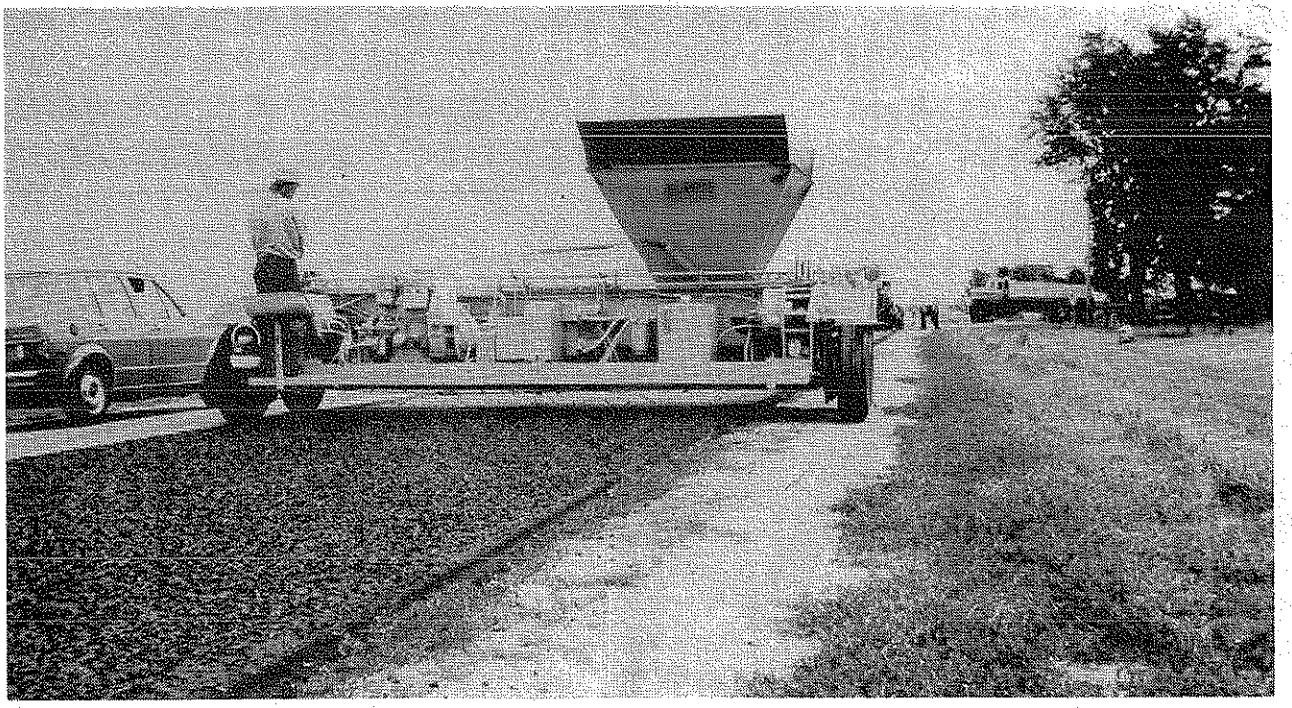
EVALUATION OF 1977 ASPHALT CONCRETE SPRINKLE TREATMENTS



Federal Highway Administration
Demonstration Project No. 50

Final Report
Project HR-1012

Prepared for
U.S. Department of Transportation
Federal Highway Administration
Contract DOT-FH-15-255

Highway Division
December 1980

Disclaimer

The contents of the report reflect the views of the author who is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Iowa Department of Transportation or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS

FINAL REPORT
FOR
FEDERAL HIGHWAY ADMINISTRATION
DEMONSTRATION PROJECT NO. 50

EVALUATION OF 1977 ASPHALTIC CONCRETE SPRINKLE TREATMENTS UNDER FEDERAL CONTRACT DOT-FH-15-255

BY

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INTRODUCTION

Iowa's first sprinkle treatment in 1974 was applied to a short section of old US 30 west of Ames. A roll type seal coat spreader was used to apply several types of sprinkle aggregates. The following year a spinner type tailgate spreader was used for sprinkle application of an Iowa 7 project in Webster County. Uniform spreading and tire marks were problems in these early projects. A special spinner spreader was built in 1976 and mounted on a truck specially equipped with smooth tires. This special unit was tested in early 1977 on a project that had been scheduled for 1976. Spinner type spreaders proved unacceptable due to non-uniformity of spreading.

