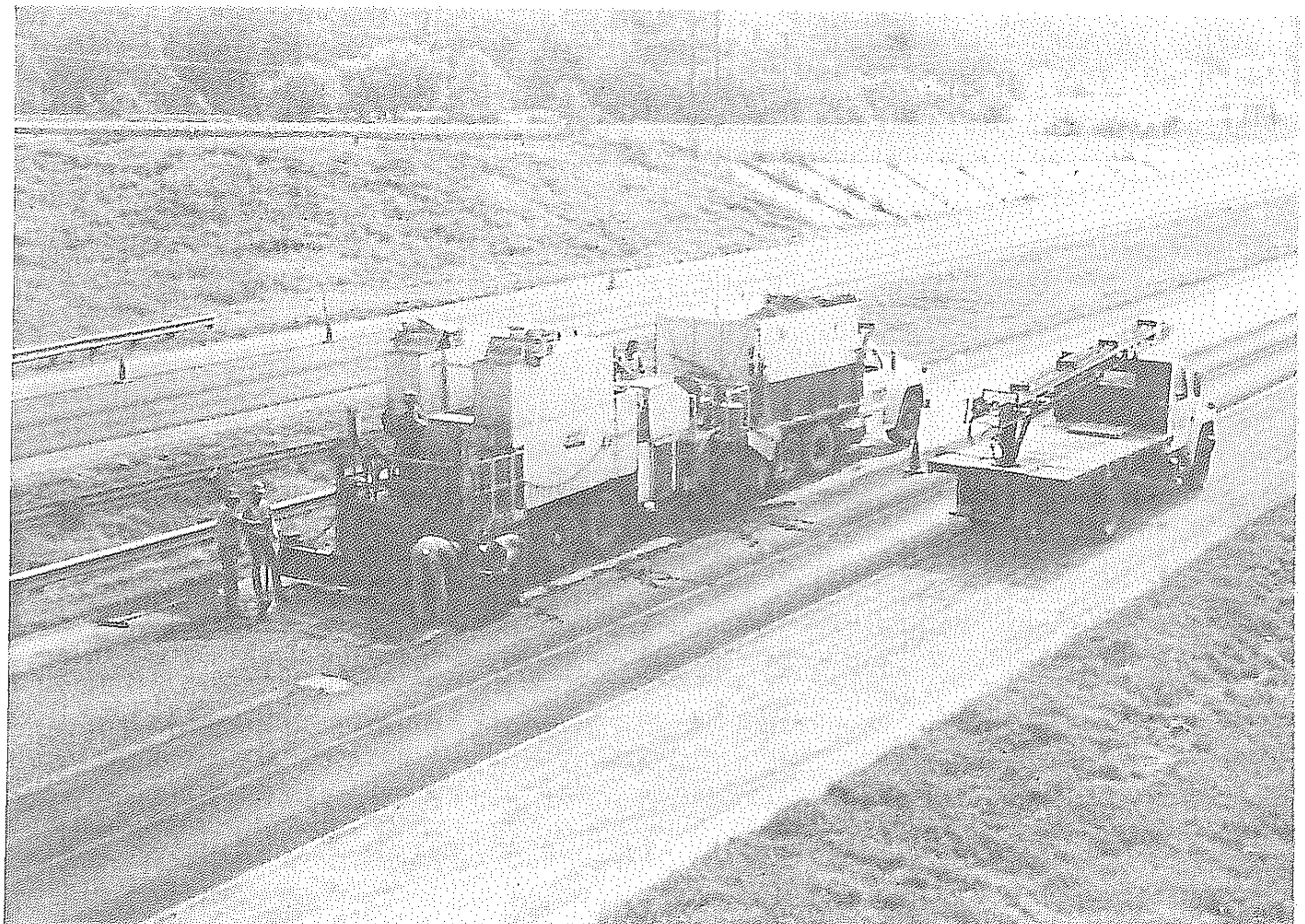
Micro Surfacing
with
Latex Modified Emulsion



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16. ABSTRACT

This is the final report for the use of emulsified asphalt in a relatively new process called "Ralumac Micro Surfacing". This process was developed in Germany and was first used in the United States in late 1980. In 1982, personnel from the Oklahoma Department of Transportation (ODOT) observed projects in another state and proposed a project in Oklahoma.

The Ralumac process incorporates natural latex rubber with the asphalt emulsion. It is mixed with aggregate and other additives in a traveling pug mill similar to but larger than that of a regular slurry machine.

The construction phase of this demonstration project was completed in June, 1983.

The evaluation of data presented shows that the service life of the test area has been enhanced. It is recommended the Ralumac process be approved for routine use as a restoration item for flexible pavements to fill surface ruts and cracks, seal the surface, and restore skid resistance.

