

Metallurgical principles for producing concrete constituents

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The production of concrete constituents involves several high temperature processes. The production of cement clinker is a complex metallurgical process in which partial melting needs to be controlled and the correct mineral phase assemblage needs to be obtained after cooling. Another example is the production of lightweight aggregates. A delicate balance needs to be found between obtaining sufficient melt of the right viscosity to capture bubbles and not obtaining too much melt for collapsing the granules. Both production processes are of increasing interest in view of carbon neutrality. Alternative clinker compositions – carbonatable – are being developed, but the urgency of the climate challenge does not permit to wait for decades to reach empirical insights on the optimal clinkering composition and process. The developments can be expedited by modeling the phase composition and calculating the distribution of the elements of interest. Lightweight aggregates are an ideal constituent for the valorization of quartz-felspar rich waste streams and can provide insulating properties to concrete products. Results show that the temperature needed for producing lightweight aggregates can be estimated well using thermodynamic modelling. Even more powerful is the capacity to screen compositions and to extract what additions are needed to optimize a certain composition in view of providing a robust melting behavior which might be used in industrial practices where temperature control ± 10 °C can only be reached in Utopia.

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