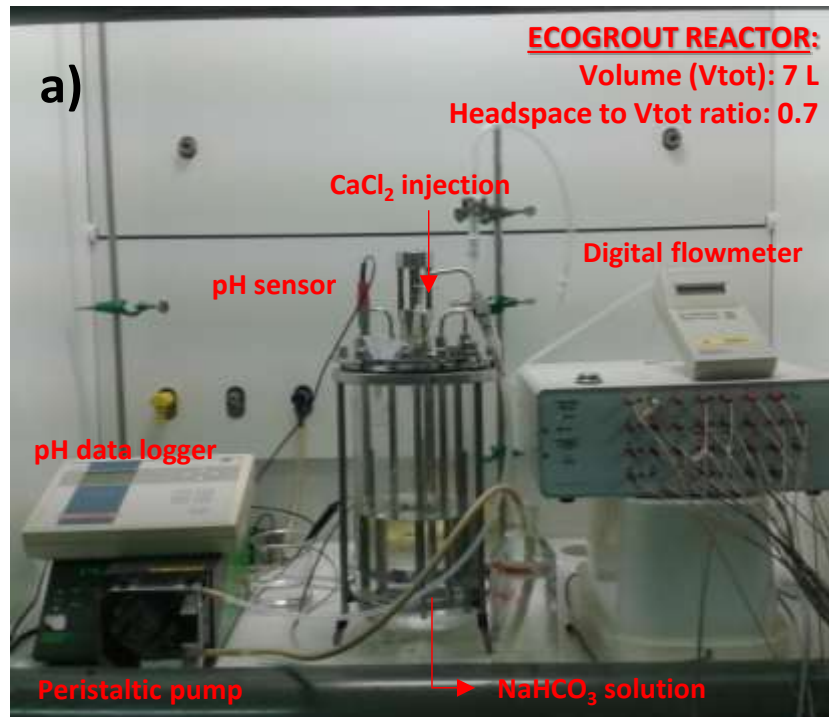


<10 mm (unsieved)

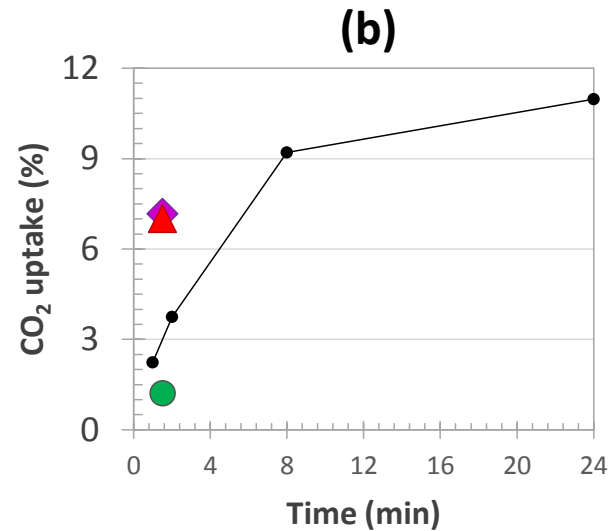
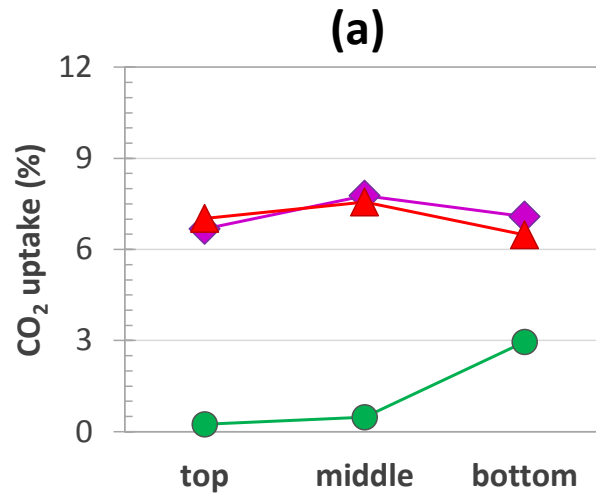
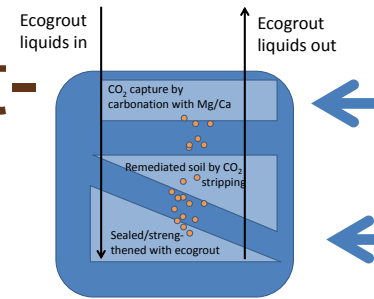
Combination: ecogrout-carbonation



