



Clays causing adhesion with tool surfaces during mechanical tunnel driving

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During mechanical excavation with a tunnel boring machine (TBM) it is possible that clays stick to the cutting wheel and to other metal parts. The resulting delays in the progress of construction work, cause great economic damage and often disputes between the public awarding authorities and executing companies. One of the most important factors to reduce successfully the clay adhesion is the use of special polymers and foams. But why does the clay stick to the metal parts? A first step is to recognize which kind of clay mineralogy shows serious adhesion problems. The mechanical properties of clay and clay suspensions are primarily determined by surface chemistry and charge distribution at the interfaces, which in turn affect the arrangement of the clay structure. As we know, clay is a multi-phase material and its behaviour depends on numerous parameters such as: clay mineralogy, clay fraction, silt fraction, sand fraction, water content, water saturation, Atterberg limits, sticky limit, activity, cation exchange capacity, degree of consolidation and stress state. It is therefore likely that adhesion of clay on steel is also affected by these clay parameters. Samples of clay formations, which caused problems during tunnel driving, will be analyzed in laboratory. Mineralogical analyses (diffractometry, etc.) will be carried out to observe which minerals are responsible for adherence problems. To manipulate the physical properties, batch tests will be carried out in order to eliminate or reduce the adhesion on tool surfaces through variation of the zeta potential.

Second step is the performance of vane shear tests on clay samples. Different pore fluid (distilled water, pure NaCl solution, ethanol and methanol) will be used to study the variation of the mechanical behaviour of clay depending on the dielectric constant of the fluids.

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