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Basic Oxygen Furnace Slag

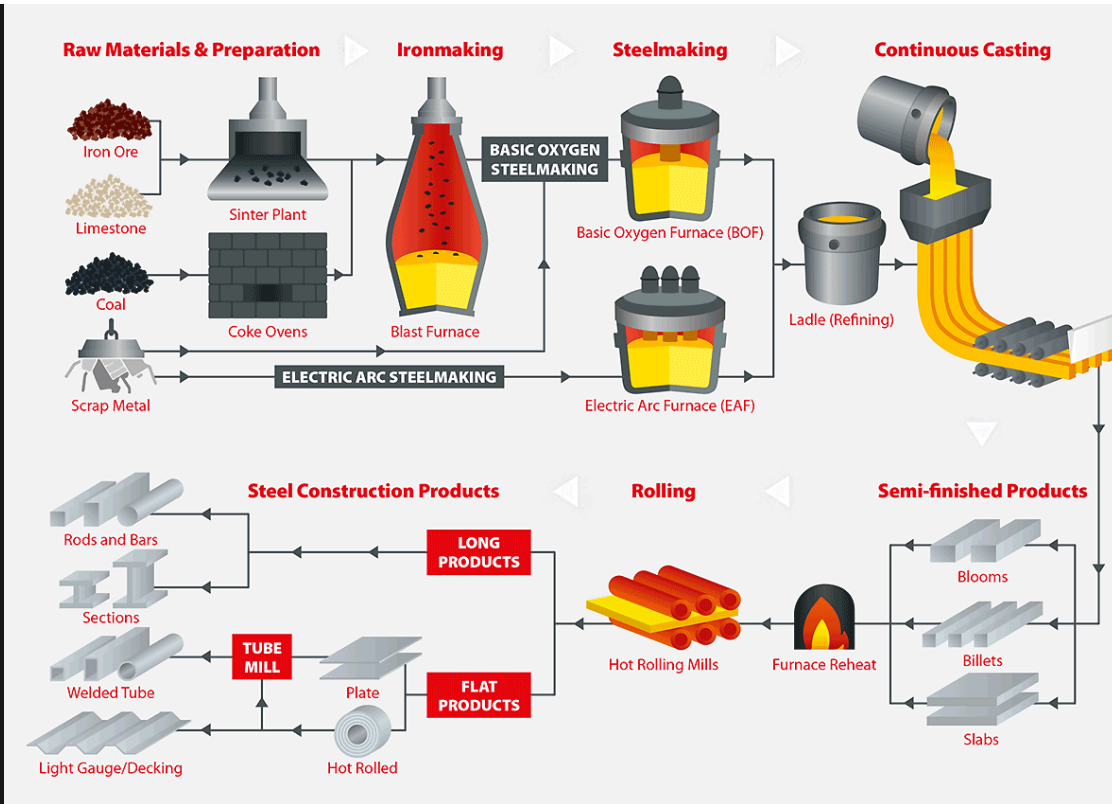
The Story of developing a new cementitious Binder

by Jonathan Zepper

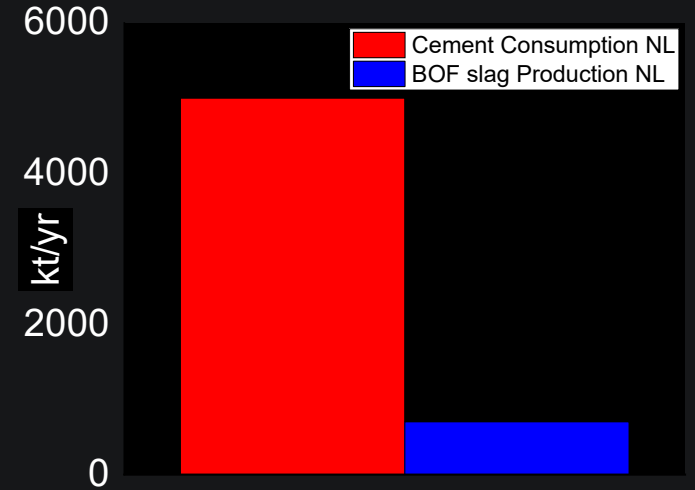
Project supervisor: Prof. Dr. Ir. Jos Brouwers
Daily supervisor: Dr. Katrin Schollbach
Sponsor supervisor: Prof. Dr. Sieger van der Laan



