

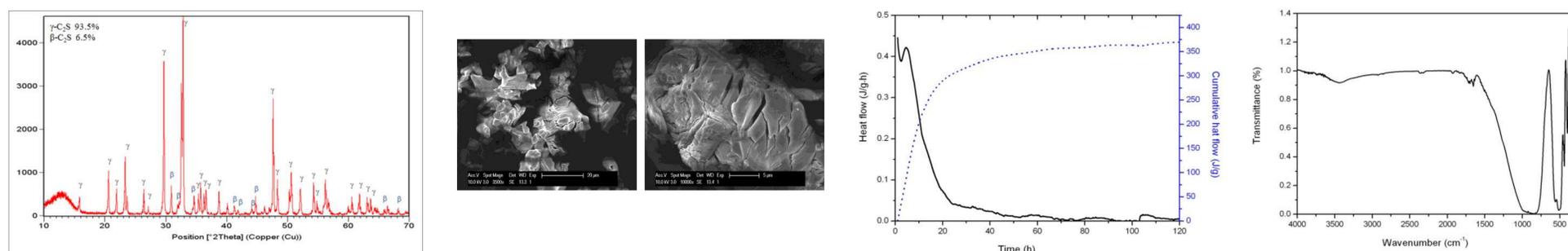
Chemical and Mechanical Activation of Gamma Dicalcium Silicate

F. Zhang, Y. Pontikes, L. Kriskova, D. Geysen, P. T. Jones, B. Blanpain
Dept. of Metallurgy and Materials Engineering, K.U.Leuven, Belgium

