

EUROSLAG'24

**“SLAGS FOR THE FUTURE...
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2024
23RD - 25TH October

Bilbao Exhibition
Centre(BEC)
LUXUA Room



Assessment pozzolanic reactivity of carbonated BOF slag

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VITO



ESTEP DISSEMINATION CORNER

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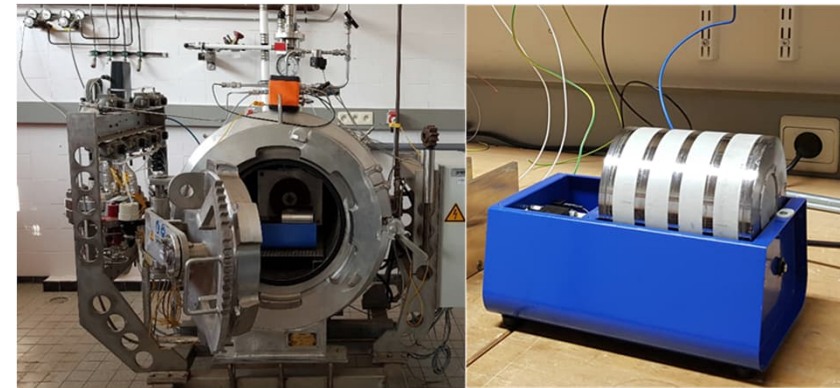
Introduction

Enforced carbonation of BOF slag

- **Enforced carbonation** is an innovative technology that converts alkaline waste into valuable supplementary cementitious materials (SCM).
 - $Ca_2SiO_4 + 2CO_2 + 2H_2O \rightarrow 2CaCO_3 + SiO_2 \cdot nH_2O$
- Basic Oxygen Furnace (BOF) slag is an ideal feedstock for carbonated construction materials, capable of absorbing up to 100-150 kg of CO₂ per tonne of SCM.
 - Overcome traditional barriers to its use as SCM, like fCaO
 - Improve reactivity by the formation of CaCO₃ and SiO₂
 - Positive impact on CO₂ reduction: new SCM, CO₂ adsorption
- The critical challenge is to establish a reliable method for accurately **assessing the pozzolanic reactivity** of carbonated BOF (cBOF) slag.

