Microsurfacing with Natural Latex–Modified Asphalt Emulsion: A Field Evaluation

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This paper presents an evaluation of the use of emulsified asphalt in a relatively new process called microsurfacing. The process was developed in Germany and was first used in the United States in late 1980. Natural latex rubber is incorporated into the asphalt emulsion and mixed with aggregate and other additives in a traveling pug mill similar to but larger than that of a regular slurry seal machine. The test section that was selected for microsurfacing is 3 mi of four-lane divided highway in an urban area. Construction was completed in June 1983. The data indicate that the service life of the test section has been enhanced. It is recommended that microsurfacing be approved for routine use in restoring flexible pavements to fill surface ruts and cracks, seal the surface, and restore skid resistance.

This is a report on the use of emulsified asphalt in a relatively new process called microsurfacing. This process was developed in Germany in 1976 and was first used in the United States in 1980. The original microsurfacing product, Ralumac, incorporates a natural latex into the asphalt emulsion. Microsurfacing consists of

- 2.0 to 4.0 percent latex base modifier (*1*, pp. 4–5) incorporated into the emulsion,
- 1.5 to 3.0 percent portland cement as mineral filler,
- 6.0 to 11.5 percent residual asphalt (the emulsion is 64 percent asphalt) (*1*, pp. 4–5), and
- 82 to 90 percent select aggregate (sand equivalency > 45).

In addition, variable amounts of water and emulsion stabilizer are added during laydown operations. These two additives combined are roughly equivalent to 9 percent of the mix.

The latex-modified asphalt emulsion is mixed with the aggregate and other additives in a traveling pug mill similar to but larger than that of a regular slurry seal machine (Figure 1). The laydown machine uses two different sizes of slurry spreader box. A 5.5-ft-wide box is primarily used for rut filling, and a 13-ft-wide adjustable box is used for surfacing. No roller compaction is required for either rut filling or surfacing.

The laydown machine is serviced by dump trucks that have been modified by the addition of two large tanks in their dump beds. These tanks carry emulsion or water. Each dump truck also carries a load of aggregate between the tanks. The laydown machine has enough on-board storage capacity to allow it to continue operating while servicing trucks are being switched.

FIGURE 1 Microsurfacing laydown machine with truck.

The only items that must be carried by the laydown machine are the portland cement and the set retardant.

The basic crew for operating the microsurfacing machine consists of six people, four on the machine and two following behind. The two following behind carry mops or squeegees and do minor hand work as needed. On the machine, one person adds the portland cement to a small hopper that meters the cement into the mix, a second person hooks up and monitors the service trucks, a third person drives the laydown machine, and a fourth person at the back of the machine controls the actual laydown operation. The operator is able to adjust the amounts of aggregate, portland cement, water, and set retardant going into the pug mill.

Variations are made as dictated by weather and roadway conditions. On dry, warm days, the operator adds more water and set retardant. On cool, overcast, or high-humidity days, the operator adds less water and set retardant. The quality of a finished microsurfacing project depends greatly on the skill of the operator and crew.

A copy of the current Oklahoma specification for microsurfacing may be obtained from the Research & Development Division of the Oklahoma Department of Transportation.

DEMONSTRATION PROJECT

In 1983 the Oklahoma Department of Transportation (ODOT), in cooperation with the FHWA, established a demonstration project to evaluate Ralumac microsurfacing. The evaluation project is located on US-64, a multilane, divided highway in Sand Springs, Oklahoma. Four distinct traffic volumes are carried over the 3.35-mi project. The four sections as distinguished by average daily traffic (ADT) are given in Table 1. The portion of US-64 covered in this study has the typical section shown in Figure 2.

*Deceased.

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TABLE 1 TRAFFIC DATA

	MILEAGE	ADT	COMMERCIAL	COMMERCIAL OVERLOADS
Section I	0.00 - 0.47	23,200	2,552	10%
Section II	0.47 - 1.64	18,400	2,706	10%
Section III	1.64 - 2.00	36,600	4,806	10%
Section IV	2.00 - 3.35	66,100	7,271	10%

Road Condition Before Construction

At the time of microsurfacing, US-64 was 14 years old. The roadway had received only routine maintenance since its original construction. The roadway was badly cracked and had ruts as deep as 0.7 in. The load-supporting ability of the roadway as measured by Benkelman beam deflections was adequate. The very nature of the problems on US-64 pointed to microsurfacing as a workable solution. Restoration of the profile of the roadway and sealing of the roadway surface on an otherwise sound road were needed. These needs could be met by microsurfacing.

