

➤ Solid-state NMR spectroscopic investigation of hydrated refractory cements. Correlation of the ^1H , ^{27}Al and ^{29}Si NMR signals with results from XRD analysis.

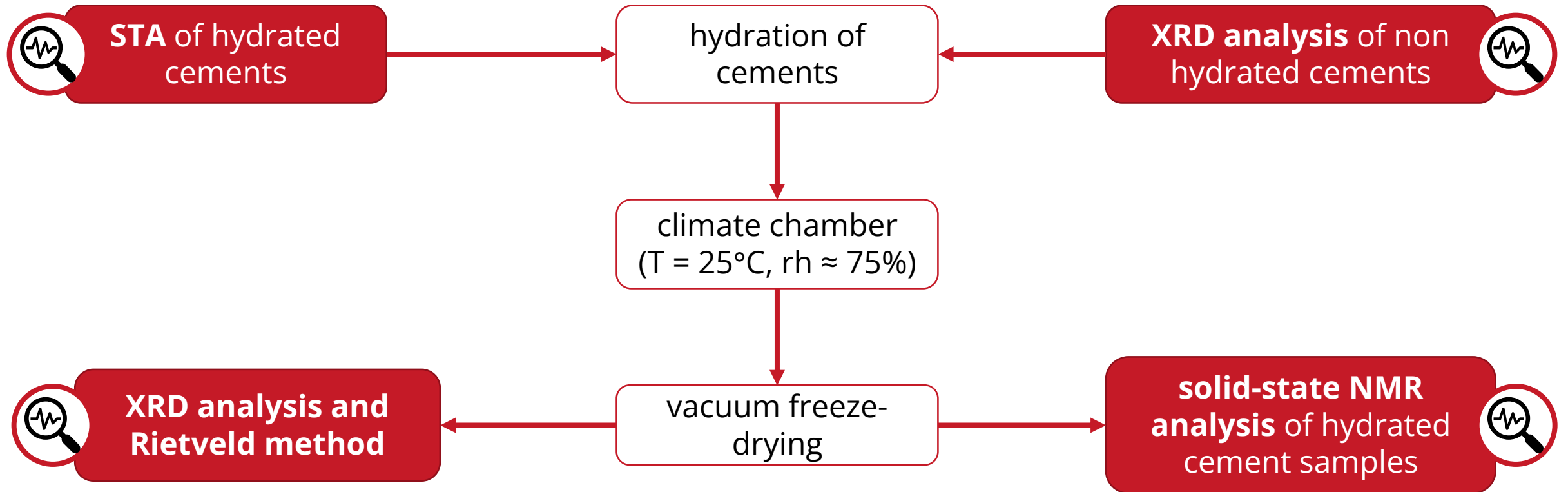
Theodor Haase Award 2024 – December^{11th}, 2024

Motivation

- investigation of phases formed during the hydration process of calcium aluminate cements (CAC)
- CACs used: Istra 45, Secar 51, Secar 71 and Secar 80
- hydration of CACs often results in X-ray amorphous structures
- solid-state NMR spectroscopy as an additional fundamental analytical method for analyzing hydrate phases of cement systems