Experimental Procedure

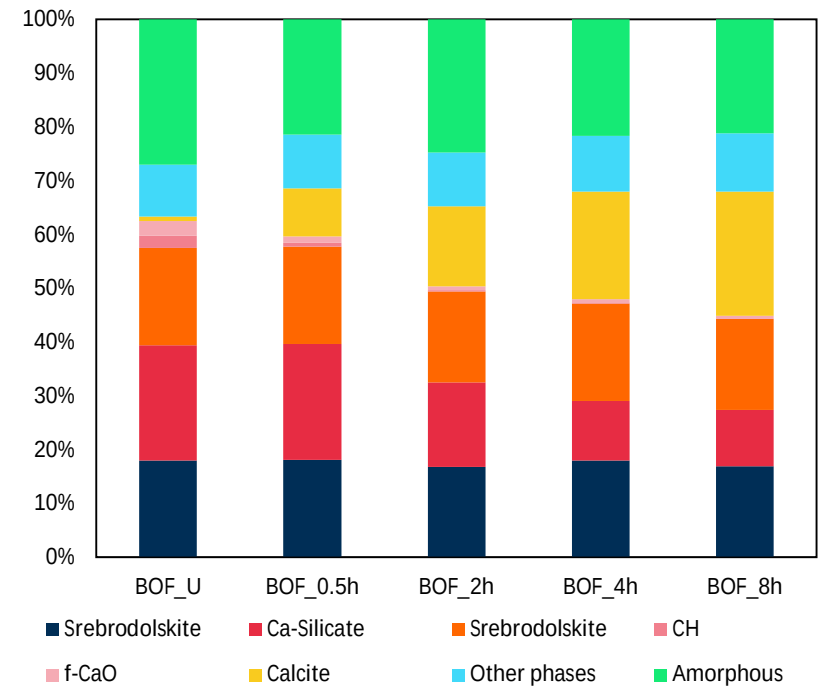
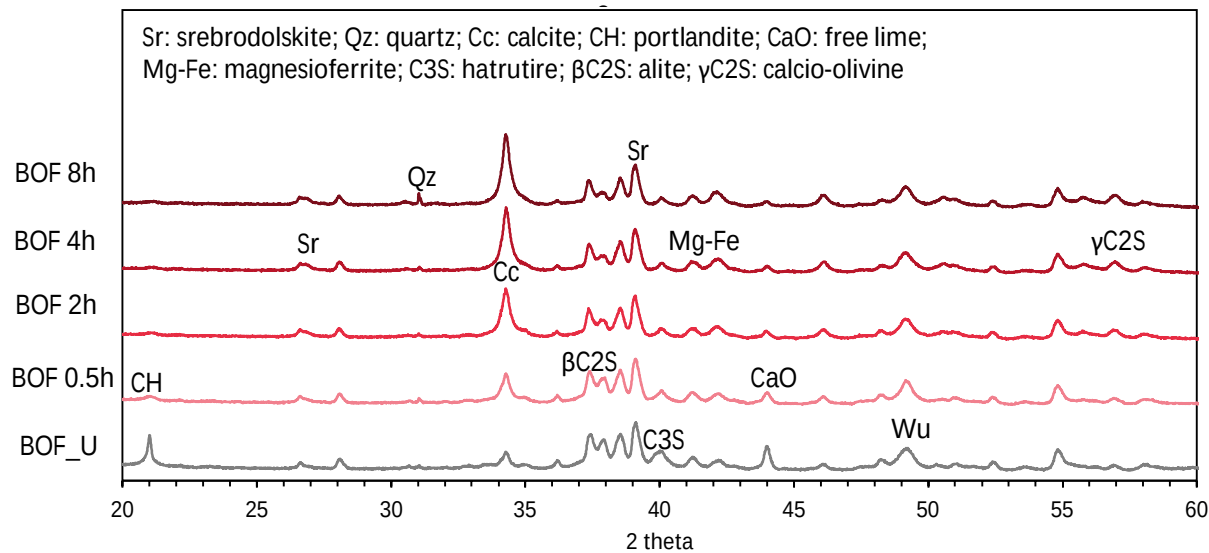
- Carbonation Conditions:
 - Semi-dry dynamic carbonation in a stainless-steel drum
 - $T = 40^{\circ}\text{C}$, $P = 0.5 \text{ bar}$, $\text{CO}_2 = 100\%$, $\text{RH} = 92\%$, and moisture content = 5%.
 - Carbonation cycles were conducted for 0.5, 2, 4, and 8h
- Material characterization: TC (total carbon content), XRD, SEM-EDS.
- Reactivity assessment: Isothermal calorimetry, R^3 test - ASTM C1897-20, and strength activity index (SAI) - EN-196-1