- 1 size fraction (<0.85 mm)
- different ecogrout reagent concentrations



Combination: ecogrout-carbonation



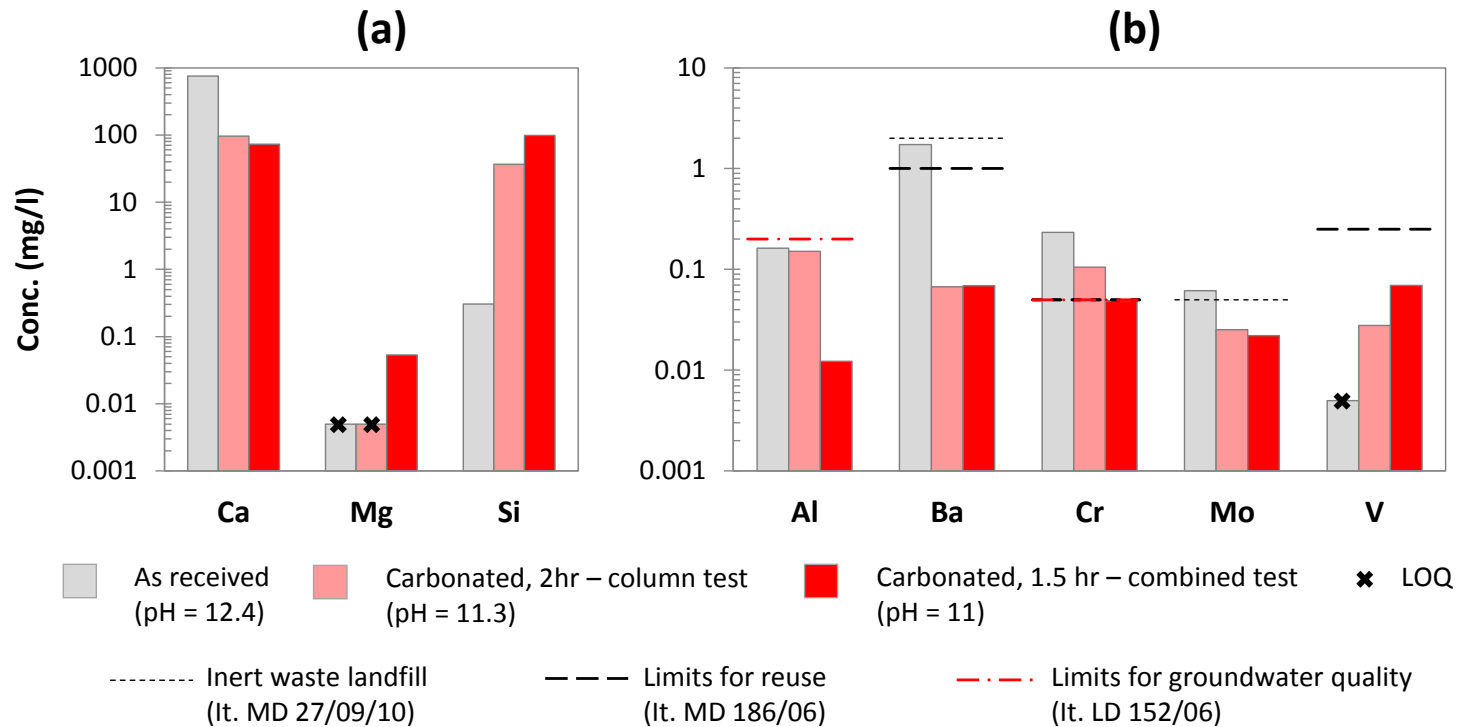
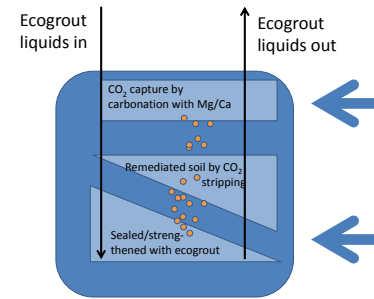
● 125 mM CaCl₂ /
250 mM NaHCO₃