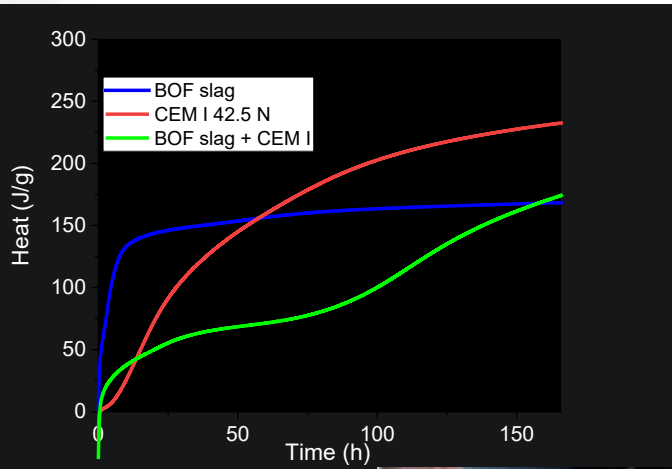
What is BOF slag?



Cement Industry in the Netherlands



Requirements for cementitious binders



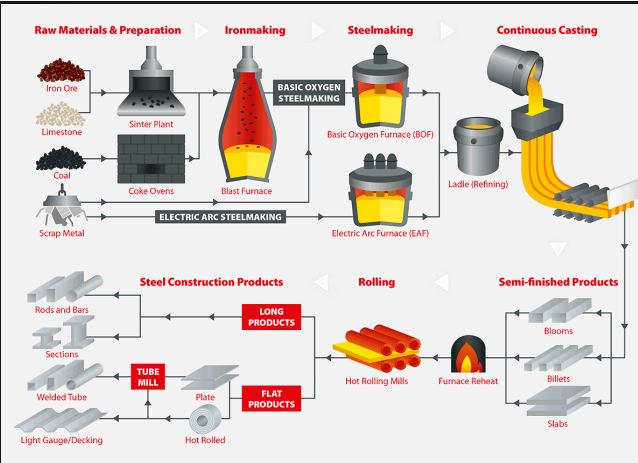
Why BOF slag as cement replacement?



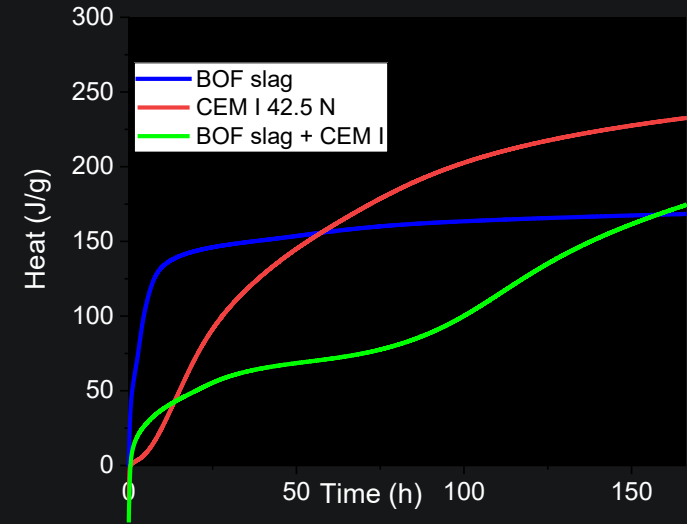
	BOF slag	OPC
CaO	35 – 56	63 - 71
FeO + Fe ₂ O ₃	6 – 37	0.5 – 5
SiO ₂	10 – 28	18 – 24
Al ₂ O ₃	1 – 12	1 – 7
MgO	1 – 11	1 - 2



