ASSESSING THE HYDRAULIC CONDUCTIVITY OF THE SEEPAGE-REDUCING MEASURE 'SAND BENTONITE' IN DIVERSE ENVIRONMENTS

In many regions of the Netherlands, water levels in waterways are higher than the surrounding groundwater, leading to seepage that can cause dike failure due to piping or soil saturation. Measures such as ZBM (Sand-Bentonite-Mixture or Zand-Bentoniet-Mengsel in Dutch), a soft liner applied at the bottom of a waterway, are applied to mitigate seepage by increasing hydraulic resistance, creating a poorly permeable layer. Joint research involving Rijkswaterstaat, Van Heteren Weg- en Waterbouw B.V and Deltares showed that ZBM could be confidently applied at the Twentekanaal, and after the successful application, the question arose about its applicability in different environmental contexts.

This thesis assesses the influence of various environmental factors on the hydraulic conductivity of ZBM used as a seepage control measure. While existing literature offers valuable insights, it often focuses on specific characteristics such as swelling capacity, leaving a gap in knowledge about the factors influencing hydraulic conductivity. By conducting small-scale (5-litre, Figure 1) and large-scale (1000-litre, Figure 2) experiments while measuring the water flowing through the ZBM layer, the potential influence of various environments on the behaviour and hydraulic conductivity of the ZBM is assessed.

The environments studied include the coarseness of the surface layer on which the ZBM is applied and the chemical composition of the water in terms of salinity and acidity. Findings indicate that the mixture settles through coarse layers even with very fine gradings, with the separation of lighter and heavier particles observed during settling. Nevertheless, of all the experiments, the lowest discharge was observed during large-scale experiments with the coarse surface.

Compared to fresh water, the experiment with water with increased salinity showed that the increased salt concentration accelerated the shrinkage of the ZBM layer, leading to the formation of cracks and increasing hydraulic conductivity. Furthermore, this study revealed the impact of ZBM on the pH of the surrounding water through an exchange of H^+ ions that increased the pH of the water to that of the mixture itself.

These results show that the hydraulic conductivity and behaviour of the ZBM can be strongly influenced by environmental factors. This indicates that it cannot be assumed that the ZBM could be applied in all environments, and results from the application of ZBM in other environments are not directly applicable to waterways with different water compositions or soil characteristics. Understanding these influences is critical to ensure the efficacy and applicability of ZBMs in different environmental contexts.

Figure 1: Small-scale experimental setup (5-litre), ZBM applied on top of sand surface

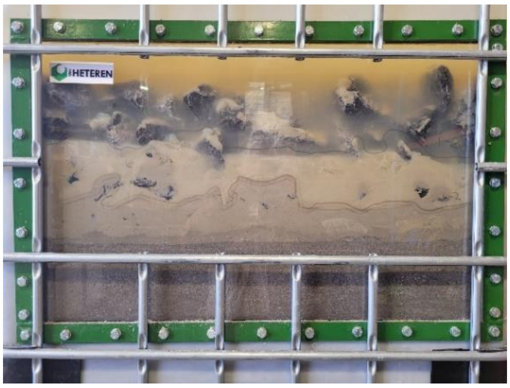

Figure 2: Large-scale experimental setup (1000-litre), ZBM applied on top of coarse surface

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