Experimental



Results

- exemplaric results of the XRD analysis and Rietveld method for Secar 80

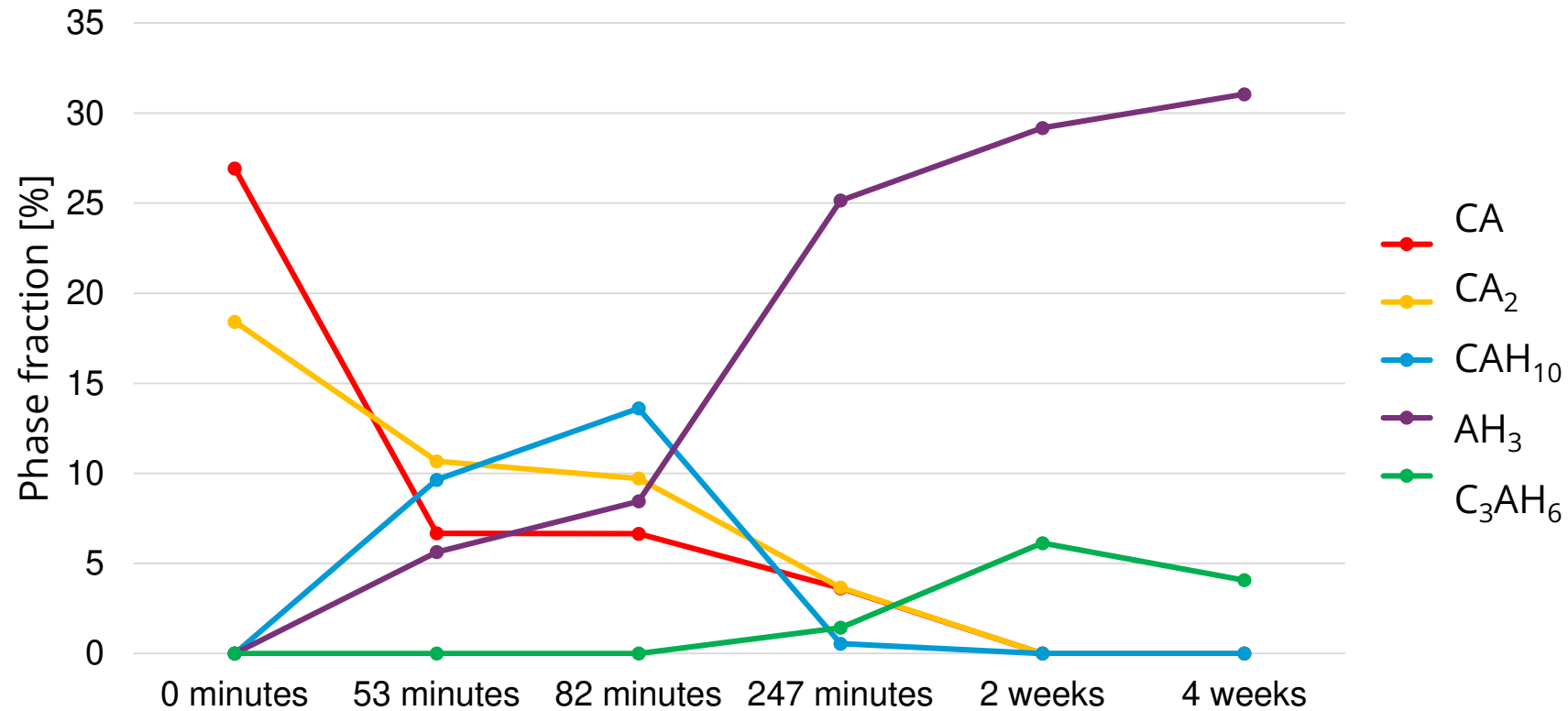


Fig. 1: Visualization of crystalline phase components in the course of the hydration of Secar 80 with results from the Rietveld analysis.