Issues of BOF slag as cement replacement

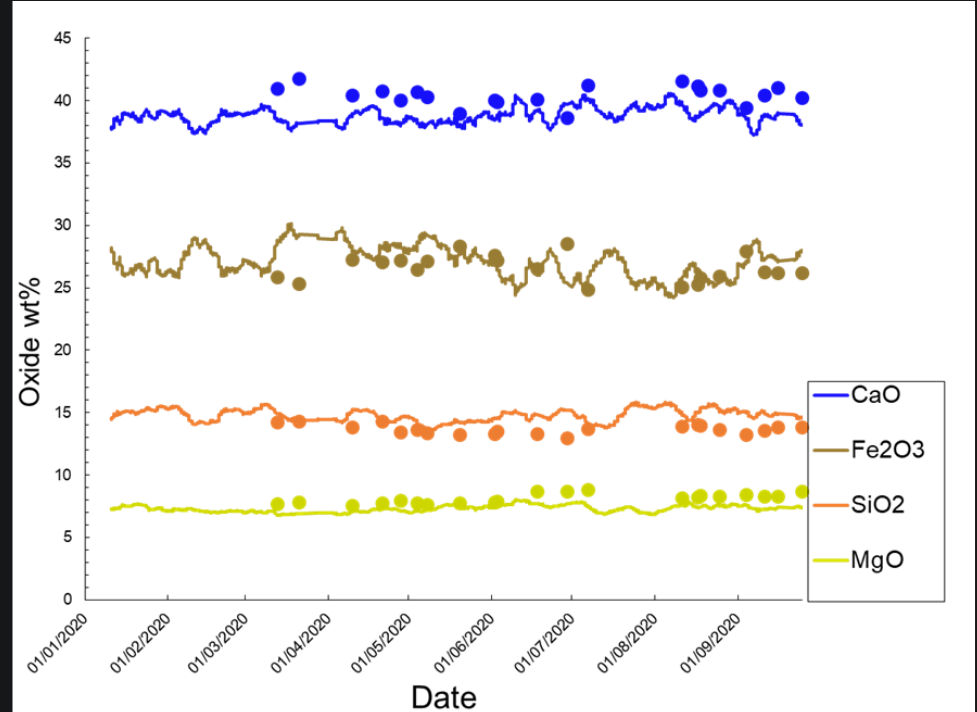
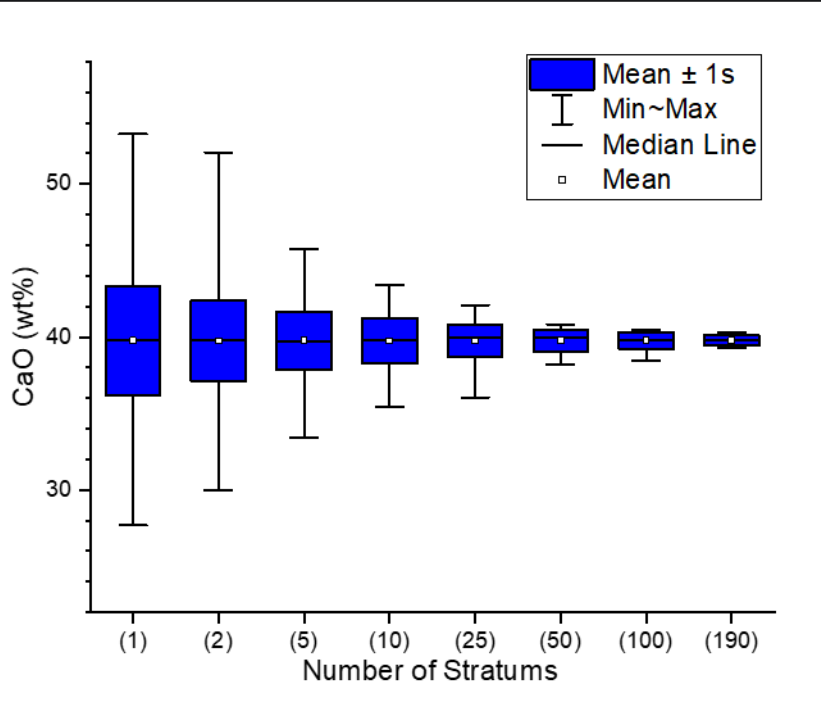


