FINAL REPORT

FOR

IOWA HIGHWAY RESEARCH BOARD

PROJECT HR-196

DUST CONTROL USING AN ASPHALT EMULSION

BY

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ABSTRACT

In an effort to control fugitive dust on a gravel surfaced roadway in Boone County, a cationic asphalt emulsion was blended with warm water and applied with an asphalt distributor. The test included various application procedures. After visual observations, it was concluded that this procedure utilizing a dilute asphalt emulsion was not an effective method of dust control.

DUST CONTROL USING AN ASPHALT EMULSION

INTRODUCTION

Dust control on unpaved roadways is not a new problem. The problem has been with us as long as the automobile, and Boone County Engineer, Carl Schnoor supports that with a 1910 publication entitled, "Dust Preventives and Road Binders." Considerable research has been conducted since that time, but we are still faced with the problem of economical dust control.

Today there is an increasing emphasis being placed on environmental control and many times without due consideration of the cost. Dust can be controlled, but not on all secondary roadways within budgets that plan for the future through a continuing paving program. The recent emphasis results from regulations by the Iowa Department of Environmental Quality under Iowa Administrative Code Subrule 400--4.3(2)c fugitive dust. Since the fall of 1976, there have been two significant instances where legal actions have been brought against county boards of supervisors and county engineers. In both cases, the Air Quality Management Division of the Department of Environmental Quality issued rulings holding the county responsible for dust control. These rulings were taken to court and proceedings are continuing.

County engineers are resisting spending much of their time or budget for an ineffective temporary control of dust. They do,

however, recognize the need for an inexpensive, easy to apply dust control product. The most common dust palliative used today is calcium chloride which costs between $500 and $800 per mile for normal application rates and may require 3 to 4 applications per summer. Calcium chloride does not perform well in dry summers such as the last two in Iowa.

All potentially economical methods of dust control need to be evaluated. One recently proposed dust control procedure utilizes a diluted cationic asphalt emulsion.

OBJECTIVE

The purpose of this research was to evaluate the application procedures and performance of a dust control system utilizing a dilute cationic asphalt emulsion. Its objective was to identify a cost-effective method of meeting dust control regulations.

FIELD TEST LOCATION AND DESCRIPTION

A field test location for the project was solicited from Boone County. The roadways selected for the research are approximately three miles north of Boone extending westerly from paved county road R-21. These two roadways (Appendix A) are in the area of the YMCA Camp, and include 5.3 miles of gravel surfacing. The surfacing material is a Class B gravel meeting the following gradation specification:

Sieve Size	% Passing
3/4"	100
#4	50 - 75
#8	25 - 55

The north roadway has substantial loose road metal while the east one mile of the south roadway has very little loose material and is well compacted. These roadways include relatively level sections except for two very steep hills. This field test layout includes numerous horizontal curves.

In 1975, the average traffic on different portions of these roadways ranged from 44 to 141 vehicles per day.

EQUIPMENT, MANPOWER AND TRAFFIC CONTROL

Boone County provided the personnel and equipment (Figures 1 and 2) for mixing and applying the dilute asphalt emulsion. Three-1000 gallon asphalt distributors (one Gunnison, one Etnyre and one Roscoe) normally used to apply MC-800 cutback asphalt were supplied. Each distributor was equipped with a propane heating system. An "inage" tank stick was available for each distributor. These were used to make two wooden "outage" sticks to eliminate the need of putting the sticks into the asphalt emulsion.

A small Gorman-Rupp portable pump was used to transfer the heated water from one distributor to another.

Traffic control and signing of the field test area were also provided by Boone County.

BLENDING AND APPLICATION

Emulsion Preparation

An attempt was made to empty the distributors, but all of the MC-800 could not be drained from the bottom of each distributor.

Figure 1: Gunnison Distributor loaded with CSS-1 Asphalt Emulsion.

Figure 2: Equipment used in the blending operation.

On July 26, the Gunnison Distributor obtained a load of CSS-1 cationic emulsion from Bitucote Products Company of Des Moines. This distributor had a system capable of pumping the emulsion into the other distributors. This Gunnison distributor was parked on a level area and the normal procedure was to pump 100 gallons (measured by the outage stick) into the Roscoe distributor that was used for application. Warm water was then added to yield 1000 gallons of dilute asphalt emulsion.

The water was obtained from the city main and heated in the Etnyre distributor that was temporarily immobile due to a transmission problem. The emulsion supplier had noted that for dilution without "breaking" the temperature of both the water and the emulsion must be above 80°F. The water varied between 80°F and 120°F and the emulsion between 85°F and 105°F at the time of blending (Appendix B). The emulsion supplier also cautioned against heating the emulsion with the distributors as the high fire chamber temperature could cause "breaking" of the emulsion. Some heating had been done prior to the caution with no apparent degradation.