Tests on the Project

The entire length of the project was tested for surface friction values, rut depths, load-supporting ability, and ride quality. In addition to these tests, five 300-ft sections were evaluated for cracking. One of the sections in the eastbound lanes evaluated for cracking was treated with a 4-oz/yd^2 nonwoven fabric.

A further test performed on this project was the comparison of the designed microsurfacing application with a thick application of microsurfacing and with an application of hot-mix asphaltic concrete. Each of the three sections for this test consisted of 1,000 ft of roadway in the westbound lanes at the west end of the project. The nominal thickness of the designed microsurfacing treatment was 0.5 in., and that of the thick section of microsurfacing was 1.1 in. The hot-mix asphaltic concrete was laid 1.5 in. thick.

Construction

Work on microsurfacing US-64 began on June 16, 1983, and required 9 workdays to complete. An additional workday was required for laying the test section of 1.5-in.-thick hot-mix asphaltic concrete. During the 9 days of microsurfacing, a total of more than 1,770 tons of material were laid. The job mix formula used on this project is given in Table 2. The yields, as pounds of aggregate per square yard, are given in Table 3.

TABLE 2 JOB MIX FORMULA—AGGREGATE

Sieve Size	Job Formula	Required by Specifications
3/8"	100	99-100
No. 4	87	86-94
No. 8	65	45-65
No. 16	44	25-46
No. 30	30	15-35
No. 50	18	10-25
No. 200	8	5-15
Sand equivalent	77	45 minimum
L.A. Abrasion	19.3	40 maximum

Trial Mixes

Percent Asphalt	Specific Gravity	Hveem Stability
7.0	2.095	38
7.5	2.119	37
8.0	2.133	40

7.5 percent asphalt was recommended.

Note: Aggregate Type: mine chat.

TABLE 3 MICROSURFACING APPLICATION RATES USED ON US-64

Application	Westbound Outside Lane	Westbound Inside Lane	Eastbound Outside Lane	Eastbound Inside Lane
Rut Filling	29.44	none	35.00	none
Surfacing	15.90	21.20	15.90	21.40
Total	45.34	21.20	50.90	21.40

Note: Units are pounds of aggregate per square yard.

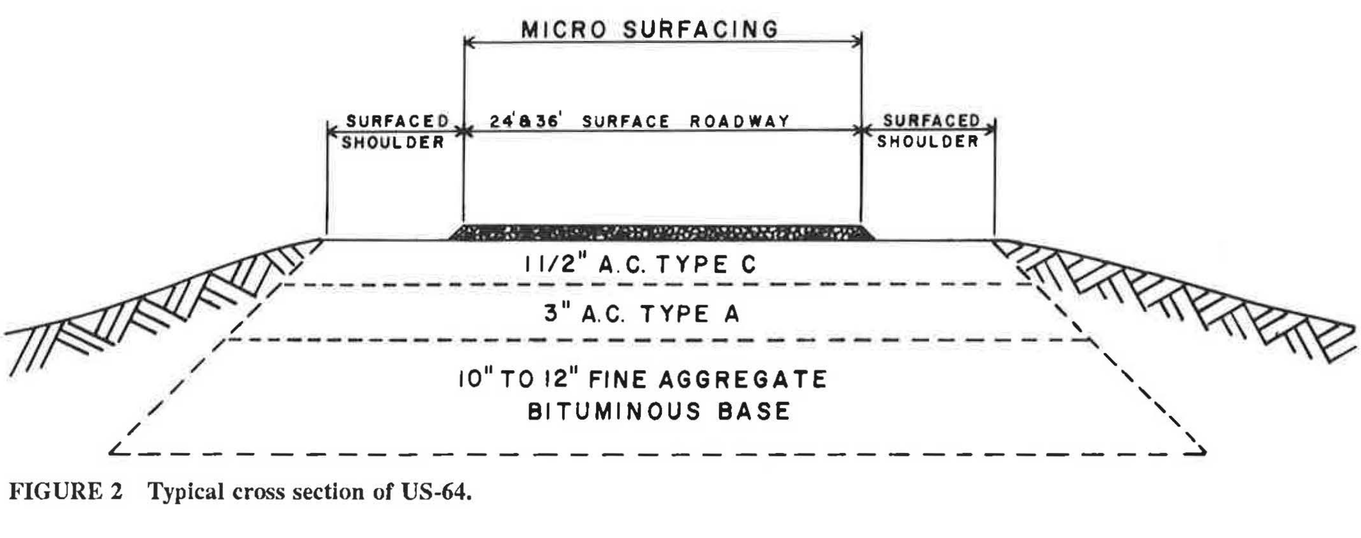

FIGURE 2 Typical cross section of US-64.