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MICRO SURFACING WITH NATURAL LATEX MODIFIED EMULSION

By

C. M. "Swede" Pederson
Principal Investigator

Under the Supervision of:

C. Dwight Hixon, P.E.
Research & Development Engineer
Research & Development Division
Oklahoma Department of Transportation

Oklahoma City, Oklahoma

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FINAL REPORT

OF

DEMONSTRATION PROJECT No. 55

ASPHALT EMULSION FOR HIGHWAY CONSTRUCTION

Background

This is the final report on the use of emulsified asphalt in a relatively new process called "Ralumac Micro Surfacing". This process was developed in Germany and was first used in the United States in late 1980. In 1982, personnel from the Oklahoma Department of Transportation (ODOT) observed projects in another state and proposed a project in Oklahoma.

The Ralumac process incorporates natural latex rubber with the asphalt emulsion. It is mixed with aggregate and other additives in a traveling pug mill similar to but larger than that of a regular slurry machine. Two sizes of box are used. One has a width of five feet and the width of the other can be adjusted from ten to thirteen feet.

The construction phase of this demonstration project was completed in June, 1983.

Site Location

The site selected for this demonstration project is on U.S. 64, a 4-lane urban highway in Sand Springs, Oklahoma. The project is approximately 3 miles in length. The Average Daily Traffic (ADT) lends itself to a better than normal experiment in that there are four distinct changes over the 3 mile extent. The four sections are listed below:

	Mileage	ADT	Commercial	Overloads
Section I	0.0 - 0.47	23,200	2,552	10%
Section II	4.7 - 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%

Typical Section

SECTION I	SECTIONS II thru IV
1 1/2" A.C. Type "C"	1 1/2" A.C. Type "C"
3" A.C. Type "A"	3" A.C. Type "A"
10" FABB*	12" FABB*

*FABB is fine aggregate bituminous base

Condition of the Roadway

The roadway was badly cracked and had ruts up to 0.7 inch. The load supporting ability as measured by Benkelman Beam deflections is presented in Table I and is adequate for this type of facility.

The project was 14 years old at the time of the Ralumac application. The only maintenance that had been performed was routine.

The Problem

The two major problems are cracking and rutting which cause (1) roof leakage and (2) water collection in ruts which can cause hydroplaning.

The Solution

A solution to the problem would involve sealing the surface and filling the ruts. The Ralumac Micro Surfacing process claims to provide these requirements. The potential advantages of Ralumac are the following:

1. Fills ruts and restores the transverse profile.
2. Seals cracks.
3. Requires no compaction.
4. Is traffic ready in 60 minutes.

Additional Experiments

Additional experiments besides filling the ruts and sealing the surface were as follows:

1. In the westbound lanes three 1000 foot extents were located in Section I.
   - (A) One extent had 1.1 inches of Ralumac placed on the surface.
   - (B) One extent had 1.5 inches of asphaltic concrete placed on the surface.
   - (C) One extent was used as a control section where the normal Ralumac application was applied.

2. In the eastbound lanes one 300 foot section of Petromat was placed on the surface prior to the Ralumac application.

Job Mix Formula

Note: Aggregate Type: mine chat.

GRADATION OF THE 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
Percent Residual Asphalt	7.5	$\pm$ 0.4
Sand equivalent	77	5 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

Application Rate for Experimental Section

Equipment has not been developed that can lay thick lifts of Ralumac. Therefore, after filling the ruts, the thick section was placed in two applications.

APPLICATION RATES FOR THE THICK SECTION

(Pounds of Aggregate per yd^2)

	Application
Rut Treatment	28.30
1st Full Lane Coverage	40.88
2nd Full Lane Coverage	44.40
Total Lane Coverage	113.58

Note: The 113.58 pounds gave a nominal thickness of 1.1 inches.

Application Rate for the Roadway

The driving lane was rutted more heavily than the passing lane so the ruts were filled only in the driving lane.

APPLICATION RATE FOR STANDARD TREATMENT

(Pounds of Aggregate per yd^2)

	WESTBOUND		EASTBOUND	
Application	Outside Lane	Inside Lane	Outside Lane	Inside Lane
Rut Treatment	29.44		35.00	
Full Lane Treatment	15.90	21.20	15.90	21.40
	45.34	21.20	50.90	21.40

Evaluation After Three Years

Wheel load support data are presented in Table I. There was significant improvement after one year and it remained satisfactory after three years. This improvement may be attributable to the retardation of roof leakage.

TABLE I

WHEEL LOAD SUPPORT

(Before and After Ralumac Application)

Deflection (Inches)	Approximate Load Support (Pounds)	Frequency of Test Value Before	Years After 1	2	3
0.016 or less	20,000 +	19	28	24	28
0.017	19,000		3	3	
0.018	18,000			2	1
0.019	17,000	4			1
0.020	16,000	2		1	1
0.021	15,000	3			1
0.022	14,000	1			
0.023	13,000	1			
0.029	10,000	1			
		31	31	31	31
Average Deflections		0.0182	0.0161	0.0165	0.0164

Rut depth data are presented in Table II. Improvement of rut depth was shown in all three years after the application.