A Bristowes Chip Spreader, imported from England, became available for use by Iowa contractors during the 1977 construction season. The six projects listed below were selected from the 1977 Primary Highway Surface Restoration Program for sprinkle treatment research:

1. Ia. 1 from Fairfield south to the Van Buren County line. Project FN-1-2(11)--21-51 Jefferson County.
2. US 20 from Independence to Jct. with Ia. 187. Project F-20-7(10)--20-10 Buchanan County.
3. US 69 from I-80 (Des Moines) north to Jct. Ia. 160. Project MP-1319-69-77 Polk County.
4. US 18 from just east of I-35 to Mason City. Project FN-18-5(27)--21-17 Cerro Gordo County.
5. US 59 from Jct. with Ia. 244 north to near Oakland. Project MP-4531-69-D4 Pottawattamie County.
6. Ia. 38 from Tipton to US 30. Project FN-38-3(11)--21-36 Cedar County.

EVALUATION OF SPRINKLE TREATMENT

Preliminary Investigation

The Iowa Surface Restoration Program is developed from road inventory data including sufficiency rating, present serviceability index and surface friction values. Roadways are selected for resurfacing on a priority system that considers present condition and traffic requirements. The traffic volumes for the 1977 sprinkle projects are given in Table I. At the time the sprinkle treatment projects were selected, FHWA participation was uncertain and the evaluation format had not been established.

The frictional values from the inventory program, prior to resurfacing determined at 40 m.p.h. in accordance with ASTM E 274 were:

1.	Ia. 1	Jefferson County	44
2.	US 20	Buchanan County	46
3.	US 69	Polk County	31
4.	US 18	Cerro Gordo County	28
5.	US 59	Pottawattamie County	41
6.	Ia. 38	Cedar County	40

Surface texture measurements are not a standard practice and therefore, not available for these projects.

Table I: Asphalt Mix Data and Traffic Volume

	Binder Course			Surface Course		
VPD	Thickness	Type	Mix Size	Thickness	Type	Mix Size
Project FN-1-2(11) Jefferson Co.						
3000	---	--	---	1-1/2"	A	1/2"
Project F-20-7(10) Buchanan Co.						
3930	1-1/2"	B	3/4"	1-1/2"	A	1/2"
Project MP-1319 Polk Co.						
8200	Cutler repaving process Addition 100 lbs. of mix per sq. yd.				A	3/8"
Project FN-18-5(27) Cerro Gordo Co.						
6000	---	--	---	1-1/2"	A	1/2"
Project MP-4531 Pottawattamie Co.						
1100	Cutler repaving process Addition 100 lbs. of mix per sq. yd.				B	3/8"
Project FN-38-2(11) Cedar Co.						
2200	1-1/2"	B	3/4"	1-1/2"	A	1/2"

Note - Type A requires 65% crushed aggregate particles. Type B requires 30% crushed aggregate particles. Quality requirements of Type A aggregate are higher than Type B.

Design Criteria and Procedure

All mixes are designed in accordance with Iowa D.O.T. standard specifications. A brief description of the binder and surface courses used on the sprinkle projects is given in Table I. The individual project mix designs (Appendix A) provide the gradation of the aggregates, type of asphalt, asphalt content, aggregate combinations and the resulting test results. The standard specifications establish a mix temperature range of 245 to 330°F for 1/2" and 3/8" mix sizes.

Construction Criteria and Procedure

The 1977 resurfacing projects had been let without sprinkle treatment. The sprinkle treatment was added to the project by extra work order to be constructed in accordance with a supplemental specification (Appendix B, Exhibits 1 & 2). Alternate sprinkle aggregate gradations were accepted on a number of the sprinkle treatment projects.

Lightweight aggregate (Haydite), quartzite, coarse grained dolomite and non-polishing limestone sprinkle aggregates were included in the 1977 experimental work. Quality tests, gradations, amounts of coating asphalt, application rates, costs and types of sprinkle aggregate for the different projects are presented in Appendix C. The dolomite and limestone application rates ranged from 7.2 to 9.1 pounds per square yard, the quartzite from 5.5 to 6.4 and the lightweight aggregate from 3.6 to 4.6 lbs. per sq. yd.

Iowa has developed an aggregate frictional characteristic classification system that establishes five types (Appendix D). This classification provides the basis for specifying a frictional quality requirement for sprinkle aggregates and asphalt surface courses. The rating for each of the 1977 sprinkle aggregates is noted in Appendix C.