The MC-800 cutback asphalt which could not be drained, came to the top when the distributor was filled with water. Most of the MC-800 was skimmed off to prevent possible damage to the pump. A substantial amount of foam and scum was produced during the

addition of water. This may have been caused by the water being added at a high velocity.

Roadway Preparation

Prior to the application of the dilute emulsion, the entire 5.3 miles of roadway were bladed to spread the loose material uniformly over the surface. After very little traffic, the roadway returned to the condition of bare wheel paths and loose material between them.

Equipment Preparation

The spray bar on the Roscoe distributor consisted of a six foot center portion and two-three foot fold up extensions. The proposed 18' wide treatment was obtained with two passes using one of the three foot fold down extensions and the six foot center portion. The only available method of varying the application rate was to vary the speed of travel as measured by the truck speedometer. Application began on July 27, and the first travel speed trial for one tenth mile was 5 m.p.h. which yielded a coverage rate of 0.14 gallons per square yard. Several trials demonstrated that a speed just under 4 m.p.h. yielded the desired 0.2 gallons per square yard rate (Appendix B). In spite of a continual effort to keep them clean, there were some problems with plugging of the spray bar nozzles. The nozzle plugging problem caused some variation in application rates.

Application Procedures

The first load of undiluted emulsion was blended and applied on July 27 and 28. The second load was blended and applied on August 1, 2 and 3. The intent was to complete one application of a 9 to 1 blend at 0.2 gallons per square yard on all but one section of the north roadway from the first load. There was some overlap at the roadway center where the treatment width was less than 18 feet.

On August 1, one test section was prewetted with water only and another was prewetted using water with a wetting agent just prior to the first dilute emulsion application. Final application of the dilute emulsion was completed on August 3, with test section locations as shown in Appendix A and designated by letter reference corresponding to the ten application procedures of Appendix C.

WEATHER

There have been many humorous comments about the variability of Iowa weather and it was extremely unusual prior to and after the initiation of this project. Iowa had been suffering from drought conditions that began during the summer of 1976 and continued with very little precipitation through mid-July 1977. Beginning July 20, just prior to the project, there was an unusually high amount of rainfall (Appendix D).

EVALUATION

The blending procedure worked quite well, but required substantial equipment and personnel (Figures 1 and 2). One problem was the small diameter water pipe used to transfer the heated water producing excess turbulence that caused some apparent breaking of the emulsion. A more efficient blending procedure would be required for routine operation.

During roadway application, an inspection of the tightly compacted areas would reveal black globules of bituminous material indicating that all of the bituminous material was not in solution.

Upon completion of the application of the first load of dilute emulsion, observers were impressed with the appearance of the treated roadway. Three days later (August 1), and after a one-inch rain on July 28, visual observations were very disappointing as the first application was barely visable. Apparently, much of the earlier favorable appearance was due to the wetting of the roadway,but after drying it returned to a dusty condition.

One reason for diluting the emulsion was to provide penetration into the surface of the roadway. The prewetting procedure was an additional effort to aid penetration. After completion of the application, a visual observation of the areas exposed with a screwdriver (Figure 3) showed penetration to be very little (no more than 1/8 inch). The prewetted sections exhibited very little

difference in the depth of penetration. On a section with substantial loose material and an application of a 3 to 1 blend (Procedure C) there was very little penetration (Figure 4). In general, the sprayed application provided a surface crust. Traffic soon broke the crust on both the compacted roadway (Figure 5) and the roadway with loose material (Figure 4).

Figure 3: Checking the depth of penetration.

The intended method of determining the quantity of dust from various test sections for comparison purposes was a volumetric sampler borrowed from Iowa State University. This volumetric

Figure 4: Crusting and coated aggregate on a section with substantial loose material.

Figure 5: Broken areas in surface crust of compacted roadway.

sampling device produces a vacuum that can be adjusted to intake a selected rate of air. For this project, the selected rate was 0.5 cubic foot per minute.The intake unit connected to the vacuum pump with flexible tubing, is placed six feet behind the vehicle's rear tire and one foot above the roadway surface. The vehicle is then driven at 30 m.p.h. and the vacuum pump is turned on and off at the desired times. A precisely weighed filter paper in the intake unit removes the dust from the air stream. The change in weight of the filter paper and its transporting container is the quantity of dust taken from each section of roadway tested. Testing of the roadway sections with this unit was conducted prior to the application. Post application testing with the volumetric sampler was eliminated due to adverse weather conditions and conclusive visual observations. Performance was evaluated entirely on the basis of visual observations.

