

LOIKKA

Sub-project 1: Early-strength development of low carbon concrete **RESULTS**

PUOLIVÄLIWEBINAARI – 14.3.2023

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The logo consists of a large, bold, white letter 'A' with a double quote symbol (”) positioned to its upper right.

Aalto-yliopisto
Aalto-universitetet
Aalto University

The word 'LOIKKA' is written in a bold, white, sans-serif font, slanted upwards from left to right.

Thermal activation



A”

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Non-destructive tests

- Temperature history and size of concrete elements differ from laboratory samples → change in early compressive strength (f_{ck})



Rebound number



Ultrasound pulse velocity

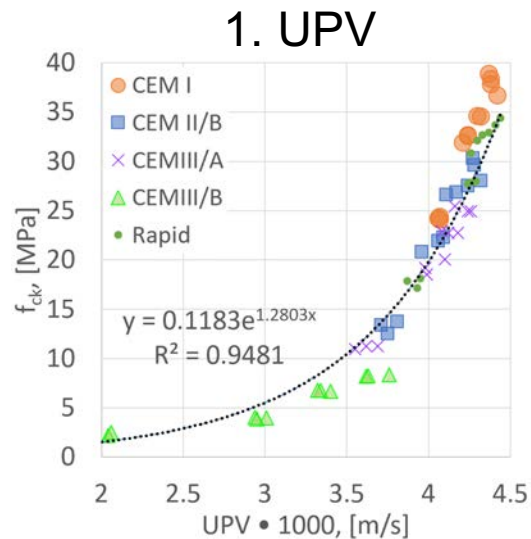
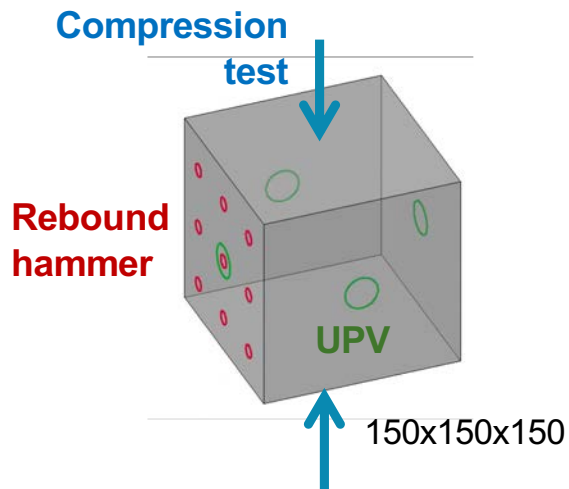


Temperature evolution
Continuous

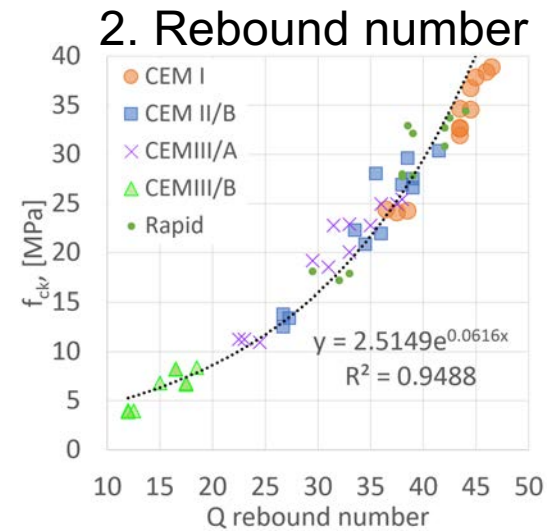
16, 24, 39, 48 hours

Find relationship:

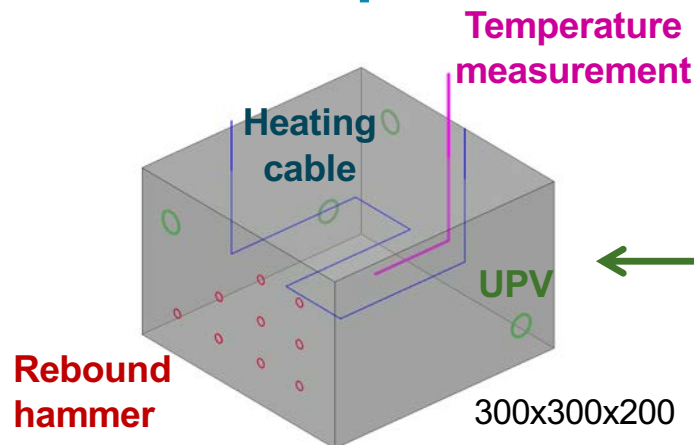
f_{ck} vs. UPV/rebound hammer



Error: 6.6%



Error: 4.9%



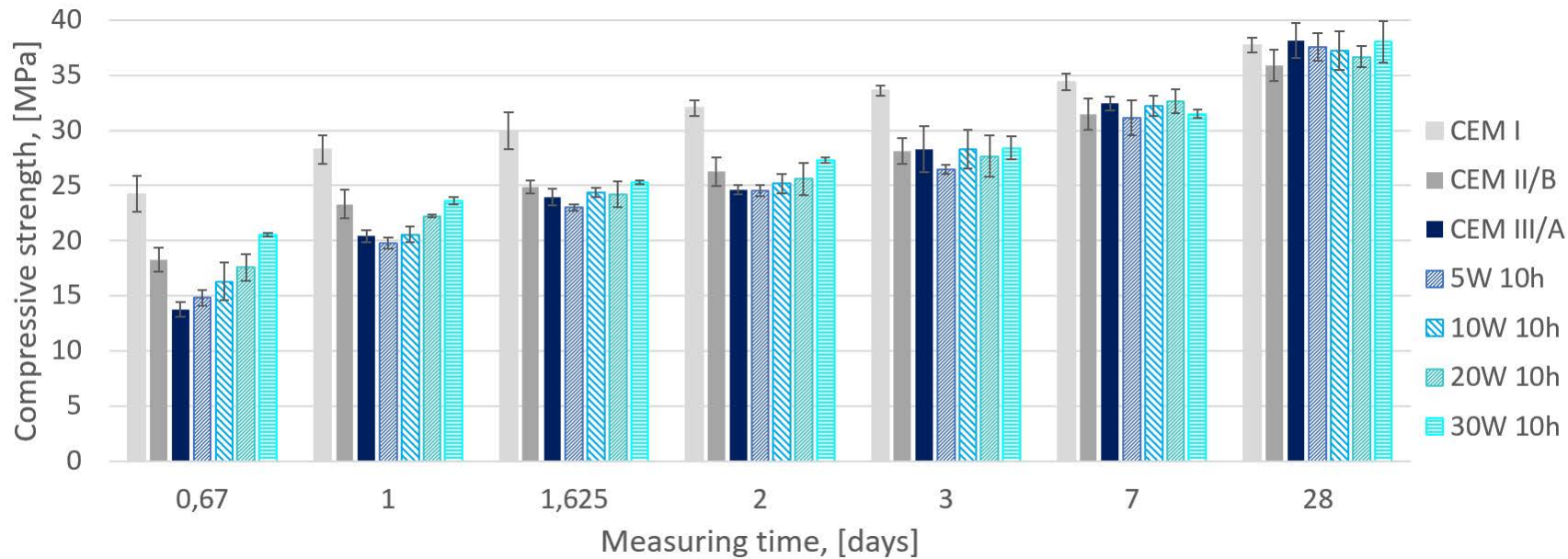
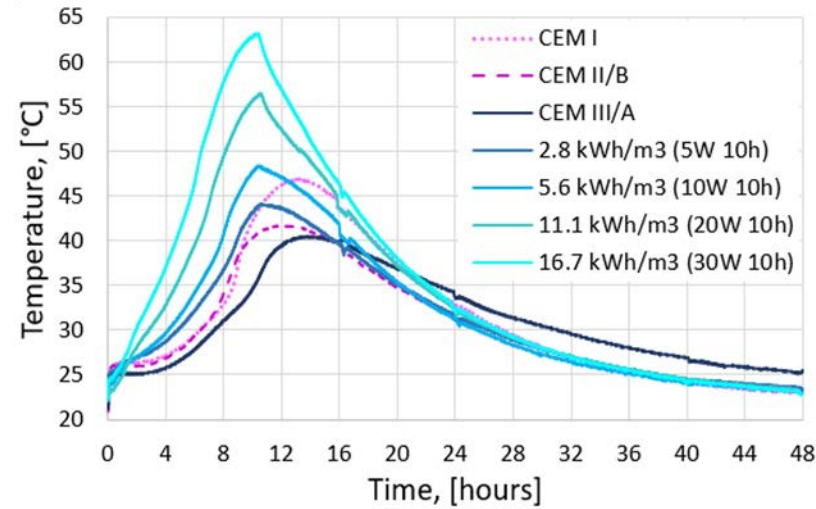
3. SonReb: UPV + RN

