

ROUTINE MAINTENANCE USES FOR MILLED RECLAIMED ASPHALT PAVEMENT (RAP)

PROBLEM STATEMENT

Reclaimed Asphalt Pavement (RAP) is produced when asphalt pavement is cold-milled to correct surface irregularities, maintain curblines, or remove a poor quality layer. The milled asphalt material is salvaged and stockpiled for reuse. Texas has recycled asphalt pavement since the 1930s. However, the state's current recycling methods for routine maintenance often use only a small portion of the RAP removed from pavements. In addition, new legislation (Article 6673i and 6674i-2 of T.C.S.) requires that the Texas Department of Transportation (TxDOT) 1) retain title to all RAP from the state highway system with the authority to transfer to another government entity, 2) maximize the use of RAP, 3) keep an inventory of RAP, and 4) annually report the use of RAP to a legislative audit committee. Also, because TxDOT Directive No. 7-92 states that the districts have primary responsibility for maximizing the use of RAP, and the appropriate TxDOT divisions guide and assist them in the handling of it, the need for complete information on RAP use is essential.

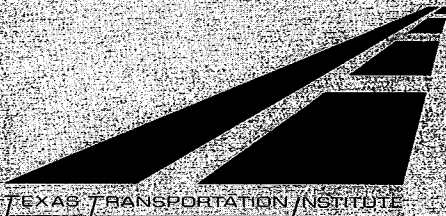
OBJECTIVES

The Texas Transportation Institute (TTI) conducted study 1272, *Routine Maintenance Uses for Milled RAP*, in cooperation with the Texas Department of Transportation (TxDOT) and the Federal Highway Administration (FHWA) to determine the most economical and effective uses of milled RAP in routine highway maintenance so that a suitable paving or maintenance material for low-volume paved areas could be produced.

Researchers first reviewed RAP literature, interviewed districts in Texas and other states, and distributed questionnaires to identify current, new, and innovative approaches to RAP use. Fourteen different projects (two construction and twelve maintenance) were then evaluated in a field study in order to further isolate the Department's existing and new uses of RAP and to collect video footage for the production of implementation videos. The laboratory testing phase of the study was conducted to identify and improve the quality of mixtures which contain RAP and to correlate laboratory properties with field performance. Samples of treated and untreated RAP from three different locations (Brownwood, Houston, and Dallas) were tested for Hveem and Marshall Stability, Resilient Modulus, Indirect Tension, and binder extraction/recovery.



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In cooperation with
Texas Department of Transportation
and the FHWA

Summary Report

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Similar lab tests were run on samples of the RAP mixtures used on the twelve maintenance projects from the field study.

FINDINGS

TxDOT Survey Results

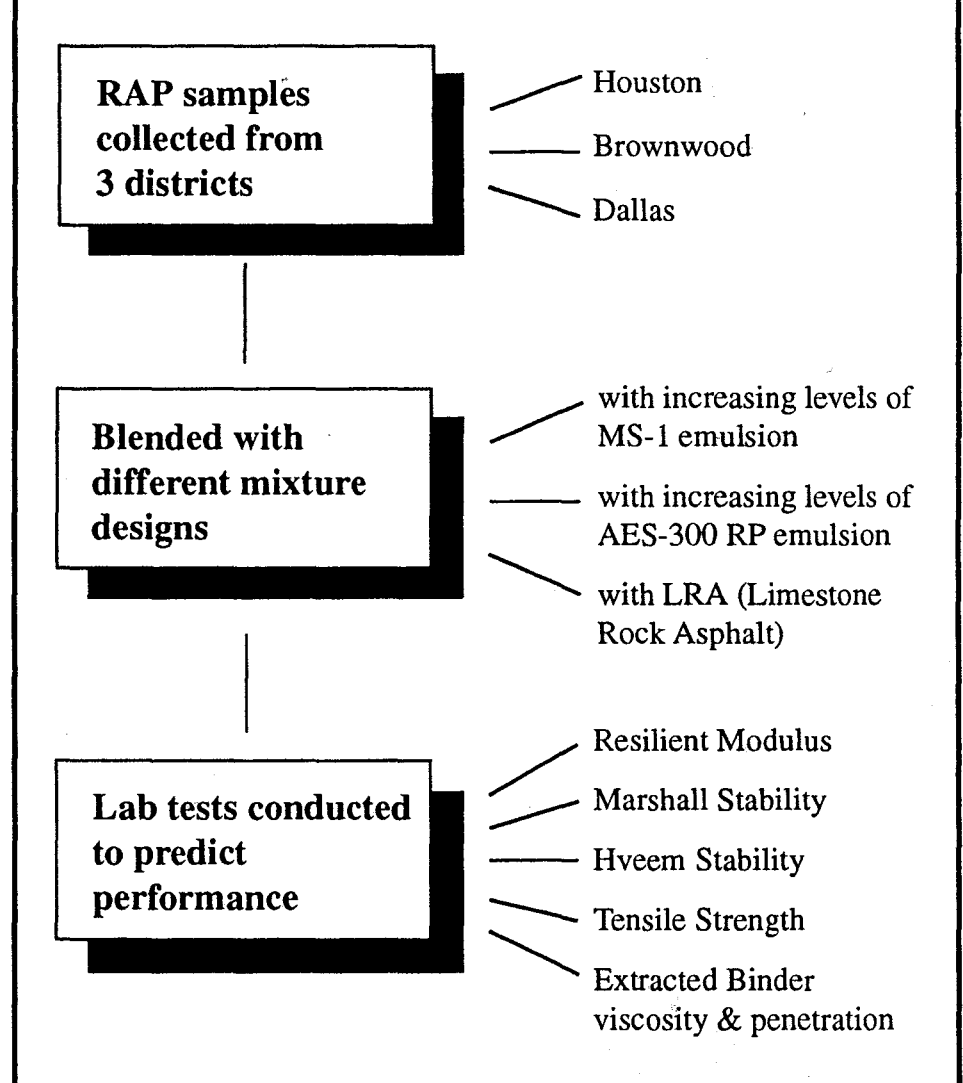
A questionnaire on use of milled RAP was distributed to all 24 TxDOT districts (in October 1990), and response was excellent. Results allowed researchers to assess the magnitude of the problem and to guide the study toward best meeting the Department's needs. The survey showed approximately 550,000 cubic yards of RAP stockpiled in the state as of October 1990. Over 80 percent of the millings produced in the state are considered to be of reusable quality, and in FY 1991, the Department was reusing about half of the RAP produced annually. In FY 1992, the first year after legislation requiring the Department to retain ownership of RAP, 60 percent was used.