TABLE 5 CRACKING

300 Ft. Section	Before L.F.	Year 1 L.F.	Year 1 Pct	Year 2 L.F.	Year 2 Pct	Year 3 L.F.	Year 3 Pct
1	1735	364	21	649	38	526	30
2	1860	335	18	614	33	374	20
3	3170	761	23	983	31	568	18
4	3700	1008	27	1268	34	364	10
Fabric	1610	128	8	421	26	400	25

NOTE: L.F. = Linear Feet of cracking.

Pct = Each years cracking as a percent of the before data.

- Cracking in both microsurfacing sections was appreciably worse than in the 1.5-in. AC section. Both microsurfacing sections exhibited transverse, longitudinal, and random cracking. In addition, the thick microsurfacing section exhibited block cracking. The 1.5-in. AC section exhibited some transverse and longitudinal cracking.

Surface friction data were obtained before, 2 years after, and 3 years after microsurfacing. These data indicate no significant change in the surface friction values before and after microsurfacing. The average friction number for the total project length before microsurfacing was 48. Two years after microsurfacing, the average friction number was 49. Three years after microsurfacing, the average friction number was 45. Surface friction data were not available for 1 and 4 years after microsurfacing.

The ride quality of the microsurfacing 3 years after application, as measured by a Mays ride meter trailer, was at an acceptable level. The average present serviceability index was 3.2. The average inches of roughness per mile was 101.

CONCLUSIONS AND RECOMMENDATIONS

The following conclusions about the three 1,000-ft sections can be drawn after 4 years:

1. No benefit was realized from the application of the extra thick microsurfacing as opposed to normal microsurfacing.
2. There was no appreciable difference among the three test treatments in terms of their effect on the load-supporting ability of the roadway.
3. The 1.5-in. AC section resisted cracking better than either microsurfacing treatment.
4. Both microsurfacing treatments performed better than the 1.5-in. AC in resisting rerutting.

Results from the 300-ft fabric test section are inconclusive. ODOT currently has more than 22 mi of microsurfacing on fabric that were laid in 1987. Observation of these sections will be required before any conclusive statement can be made about the use of fabric under microsurfacing.

On the basis of the field data obtained for the entire project, the following statements can be made about the condition of the roadway 4 years after treatment with microsurfacing.

1. The load-supporting ability of the roadway, as measured by Benkelman beam, was generally improved over that measured before microsurfacing.
2. Rut depths were shallower overall than those measured before microsurfacing.
3. Data from the crack map sections indicate that the quantity of cracking after 4 years was below 50 percent of the quantity of cracking measured before microsurfacing.

The results of the field tests conducted on US-64 show that microsurfacing enhanced the life expectancy of the roadway. It is recommended that microsurfacing be used to restore flexible pavements that are rutting or cracking. Microsurfacing is not recommended for use on pavements that lack adequate load-supporting ability.

UPDATED STATUS OF MICROSURFACING

After completion of the evaluation of the demonstration project on US-64, ODOT used microsurfacing routinely on state-aid projects. However, it remained an experimental feature on federal-aid projects; evaluations of several projects are continuing. Several hundred lane miles of the natural latex system were in place by the end of the 1987 construction season, including sections of heavily traveled Interstate in the Oklahoma City area.

A second microsurfacing system, in which synthetic latex was used, was placed under evaluation in the spring of 1987. This system uses different emulsifying and set-retarding agents than those used in the natural latex system.

At the end of the 1987 construction season, 21 lane miles of the synthetic latex system were under evaluation. In one project on rural OK-77, synthetic latex was used on the entire 10 mi. In another project, the synthetic system and the natural system were placed end to end. This was a microsurfacing project on I-40 in Canadian County, Oklahoma, that included a ½-mi test section of the synthetic latex material within the 14-mi project in which natural latex microsurfacing was used. Evaluation of the microsurfacing products on these and other projects will continue at least through the early summer of 1988.

This paper has dealt with one paving system that uses a latex-modified asphalt emulsion. Latex and polymer modifiers are also in use with hot-mix asphalt, cold-mix asphalt recycling, and asphalt surface treatments. Modified asphalts are evolving and developing. It is certain that the years to come will bring several new paving materials composed of chemically modified asphalts.

REFERENCES

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