$$f_c = 2,33 \times 10^{-9} \times UPV^{2,32} \times RN^{1,04}$$

Error: 3.5%

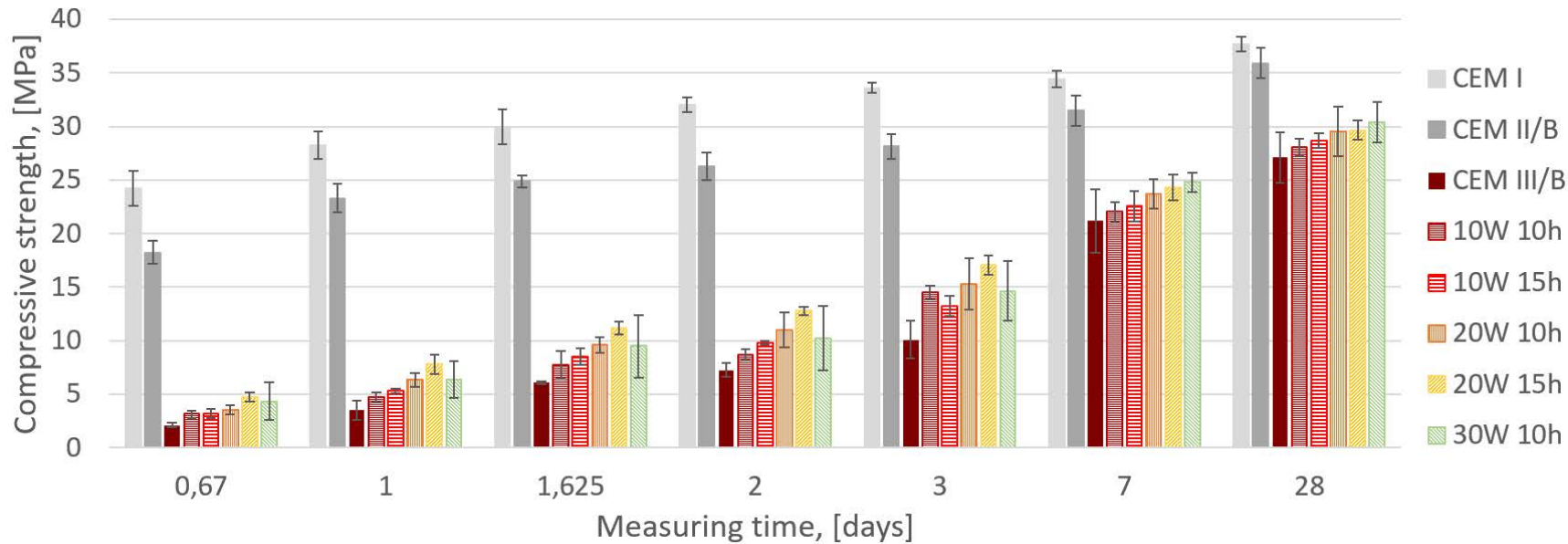
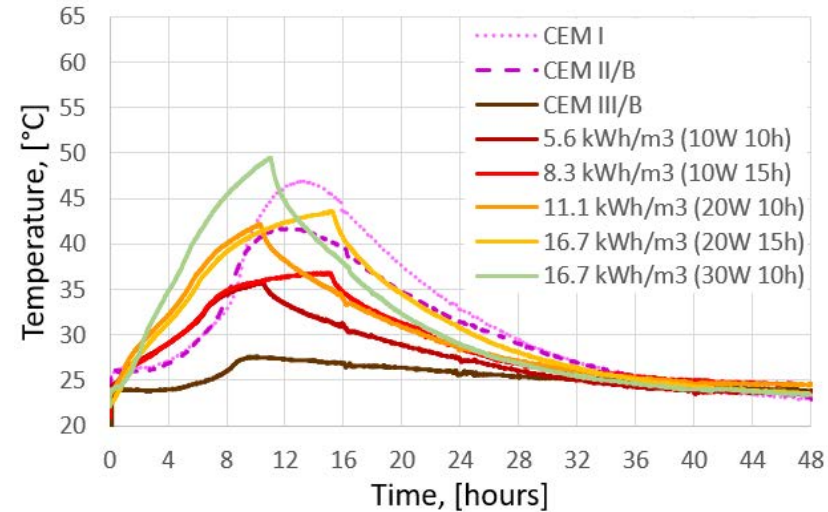
CEM III/A (~40% of slag)