The sprinkle aggregates were precoated at about 250°F with the same asphalt cement that was used in the surface course mix. Both drum mixers and batch plants were used for the precoating. The amount of asphalt that provided the desired precoating was approximately 1% of the dry weight for conventional aggregate and 2% for lightweight aggregate. After precoating, the sprinkle aggregate was stockpiled and allowed to cool. Stockpiling in tall piles was determined to be detrimental as it slowed cooling and caused caking of the chips. Wetting the stockpile was beneficial in alleviating this condition.

The Bristowes Spreader is driven hydrostatically by a small diesel engine. The 14 feet long spreading hopper, suspended between sets of tandem wheels, spans the freshly laid asphaltic concrete. The spreading hopper is charged by a 5 feet by 6 feet bin that continually oscillates between the ends of the hopper. The small bin size presented problems in charging with a standard loader, but a small Bobcat type loader functioned satisfactorily. A unique feature of the Bristowes Spreader was the fluted drum that metered the chips. This prevents a continual dribbling of the chips while stopped. Drums with various flute sizes are available and are to be matched to the size of sprinkle aggregate to be spread.

Observations indicated that a uniform size chip with a very small percentage passing the No. 4 sieve yielded the best application. The fine particles whip-off the road more readily and also adhere to the flutes of the spreader drum interfering with the metering of the aggregates. The chips were placed at ambient temperature and during extremely hot weather the coated chips had to be watered to prevent sticking and caking at the spreader. Sprinkle aggregate is lost where it is accidently spilled on the mat or applied in excess. There is loss of chips any time they are in such close proximity as not to allow asphalt matrix between the chips. The spreading of the chips is immediately behind the laydown machine.

By specification, the mix temperature for 3/8" and 1/2" size surface courses must be maintained between 245^{o} and 330^{o}F with the temperature normally being approximately 270^{o}F. A steel vibratory roller was used for initial compaction. The final rolling in all cases was by a steel roller without vibration. Compaction was not specified by the number of passes, but must meet 94% of laboratory Marshall density. Limited use of a pneumatic roller demonstrated a potential problem of removing the chips from the mat unless:

1. The roller was sufficiently heated.
2. Water was used.
3. The steel roller had satisfactorily embedded the chips.

Initial compaction was maintained as close as possible to the spreading of chips and the laydown machine.

Cost Comparison

The cost of the sprinkle treatments, (based on 1977 prices) is given in Appendix C. In general, the additional cost was $0.18 per square yard or $2,500 per two-lane mile of roadway. On a 1977 interstate resurfacing project, 35% quartzite or trap rock was specified in the surface course to provide a good and enduring frictional characteristic. The quartzite increased the cost of the mix by $7,750 per two-lane mile when compared to a mix using locally available aggregate. The location of individual projects with respect to a source of aggregate exhibiting good skid resistant qualities will influence this cost. The effect of using a sprinkle treatment to obtain adequate frictional values instead of high quality aggregate throughout the asphalt concrete surface course is a savings of $5,250 per two-lane mile.

Conservation of Natural Resources

Sprinkle treatment at 7.5 pounds per square yard on a 24 foot roadway would require 53 tons per mile. If an aggregate with good frictional characteristics were specified as 30% of a 1" thick surface course, 221 tons per mile would be required. This would result in a savings of 168 tons per mile of high quality aggregate.

This results in another benefit for Iowa. Due to the limited amount of gravel larger than a 1 inch sieve size, it is not economically feasible to use crushed gravel in surface course mixes to provide roadways with high frictional value. They are presently available in sufficient quantity for sprinkle application.

Post Construction Performance

A summary of the data resulting from frictional testing is given in Table II. Appendix E includes more detailed information on the frictional testing including speed gradients determined in 1977.

The "control" sections cited in Table II were conventional resurfacing using the mix designs given in Appendix A without sprinkle treatment.