TABLE II

RUT DEPTHS

(Before and After Application)

Ruts (Inches)	Frequency of Test Value Before	Years After 1	2	3
0.7	3			
0.6	1			
0.5	3		1	
0.4	5	1		
0.3	8	1	4	2
0.2	5	10	12	10
0.1	2	13	14	19
0	7	9	3	3
Total	34	34	34	34
Average	0.29	0.12	0.17	0.14

Crack data are presented in Table III. About one month before the application of Ralumac, RS-2 asphalt was used to seal the cracks and it had not completely cured before the Ralumac application. Later, as reflected cracks appeared, the RS-2 in effect "resealed" some of them. Thus, there were fewer open cracks after the third year.

TABLE III

CRACKING (LINEAR FEET)
300 Foot Sections

Section	Before	1 Year Feet	1 Year %	2 Years Feet	2 Years %	3 Years Feet	3 Years %
I	1735	364	21	649	38	526	30
II	1860	335	18	614	33	374	20
III	3170	761	23	983	31	568	18
IV	3700	1008	27	1268	34	364	10
Petromat	1610	128	8	421	26	400	25

Note: % = percent of cracking resulting from reflection of cracks existing prior to application.

Skid data are presented in Table IV. There are no real differences in the before and after data.

TABLE IV

SKID TRAILER TESTS

Section	ADT	Before	2 Years	3 Years
I	23,200	48	50	45
II	18,400	51	49	47
III	36,600	46	48	46
IV	66,100	46	48	42

Skid data not available for 1 year after application

Ridemeter data are presented in Table V. Both inches of roughness and present serviceability index are presented for three years after treatment. Both are at an acceptable level.

TABLE V

MAYS RIDE METER DATA

THREE YEARS AFTER RALUMAC APPLICATION

Inches of Roughness Per Mile

Section	Westbound Outside Lane	Westbound Inside Lane	Eastbound Outside Lane	Eastbound Inside Lane	Average
I	135	79	84	86	96
II	98	111	91	104	101
III	111	92	122	125	113
IV	87	108	73	104	93
Average	108	98	93	105	101

Present Serviceability Index

Section	Westbound Outside Lane	Westbound Inside Lane	Eastbound Outside Lane	Eastbound Inside Lane	Average
I	2.5	3.5	3.4	3.4	3.2
II	3.2	2.9	3.3	3.1	3.2
III	2.9	3.3	2.7	2.7	2.9
IV	3.4	3.0	3.7	3.1	3.5
Average	3.0	3.3	3.3	3.1	3.2

The additional experiments of the two thick applications are showing very little deterioration after three years, therefore more time will need to pass before any conclusions can be made.

Conclusions

The evaluation of the data presented in Tables I thru V shows that the life expectancy of this highway has been enhanced by the use of the Ralumac treatment.

Recommendations

It is recommended the Ralumac process be approved for routine use as a restoration item for flexible pavements to fill surface ruts and cracks, seal the surface, and restore skid resistance. This tool should not be used if the pavement does not have adequate load supporting ability.

Implementation

The Ralumac process has been used in the following applications:

1. As a seal coat
2. To fill ruts only
3. To fill cracks
4. As an inner layer to fill ruts and cracks and seal the surface prior to an asphalt concrete overlay.

More than 600 lane miles of Ralumac have been applied on the state system during this three year evaluation.

APPENDIX A

OKLAHOMA DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISIONS
FOR
MICRO SURFACING

These Special Provisions revise, amend, and where in conflict, supersede applicable Sections of the Standard Specifications for Highway Construction, Edition of 1976, and the Supplement thereto, Edition of 1984.

409.01. DESCRIPTION. (Amend to include the following). This work shall consist of the application of latex modified Micro Surfacing material to an existing surface. The modified Micro Surfacing shall be a mixture of emulsified asphalt, mineral aggregate, mineral filler, water, other additives, and a latex modifier properly proportioned, mixed and spread on the surface in accordance with these Specifications, and as directed by the Engineer.

409.02. MATERIALS. (Amend to include the following).
(a) Emulsified Asphalt. The emulsified asphalt shall be CSS-1h (cationic). It shall show no separation after thorough mixing and shall conform to Subsection 708R.03.

(b) Mineral Aggregate. The mineral aggregate shall be chat aggregate commonly called "Joplin Chat" or Miami Chat", and shall conform to the following graduation requirements for the type specified.