Results

Carbonation process of BOF slag

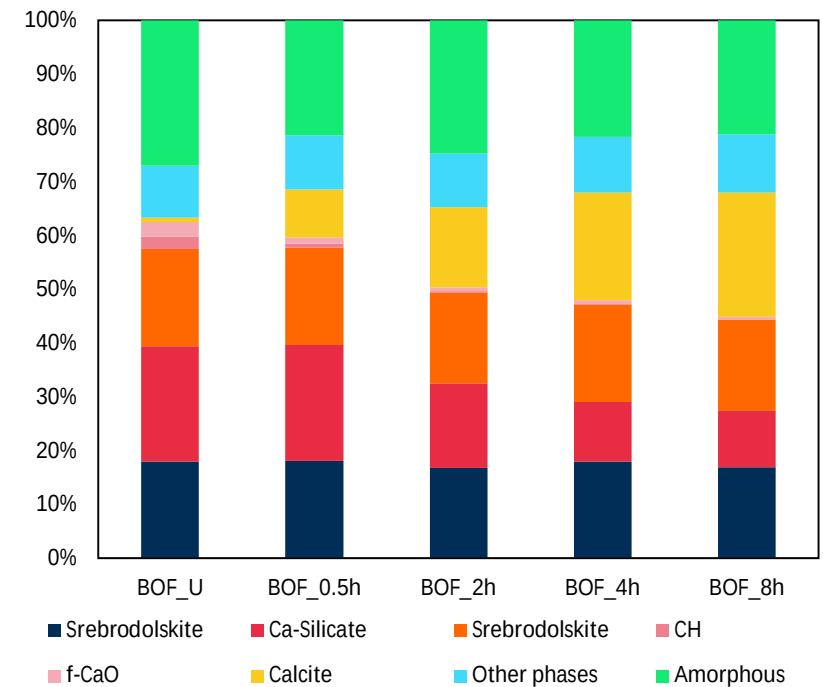
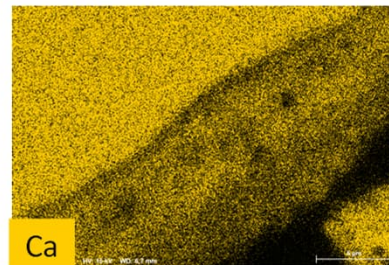
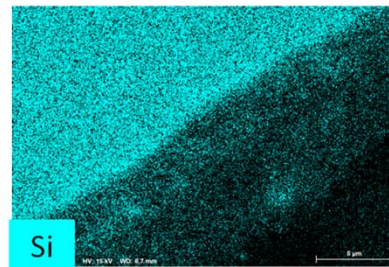
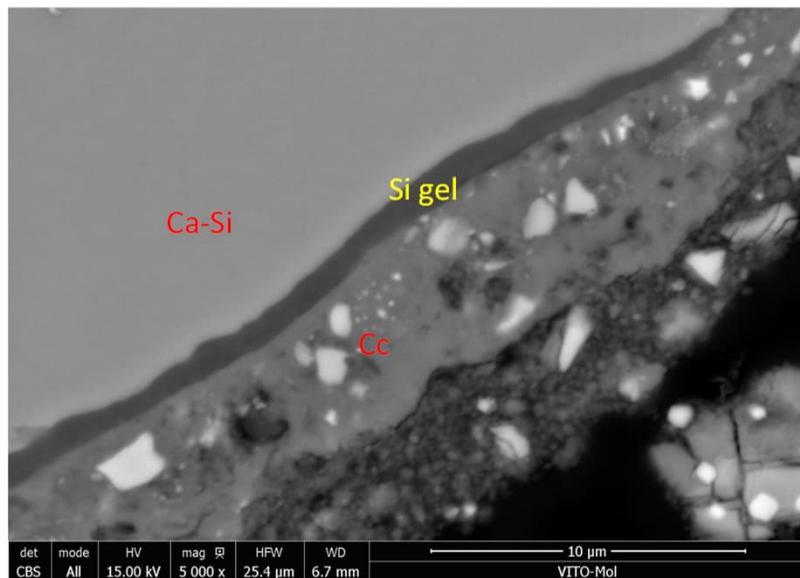
	BOF_U	BOF_0.5h	BOF_2h	BOF_4h	BOF_8h
TC (%C)	1,37	2,25	3,59	3,72	4,07