Table II: Frictional Testing Summary

	-40 mph-			
	1977	1978	1979	1980
Ia. 1 Van Buren				
Sprinkle (dolomite)	49	51	55	56
Sprinkle (haydite 3/4")	44	55	48	52
Sprinkle (haydite 1/2")	49	56	46	56
Control	42	52	51	52
US 20 Buchanan				
Sprinkle (limestone)	47	48	45	53
Control	42	44	39	47
US 69 Polk				
Sprinkle (haydite)	48	49	47	45
Sprinkle (limestone)	36	36	33	30
Control	35	38	33	32
US 18 Cerro Gordo				
Sprinkle (quartzite)	54	48	43	45
No Control (p.c. section)	--	--	--	--
US 59 Pottawattamie				
Sprinkle (haydite)	52	53	58	53
No Control	--	--	--	--
Ia. 38 Cedar				
Sprinkle (quartzite)	52	51	55	54
Sprinkle (dolomite)	50	49	50	51
No Control	--	--	--	--

DISCUSSION AND OBSERVATIONS

The Bristowes Spreader straddled the fresh mat and did not leave the objectionable tire tracks while providing a uniform aggregate application. Two minor problems were encountered on roadways with narrow shoulders. Charging the bin from the open traffic lane presented a potentially hazardous traffic situation. When the shoulder slope was too steep, the Bristowes Spreader would scalp the fresh mat. The new Bristowes Spreaders were raised five inches in an effort to alleviate this problem with steep shoulder slopes.

Problems may be encountered in properly heating and drying the small quantities of sprinkle aggregates. It is difficult to consistently maintain the desired temperature and in some cases there is not adequate time to allow the moisture to leave the aggregate. Poor coating normally results when the temperature drops below 220^{o}F or may occur due to excess moisture in the sprinkle aggregate. These problems can normally be overcome in a batch plant by varying the mixing time to compensate for moisture or temperature and achieve coating. Consistent aggregate coating in a continuous plant is more difficult due to the fixed mixing time.

There are a number of factors that influence the sprinkle aggregate retention. As noted, the gradation of the aggregate is important with fine material contributing to a treatment that is more prone to aggregate loss. A substantial number of experimental variations have been applied to determine the optimum sprinkle aggregate application rate. The goal is the maximum quantity that can be applied with asphalt concrete between all chips for sufficient embedment.

Uniform distribution of the chips is necessary to avoid aggregate loss. Improper use of the Bristowes Spreader can result in nonuniform spreading often referred to as corrugations. This is a pattern of transverse strips of excessive chip application. The spreader drive mechanism must be tight and positive to avoid free movement of the fluted drum. Rocking action of the spreader is reduced if the traveled surface of the shoulder is relatively smooth. Minimizing the number of starts and stops with the spreader may also reduce the corrugation problem.

The percent of asphalt cement for coating the chips, the type and temperature of the mixture and the rolling equipment and procedure also affect chip retention.

The sprinkle treatment projects were reviewed soon after construction in 1977. They were rated on the basis of sprinkle aggregate loss as:

Project	Sprinkle Aggregate Loss
Ia. 1 Van Buren	slight
US 20 Buchanan	very slight
US 69 Polk	slight
US 18 Cerro Gordo	moderate
US 59 Pottawattamie	slight
Ia. 38 Cedar	moderate

Periodic field reviews have been conducted. Visual observations indicate very little aggregate loss during the past two years. The major loss of chips occurred soon after construction (within 6 months). Improper or inadequate procedures during construction are the major factors contributing to sprinkle aggregate loss. Highway traffic may result in immediate aggregate loss due to inadequate embedment or insufficient time for cooling. Subsequent highway traffic does not result in

significant additional loss. The Cerro Gordo project emphasizes this finding. The project was constructed late in the season and subsequent evaluation indicated that the surface course was too low in asphalt content and the sprinkle aggregate was poorly coated. There was some initial loss to support the "moderate" rating, but there has been essentially no loss after six months.

Macrotexture is substantially increased by sprinkle treatments. Iowa research[1] has shown that texture depths on asphalt surfaces without sprinkle treatments range from 0.003 to 0.011 inches depending on the type of mix. Sprinkle treatments on the same asphalt mixes yielded texture depths ranging from 0.010 to 0.042 inches. Even though this additional macrotexture may not significantly affect results of the standard friction testing (ASTM E274), it will be beneficial in preventing loss of tire contact during periods of heavy rainfall.

In general, the friction results for all roadways included in this demonstration project are good (Table II). The friction numbers for sprinkle treatments are generally higher than corresponding mixes without treatment. The exception to both of the previous statements is the limestone sprinkle treatment on US 69 in Polk County. The limestone sprinkle aggregate was the same limestone that comprised 65% of the surface course mixture. This two-lane roadway is near Des Moines with a traffic volume of about 8,200 vehicles per day.

The haydite sprinkle on this same roadway has a friction number of 45 after 3 years exhibiting the superior frictional performance of a good sprinkle treatment application with a quality aggregate.

