TEXAS TECH UNIVERSITY
CENTER FOR MULTIDISCIPLINARY RESEARCH IN TRANSPORTATION

Project Summary Report 1509-S

Project 9-1509

PROJECT SUMMARY REPORT

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Road to Recycling: Findings and Recommendations

The Priority Technology Program (PTP) of the Federal Highway Administration (FHWA) is designed to accelerate the development of highway technology by the testing and evaluation of new technologies. One such technology is the use of environmentally beneficial recycled materials. The use of recycled materials in highway construction can help to reduce waste stockpiles and the filling of landfills, as well as provide quality, economical substitutes for scarce or higher-priced virgin materials. The Texas Department of Transportation (TxDOT), the Texas Natural Resource Conservation Commission (TNRCC), and the FHWA invested more than $750,000 in a previous series of research studies including literature surveys and laboratory testing of an array of nonhazardous recycled materials (NRM's). Several universities completed the previous studies, and draft specifications were developed for the NRM's. The purpose of the Road to Recycling project was to employ the draft specifications developed in the previous studies and demonstrate the application of several NRM's in roadway construction test projects. Each test project was monitored in performance evaluation.

The Road to Recycling report (9-1509-2) provides background information for each recycled material studied, descriptions of pilot projects, material cost information, performance evaluations, and specifications used in each pilot project.

Figure 1. Shredded brush used as erosion control in Lufkin

What We Did…

A literature review was performed to facilitate data collection efforts associated with the evaluation of the recycled materials. Contacts were then made with TxDOT personnel associated with the test projects as well as personnel from recycled material suppliers and contractors. The test projects that were used to evaluate each recycled material are shown in the table on page 2.

Data regarding recycled material operators was then collected to determine quantities of each ma-

Table 1. Test Projects Using Recycled Materials

No.	Material	Application	Location
1	Roofing Shingles	Hot Mix Asphalt Concrete (HMAC)	SH 31 in Corsicana (Dallas District)
2	Glass Cullet	Flexible Base	Colonial Pkwy & North Teal Drive in Devine (San Antonio District)
		Flexible Base	Antilley Road in Abilene (Abilene District)
		Pipe Bedding	SH 62 & FM 105 in Orange County (Beaumont District)
3	Bottom Ash	HMAC	I-30 in Mt. Vernon (Paris District)
4	Crushed Concrete	Flexible Base	SH 6 in Hempstead (Houston District)
5	Compost	Erosion Control	Ben White Blvd. & Lamar Blvd. in Austin (Austin District)
6	Shredded Brush	Erosion Control	SH 103 in San Augustine County (Lufkin District)
7	Blasting Sand	Stabilized Base	SH 6 in Hempstead (Houston District)
8	Scrap tires	Embankments	Loop 375 (El Paso District)
		Crumb Rubber in HMAC	US 385 in Crane (Odessa District)

terial being disposed of and quantities being used. Current market forces and the prices of the materials were recorded, as well as cost to dispose of the materials in municipal or other special landfills. Data collected on the test project construction included construction details, materials test data, and materials cost, including transportation cost. The performance of the test projects was monitored through condition surveys, coring, and non-destructive testing. Economic and performance evaluations of each recycled material were conducted to determine their effectiveness in the respective applications. An economic model to evaluate the use of a recycled material was developed. The TxDOT specifications were updated based on the performance evaluation.

What We Found...

Both post-consumer and post-industrial roofing shingles were successfully demonstrated as additives to hot mix asphaltic concrete pavements. Performances of the demonstration project test sections are comparable to those of conventional mixes.

Glass cullet was used in three demonstration projects. In the first project, a base for flexible asphalt pavement was constructed using a blend of glass cullet and crushed limestone. The base performed satisfactorily under design loadings. However, closure of a nearby roadway significantly increased heavy truck traffic on the demonstration section and some rutting and fatigue cracking was observed. In a second demonstration project, glass cullet was mixed with limestone and used as a flexible base for a roadway section. No distress occurred in the roadway section during the two years it was monitored. The third glass cullet demonstration project used the cullet as a pipe bedding material. No problems with the pipe-bedding application have been reported.

