

Low carbon footprint mortars: influence of the moisture content of the replacement addition on hydration processes

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Main Objective:

To evaluate the effect of as-received or pre-dried mineral additions with high titania content in the hydration processes of cement-based mortars when incorporated as partial replacement of Portland cement mortars.

Materials and Methods:

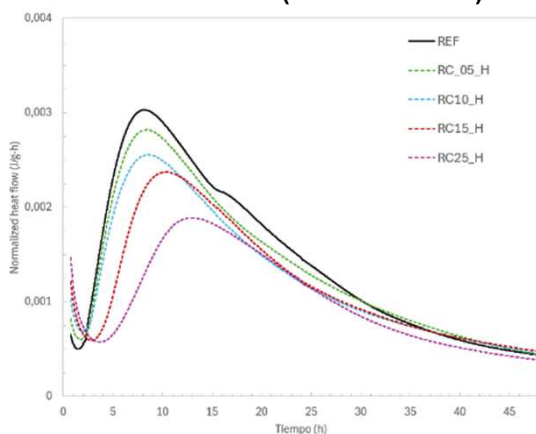
Materials: CEM I 42.5R, TiO₂-based mineral addition (“as-received” and “pre-dried”), tap water

Replacement ratios: 0%, 5%, 10%, 15% or 25% by mass of cement

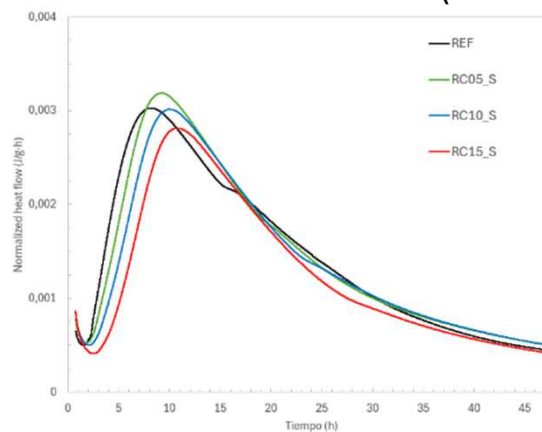
Hydration Analysis: isothermal calorimetry (heat flow measurements)

Results:

As-received (≈30% moisture):



Pre-dried: (≈3% moisture)



Effects in the hydration processes comparing with pattern:

- When **as-received mineral addition** is used, a decrease of the main peak is registered with the higher percentage of replacement. Additionally, longer dormant periods occurs that promote the delay of the hydration peak. The higher degree of substitution, the higher delay.
- When **pre-dried mineral addition** is used, the delay of the dormant periods also occurs, although is less significant. However, in this case, the intensity of the peak is similar or even higher than in the reference case when replacements till 10% in cement weight are used.

Conclusions:

The hydration kinetics is modified with the partial replace of cement by mineral additions with high titanium content.

- 1) The use of “as received” samples promotes early phases dilution and lower hydration heat flow.
- 2) Increasing the percentage of substitution promotes the delay of the dormant period, with higher effect in the case of using “as received” mineral addition.
- 3) In “pre dried” samples, the main peaks of maximum heat flow associated to the gel C-S-H hydration are almost equal or even higher than in pattern, but lower and later peaks in “as received” samples may indicate possible inhibition of setting.
- 4) The secondary peak, associated to the hydration of aluminate phases, is not observed when high content of mineral additions is included in the mortar formulation.
- 5) Further studies focussed on the structure development at higher curing ages are needed to confirm the viability of using the mineral addition as partial replacement of cement in mortars.