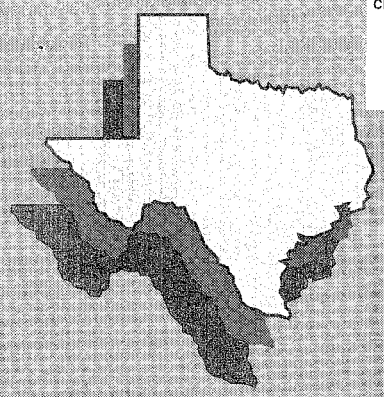

DEPARTMENTAL INFORMATION EXCHANGE

CTR

in cooperation with
Texas Department of Transportation
and the FHWA

Research Summary Report

D-10 Research • P.O. Box 5051
Austin, Texas • 78763-5051
512-465-7644 • TxAn 241-7644

Summary Report 1222-1(S)
July 1992

ESTABLISHMENT OF ACCEPTANCE LIMITS FOR 4-CYCLE MSS AND MODIFIED WET BALL MILL TESTS FOR AGGREGATES USED IN SEAL COATS AND HOT-MIX ASPHALT CONCRETE (HMAC) SURFACES

by
Ray Donley III
Center for Transportation Research

PROBLEM STATEMENT

Because the aggregate used in pavements can affect concrete material properties and, hence, pavement performance, the Texas Department of Transportation (TxDOT) has, over the past few years, undertaken a number of research studies to evaluate and predict the performance of various aggregates used in pavement surface courses. Laboratory tests have proved particularly useful in these studies. One of the most effective has been the magnesium sulfate soundness (MSS) test, which measures an aggregate's resistance to weathering in hot-mix asphaltic concrete (HMAC) and seal coats.

Using the acceptance levels for the 4-cycle MSS test recommended in a previous study, many TxDOT districts reported that improved pavement surface performance resulted from the elimination of unsound aggregate sources. These acceptance limits—30 percent loss for HMAC and 25 percent loss for seal coats—were based on laboratory testing of several aggregates and on a field evaluation of a limited number of test sections and aggregates. The aggregates examined in the field covered a wide range of soundness loss and were selected from different regions in the state. Because only a few of those aggregates tested were in the midrange (15 to 30 percent) of MSS loss, there is some concern that the recommended values may be too high.

Since that earlier study, the department has replaced the 4-cycle MSS test with the 5-cycle MSS test. Thus there was a need to update the recommendations to determine if the earlier acceptance levels were still valid. Additionally, the study team sought to confirm the reliability of the Texas Degradation Test (TDT). This test, a modification of the wet ball mill test (Tex-116-E) used to evaluate aggregate quality, has been proposed as a substitute for the MSS test.

Underlying all these efforts has been a central assumption: If aggregate quality can be correlated with aggregate performance in the lab, then the performance of other aggregates can be estimated based on an evaluation of their quality.

OBJECTIVES

The Center for Transportation Research (CTR) of The University of Texas at Austin, in cooperation with the Texas Department of Transportation (TxDOT) and the Federal Highway Administration, attempted in this research to upgrade the performance evaluation of aggregate used in pavement surface courses by establishing

acceptance limits for both the 5-cycle magnesium sulfate soundness (MSS) test and the Texas Degradation Test (TDT), also called the modified wet ball mill test. In identifying these limits, the project team sought to confirm and extend the levels established in an earlier project report. In this project, however, the CTR researchers concentrated on aggregates with 4-cycle MSS values between 15 and 30 (i.e., midrange values).

FINDINGS

Because the performance of aggregates can be affected by surface type, construction methods, environment, average daily traffic (ADT), and type of traffic, this study included three types of pavement surfacing—hot-mix asphalt concrete (HMAC), seal coat, and microsurfacing seal. Various levels of average daily traffic (ADT) were used to provide broad coverage over the inference region. Moreover, the selected aggregate sources (and road sections constructed with them) were located in seven districts (Lubbock, Odessa, San Angelo, Abilene, Waco, Austin, and Corpus Christi) and in two of the four climatic regions in Texas (Corpus Christi is in region IV, all other districts are in region V). Data supplied by the districts regarding construction practice, weather conditions during construction, and application rates were also included. Evaluation of the pavement surfaces involved friction measurements, pavement condition ratings, and macro photographs. Visual surveys and physical measurements using conventional measuring tools were also used to rate pavement condition.

Among the many findings of the study were the following:

(1) The 4-cycle and 5-cycle MSS loss values indicate the same aggregate properties, as they correlate very strongly (a correlation coefficient of 94 percent).

(2) The researchers found that 29 percent and 35 percent MSS loss with 5 cycles provides the same quality indication as 25 percent and 30 percent MSS loss does for the 4 cycles.

(3) For the Texas Degradation Test, an allowable loss of 10 percent indicated that good-quality aggregates are not discriminated against, and, in most cases, ensures that only high-quality aggregates are included.

(4) The MSS loss values, along with other data considered in this project, explained 74 percent of the variability associated with the prediction of the friction number (FN) for the hot-mix asphaltic concrete surfaces. For seal coat surfaces, they explained about 70 percent of the variability. (Because of insufficient data, analyses were not conducted for the microsurfaces.)

(5) The TDT results, along with other data, explained 76 percent of the variability associated with the prediction of the friction number for the HMAC surfaces and 62 percent of the variability for the seal coat surfaces. (Lack of sufficient data precluded analyses of the microsurfaces.)

(6) The MSS loss values and the TDT results, together with other data, explained 78 percent of the variability in predicting FN values for the HMAC surfaces. For the seal coat surfaces, the correlation coefficient was about 70 percent. (Again, because of insufficient data, analyses were not conducted for the microsurfaces.)

(7) The aggregates included in this study will not provide good performance in high-volume roads (ADT greater than 10,000 vpd) for the estimated average life of 10 years for HMAC surfaces.

CONCLUSIONS

This study recommends that the 5-cycle MSS loss and TDT results be collected for all aggregates used in HMAC, seal coats, and in microsurfaces. In addition, to ensure a good pavement surface quality through the selection of good-quality aggregate, the following allowable loss guidelines are recommended for the 5-cycle MSS test:

For the Texas Degradation Test, the allowable percentage losses recommended to ensure good-quality aggregate are:

Surface Type	Maximum Allowable % Loss
HMAC	35
Seal Coat	29
Microsurfaces	35

Whenever it is necessary to measure surface texture, the mini-texture meter should be used to obtain a reliable, accurate, and representative measure of the surface texture depth. Finally, all test sections should continue to be monitored to obtain more information regarding the long-term performance of the aggregates.

Surface Type	Maximum Allowable % Loss
HMAC	10
Seal Coat	10
Microsurfaces	10

The information described in this summary is reported in detail in Research Report 1222-1, "Establishment of Acceptance Limits for 5-Cycle MSS and Modified Wet Ball Mill Tests for Aggregates Used in Seal Coats and HMAC Surfaces," by Sibty Hasan, Alvin H. Meyer, and David W. Fowler, November 1991.