EK35®

NTNU Laboratory Evaluation of EK35 Treated Aggregate

Background

The mechanical properties of pavement layers are of major importance when it comes to ensuring a well-performing road and/or runway. Very little research and testing is available for non-traditional stabilization chemistries. A laboratory study was conducted by the Norwegian University of Science and Technology to assess the performance and mechanical properties of aggregate treated with non-traditional stabilization technologies. EK35 was among the 14 different chemistries evaluated.

Testing

Laboratory testing was performed on base course aggregate with quality mechanical properties.

Repeated Load Triaxial Testing (RLTT) – Phase 1

The Repeated Load Triaxial Test is a comprehensive method for evaluating the mechanical properties of a pavement layer when subjected to simulated traffic loading. RLTT evaluates the treated aggregate's resilient modulus and resistance to deformation. Three application rates were selected for testing: 1.5%, 2.5% and 3.5%.

Freeze – Thaw Evaluation – Phase 2

Freeze-thaw testing was performed on RLTT specimens to evaluate EK35's performance after being exposed to 10 freeze/thaw cycles. Based on Phase 1 testing, the application rate selected was 1.5%. Each treated specimen was submerged in water for 5 minutes then removed and allowed to free drain for 5 minutes. The specimens were then placed in a freezer for 24 hours. After freezing the samples were allowed to thaw at room temperature. This process was repeated for 10 cycles.

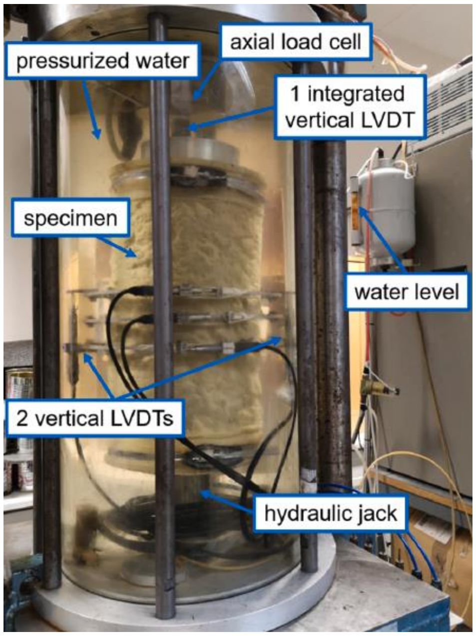

Figure 1: RLTT Specimen Setup

Figure 2: Rolling Bottle Test Setup

Rolling Bottle Testing (RBT)

The Rolling Bottle Test is a standardized procedure to assess the adhesion between the aggregate particles and EK35's binder. 150 grams of loose aggregate was treated with 4.5 grams of EK35. The coated loose particles were placed at room temperature for 30 days to allow bonding to occur. The loose aggregate was then placed in glass bottles filled with distilled water. A glass road was inserted into the bottles to provide the mechanical stirring action and prevent clumping. The bottles were then placed on a roller at a speed of 60 rounds per minute. The specimens were subjected to 14 different time intervals up to 24 hours. A total of 84 specimens were tested. After the cycles were completed the samples were weighed and visually evaluated to determine EK35's susceptibility to stripping from the coated aggregate.

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Results

- In Phase 1 testing, specimens treated with EK35 at 1.5% displayed better mechanical properties than specimens treated at higher application rates. This is true for resilient modulus and resistance to deformation.
- In Phase 2 testing (freeze/thaw), a significant stabilization effect was found in EK35 treated specimens before and after freeze/thaw conditions. The results indicate a slight increase in performance after 10 freeze/thaw cycles.
- After the completion of the Rolling Bottle Test at 24 hours, EK35 still covered the surface and some underlying particles became slightly exposed. EK35 adheres well with the aggregate particles when subjected to high moisture level or external actions in general.

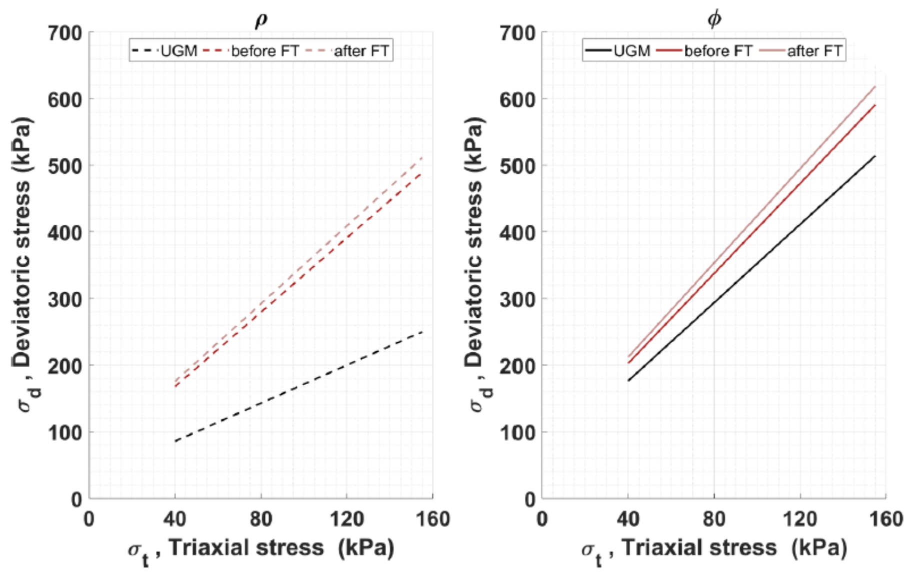

Figure 3: Elastic limit angle ρ and failure limit angle φ for SF-1 specimens before and after 10 FT cycles (w = 0%) compared to UGM (untreated).

Conclusions

- "As the synthetic fluid does not freeze, its effectiveness does not seem impaired by rigid temperatures in harsh environments and therefore can be adopted in remote communities in cold regions as documented in few other studies."
- "The properties of the treated aggregates do not significantly change after the exposure to freezing-thawing actions, thus representing a promising solution for road construction in cold climate regions."
- "The synthetic fluid properly adheres to the aggregates when exposed to severe mechanical actions also in wet conditions and therefore exhibits very limited leaching potential."
- "In some contexts, having the opportunity to achieve a lower resilient modulus and easily regrade the particle aggregates covered by an agent which does not set up may represent a preferable condition."
- "The results document a meaningful variation in both resilient modulus and resistance to permanent deformation of the treated specimens, ranging from significant reduction to significant improvement of the mechanical properties depending on the quantities of synthetic fluid and water. A general decrease in the mechanical properties is evident when a high quantity of synthetic fluid and water are mixed with the rock aggregates as the particle matrix becomes waxier."

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