14-4: Rehabilitating Oil-Field-Damaged Roads with Foamed Asphalt

How the Technology Works

Foamed asphalt is a stabilization technique used widely throughout Europe.

However, the European process is relatively new to the United States. Advances in construction equipment allow for deep road base stabilization at a lower cost compared to other stabilization techniques.

The European foamed asphalt stabilization technique involves the following construction activities:

1) pulverizing the existing road surface,

2) shaping the surface to near final grade,

3) mixing and injecting foamed asphalt cement, and

4) compacting to final grade.

The preferred method is to initially pulverize the existing road bed without injection of asphalt cement. This allows the contractor the opportunity to adjust the grade to its near final profile prior to mixing and injection. During the mixing and injection process, hot paving-grade asphalt cement is foamed or expanded and injected into the chamber of the remixing unit.

The Challenge

The Texas Department of Transportation (TxDOT) faces a major engineering challenge to rehabilitate its rural road network severely damaged by energy development traffic. These pavements typically consist of 6 inches of untreated base with thin surface layers typically less than 2 inches. These roads need major upgrading and strengthening to handle the intense traffic loads. Also, because of the lack of a detour, TxDOT requests that traffic be allowed to drive over the rehabilitated section by the end of each work day. This early opening requirement has caused performance problems with typical full depth reclamation approaches.

Opening to intense truck traffic as early as 2 hours after construction presents a major engineering challenge.

On FM 99, TxDOT field-changed a 1-mile section to use foamed asphalt to meet the early opening requirement and to provide a structurally sound base layer. The Texas A&M Transportation Institute (TTI) assisted with materials mixture design and construction monitoring of this test section.

The test section on FM 99 was constructed to investigate the following three main outcomes:

- A foamed asphalt treated base that could be opened to traffic less than 2 hours after compaction,
- A base that could withstand the intensity of traffic loads, and
- A design modulus for foamed asphalt that should be used in future pavement design in Texas.

Work Performed

As a first step in the evaluation, a ground-penetrating radar (GPR) survey examined the test section variability and checked layer thicknesses. The main finding from the GPR was that the asphalt layer was not 1 inch thick, but instead varied between 3 and 5 inches. However, the structure in the 1-mile test section was uniform.

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A test pit was dug in a representative area, and samples of the obtained materials were returned to TTI for stabilization design.

Laboratory design constituted a significant and critical part of the project process. The laboratory design used TTI's Wirtgen WLB10 lab foaming unit. Based on laboratory testing, TTI determined the materials from FM 99 should employ 1.5 percent cement and 2.4 percent foamed asphalt for stabilization. The proposed sequence for recycling FM 99 with foam asphalt took place in one pass, with the section opening to traffic as soon as possible after compaction. Due to the material thickness, the research team used a 20-ton roller to ensure compaction was met.

A test checking the expansion of foam asphalt.

During field construction, the expansion of the foam asphalt was checked using the recycler's test spray nozzle. The TxDOT specification requires a half-life of at least 6 seconds; the above figure illustrates the foamed asphalt test spray, which exhibited a half-life of more than 10 seconds.

In addition to the required gradation and density checks, field staff undertook limited testing using a dynamic cone penetrometer (DCP) to evaluate compaction with depth. Due to the thick lift being compacted at once, the DCP uses a standard sliding hammer to drive a standard cone into the material under test and evaluates bearing resistance with depth.

> **"This section while under traffic experienced 4 inches of rain without damage before the final seal was placed."**
>
> **—Tom Scullion, TTI Senior Research Engineer**

The results showed the material did not have any significant weak zones throughout the depth profile of 11 inches being compacted. This provided the project team confidence that the treated base was being uniformly compacted with depth.

Conclusions

The conclusions on the FM 99 test section so far include:

- **The foamed asphalt's main advantage is its ability to allow traffic on the section almost immediately after compaction.** Foamed asphalt appears to be a viable option for rehabilitating the roads in South Texas.
- **The foamed asphalt base appears to be moisture resistant;** this section while under traffic experienced 4 inches of rain without damage before the final seal was placed.
- **Foam asphalt will only work if a full engineering evaluation is completed.** Up-front testing and representative sampling are a must. The lab design process described is critical.
- **The compaction approach and equipment selected produced a base that met gradation and density requirements** and was measured by the DCP to be uniformly compacted with depth.
- **Until further data are collected, a design modulus of 300 ksi should be considered for any future foamed asphalt design work.** The project team plans to retest after 3 months under traffic to determine if the high modulus values remain under these intense loads.
- **The construction specification employed on FM 99 should be evaluated to determine if any changes are needed to the specification.**

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