At the time this study began, the most common maintenance RAP uses were for driveways, mailbox turnouts, and shoulder repairs. District maintenance personnel reported improvements in RAP quality as a result of blending it with emulsions or with other maintenance mixes. The survey results also support that further crushing RAP millings is unnecessary for most maintenance uses because the particle size is generally less than 1 1/2 inches.

RAP Use Outside Texas

Research shows that most other state DOTs use RAP in hot

Researchers conducted a thorough Laboratory Investigation



recycling mixtures and do not retain ownership of RAP. No innovative concepts for consumption of RAP in routine maintenance were identified in this study. Several states allow the use of small quantities of RAP in hot mix, often without altering the mix design. (Allowable percentages of RAP in hot mix range from zero to 70 percent.) The smaller percentages (10%) have a negligible effect on the selec-

tion of asphalt grade and are not a significant factor in plant emissions. Often, less RAP is allowed in surface mixtures than in those for base or binder courses.

Field Study

Twelve different field projects which used different RAP maintenance mixes were tested for research purposes. The following study findings resulted from analysis of this research phase:

- Although a uniform blend was achieved in mixing RAP with emulsion using both pugmill mixing and blade/pulver-mixing, and both are cost comparable, the blade/pulver-mixing process is more time-consuming and labor-intensive. For cost-effective contracted pugmill mixing, at least 5000 cubic yards of RAP should be blended.

- Handling of RAP material should be minimal to keep cost and road construction activity down. So blending RAP or treated RAP with conventional maintenance mixtures should occur at the stockpile rather than the job site.

- When stockpiled, untreated RAP should be used within one year to prevent it from "setting up," and RAP blended with a recycling emulsion and stockpiled for maintenance use should be allowed to cure a length of time as specified by the emulsion manufacturer so that the recycling emulsion can have a soft-

ening effect on the aged binder in the RAP. A RAP stockpile which has been treated with a recycling emulsion should also be used within one year of processing.

- Test sections of RAP and treated RAP blended with conventional maintenance mixtures—Hot Mix Cold Laid (HMCL), ACP, and Limestone Rock Asphalt (LRA)—were placed in five locations across the state, and, according to the ongoing monitoring, all test sections are performing satisfactorily.

- RAP was used as a base material or to supplement the base in three successful maintenance projects (Bryan, Yoakum, and Houston districts) in this study.

Laboratory Study

In conducting the study's laboratory testing phase, researchers focused on cold mix designs using MS-1 and AES-300RP mixture additives and their effects on three different RAP sources. Also evaluated were the three RAPs

when blended with LRA.

Tests show that increasing levels of emulsion (AES-300RP and MS-1) generally causes a decrease in Hveem stability, resilient modulus, and tensile strength. Hveem stabilities for RAP blended with AES-300RP are generally less than 25; however, field performance in routine maintenance for low-traffic areas has been satisfactory on these mixtures.

Laboratory samples of RAP blended with LRA (50/50) showed increases in Hveem stability, Marshall stability and resilient modulus over that of the LRA alone. Also, laboratory properties of RAP and treated RAP are significantly improved when blended with conventional maintenance mixtures such as HMCL and LRA.

Mixture tests in this study indicate that Hveem stability appears to be the best test for characterizing RAP and RAP blends in terms of expected performance, and RAP mixtures are generally more susceptible to moisture damage than conventional maintenance mixtures.

CONCLUSIONS

The laboratory and field performance of RAP as a maintenance mixture can be improved by mixing the RAP with a recycling agent. The laboratory properties and field performance of raw RAP and processed RAP can be significantly improved when blended with commonly available maintenance mixtures such as hot-mixed, cold-laid asphalt concrete pavement and cold-mixed LRA pavement.



When old asphalt is removed, it can be salvaged and reused.

TxDOT has established an ongoing research study (0-187-13) to monitor performance of the field maintenance projects constructed during this study. Due to continuing public pressure on government agencies to recycle waste materials, implementation of this study's findings has national significance. Two videos—one instructional for maintenance personnel and one

focusing more on benefits and uses for engineers and technicians—will be produced, as well as a field manual (guidelines) on using RAP in routine maintenance activities.

Prepared by Kelly West, Science and Technology Writer, Texas Transportation Institute.

The information in the summary is reported in detail in TTI Research Report 1272-1, "Routine Maintenance Uses for Milled Reclaimed Asphalt Pavement (RAP)," by Cindy K. Estakhri and Joe W. Button, December 1992. The contents of the summary do not necessarily reflect the official views or policies of TxDOT or the FHWA.

RELATED READINGS

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