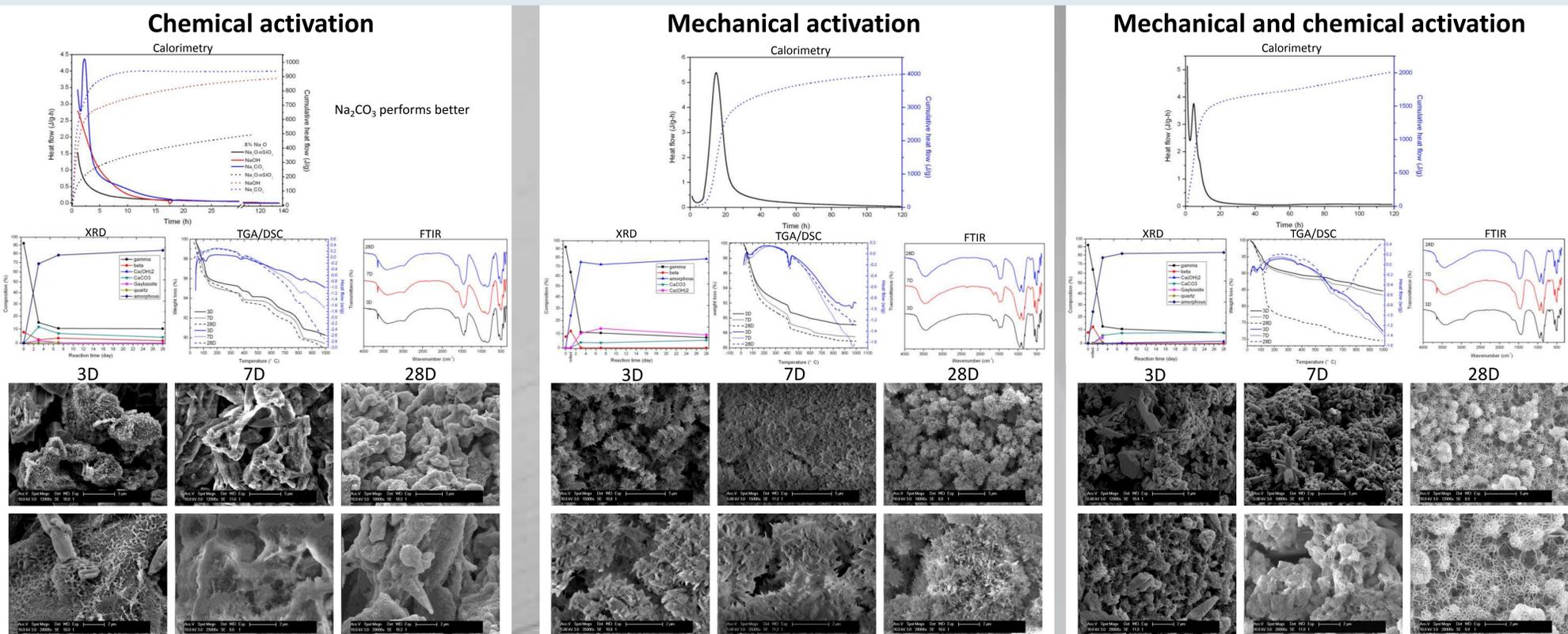
Abstract

Dicalcium silicate ($2\text{CaO}\cdot\text{SiO}_2$ or C_2S) constitutes a significant fraction of ladle metallurgy (stainless steel) slags and unless stabilised into the beta polymorph ($\beta\text{-C}_2\text{S}$), the thermodynamic stable gamma dicalcium silicate ($\gamma\text{-C}_2\text{S}$) will form during cooling. Formation of $\gamma\text{-C}_2\text{S}$, however, is accompanied with the physical disintegration of slag into a fine powder and, moreover, $\gamma\text{-C}_2\text{S}$ does not hydrate in the presence of water. In order to investigate the cement making potential of C_2S rich slags, this work investigates methods to enhance the hydraulic reactivity of pure $\gamma\text{-C}_2\text{S}$ by the addition of chemical activators, such as solutions of NaOH , Na_2CO_3 and sodium silicate, or by prolonged milling in a bead mill. The hydration reactions were followed by isothermal calorimetry, XRD, FTIR and TGA/DSC analysis. Results demonstrate that both Na_2CO_3 and milling to $d_{90} < 10 \mu\text{m}$ are effective and opportunities emerge for different valorisation routes for stainless steel slags

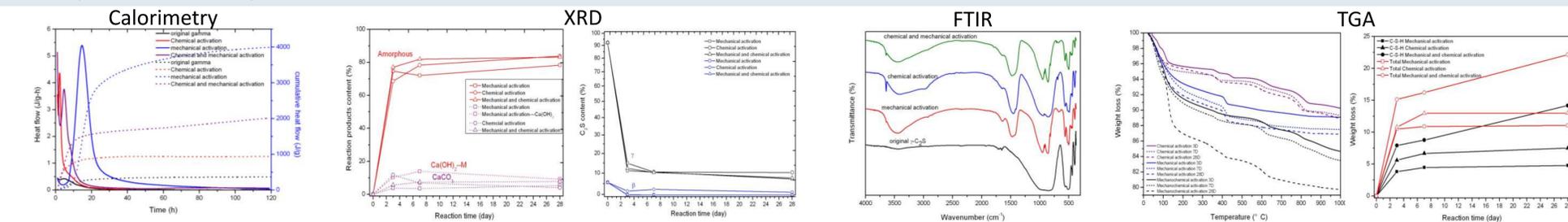
Preparation of $\gamma\text{-C}_2\text{S}$



Hydration results



Comparison of hydration results



Conclusions

- ✓ $\gamma\text{-C}_2\text{S}$ was successfully synthesised and activated, creating opportunities for different valorisation of stainless steel slags.
- ✓ Na_2CO_3 solution with 8 wt% Na_2O is an effective chemical activator. Bead-milling and mechanical activation also promote hydration of $\gamma\text{-C}_2\text{S}$.
- ✓ Combination of chemical and mechanical activation contributes marginally to the hydration of $\gamma\text{-C}_2\text{S}$.
- ✓ The $\gamma\text{-C}_2\text{S}$ hydration mainly occurred during the first 3 days towards C-S-H and CaCO_3 .
- ✓ The morphology of C-S-H is different when different activation methods are used.

The authors gratefully acknowledge Aperam (former ArcelorMittal Stainless Europe) and the IWT O&O project 090594 for the financial support. Y. Pontikes is thankful to the Research Foundation - Flanders for the post-doctoral fellowship.

The authors also express their gratitude to Dr. Ö. Cizer, M. Salman, Prof. L. Vandewalle and Prof. K. Van Balen for their cooperation.