There was rain on August 5, 7 and 8, with the next field review on August 11. At that review, the difference between applications could still be distinquished, however, the roadway was still damp. The appearance of most sections indicated that the desired dust control was not obtained. The prewetted sections on the north roadway looked the best.

The next field review was on August 25, 1977. It was impossible to distinquish most sections and there was no visual

benefit from the dilute emulsion application. The remaining signs of the application were surface coatings on the compacted areas (exhibiting chuckholing) and coated aggregate in the ridges of loose material. Neither of these were considered a benefit.

The County Engineer avoided blading these roadways until problems with washboarding and chuckholing made maintenance necessary. His visual observation indicated that the effectiveness lasted only a short time. In his opinion, calcium chloride was more cost effective than dilute emulsion on this roadway.

CONCLUSIONS

Based on this research, it can be concluded that:

1. The blending and application were satisfactory for this research, but would have to be improved to reduce equipment and personnel requirements for a routine, cost-effective procedure.
2. The dilute cationic asphalt emulsion did not provide satisfactory dust control, and therefore, is not cost effective.

ACKNOWLEDGMENTS

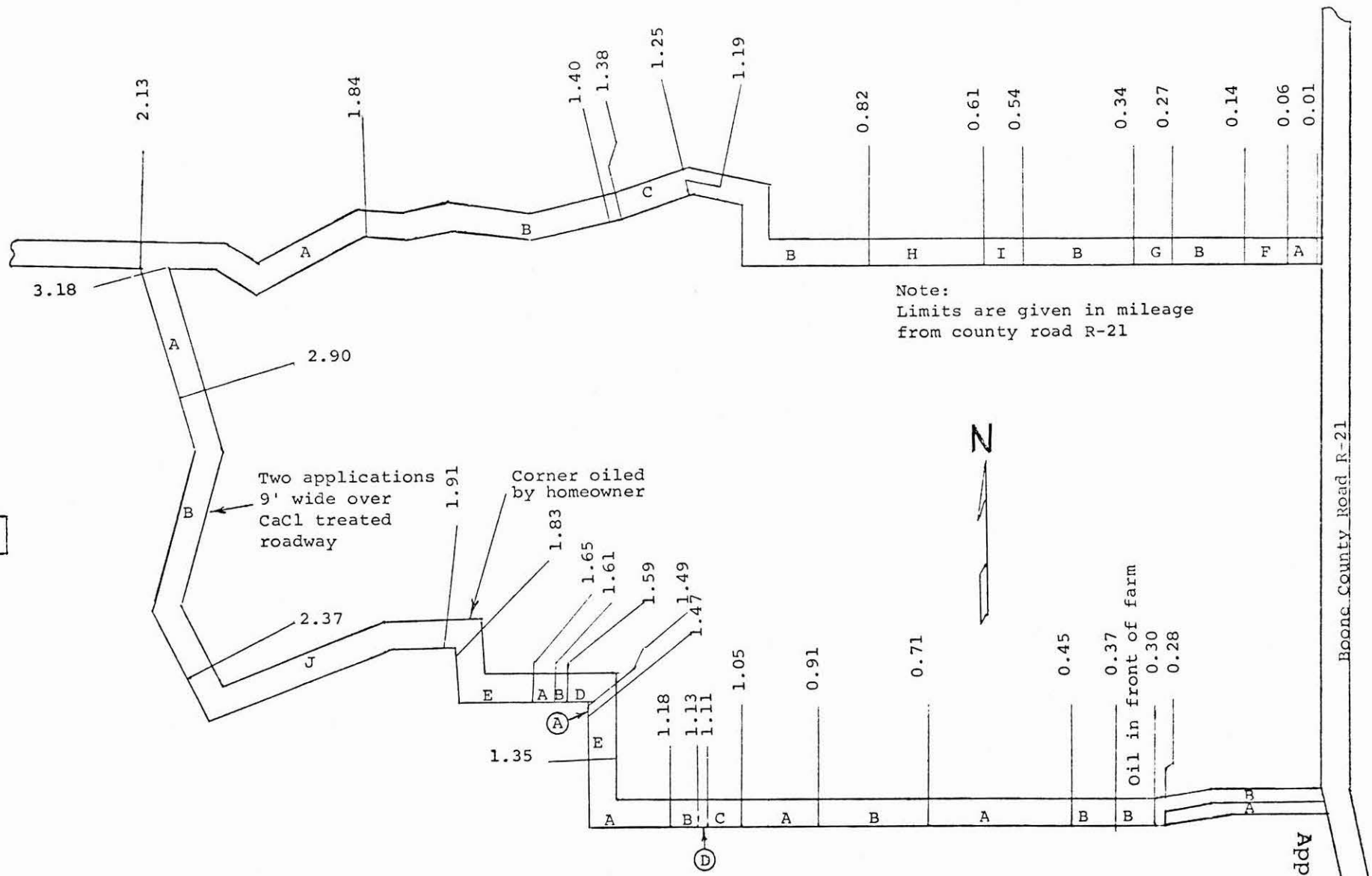
Appreciation is extended to the Boone County Board of Supervisors, Boone County Engineer Carl Schnoor and his personnel for providing the field test site, equipment and personnel.

