Hydration Behavior Of Celitement

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Celitement

- is a spin-off of the Karlsruher Institute of Technology (KIT) in cooperation with the industry partner Schwenk
- is the brand name for a group of high-quality hydraulic binders
- is comparable to Portland cement (OPC) in applicability and durability
- is based on the same raw materials as OPC
- is a pure CSH-binder with a dense microstructure
- is produced by an innovative combination of a hydrothermal process with subsequent grinding where the hydraulic binder forms
Production and Hydration of Celiment

-1CO₂ \uparrow

CaO + SiO₂ + H₂O

Hydrothermal-Process

\[ \text{200°C} \]

C-S-H

Grinding

Celiment hCHS

Hydration

CSH

Compared to OPC

3CaCO₃ + SiO₂

-3CO₂ \uparrow

\[ \text{1450°C} \]

Ca₃SiO₅ + 3H₂O

2Ca(OH)₂+CSH*

\[ *\text{CaO-SiO₂-H₂O} \]

→ What impact has the absence of Portlandite (CH) in the hydration process?
Heat Flow for Celitement and OPC

Compressive Strength Celitement (N/mm²):
1d – 26  2d – 34  7d – 42  28d - 48

Heat of Hydration after 6 days:
CEMI 32.5R  280 J/g
CEMI 42.5R  297 J/g
Celitement  111 J/g

→ Low heat of hydration due to less solution of Ca
Measurement Conditions

TAM Air 8-channels with 20ml Admix glass ampoules and syringes for water injection

1g Sample + 1g H₂O
water demand Celiment: w/c-0.4

No stirring required

Subtraction of initial background

→ Deviation in heat of hydration due to sample inhomogeneity and measurement: ±2%
Influence of C/S-ratio on the Heat Flow

Is there an increase in cumulative heat with C/S?
What parameters control the reactivity of the binder?

Heat ~ Enthalpy of Ca solution hence no straight dependency on C/S

Influence of C/S-ratio on the Heat of Hydration

What parameters control the reactivity of the binder?
Influence of Grinding Time on the Heat Flow

→ Is there a decrease in cumulative heat with overgrinding?
Influence of Grinding Time on the HoH

- Difference in kinetics, not in the amount of Ca that is available for solution

→ How does the addition of reactive Ca affect the kinetics?
Co-grinding of Celitement with CH

What are the differences in solution-precipitation mechanisms in samples with addition of 5 and 10% CH?
Is the formation of CSH terminated after 40h of hydration?
Co-grinding of Celitement with CH

→ High amount of Ca dissolution from CH results in the formation of a passivation layer of CSH on hCHS
Calorimetry on Cemitement...

- is challenging because binders with low C/S-ratio produce low cumulative Heat of Hydration

- can only provide information on the kinetics of the Hydration but not on the material properties

- with addition of CH proves that the hydration behavior of binders with low Ca-content strongly depends on the pH