With heat curing of 16.7 kWh/m³ CEM III/A reaches and exceeds f_{ck} of CEM II/B



CEM III/B (~70% of slag)

Heat curing was not sufficient to accelerate f_{ck} of CEM III/B



Chemical activation

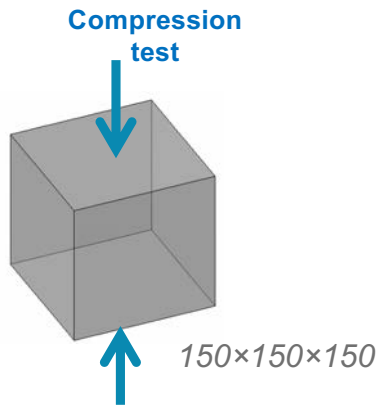


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Commercial activators

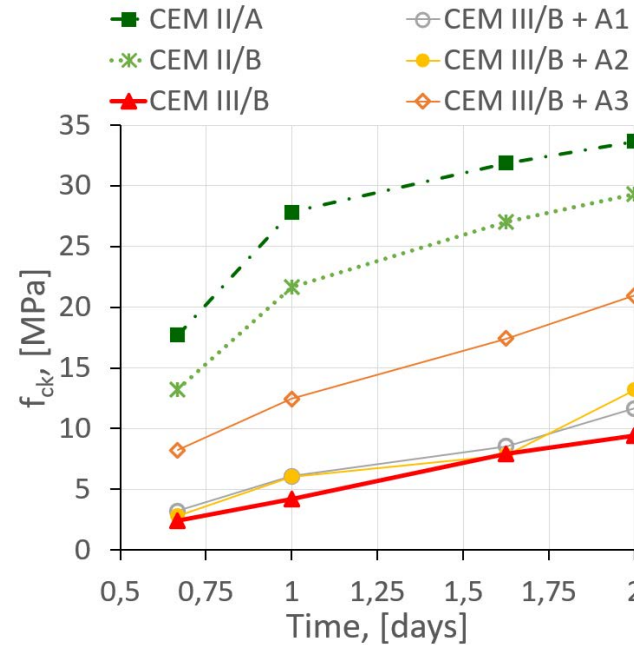
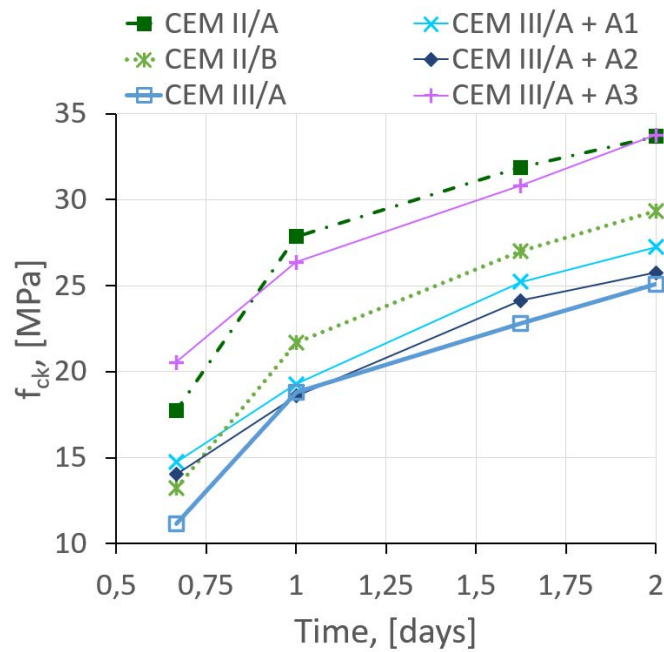
Early strength development