J. M. Hoover of Iowa State University assisted with technical direction and made dust sampling equipment available. Bob Ash provided technical assistance for blending the asphalt emulsion and water, and Bitucote Products Company provided an emulsifying agent and DC-200 anti-foaming agent.

R. H. Given, George Calvert,B. H. Ortgies and Lowell Zearley of the Iowa DOT also assisted with the project.

The contents of this report reflect the views of the author and do not necessarily reflect the offical views or policy of the Iowa Department of Transportation. This report does not constitute a standard, specification or regulation.

APPENDICES



TEST SECTION LAYOUT
(3 miles north of Boone)

SUMMARY OF EMULSION BLENDING AND APPLICATION

Distributor Load	Emulsion Temp. °F	Water Temp. °F	Length of run (miles)	Volume Load (gallons)	Coverage gal./sq.yd.	Remarks
1	100	80	1.00	1000	0.19	
2	100	100	0.86	1000	0.22	
3	100	100	1.07	1000	0.18	
4	100	85	--	1000	--	
5	100	120	0.91	1000	0.21	
6	100	95	1.05	1000	0.18	
7	100	92	0.95	1000	0.20	
8	100	100	0.97	1000	0.20	
9	100	110	1.00	1000	0.19	
10	--	--	0.50	--	--	
11	100	105	1.03	1000	0.18	
12	100	95	0.96	1000	0.20	
13	105	115	0.89	1000	0.21	
14	105	100	1.10	1000	0.17	
15	105	95	--	1000	--	
16	105	95	--	1000	--	940 H_2O, 60 Emulsion (16 to 1)
17	105	90	0.89	1000	0.21	
18	105	--	0.71	740	0.20	185 Emulsion 555 H_2O (3 to 1)
19	85	112	0.76	1000	0.25	
20	85	105	0.76	--	--	

SUMMARY OF APPLICATION RATES AND PROCEDURES

A. One application of a 9 to 1 blend at a rate of 0.2 gallon per square yard.

B. Two applications of a 9 to 1 blend at a rate of 0.2 gallon per square yard.

C. One application of a 9 to 1 blend at a rate of 0.2 gallon per square yard and one application of a 3 to 1 blend at a rate of 0.2 gallon per square yard.

D. Two applications of a 9 to 1 blend at a rate of 0.2 gallon per square yard and one application of a 3 to 1 blend at a rate of 0.2 gallon per square yard.

E. One application of a 9 to 1 blend at a rate of 0.2 gallon per square yard and one application of a 16 to 1 blend at a rate of 0.4 gallon per square yard.

F. Prewetted with water at a rate of 0.28 gallon per square yard followed by two applications of a 9 to 1 blend at a rate of 0.2 gallon per square yard.

G. Prewetted with a solution of one gallon of wetting agent in 280 gallons of water at a rate of 0.15 gallon per square yard followed by two applications of a 9 to 1 blend at a rate of 0.2 gallon per square yard.

H. One application of a 9 to 1 blend at a rate of 0.2 gallon per square yard followed by maintaining with a patrol then two applications of a 9 to 1 blend at a rate of 0.2 gallon per square yard.

I. One application of a 9 to 1 blend at a rate of 0.2 gallon per square yard followed by maintaining with a patrol then one application of a 9 to 1 blend at a rate of 0.2 gallon per square yard.

J. Two applications of a 9 to 1 blend at a rate of 0.2 gallon per square yard 18 feet wide and one application of the same blend and rate on the center 9 feet.

PRECIPITATION RECORD
(As recorded by the Boone Water Works)

Date		Amount	Date		Amount
July	20	0.10	September	2	0.26
	21	0.01		3	0.48
	24	0.18		6	0.39
	28 (AM)	0.06		8	0.64
	28 (PM)	0.95		12	0.07
	30	0.02		16	0.25
August	1	0.59		17	0.30
	5	0.75		21	0.02
	7	2.82		22	0.30
	8	0.68		23	0.80
	13	0.02		28	0.71
	15	2.62		29	0.35
	20	0.85		30	0.70
	25	0.51	October	6	0.17
	26	0.07		7	1.03
	27	2.03		10	0.04
	30	0.76		14	0.07
	31	0.30			