◆ 250 mM CaCl₂ /
500 mM NaHCO₃

▲ 300 mM CaCl₂ /
600 mM NaHCO₃

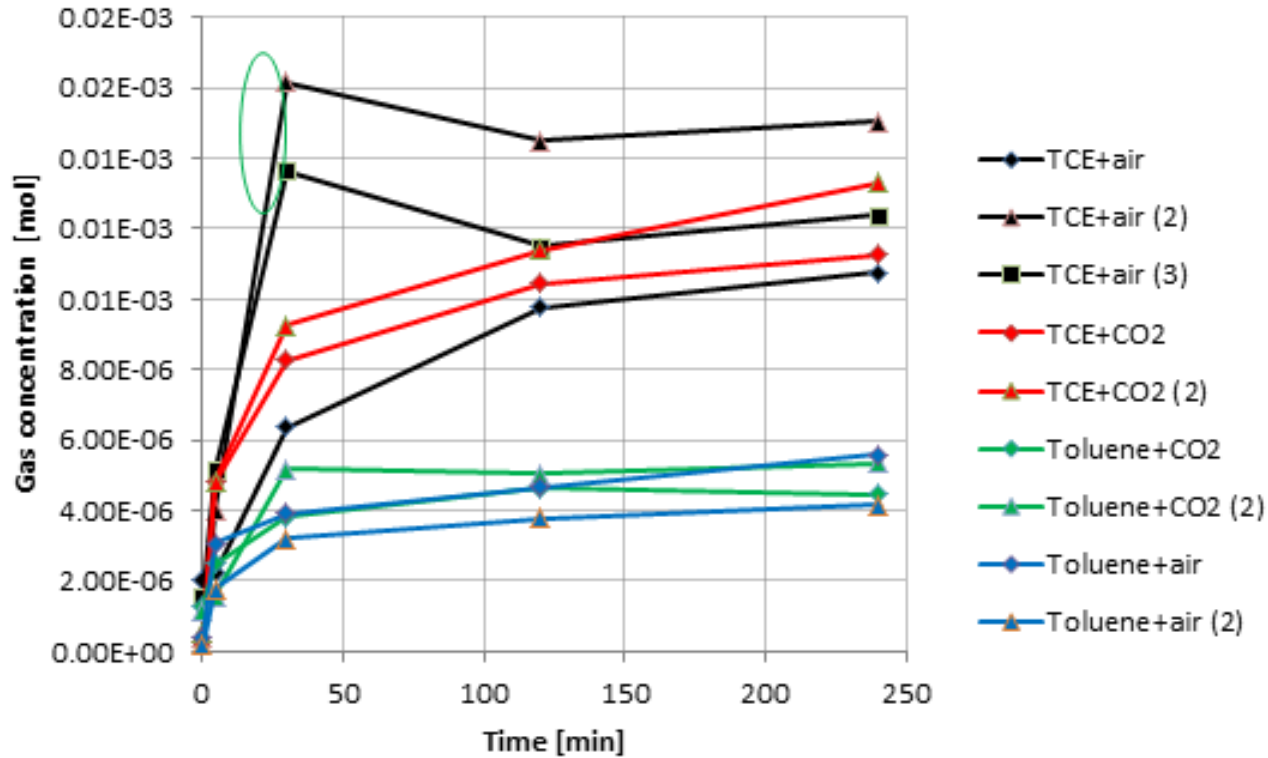
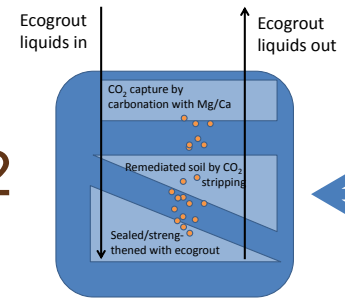
—●— CO₂ uptake kinetic from column tests (Fraction A)