[1]Shelquist, Robert A. "Sprinkle Treatment of Asphalt Surfaces" Iowa DOT, October 1979.

Construction techniques are constantly improving and consequently better sprinkle treatments can be applied today than those built in 1977. Specifications have been modified to include the most recent findings.

Supplemental Specification 824 covering the 1978 Sprinkle Treatment projects is included as Appendix F. The current specification (April 22, 1980) is included as Appendix G.

CONCLUSIONS

1. Sprinkle treatments are an effective means of providing pavements with high quality frictional properties.

2. Fine material in the sprinkle aggregate is detrimental. A coarser one size aggregate yields the best sprinkle applications.

3. Sprinkle aggregates should be produced from hard, durable materials with a history of good frictional properties.

4. Good coating of the sprinkle aggregate is achieved more consistently in batch plants than in drum plants.

5. Sprinkle treatments result in a substantial increase of macrotexture.

6. Sprinkle treatments may result in a monetary savings in construction of pavements where special aggregates are required to assure durable friction characteristics.

7. Sprinkle treatments conserve high quality aggregate.

ACKNOWLEDGEMENTS

The cooperation of the Offices of Construction, Materials and Maintenance was greatly appreciated. A special thanks is extended to B. H. Ortgies, Charles Potter, Joe Shay and Vernon J. Marks for their participation.

APPENDICES

* CORRECTED REPORT

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
ASPHALT CONCRETE MIX DESIGN
LAB LOCATION AMES

MIX, TYPE AND CLASS: TYPE A SURFACE LAB NO. ABD7-55

INTENDED USE:

SIZE 1/2" SPEC. NO. 802 DATE REPORTED 5/10/77
JEFFERSON FN-1-2(11)--21-51
COUNTY VAN BUREN PROJECT FN-1-1(7)--21-89

CONTRACTOR NORRIS CONSTR. CO.
AT VARIOUS LOCATIONS FROM VAN BUREN CO. N. 3.0 MIL.
PROJ. LOCATION AT VARIOUS LOCATIONS FROM KEOSAUQUA N. 9.6 MI. TO JEFF. CO. LINE

AGG. SOURCES 1/2" LST.- DOUDS MINE - VAN BUREN CO., *3/8" LST.CHIPS-DOUDS MINE-VAN BUREN CO., CONC. SAND - FARMINGTON - VAN BUREN CO.
JOB MIX FORMULA AGGREGATE PROPORTIONS: 45% AAT7-97, 20% AAT7-98, 35% AAT7-99

JOB MIX FORMULA - COMBINED GRADATION

1-1/2"	1"	3/4"	1/2"	3/8"	NO.4	NO.8	NO.16	NO.30	NO.50	NO.100	NO.200
		100	99	91	70	48	38	22	10	6.6	5.9
TOLERANCE: +OR-			98/100		7	5		4			2

75 BLOW MARSHALL DENSITY 2.26
ASPHALT SOURCE AND APPROXIMATE VISCOSITY SUGAR CREEK-1010 POISES (60-70 PEN)
PLASTICITY INDEX

% ASPH. IN MIX	5.0	6.0	7.0
NUMBER OF MARSHALL BLOWS	50	50	50
MARSHALL STABILITY - LBS.	2508	2233	2025
FLOW - 0.01 IN.	7	7	7
SP.GR. BY DISPLACEMENT(LAB DENS.)	2.19	2.23	2.25
BULK SP. GR. COMB. DRY AGG.	2.528	2.528	2.528
SP. GR. ASPH. @ 77 F.	1.028	1.028	1.028
CALC. SOLID SP.GR.	2.44	2.40	2.37
VOIDS - CALC.	10.2	7.3	5.1
CE SP. GR.	2.42	2.39	2.36
% VOIDS - RICE	9.5	6.7	4.7
% WATER ABSORPTION - AGGREGATE	3.14	3.14	3.14
% VOIDS IN THE MINERAL AGGREGATE	17.7	17.1	17.2
% V.M.A. FILLED WITH ASPHALT	42.2	57.5	70.4
CALCULATED ASPH.FILM THICKNESS(MICRONS)	6.3	8.2	10.2

A CONTENT OF 6.50% ASPHALT IS RECOMMENDED TO START THE JOB.
DENSITIES SHOULD BE CHECKED IMMEDIATELY TO INSURE VOID COMPLIANCE.