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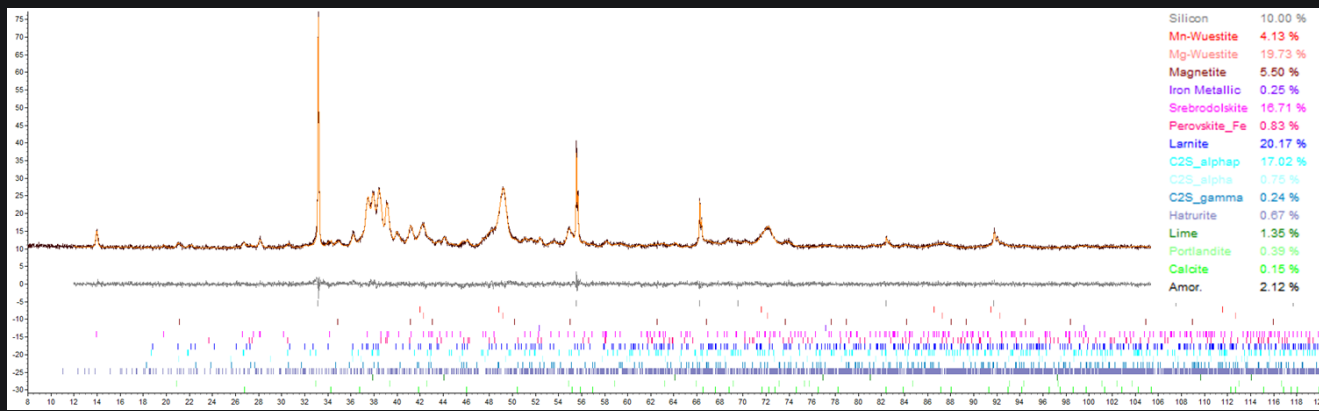


Solving the issues of BOF slag

Variable Composition



Characterization



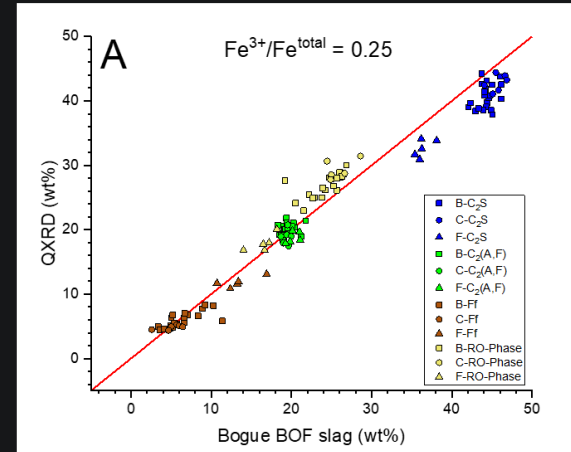
$$X_{C_2S(total)} = 2.867 X_S + 2.185 X_P + 1.925 X_V - \alpha * LOI_{Fe-corr}$$

$$X_{C_2(A,F)} = 2.434 * \left(\frac{Fe^{3+}}{Fe^{total}} \right)_i * X_F + 2.1 X_A + 2.404 X_T$$

