Optimised grout formulation for filling cavities in river dams

Graduate

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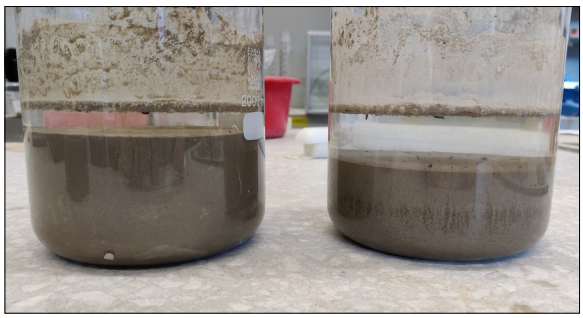
Problem: In order to fill cavities along riverbanks that may be caused by animals or human activities, such as drilling, it is necessary to develop a mortar that has minimal shrinkage, is injectable, is not susceptible to damage caused by contact with water and is environmentally friendly. The goal of this thesis is to test the feasibility of using so-called liquid soil for this purpose. Liquid soil is a mixture consisting of a source material, which is normally soil, water and additives such as plasticisers and accelerators that make the mixture temporarily fluid and thus suitable for filling cavities that are difficult to fill with other techniques. This mixture allows the final mechanical and physical properties to be similar to the soil in which it will be used because soil from the same location can be used as the source material, which is the main component.

Approach: Four liquid soil mixtures are prepared from the recipe provided by LogBau. A fine mineral material was used as the source material, a mix of 80% sand and 20% silt and 100% silt. The fourth mixture is prepared using the fine material but doubling the amount of water to assess its impact on properties. First the source materials and mixtures are characterised by determining the Atterberg limits (liquid limit and plastic limit). The grain size distribution was then determined for the fine mineral material and the mixture prepared with it by the aerometric method. To assess injectability, the viscosity of the mixtures prepared with the fine mineral material was measured using a rheometer. Finally, the hydraulic properties have been evaluated, namely the shrinkage during the curing phase and the behaviour in contact with water.

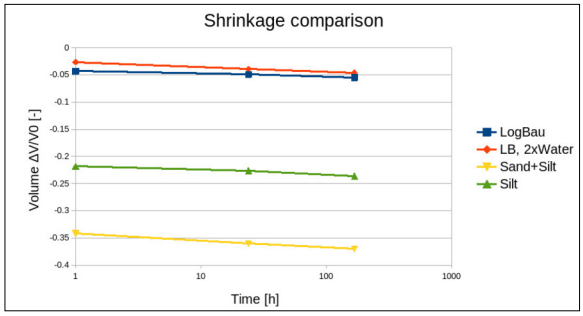
Result: The mixture prepared with more water has a viscosity of about 600 mPas at a rate of 120 s^{-1}. This rate is lower than what would be needed to test its injectability, but comparing the result with another mixture that can be injected does not deviate much. A test with an injection machine is still necessary to assess its feasibility. Tests for shrinkage showed that the mixture prepared with the material up to the lowest value, around 5%, while the other two mixtures significantly higher, between 20 and 30%. In all mixtures, most of the shrinkage occurred in the first 24 hours, after that it was minimal. The Immersion tests over 7 days showed no signs of damage or changes in sample volume therefore indicating that these mixtures can be used in contact with water. As a conclusion, the use of liquid soil can serve as an alternative for filling cavities along rivers. The use of source materials different from that used to develop the recipe used in this thesis, however, requires research to assess the feasibility of substitution

Liquid soil used to fill a ditch
https://de.wikipedia.org/wiki/Flüssigboden

Segregated mixtures
Own presentment



Comparison between the shrinkage of the mixtures
Own presentment



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