Carbonated slag: environmental effect

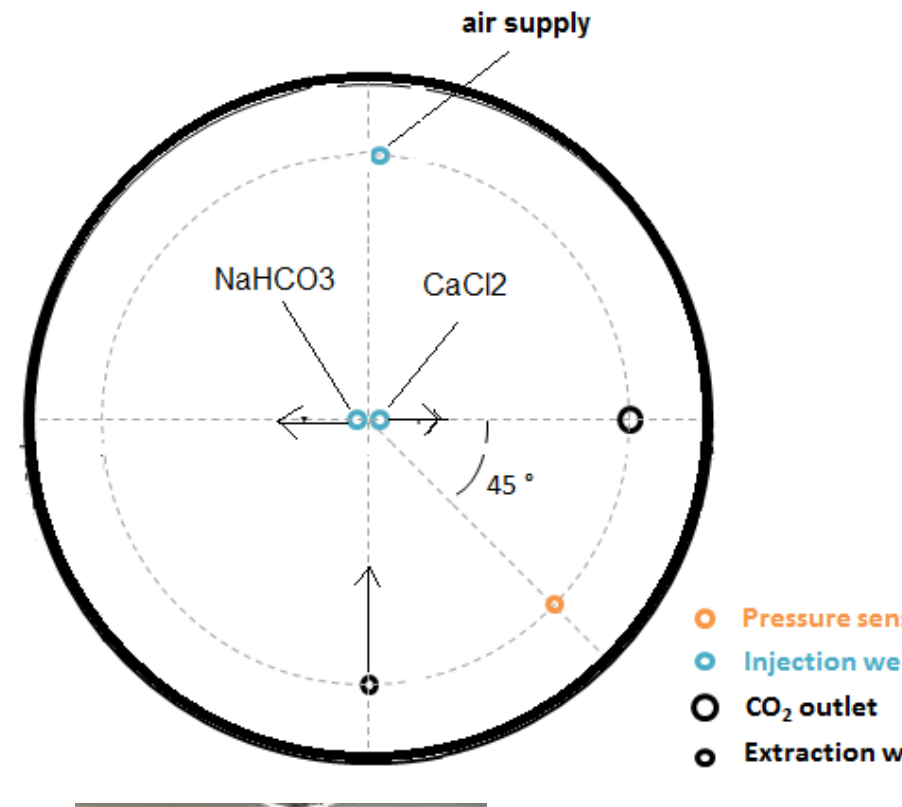
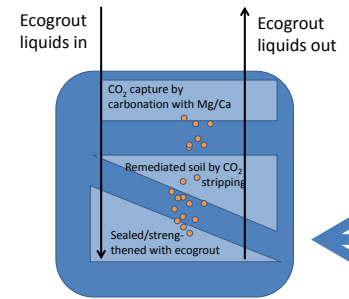


Leaching for 24 h at L/S 10 L/kg (stirred)

