DURABLE AND SUSTAINABLE SHOTCRETE

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Nowadays there is a special need to develop “new” construction materials to reduce the environmental footprint of structures. Investigations focus on durability of constructions and the use of sustainable materials and the reduction of CO_2 emission (especially of the binder). Constructions have to be sustainable and durable. This will lead to low maintenance work and costs as well as a good life cycle performance.

The aim of the Austrian research project „Advanced and Sustainable Shotcrete - ASSpC“ is to improve shotcrete mix design regarding durability and sustainability. There are different ways which may lead to success, one possibility is to replace part of the clinker content in the binder with supplementary cementitious materials.

But it is crucial that new mix designs fulfil the technical requirements on site concerning workability and early age strength development, too.

One central issue of the research project is to investigate how the pumpability of shotcrete can be determined in lab. At the moment there is no proven method available to measure the pumpability of shotcrete. Several test methods are used to determine the stability, tendency to segregation, bleeding and of course the consistency of concrete. Common test methods like the spread flow table and V-funnel flow time are used as well as two point test methods like the concrete rheometer eBT2 and Sliper. The segregation tendency is evaluated by the filter pressing test and the bucket setting test. Results from lab will be compared to results from site to define threshold values and parameters which describe the pumping characteristics of shotcrete base mix.
In addition to that the early age strength development of the shotcrete mix design is investigated with the Minishot System designed by Sika. The shotcrete system is downscaled to a mini spray unit. In opposite to common test methods it is not necessary to mix the accelerator into the cement paste or mortar, but it will be added at the nozzle. The paste is sprayed by a downscaled nozzle and thus a realistic shear stress can be achieved. The paste is applied to a pulsment ultrasound spectrometer and the shear modulus development is measured continuously over time. The results can be linked to the strength development of shotcrete.
The paper presents the tests procedures mentioned above in detail as well as first results with different shotcrete mix-designs.