	Percent Passing	
Sieve Size	Type I	Type II
3/8"	100	99-100
No. 4	98-100	80-94
No. 10	68-86	40-60
No. 40	22-41	12-30
No. 80	10-25	8-20
No. 200	5-15	5-15

(c) Mineral Filler. The mineral filler shall be a recognized brand of Portland Cement that is free from lumps. It may be accepted upon visual inspection.

(d) Water. The water shall be potable and shall be free of harmful soluble salts.

(e) Latex Modifier. A latex based modifier, "Dynatex Latex" as distributed by Guthrie Industries, Inc. or other approved equal, shall be milled into the asphalt emulsion. This additive shall allow the Micro Surfacing mixture to cure sufficiently so that normal traffic can be permitted within one hour's time, without damage to the surface.

(f) Other Additive. These additives are any other materials that are added to the Micro Surfacing mixture or any of the component materials to provide the specified properties. The emulsifier, "Peral No. 417" as manufactured by Raschig GMBH is the only other additive currently approved.

(g) Composition of Mixtures. The Engineer shall approve the design mix and all Micro Surfacing materials and methods prior to use and shall designate the proportions to be used within the following limits.

Residual Asphalt	6% to 11-1/2% by dry weight of aggregate.
Mineral Filler	1.5 to 3.0% by dry weight of aggregate
Latex Based Modifier	As required to provide the specified properties.
Water	As required to provide proper consistency.

The blended materials shall have a Hveem stability of 35 or more, when tested in accordance with OHDL-16.

Samples that are to be tested for stability shall be air dried for 2 to 3 days at room temperature. After air drying, the samples shall be placed in an oven at approximately 250° F. for a minimum of two hours. The samples shall then be molded in accordance with OHDL-8.

409.03. EQUIPMENT. (Amend to include the following). The material shall be mixed by a self propelled Micro Surfacing mixing machine which shall be a continuous flow mixing unit able to accurately deliver and proportion the aggregate, emulsified asphalt, mineral filler and water to a revolving multi-blade mixer and discharge the thoroughly mixed product on a continuous flow basis. The machine shall have sufficient storage capacity for aggregate, emulsified asphalt, mineral filler and water to maintain an adequate supply to the proportioning controls. The machine shall be equipped with self loading devices which provide for the loading of all materials while continuing to lay Micro Surfacing, thereby eliminating unnecessary construction joints.

Individual volume or weight controls for proportioning each material to be added to the mix shall be provided. Each material control device shall be calibrated and properly marked.

The aggregate feed to the mixer shall be equipped with a revolution counter or similar device so the amount of aggregate used may be determined at any time.

The emulsion pump shall be the positive displacement type and shall be equipped with a revolution counter or similar device so that the amount of emulsion used may be determined at any time.

The mixing machine shall be equipped with a water pressure system and nozzle type spray bar to provide a water spray immediately ahead of and outside the spreader box.

The mixing machine shall be equipped with an approved fines feeder that shall provide a uniform, positive, accurately metered, predetermined amount of the specified mineral filler at the same time and location that the aggregate is fed.

409.04. CONSTRUCTION METHODS. (Amend to include the following). (a) Weather Limitations. The material shall be spread only when the atmospheric temperature is at least forty (40°) degrees F. and rising and the weather is not foggy or rainy.

(b) Surface Preparation. The area to be sealed shall be thoroughly cleaned of all vegetation, loose aggregate and soil. Water used in pre-wetting the surface shall be applied at a rate to dampen the entire surface without any free flowing water ahead of the spreader box.

(c) Spreading. The Micro Surfacing mixture shall be spread uniformly by means of a mechanical type squeegee box, equipped with paddles to spread the materials uniformly throughout the box. Flexible seals shall be in contact with the road to prevent loss of mixture from the box. The rear flexible seal shall act as a strike off and shall be adjustable. The spreader shall be maintained to prevent the loss of the Micro Surfacing product in surfacing super-elevated curves. The mixture shall be spread to fill all cracks and minor surface irregularities and leave a uniform non-skid application of fine aggregate and asphalt on the surface.

The seam where two spreads join, shall be neat appearing and uniform. If in the opinion of the Engineer the seam is rough enough to cause a noticeable effect on steering of an automobile, the seam shall be removed and a new Micro Surfacing patch applied.

The self-loading devices shall be operated in such a manner as to eliminate unnecessary construction joints.

All excess material that overruns in gutters shall be removed or squeegeed back onto the surface.

All excess material shall be removed from ends of each job site immediately.

(d) Curing. Adequate means shall be provided to protect the Micro Surfacing from damage by traffic until the mixture has cured sufficiently so that it will not adhere to or be picked up by the tires of vehicles. Any damage done by traffic to the Micro Surfacing shall be repaired by the Contractor.

409.05. METHOD OF MEASUREMENT. (Amend to include the following). (a) Mineral Aggregate will be measured by the dry weight ton.

(b) Emulsified Asphalt will be measured by the gallon or ton.