Project Summary

Texas Department of Transportation

0-4872: Material Design and Testing Methods for Homemade and Containerized Cold Mix

Background

Cold patching asphalt mixtures constitute an essential element in the maintenance of Texas' highway infrastructure. These mixtures are often used to patch potholes in areas with cold and wet weather, particularly when hot mix asphalt is not available as a result of, for instance, plant winter closure. Since these mixtures are often applied under adverse conditions when the pavement is most susceptible to deterioration, proper application and adequate performance is imperative. When applied correctly and in a timely manner, this material can prevent further damage to the pavement structure, which could potentially translate into extensive and costly repairs.

Cold patching mixtures can be mixed in-house (homemade) or purchased from vendors and packaged in bags or buckets (containerized). However, there is no standard mix design or performance-based specifications for the acceptance and use of such mixtures. Consequently, the Texas Department of Transportation (TxDOT) has encountered multiple problems during storage, installation, and in-service life of these mixtures, which adversely affects their performance and cost effectiveness.

A problem often noted with cold patching mixtures is the limited storage life. Many of the homemade mixtures are stockpiled and left outside unprotected. The packaging of most containerized mixtures is not designed for rough handling and may easily tear, resulting in the material being exposed to the elements and allowing volatiles to evaporate. This, coupled with cold weather working conditions, often results in a hardening of the material, or loss of workability. Workability is essential both in the stockpile during storage and in the field during installation. An unworkable mixture can result in inadequate compaction and poor performance in the field. Yet, an easily workable mixture can result in inadequate stability under traffic loads. Inadequate workability and stability at the time of patch installation frequently results in a lack of patch durability.

Despite the increased interest in the performance of cold patching mixtures, there is very little in terms of performance-based design procedures, specifications, or evaluation methods. Oftentimes, the design of cold patching mixtures varies from area to area and is a "trial and error" procedure that depends on history and experience with the particular patching mixture and the experience of the personnel involved. To date there is no significant correlation between laboratory and field performance, which is a result of the lack of performance-related evaluation methods.

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What the Researchers Did

A research study was sponsored by TxDOT and conducted by the Center for Transportation Research (CTR) to investigate the failure mechanisms, material candidates, and current procedures to develop a standardized mix design for homemade mixtures. Laboratory and field evaluations were also conducted to establish standard laboratory testing and methods of field evaluation to ultimately develop performance-based specifications for the approval and use of cold patching mixtures.

The influence of material characteristics such as gradation, aggregate type, binder viscosity, binder content, compaction, temperature, curing time, and the use of admixtures was analyzed through a series of laboratory tests to determine their impact on the workability and stability of cold patching mixtures. Multiple containerized and homemade mixtures were tested in the laboratory. A modified Marshall test was developed to determine the stability as a means of characterizing short-term performance of the mixtures. Furthermore, cold patch slump test (CPST) results and subjective workability ratings were analyzed to identify those mixtures with adequate workability. The compilation of test results was used to identify those mixtures with desirable mixture characteristics, which then underwent accelerated pavement testing under the Model Mobile Load Simulator (MMLS3). In addition, the mixtures were also installed and monitored in the field under cold and wet conditions in the Lubbock District.

What They Found

A variety of homemade and containerized mixtures were installed in fabricated potholes under standardized conditions. The mixtures were then subjected to repetitive wheel loads under the MMLS3 and their rutting progression was monitored. The total number of wheel passes to failure (3/8 inch) was used to characterize the durability and performance of the cold patching mixtures.

Based on these and previous test results, three mixtures were identified for further testing in an elaborate field trial. These mixtures were installed and monitored on US 60 near Bovina in the Lubbock District. The mixtures included two homemade and one containerized mixture. Results from field trials indicate that all three mixtures perform adequately in the field with the containerized mixture slightly outperforming the two homemade mixtures. The homemade mixes, however, are characterized by a significantly lower initial cost.

What This Means

This study served to establish standard tests and field monitoring guidelines for improving the design of cold patching mixtures. Based on cost-effectiveness analysis, results from the field trial verified that the homemade mix design guidelines developed are adequate. Furthermore, MMLS3 results also proved to be a good indication of performance in the field, which indicates this method could be used to evaluate other mixtures in the future. However, during this study, a limited number of homemade mixtures were evaluated (primarily in the Lubbock District) so the results applied only to the range of mixtures evaluated. Validation of the findings in other regions of the state is necessary.

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