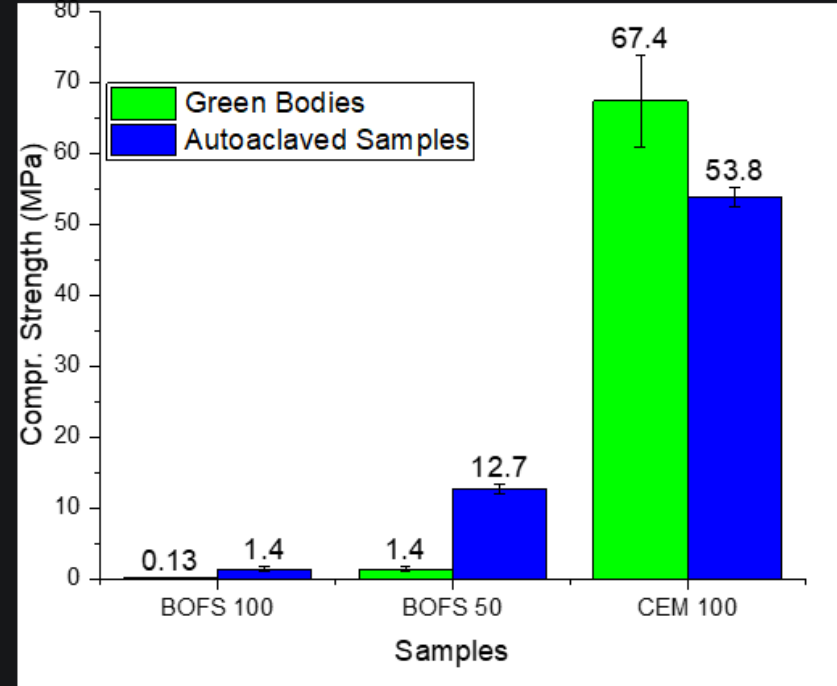
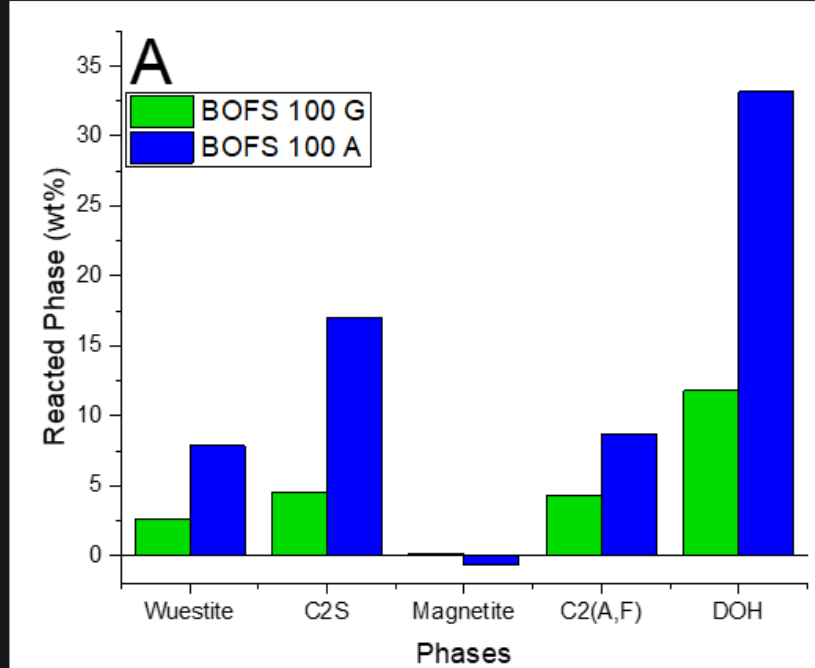
$$X_{Ff} = 1.45 * \left(X_F - \left(0.587 * \left(2.434 * \left(\frac{Fe^{3+}}{Fe^{total}} \right)_i * X_F \right) \right) \right)$$

$$X_{RO} = ((X_f - 0.31 X_{Ff}) + X_M + X_m + X_{Cr}) / (1 - \beta)$$

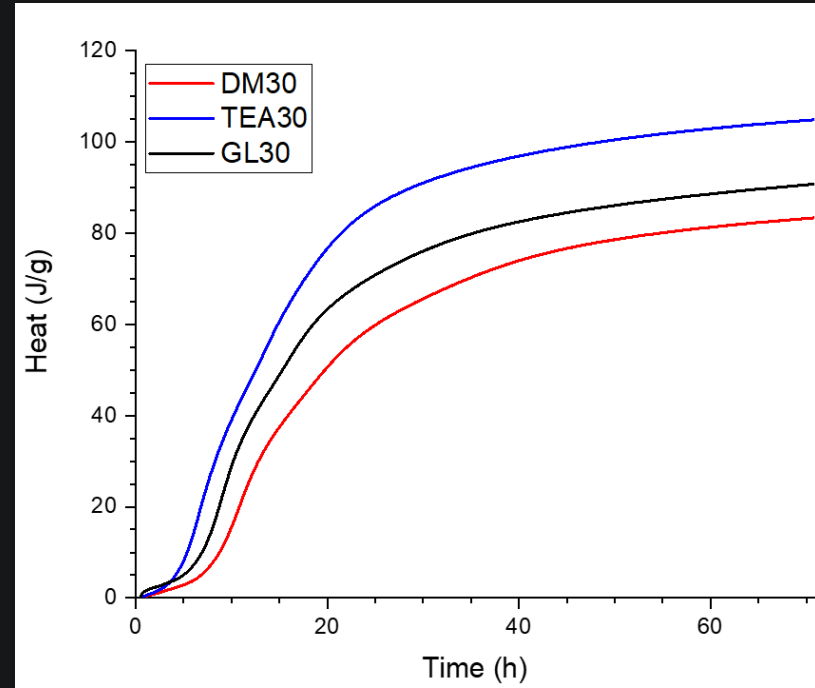
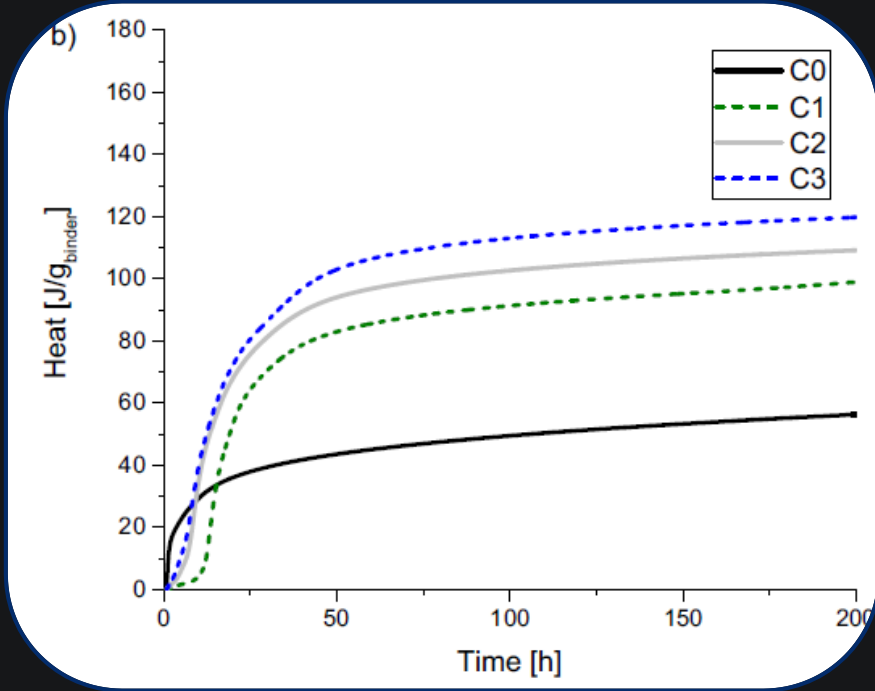
$$X_{f-c} = X_C - \left(1.867 X_S + 1.185 X_P + 0.925 X_V + 1.1 X_A + 1.404 X_T + 1.004 * \left(\frac{Fe^{3+}}{Fe^{total}} \right) * X_F \right) - \beta * X_{RO}$$



