

INVESTIGATIONS REGARDING THE PUMPING PROCESS OF WET-MIX SHOTCRETE

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Workability is a physical property of fresh concrete, which can't be described with only one single parameter or measured with one single test method. Pumpability and sprayability plays an important role for wet-mix sprayed concrete. The material must be conveyed through the pipe without changing its properties and mix proportion. The mix should leave the nozzle in a uniform stream intermixed homogeneously with the accelerator.

When concrete is pumped through a pipe, a thin layer of paste is lubricating the wall of the pipe. The interaction of the lubricating layer and the pipe wall is of great importance for pumpability. The shear of the layer allows the slipping of the concrete and leads to a reduction of the required pumping pressure. In this presentation a sliding pipe rheometer "Sliper" is used to determine the pumping capacity of concrete. The Sliper consists of a pipe and a guided piston which is standing on the ground. A pressure sensor is integrated onto the piston. When the pipe is sliding downwards, the pressure in the pipe as well as the speed of the pipe are recorded. Rheological parameters as well as the supposed pumping pressure may be estimated.

The cohesiveness of concrete is important to avoid blockages in the conveying pipe. Blockages can occur, when the paste separates from the aggregate skeleton because of a high pressure in the pipe. The stability of the wet-mix was determined by a filter pressing test.

Mixes tested by the Sliper and the filter press were then sprayed with a wet-mix shotcrete machine Sika PM 500. This machine was equipped with seven pressure sensors, which could monitor the pressure over time. The sensors measured the pressure of the hydraulic system, the mix at the beginning and end of the pumping line, the pressure of the accelerator shortly after the pump and at the end of the hose, the pressure of the air and finally the pressure in the aerosol converter.

Simultaneously, the spraying was filmed by a high-speed camera. This slow-motion recording shows the homogeneity and pulsation of the spray jet. At its best, shotcrete should emerge from the nozzle in a steady, uninterrupted flow.

Different durable and sustainable mixes, developed under the Austrian research project ASSpC, were sprayed at different output of the shotcrete machine. The results and lessons learned from the results will be final part of the presentation.