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Research Report 1902-1S

USE, AVAILABILITY AND COST-EFFECTIVENESS OF ASPHALT-RUBBER IN TEXAS

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PROBLEM STATEMENT

Approximately 150 million scrap tires are currently stored in Texas while another 18 million are being discarded annually. This accumulation of scrap tires could be used to produce 108,000 tons of rubber suitable for asphalt-rubber products. The Texas State Department of Highways and Public Transportation (SDHPT) uses more than 1,000,000 tons of asphalt cement annually. If just 10 percent of this paving asphalt cement was routinely replaced with asphalt-rubber, more than 20 percent of the annual production of waste tires would be utilized. However, only slightly more than one percent of this paving asphalt is replaced with asphalt-rubber.

Only 60 percent of a tire's weight is consumed in producing asphalt-rubber. The remaining products include steel, fiber and additional rubber.

The Texas SDHPT is currently using about 13,000 tons per year of asphalt-rubber which accounts for approximately 430,000 scrap tires. However, most of the waste tires come from other states. The availability of crumb rubber in Texas is a rapidly changing issue. Findings indicate that over the next year, 7 to 10 million tires may be recycled in plants around Texas.

OBJECTIVES

A study was conducted for the Texas SDHPT by the Texas Transportation Institute (TTI) to address the following issues.

1. The current extent of usage of asphalt-rubber by the Department.
2. The availability of crumb rubber produced from scrap tires and the availability of asphalt rubber in the state.
3. The cost-effectiveness of asphalt rubber as compared to conventional paving materials based on existing information and on the experience of Department personnel.

Background information was obtained by reviewing published material, conducting phone interviews with knowledgeable Department personnel and evaluating existing laboratory information.

RESULTS

The Texas SDHPT currently utilizes asphalt-rubber in four different applications. They are listed in descending order of their volume of asphalt-rubber consumption.

1. Chip-Seal or Stress-Absorbing Membrane (SAM) Construction.

Asphalt-rubber chip seals have been constructed, at least on an experimental basis, in all parts of Texas. However, there are only five out of 24 highway districts currently constructing asphalt-rubber chip seals with some regularity.

Historically, utilization of asphalt-rubber for chip seals in most highway districts has not been a standard practice, and 13 districts have no plans for increasing their use in the future. The primary reason cited for this is that asphalt-rubber is too expensive and has not proven to be cost effective in this application.

An asphalt-rubber chip seal costs two to three times more than a conventional chip seal. However, proponents of asphalt-rubber chip seals claim they will last twice as long as a conventional chip seal.

There is not enough available information to accurately determine the cost-effectiveness of asphalt-rubber chip seals. However, an annualized cost analysis performed in this study revealed that an asphalt-rubber chip seal would have to last three times longer than a conventional asphalt chip seal in order to have an equivalent annual costs.

Districts in Texas which are experienced with asphalt-rubber chip seals do not usually construct them on a pavement where a conventional chip seal is a viable option. Asphalt-rubber chip seals are used successfully as a rehabilitative measure rather than preventive measure, and they are often placed on high-traffic-volume roads. Therefore, a more valid comparison for asphalt-rubber chip seals might be with a thin overlay or multiple chip seal, in which case, the asphalt-rubber is much more likely to be cost effective.

2. Stress-Absorbing Membrane Interlayer (SAMI) Construction.

Only six Texas highway districts have built stress absorbing membrane interlayers (SAMI). Opinions of Department personnel regarding asphalt-rubber interlayers are much more favorable than those regarding asphalt-rubber chip seals. Most of the districts that have installed SAMI's believe they are effective in delaying reflective cracking. Some also believe SAMI's will reduce intrusion of surface water and pumping even after cracking occurs in the surface layer.

An asphalt-rubber SAMI may provide cost-effective improvements in performance of hot-mixed asphalt concrete overlays. Based on an annualized cost analysis performed in this study, an asphalt-rubber interlayer would need to last approximately 50 percent longer than an overlay constructed without an interlayer in order to be cost effective.

3. Crack and/or Joint Sealing.

Asphalt-rubber crack sealant, which contains 20 percent ground tire rubber, is essentially the only crack sealant used by the Texas SDHPT. The Department uses approximately 3.5 million pounds of crack sealant annually.

Asphalt-rubber crack sealant is considered by all personnel interviewed in highway districts to be the best product available for sealing cracks in asphalt concrete and portland cement concrete pavements.

4. Hot-Mix Asphalt Concrete Pavment Construction.

Asphalt-rubber has been used on a very limited basis in Texas for construction of hot-mixed asphalt concrete (HMAC). The use of crumb rubber in HMAC is gradually gaining popularity across the Unites States; however, the technology is still somewhat in an experimental state of development.

Results indicate that fatigue performance of asphalt concrete mixtures is significantly improved with the addition of ground rubber. Therefore, areas where fatigue cracking is anticipated to be the primary mode of pavement distress, asphalt rubber may be a cost-effective alternative, and thus should be considered in the selection of materials for pavement design and construction.

Compared to additive-modified mixtures, the expected performance of asphalt-rubber, in terms of both fatigue cracking and rutting, needs to improve and the cost be reduced in order for it to be more competitive with polymer additive-modified mixtures, such as Kraton, Elvax and Novasphalt. The major component of the in-place cost is the cost of the asphalt-rubber binder itself. This cost may range from 41 to 45 percent of the in-place cost depending on the binder content.

RECOMMENDATIONS

The Texas SDHPT and/or the Texas Legislature should carefully consider promoting the use of tire rubber in asphalt since the benefit-cost ratios are not sufficiently high for every application. Providing a bonus for using tire rubber in asphalt pavements will not solve the problem. Careful consideration should be given to future utilization of asphalt pavement layers treated with rubber. For example, aged asphalt-rubber may not accommodate recycling as well as unmodified asphalt. Agencies currently promoting the use of tire rubber in asphalt may be forced to place additional controls on the recycling of this product. A solution to the problem will require more research and engineering to provide self-supporting, cost-effective uses for scrap tires. There may be more economically efficient ways to recycle tires in much greater volumes than in asphalt pavements.

The applications of asphalt-rubber described in this summary are reported in detail in Research Report 1902-1F. Appendix A of this report contains descriptions of current and proposed innovative uses for scrap tires other than in asphalt pavements which could potentially consume all of the scrap tires produced in the United States.