CEM III/A (42% of slag)
CEM III/B (70% of slag)

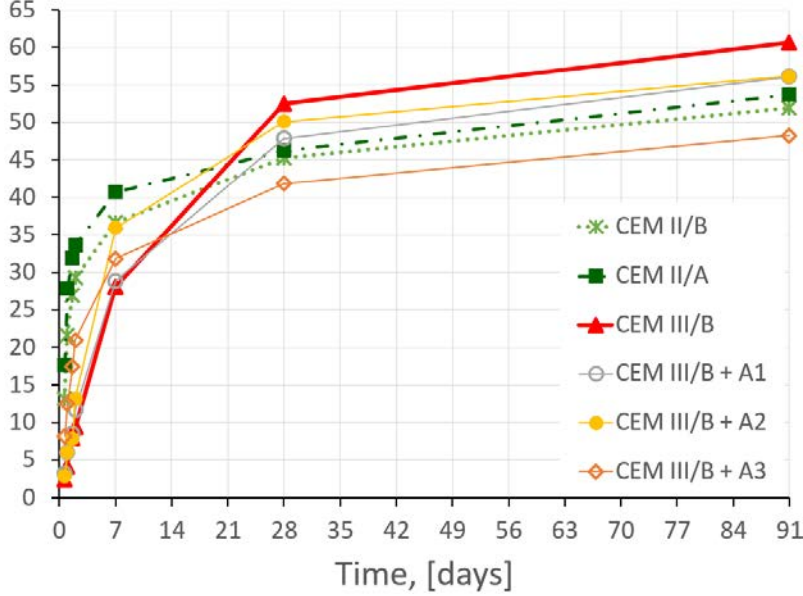
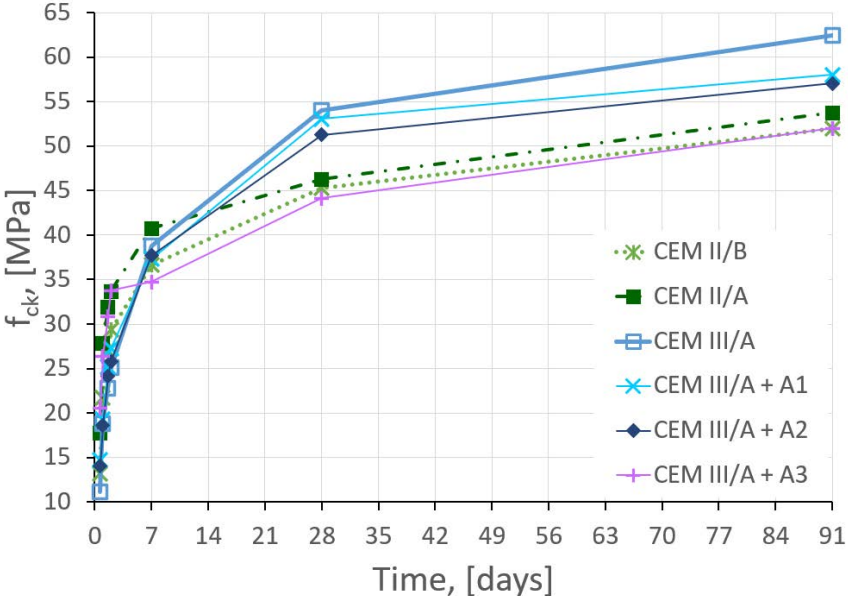


