LOUISIANA TRANSPORTATION RESEARCH CENTER LTRC

TECHNICAL SUMMARY

Identification and Stabilization Methods for Problematic Silt Soils: A Laboratory Evaluation of Modification and Stabilization Additives

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INTRODUCTION

Many areas of Louisiana consist of soils with high silt contents, low strengths, and minimal bearing capacity. Construction traffic on these soils can cause detrimental pumping action when they are wet. These wet subgrades under Louisiana pavements cause both construction and in-service performance problems.

For many years, DOTD bid the job with as much as 10 percent lime by volume on an as- needed basis to treat the problem silts. This effort is conducted in order to dry the soil, eliminate the pumping action, and provide a stable subgrade for preparing the base. The permanence of the silt-subgrade during the extended period of construction activities and conditions, and the long-term performance of the subgrade in supporting the completed pavement are not addressed. The only role of the subgrade considered in current pavement design is to provide a working table to support the base during construction.

With the results published in May 2002, the first phase of the research effort on these soils further refined the description of the pumping problem and guidelines for the identification of problem silt-soil. Based on these findings, the DOTD specifications for usable soils were changed to reduce the potential for constructing roadway embankments with pumping silt soils.

In order to address the questions concerning a comparison of the performance of other reagents for treating/stabilizing the problem silts and the impact that they may have on pavement design in the future, the investigation was extended to include limited laboratory tests that would address construction needs and long-term performance.

OBJECTIVE

The objectives of this research are to conduct a laboratory comparison of the performance of common modifying and/or stabilizing reagents 1) during construction operations and 2) as support for the in-service pavement.

RESEARCH APPROACH

The original testing program focused on characterizating pumping soils and the attributes contributing to their instability during compaction activities. A second objective considered methods for modifying and stabilizing the natural soils to prevent pumping during compaction.

This continuing investigation extended the testing program of the second objective, i.e., modification and stabilization. It involved a study of the selected reagents based on criteria established for the mixtures to be used that would provide a common

and equal basis for comparison. The characteristics and performance of the selected mixtures were compared.

Common reagents, i.e., lime, lime-fly ash, Portland cement, and slag cement, used in stabilization and modification efforts were included as admixtures with three high silt (and fine sand) soils in the study. A series of laboratory tests simulated the moisture and loading conditions that these soils plus admixtures could experience during subgrade construction operations and longer term, in-service support of the completed pavement.

The laboratory program consisted of classifications tests, compaction tests, undrained strength tests, cyclic triaxial compression tests, and tube suction tests. Comparisons were based on the performance of mixtures with equal material costs.

CONCLUSIONS

To achieve long term stability and the greatest increase in strength, the cements followed by the lime-fly ash produced the best results. For initial moisture contents that exceed the optimum value by only a few percentage points (+/- four percent wet of optimum), smaller levels of reagents (percent by volume) were sufficient to retard or even eliminate deformation under low cyclic loads, but extremely wet soils (+/- eight percent optimum) required larger volumes of reagents to dry.

RECOMMENDATIONS

For long-term resistance to seasonal variations with respect to moisture changes, a cementing or pozzolanic reagent should be used to provide the greatest advantages. The selection of the reagents used should include consideration for both compaction and construction support, and continuous in-service support for the pavement during wet seasons. Cement and lime-fly ash would address both.

The selection of the reagent(s) and mix percentages used to treat and/or stabilize the problematic (pumping) silty-soils must also consider constructability questions involving blending and compaction.

Utilizing the stabilized subgrade as a sub-base structural component in the design of the pavement should also be considered.