



*The Ohio Department of Transportation
Office of Research & Development
Executive Summary Report*

Beneficial Utilization of Lime Sludge for Subgrade Stabilization: A Pilot Study

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Problem

A global chemical stabilization design is recently adopted by the Ohio Department of Transportation (ODOT). This produces performance and economic benefits in providing pavement with a rugged base supporting. Given the large quantities of lime required for implementing a global soil stabilization, it is the interest of transportation agencies if inexpensive sources of soil stabilizer can be utilized for subgrade stabilization. One potential resource can be utilized is the lime sludge produced from drinking water plants.

The purpose of this study is to *conduct pilot experiments to assess the feasibility of lime sludge for subgrade stabilization*. The study focused on the feasibility of using lime sludge as a substitute of regular lime used in road construction, design issues such as method of lime sludge introduction, the optimum content of lime sludge and the long term performance, etc. Special local issues such as freezing-thawing durability were investigated for implementing in Ohio.

Objectives

Conduct experiments to evaluate the use of lime sludge for performance improvements in the typical types of subgrade soils in Ohio.

Description

Experimental study was conducted on five types of soils, including low plastic clay soil and high plastic clay soils. The experimental testing include the measurement of soil index properties, characteristics of lime sludge,

testing for pH values of lime sludge and stabilized soil, testing for unconfined compressive strength of soil and stabilized soil, microstructure testing, and so on.

Factorial experimental design is used in designing the experiments. Factors considered in the experimental program include:

- Lime sludge content: The lime sludge content varies from (0%, 5%, 10%, 15% and 20%).
- Strength development with time
- Freeze-thaw durability

Conclusions & Recommendations

Beneficial utilization of lime sludge in transportation construction presents an opportunity to achieve sustainable utilization of a precious natural resource.

- 1) Chemical analyses indicate lime sludge has similar chemical components as commercial hydrated lime.
- 2) Common procedures for determining the optimal lime content for soil stabilization based on pH values are found not applicable for lime sludge. Instead, performance criteria based on unconfined compression tests need to be utilized. Lime sludge was found to increase the soil deformation modulus and reduce the plastic behaviors.
- 3) Wet mix and dry mix methods do not appear to significantly affect the strength of lime sludge modified soil.

Considering of the economic factors associated with drying lime sludge, lime sludge can be introduced in the slurry format via the wet mix procedure.

- 4) The existing testing data indicated that lime sludge does not significantly improve the unconfined soil strength. Lime sludge however demonstrated the positive effects in reducing the plasticity

of soils and improving the freeze/thaw durability.

The following recommendations are made based on the pilot testing program:

- 1) Extend the experimental program to study the effects of non-uniformity of the chemical components of lime sludge on the effectiveness of subgrade stabilization;
- 2) Conduct field demonstration project to collect long term performance data, which will help quantify the effectiveness of lime sludge as an economic and sustainable material.

Implementation Potential

This study can be implemented by 1) utilizing the testing procedures used by this project to determine the optimal lime sludge content; 2) Upon further validation of long term field performance, incorporating lime sludge as a candidate material in the ODOT materials Supplement specifications (No. 1120) for Design of Chemical Stabilization.