A1 – x-seed
A2 – Calcite-based
A3 – Alkali-based



Commercial activators

Compressive strength at later ages



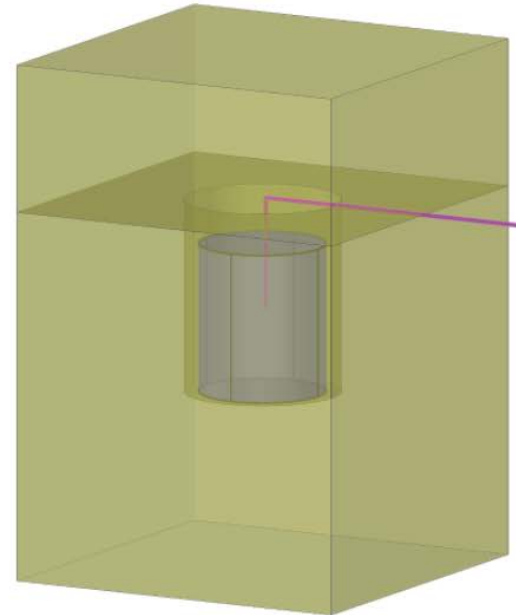
Alkali-activators

Prisms

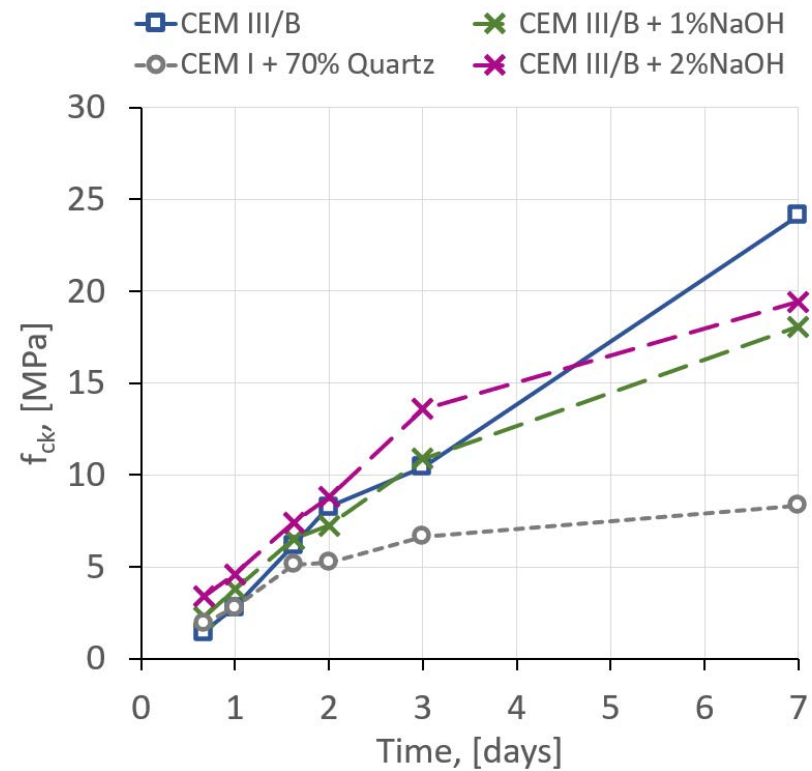
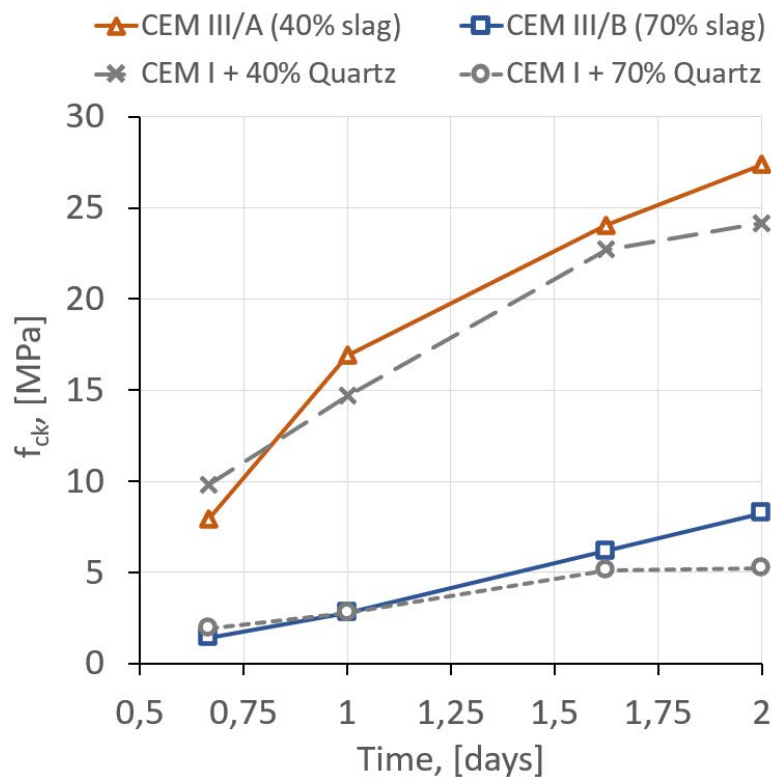
40×40×160