Results

Carbonation process of BOF slag

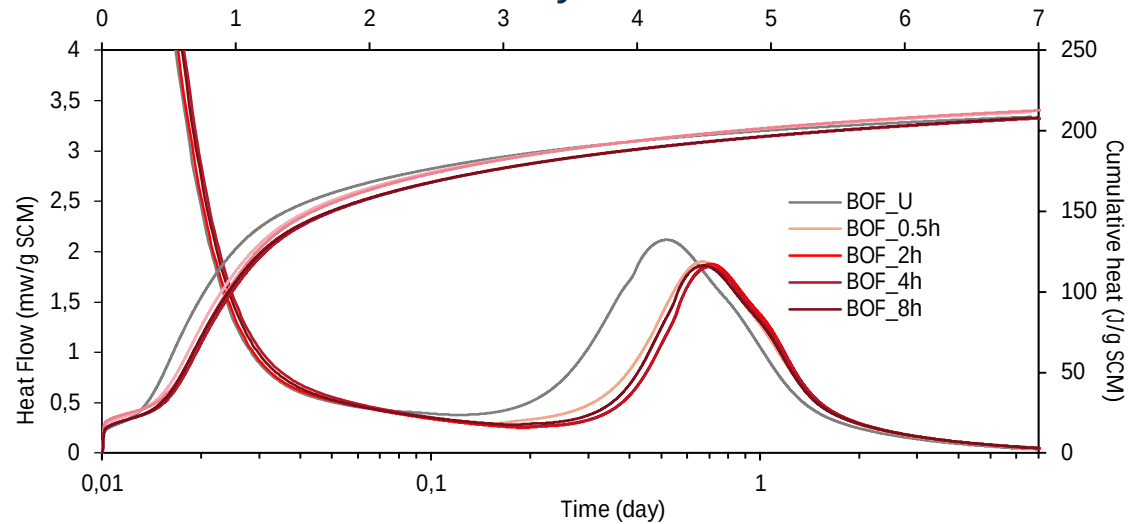
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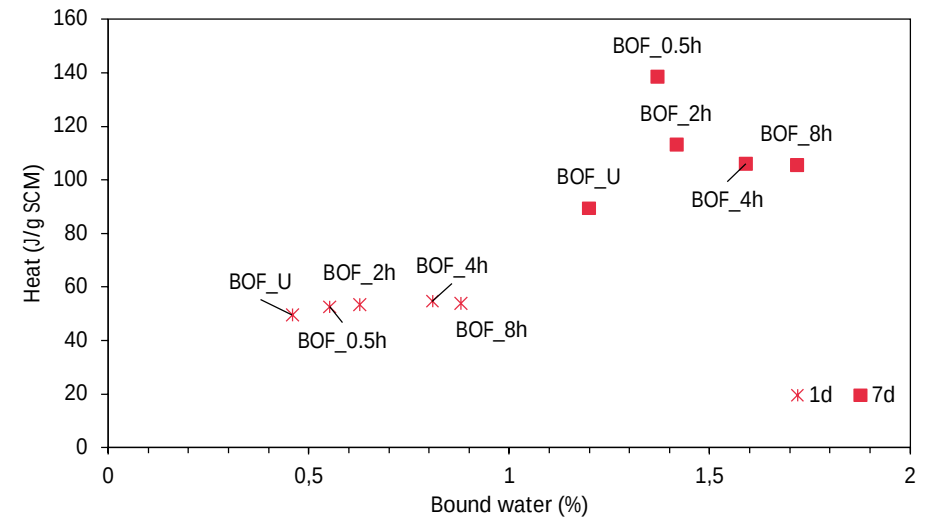
Results

