FACT SHEET

Guidelines for Chemically Stabilizing Problematic Soils

PROJECT TITLE

Guidelines for Chemically Stabilizing Problematic Soils

STUDY TIMELINE

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INVESTIGATORS

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FURTHER RESOURCES

https://www.mdt.mt.gov/research/projects/geotech/chemical_stablize.shtml

Introduction or Problem Statement

Montana has a diverse geology and a wide variety of subgrade soils are present across the state. These subgrades include soils that have low bearing capacities such as soft clays and loose sands as well as soils with high bearing capacity such as dense sands and stiff clays. In addition, the state also has expansive soils that are capable of volumetric strains due to moisture fluctuations. The pavement subgrade section of the geotechnical manual of the Montana Department of Transportation (MDT) lists geosynthetic reinforcement as well as chemical treatment as choices for subgrade stabilization. The practice has been inclined towards geosynthetic usage due to the familiarity with the method and applicability for all soil types. Through this project, MDT sought an understanding of chemical methods for subgrade stabilization and the development of stabilization guidelines tailored to the needs of MDT, thus, providing an alternative for subgrade stabilization other than geosynthetics.

Methodology or Action Taken

In the process of developing these guidelines, several tasks were performed.

- Review of literature and a current practices survey of states neighboring Montana
- Collection of a wide variety of problematic soils,
- Establishment of the baseline data and determination of the type and amount of additive for chemical stabilization,
- Study of chemical and mineralogical changes between treated and untreated samples,
- Establishment of curing and moisture conditioning protocols to minimize curing time,

- Determination of the durability of stabilizing effects against freezing/thawing and wetting/drying, and
- Perform a life-cycle cost analysis (LCCA).

Conclusions or Next Steps

- Out of the six soils collected, there were two high plasticity clays, two low plasticity clays, one low plasticity silt, and one silty sand. Two out of six soils contained soluble sulfates in excess of 10,000 ppm and, all but one soil contained organic content greater than 1%. Such soils require special attention in selecting stabilization method and durability.
- It was noted that only 2% lime was sufficient to increase strength above 50 psi (strength target for treated soil) for soils tested in this research. One soil required 7% cement to increase the strength above 50 psi. However, some of these samples have high sulfate contents which can cause issues with durability.
- Of the three different accelerated curing protocols studied in this research, Humidity Controlled Accelerated Curing (HCAC) is the most practical and reliable. This protocol is recommended when time is of the essence, otherwise, the ASTM standard 7-day curing protocol should be used.
- Based on the Freeze/Thaw and Wetting/Drying durability studies, the results generally show that cement treatment is most compatible in terms of durability at 7-9% cement. It should be noted here that two soils would be suitable to be treated with lime but did not fare as well as the others.
- The durability of chemical treatment on four of the soils was poor compared to other Montana soils. This could be due to the high amounts of sulfates present in these soils.
- The general cost increase in construction is higher for special borrow than chemical stabilization. The percentage increase in initial construction cost due to the use of a chemically treated subgrade soil varied from 6.9% to 8.4%. The increase in construction cost for pavements on special borrow varied from 12.6% to 15.3%.
- Special borrow is more favorable than chemical stabilization in the long term when compared to soils that failed in the durability tests. When considering soils that performed well in the durability test, chemical stabilization is the more favorable alternative than special borrow.
- Based on the results of the lifecycle cost analysis (LCCA), it can be concluded that using chemical stabilization on problematic soils is more advantageous than special borrow, if the durability of the treatment is high. When durability results are poor for chemical treatments, special borrow is more cost advantageous in the long term.

Potential Impacts and Benefits

The life-cycle cost analysis (LCCA) indicated cost savings ranged from 9% - 15.9%.

An implementation plan has been developed to include the following tasks:

- Develop training materials and provide training.
- Evaluate appropriate projects for deployment and track results.
- Deploy chemical stabilization in appropriate projects.