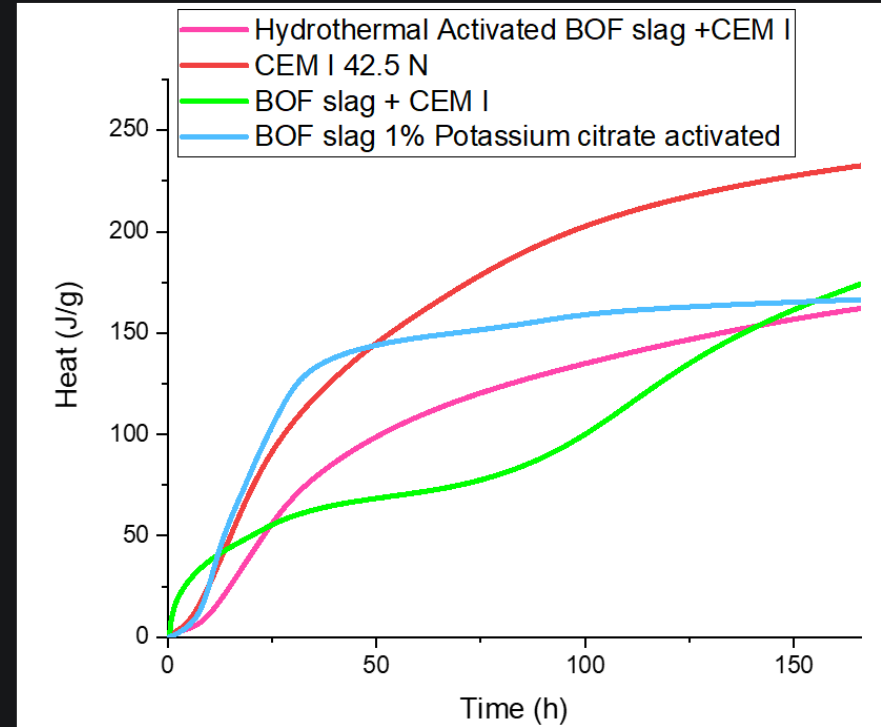
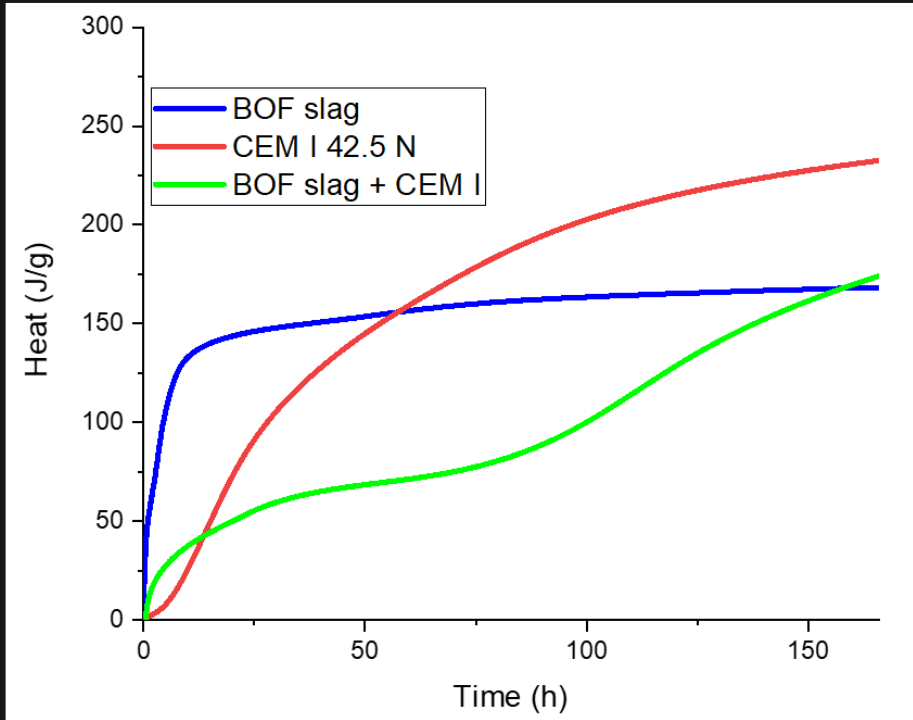
Low hydraulic reactivity