Bottom ash was used as fine aggregate in hot mix asphalt for surface and base layers on an interstate highway. Its performance proved very satisfactory based on visual distress surveys, falling weight deflectometer tests, skid resistance tests, and surface roughness tests.

A demonstration project was constructed using a crushed concrete base under a concrete freeway. Section design characteristics were documented. TxDOT engineers observed no difference be-

Figure 2. Mixing of glass cullet with limestone in Abilene District

tween the performance of crushed concrete and that of conventional limestone base.

Compost (Dillo Dirt™) was applied to a nine-acre area historically resistant to vegetation growth. Within a short period of time, grass began growing and provided protection against soil erosion.

Shredded brush achieved erosion prevention in an area where other erosion prevention measures had proven unsuccessful. Although the shredded brush prevented erosion, heavy application reduced the amount of sunlight reaching the soil, and it is suggested that shredded brush be considered a temporary soil erosion measure used during construction projects.

Spent blasting sand was used as fine aggregate in base material. Application of the spent blasting sand was considered routine by the project engineers. No significant problems have been noted in subsequent performance observations.

Tire chips resulting from shredding of scrap tires were used as embankment fill material employing two methods. In the first method, tire chips were enclosed in a geotextile wrap and covered with compacted soil and incorporated in a bridge embankment. In the second method, tire chips were blended 50-50 with traditional fill material. Long-term monitoring of the embankment settlement has shown no significant problems.

In a second demonstration project using scrap tires, a hot rubber underseal was used with a crumb rubber modified asphaltic concrete overlay. This test project performed extremely well and no significant maintenance has been required in the two years since its construction.

The Researchers Recommend . . .

Non-hazardous recycled materials (NRM's) proved successful in a variety of roadway construction applications. Specifications and special provisions developed in previous studies and applied during the demonstration projects provide sufficient guidelines for engineering design. NRMs' offer sound solutions to current supply needs in regions of scarce construction materials, and many TxDOT engineers routinely use NRM's in construction projects. Furthermore, NRM's usage will likely increase in the future as natural resources for construction materials are depleted.

The researchers recommend training for TxDOT engineers. Training sessions can be used as a forum for introducing NRM's not currently used in the specific region and exchanging ideas for expanding the use of NRM's in construction projects. Training will create open dialog between TxDOT engineers, contractors, material suppliers, and local road construction personnel on successful usage of NRM's.

Because NRM's will undoubtedly increase in usage to supplement or replace depleted traditional materials, a long-range material utilization plan should be developed for both natural materials and NRM's. The utilization plan should concentrate on types and demands for current materials regarding qualities and quantities and on forecasts of future supplies to enhance efficient material usage.

For More Details…

The research is documented in the following reports:

Report 1509-2, Road to Recycling: Findings and Recommendations.

Research Supervisor: Phillip T. Nash, P.E.
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To obtain copies of the reports, contact the Center for Transportation Research Library at (512) 332-3126.

TXDOT IMPLEMENTATION STATUS

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The information developed under this research project is being implemented with IPR 5-1509. The IPR summarizes all the available information on non-hazardous recycled materials and the development of a four-hour course for district personnel. The IPR also covers the delivery of seven regional workshops all around the state. The objective of the workshops is to make district personnel aware of all possible uses of several non-hazardous recycled materials. Once all the workshops have been completed, RTI will evaluate and determine whether more courses are needed or additional training is required.

For more information, contact; Dr. German Claros P.E., Research and Technology Implementation Office (512) 467-3881, gclaros@dot.state.tx.us.

Your Involvement Is Welcome...

This research was performed in cooperation with the Texas Department of Transportation and the U.S. Department of Transportation, Federal Highway Administration. The contents of this report reflect the views of the authors, who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the FWHA or TxDOT. This report does not constitute a standard, specification, or regulation, nor is it intended for construction, bidding, or permit purposes. Trade names were used solely for information and not for product endorsement.