Reactivity assessment of carbonated Slag

Isothermal Calorimetry

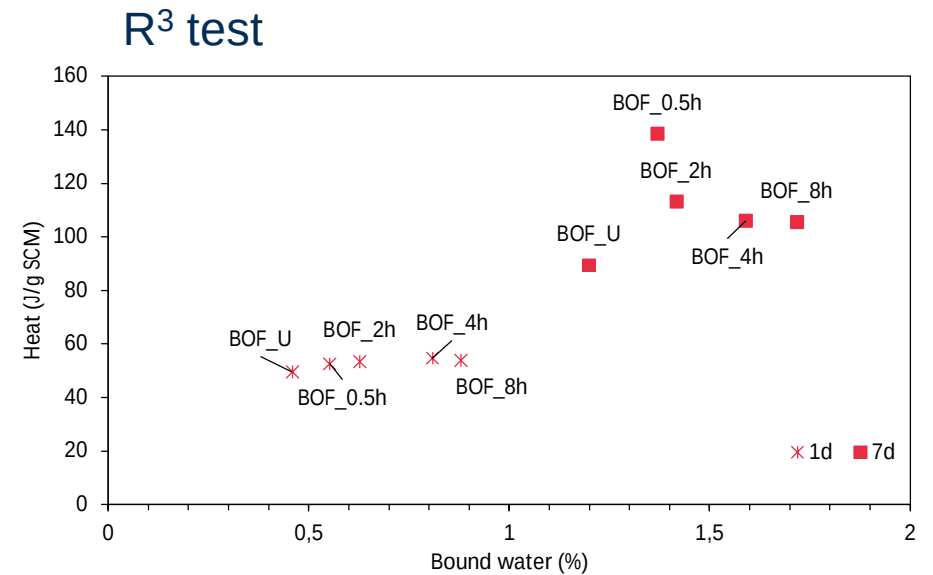
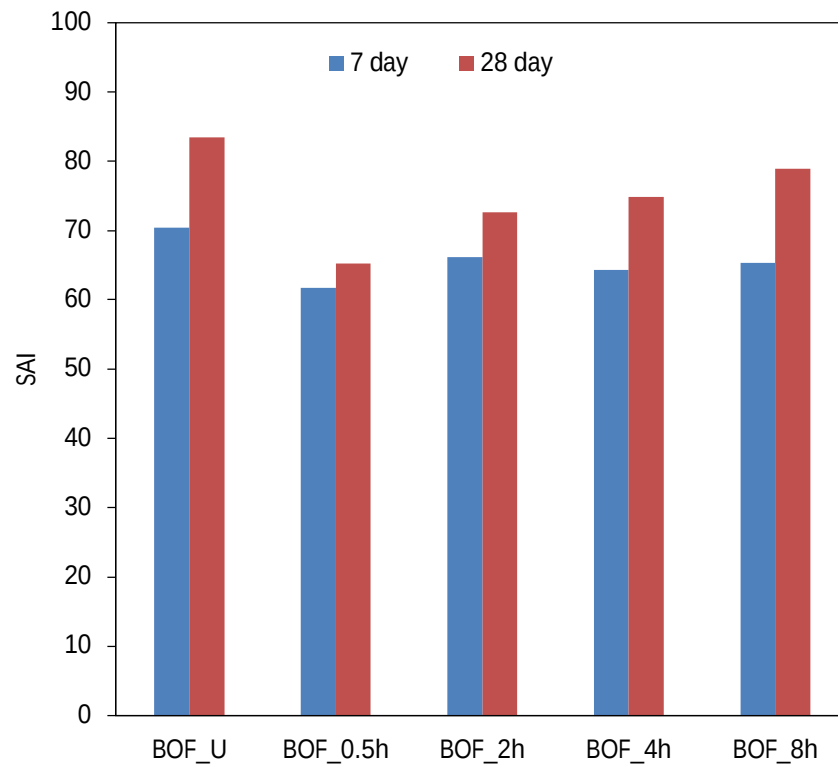


R³ test



Results

Reactivity assessment of carbonated Slag



Conclusion

- The **SAI does not correlate with R^3 values** from heat release and bound water, due to the slow reactivity of silica gel, requiring longer hydration times for reacting.
- The R^3 test shows significant heat release increases after 3 days, indicating cBOF slag needs extended hydration to measure pozzolanic reactivity accurately.
- The absence of correlation between **R^3 methods** suggests that C2S/C3S phases and CH contribute to hydration but these contributions are not reflected at bound water at 350°C and in SAI. Thus, heat release may not reliably determine cBOF slag reactivity.
- Although BOF_U has the highest SAI, this is unsupported by R^3 data and overlooks potential volume instability from f-CaO.

Thank you

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**Funded by
the European Union**



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01/11/2024

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