C = CaO, A = Al₂O₃, S = SiO₂, T = TiO₂, H = H₂O

Results

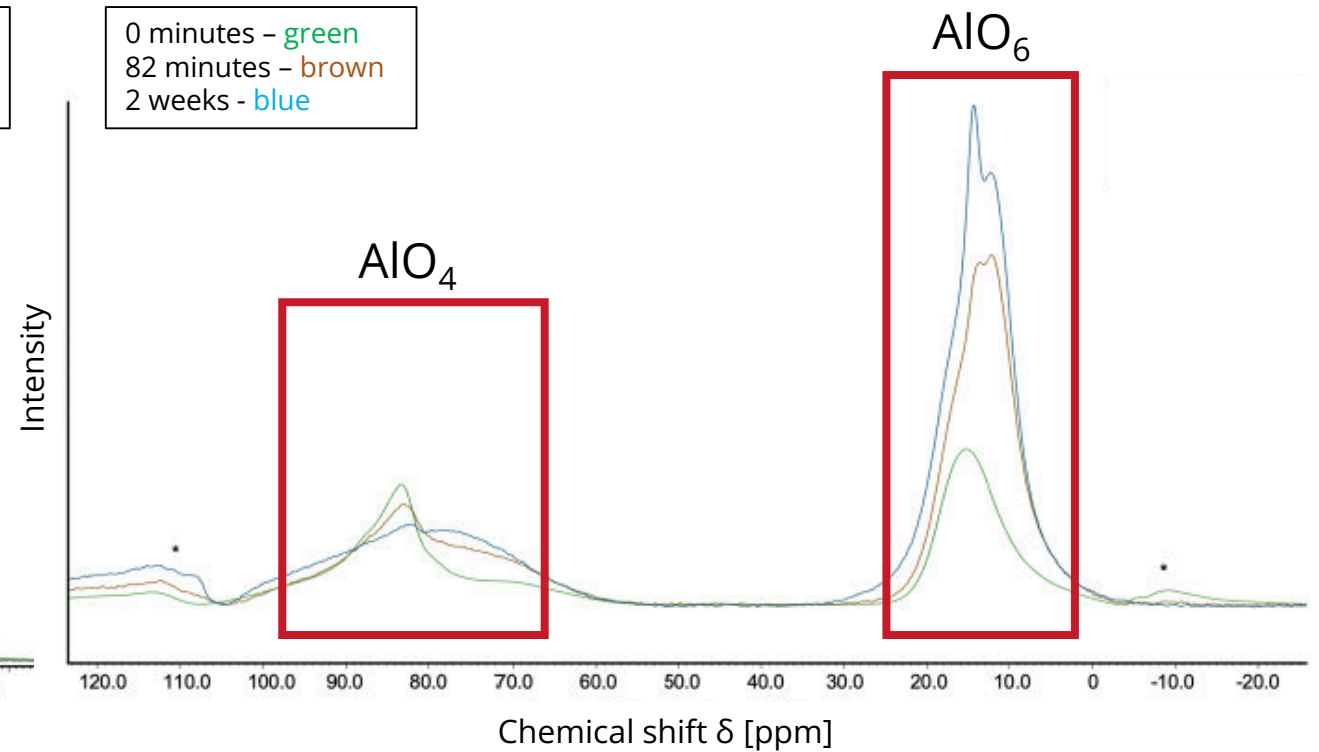
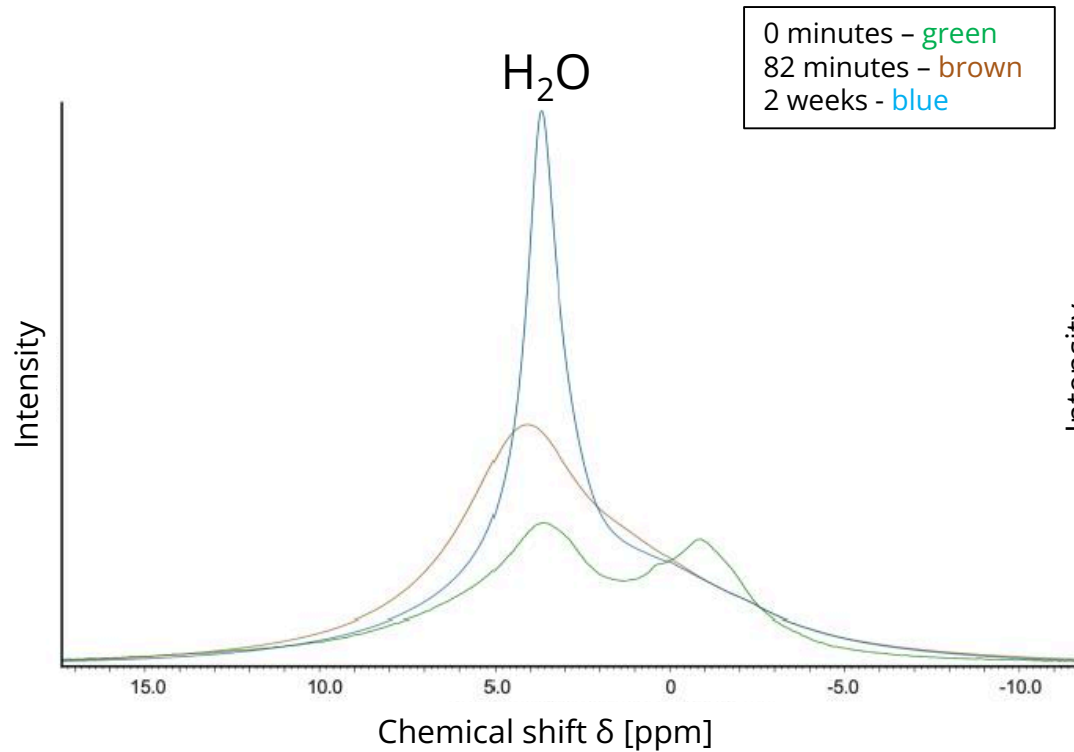


Fig. 2: ^1H -MAS NMR spectra of Secar 80 at different hydration times.

Fig. 3: ^{27}Al -MAS NMR spectra of Secar 80 at different hydration times.

Conclusion

- almost all of the predicted cement phases were identified
 - signal width in combination with given literature provided information about cristallinity of the cement phases
 - high correlation between XRD and NMR data
 - evaluation of NMR measurements only possible to a limited extent due to overall broad and partially overlapping signals
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- through expanded research based on the results, it is possible to further deepen and differentiate the composition of hydrate phases → more detailed understanding → allows a well-founded evaluation and future optimization of cement systems

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Thank you for your attention