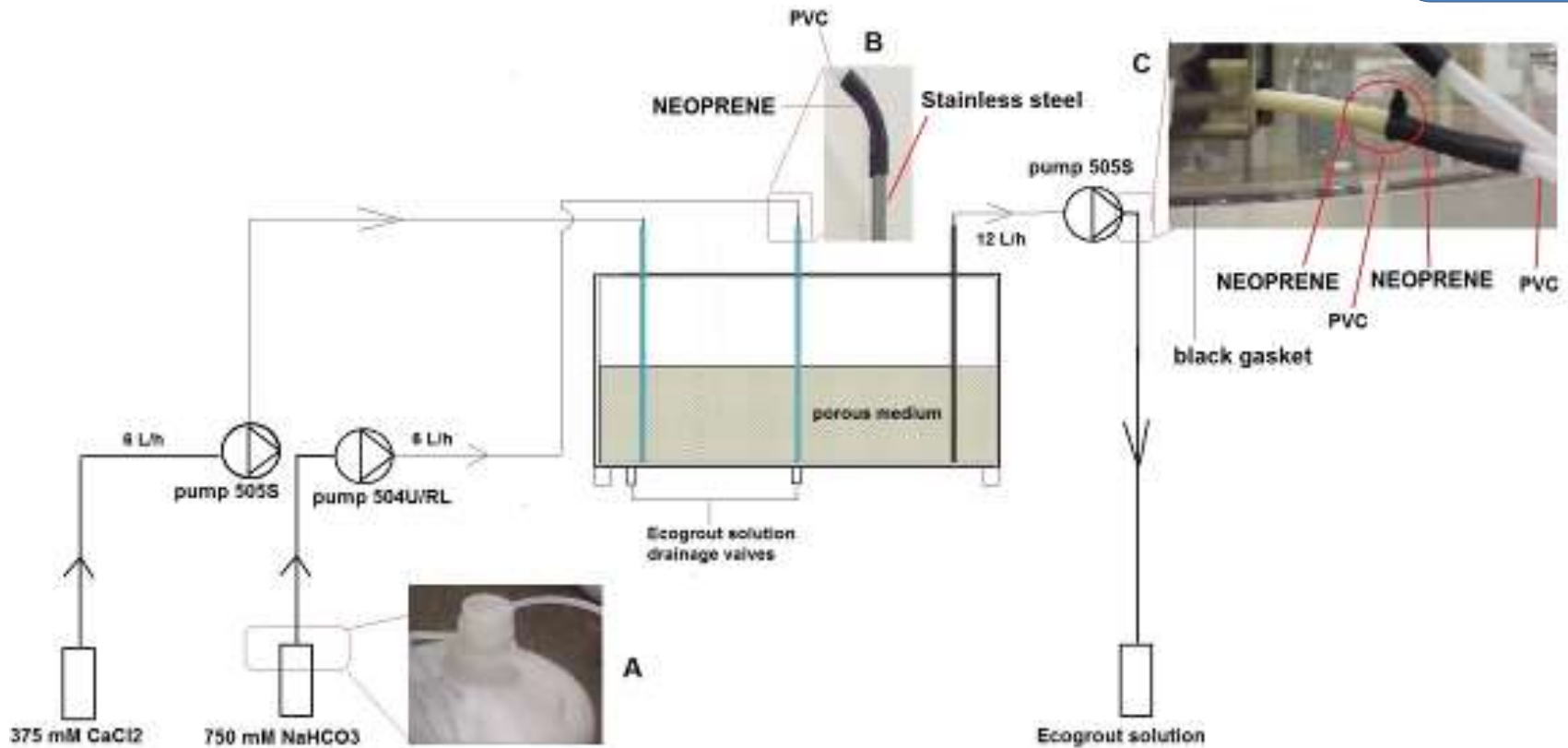
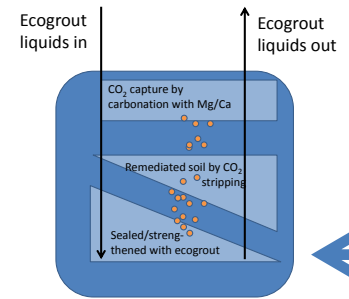
Remediation with CO₂



