Influences of the grout composition on the dewatering behaviour of annular gap grouts

Bou-Young YOUN, Rolf BREITENBÜCHER
Institute for Building Materials, Ruhr-University Bochum, Universitätsstr. 150, 44801 Bochum, Germany

The hollow space between tunnel lining and bedrock, caused during tunnel driving with segment lining, must be filled with a so-called annular gap grout, to embed the tunnel lining in an adequate position and minimize the settlements of the ground surface. The decisive requirements on such annular gap grouts are on the one hand optimal flow properties lasting for several hours and sufficient sedimentation stability at the same time during processing and grouting phase. On the other hand, this material has to exhibit a rapid development of shear strength immediately after grouting, corresponding to that of the surrounding soil. This can be achieved by pressing out the excess water of the grout into the soil. Thus, two contradictory requirements are prescribed for annular gap grouts. Hitherto, grouts have been exclusively defined on empirical basis. Studies about specific investigations on grout compositions with regard to dewatering and infiltration behaviour into the surrounding soil or into the previous and already partially hardened grout are missing so far.

The key objective of the research thesis is, to describe the dewatering and infiltration behaviour of grouts, based on experiments. By means of this description, the annular gap grout should be also performed in accordance with a real design concept, to ensure a diagnosable and unerring annular gap grouting in praxis.

For this purpose, the correlations between the individual components of grout composition and the dewatering behaviour under defined boundary conditions as pressurization, filter mesh and permeability as well as the development of shear strength have to be investigated fundamentally.

Within the scope of this research work, the workability and dewatering behaviour of different grout compositions for annular gap grouting were observed under defined pressure conditions, filter mesh and permeability. In addition, the development of shear strength and compressive strength was examined at un-drained specimens – reflecting the worst case of no dewatering due to a nearly impermeable soil – and by comparison, also at drained specimens. The preliminary investigations were carried out on grout compositions, which are commonly practiced for a major traffic tunnel, by using a standardized test procedure, called “filter press test” according to DIN 4126. Further investigations focussed on grout compositions with relatively small cement contents, due to the fact, that high compressive strengths, achieved by high cement contents, are generally not required. These grout compositions were performed with different variations of parameters as cement-fly ash ratio, granulometry of fines, additives and aggregates. In this context, the test setup was modified to simulate the annular gap with its width up to 18 cm. The amount of filtrate water, including temporal changes, was determined.

From the results, influences of the parameters on the workability and on the development of required strength, achieved by the dewatering behaviour, were analyzed and discussed.