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CALCINED CLAYS FROM SECONDARY RAW MATERIALS FOR CEMENT PRODUCTION

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There are major challenges which the cement industry and the entire cement and concrete value chain are facing in their quest for climate neutrality. This is due to the fact that large quantities of CO_2 are released in the production of cement and its preliminary product, cement clinker. The large-scale industrial transformation processes impact not only the future technology of cement production, but also the availability of primary raw materials. Resources like fly ashes and granulated slag, which were used in great quantities during the last decades, are not going to be available in the near future anymore and have to be replaced.
It is assumed, that Germany will need 4,3 Mio t of calcined clays in 2050 as a reactive main component of cement [1]. Aside from production of calcined clay from primary clay deposits, calcination of secondary deposits from gravel and sand production or waste rock piles are spotlighted for a sustainable cement production. Generally, clays with low ceramotechnical properties are appropriate for cement production. In view of the future increase in demand for calcined clays in the context of the decarbonization process, it will be necessary to build or retrofit significantly more rotary kilns and flash calciners for clay calcination.

In a research project, samples from various primary and secondary clay deposits were chemically and mineralogically characterized and calcined at different temperatures. Reactivity determinations using different methods like ASTM C 1897-20 (heat of hydration and chemical bound water at 7 days of hydration) and reactive SiO_2 (acc. EN 197-1) led to the selection of ten samples that were used for performance tests of laboratory composite cements with 25 and 40 mass % of calcined clay respectively. Four of these cements with 25 mass % clay and two with 40 mass % clay were also used for durability tests of concrete.
The results show, that most of clay-containing raw and waste materials, that have clay contents of more than 50 mass %, were suitable for the production of calcined clays for the cement industry. These clays included filter cakes, plastic clays, mudstones, and waste rock. Even with the usage of these broad range of calcined clays, the production of composite cements according to the requirements of the European cement standards was possible.

[1] Verein Deutscher Zementwerke, VDZ, Ed. Resources of the future for cement and concrete - potentials and action strategies. Düsseldorf, 2022. Verfügbar unter: https://www.vdz-online.de/ressourcenschonung