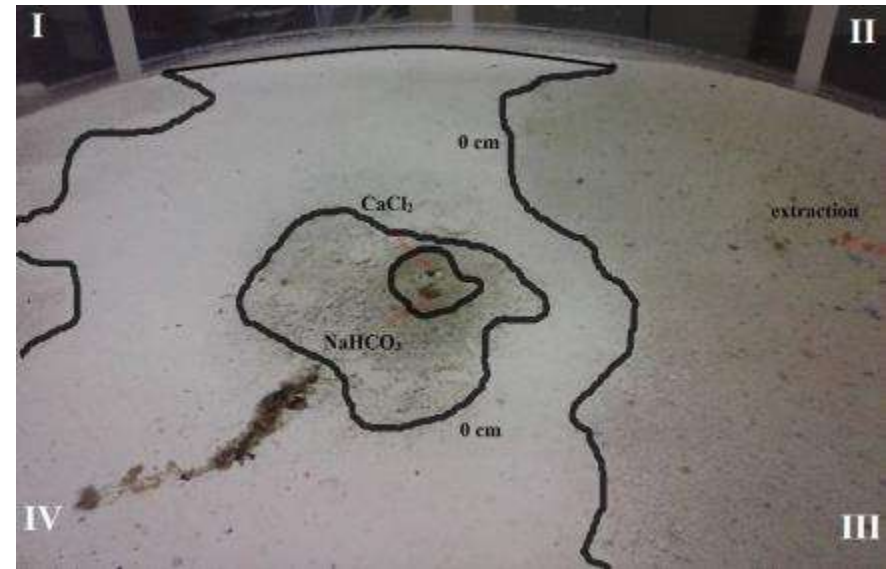
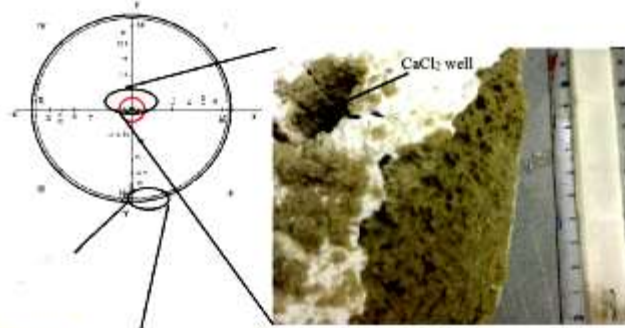
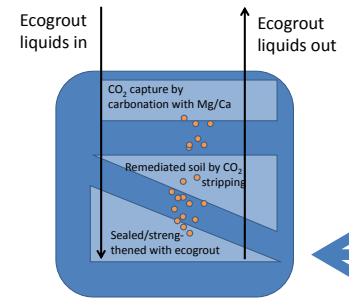
3D effect