Insulated box

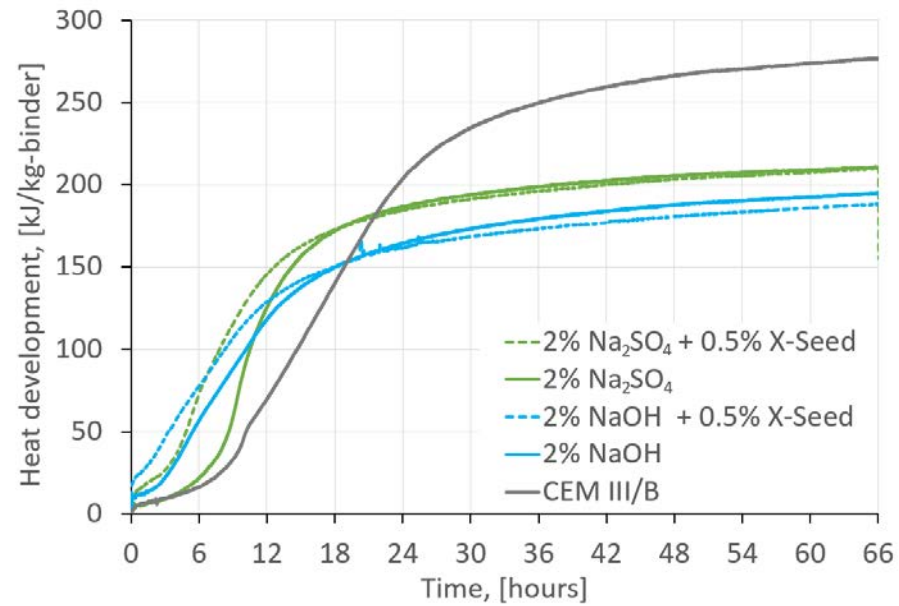
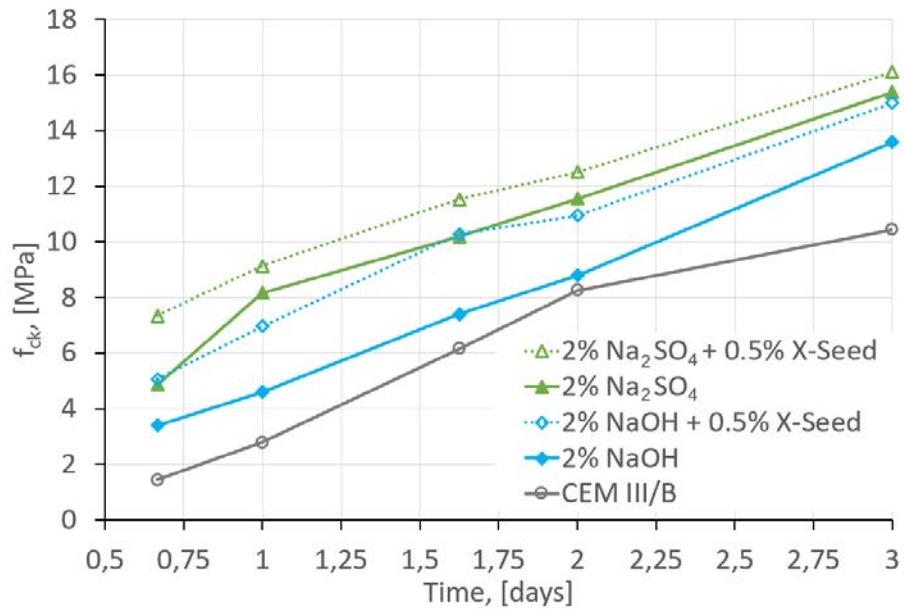


Slag reactivity with and without chemical activation



Alkali-activators

CEM III/B + NaOH/Na₂SO₄ + X-Seed



Summary

1. CEM III/A (40% slag):

- Easy to accelerate compressive strength with both thermal and chemical activation.

2. CEM III/B (70% slag):

- Thermal activation was not efficient
- Chemical activation to be considered as the main solution
→ requires further research