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Research topic:
Influences of two-stage mixing on the hydration behaviour of Portland composite cements and on the performance of concrete

1 Aim of research

In order to conserve resources, lower energy requirements and reduce greenhouse gas emissions, the increased use of cements with a significantly reduced clinker content due to other main constituents is necessary. However, the lower the clinker content in cement, the lower the early strength of concrete. This may require adjustments in the concrete processing industry and often makes the practical acceptance of clinker-efficient cements in construction more difficult.

2 Working hypothesis

The early strength of concrete increases with increasing conversion of the cement into hydrates in the early phase of hydration. Early cement hydration should increase with the input of energy during the mixing process. The energy input should increase both through more intensive mixing in two stages and as a result of increased interaction between the particles of the different main constituents in Portland composite or composite cements.

3 Research objective

The aim of the research project was to determine the influence of two-stage mixing on the early hydration and microstructure development of clinker-efficient Portland composite and composite cements as well as on the strength development and durability of concrete. Systematically, the aim was to determine the extent to which the performance of ternary cements can be improved by two-stage mixing processes and thus the proportion of raw material and energy-intensive clinker can be utilised more efficiently or further reduced.

4 Summary of the research results

The early strengths of the tested cements could not be significantly increased with the used two-stage mixing processes. The mechanisms of an accelerating effect of two-stage mixing on early cement hydration postulated in the literature could not be confirmed. The two-stage mixing methods used did not show any advantages compared to normal forced mixing. The effect of the PCE-based superplasticisers used was reduced as a result of two-stage mixing. A complete loss of effectiveness could not be determined. The results of the mortar tests were confirmed by tests on concretes. The durability of concrete was not affected by two-stage mixing, but neither was it improved.

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