Low hydraulic reactivity



Application as supplementary cementitious material

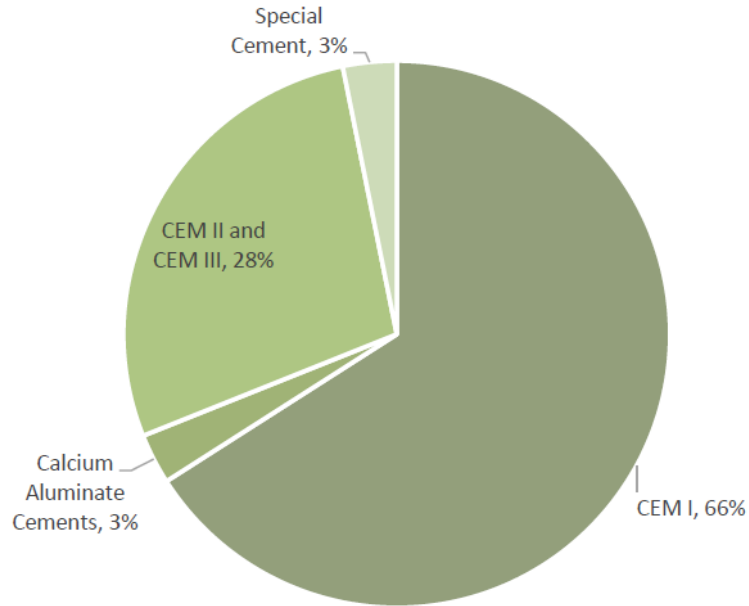


Future Problems and Possibilities

Future Problems



Future Possibilities





Clinker
based
cements



BOF
slag based
cements

Thank you

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TATA STEEL



HESS
AAC SYSTEMS



**Blue Phoenix
Group**



m2i materials
innovation
institute



TU/e Technische Universiteit
Eindhoven
University of Technology

Introduction

- what is BOF slag
- Cement industry
- Problems (free lime, compositional range, low hydraulic reactivity (reaction with water, not working as SCM))
- Good characterization

Content

- Characterization: Bogue modelling
- Compositional difference not an issue
- Application SCM or lone binder
- SCM not working at least not at CEM III levels
- Lone binder better working but not in standard recipe (free C is low)
- High free lime other treatment method (autoclaving and mechanochemical activation/heat treatment)