Setup large scale

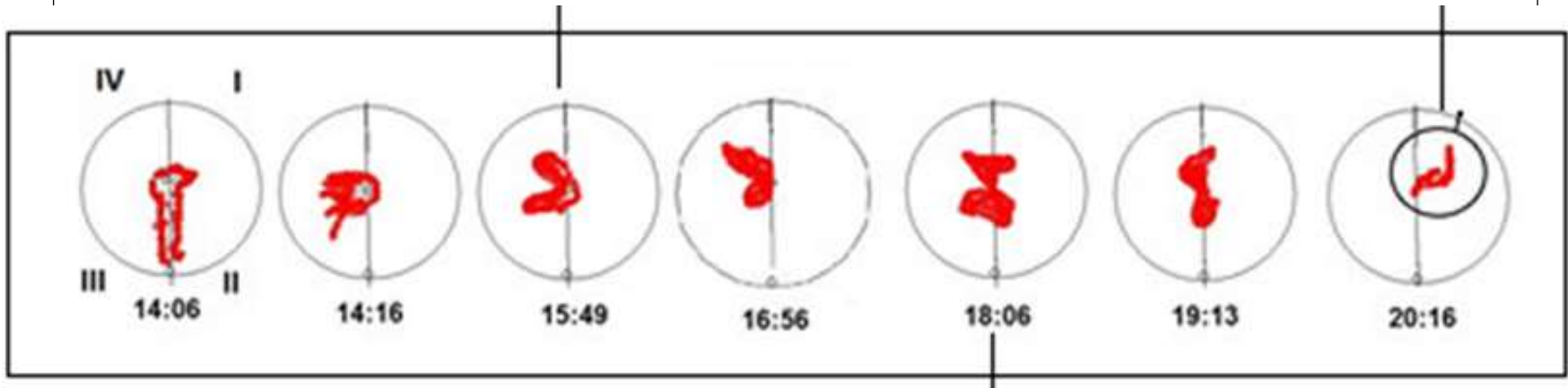
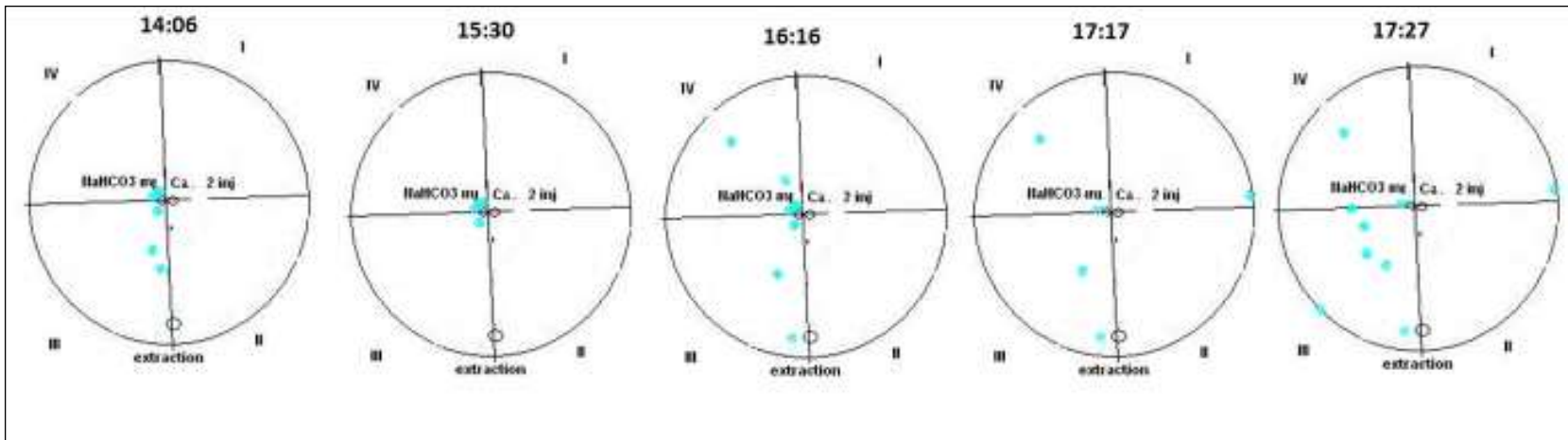
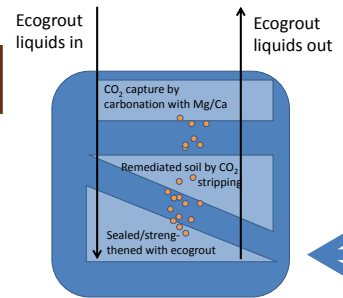


Experiments in fine sand



Experiments in coarse sand

Gas, Colour → form



Conclusions

- We can strengthen soil over signif distance
- ... combined with CO₂ based remediation
- ... which CO₂ can be captured by slag
 - CO₂ uptake seems stronger than without ecogrout
 - Improves leaching behaviour
- 3D behaviour fundamentally different from 1D
- Permeability reduction through CO₂
- 1 technique in a toolbox, customization needed
 - Honeycomb structures?
 - Pulsed injections?