COPIES:
ASPH. MIX DESIGN
FN-1-2(11)--21-51, JEFFERSON
FN-1-1(7)--21-89, VAN BUREN
R. PERCIVAL
J. DEMETER
B. ORTGIES
C. HUISMAN
L. ZEARLEY
NORRIS
C. JONES
D. HINES

SIGNED: BERNARD C. BROWN
TESTING ENGINEER

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
ASPHALT CONCRETE MIX DESIGN
LAB LOCATION AMES

MIX, TYPE AND CLASS: TYPE A SURFACE LAB NO. ABD7-90

INTENDED USE:

SIZE 1/2" SPEC. NO. 802 DATE REPORTED 6/3/77

COUNTY BUCHANAN PROJECT FN-20-7(10)--21-10
FN-150-3(15)--21-10

CONTRACTOR EVERDS BROS.
FROM JCT. WITH IA. 187 WEST 11.9 MI. INTO INDEPENDENCE
PROJ. LOCATION IN INDEPENDENCE FROM 8TH ST. NORTH TO US 20

AGG. SOURCES 1/2" CR. LST. - JESUP QR. - BUCHANAN CO.,
SAND - BURNS PIT - BUCHANAN CO.
JOB MIX FORMULA AGGREGATE PROPORTIONS: 65% AAT7-231, 35% AAT7-232

JOB MIX FORMULA - COMBINED GRADATION

1-1/2"	1"	3/4"	1/2"	3/8"	NO.4	NO.8	NO.16	NO.30	NO.50	NO.100	NO.200
			100	92	66	51	39	29	13	7.0	5.9
TOLERANCE: +OR-			98/100	7	7	5		4			2

75 BLOW MARSHALL DENSITY		2.34	
ASPHALT SOURCE AND APPROXIMATE VISCOSITY	KOCH - 1190	POISES	
PLASTICITY INDEX			
% ASPH. IN MIX	4.0	5.0	6.0
NUMBER OF MARSHALL BLOWS	50	50	50
MARSHALL STABILITY - LBS.	2250	2083	2075
FLOW - 0.01 IN.	8	8	10
SP.GR. BY DISPLACEMENT(LAB DENS.)	2.30	2.33	2.36
BULK SP. GR. COMB. DRY AGG.	2.673	2.673	2.673
SP. GR. ASPH. @ 77 F.	1.027	1.027	1.027
CALC. SOLID SP.GR.	2.52	2.48	2.45
VOIDS - CALC.	8.7	6.1	3.5
RICE SP. GR.	2.48	2.44	2.41
% VOIDS - RICE	7.4	4.5	2.0
% WATER ABSORPTION - AGGREGATE	0.27	0.27	0.27
% VOIDS IN THE MINERAL AGGREGATE	17.4	17.2	17.0
% V.M.A. FILLED WITH ASPHALT	49.8	64.3	79.4
CALCULATED ASPH.FILM THICKNESS(MICRONS)	6.5	8.3	10.1

A CONTENT OF 4.75% OF ASPHALT IS RECOMMENDED TO START THE JOB.

COPIES:
ASPH. MIX DESIGN.
PROJECTS LISTED ABOVE
R. C. HENELY
W. J. CRAWFORD
B. ORTGIES
C. HUISMAN
L. ZEARLEY
EVERDS
C. JONES
D. HINES

SIGNED: BERNARD C. BROWN
TESTING ENGINEER

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
ASPHALT CONCRETE MIX DESIGN
LAB LOCATION AMES

MIX, TYPE AND CLASS: TYPE A SURFACE LAB NO. ABD7-131

INTENDED USE:

SIZE 3/8" SPEC. NO. 802 DATE REPORTED 7/1/77

COUNTY POLK PROJECT MP-1318--69-77
MP-1319--69-77

CONTRACTOR DES MOINES ASPHALT
PROJ. LOCATION ON IA. 141 FROM BEAVER CREEK BRIDGE N. TO JOHNSTON (1.1 MI.)
ON IA. 69 FROM I-80 NORTH TO ANKENY (3.5 MI.)

AGG. SOURCES 3/8" CR.LST. CHIPS-FERGUSON QR.-MARSHALL CO., 3/8" CR.LST.-FERGUSON QR.-MARSHALL CO., SAND - JOHNSTON PIT - POLK CO.
JOB MIX FORMULA AGGREGATE PROPORTIONS: 20% AAT7-90, 45% AAT7-88, 35% AAT7-89

JOB MIX FORMULA - COMBINED GRADATION

1-1/2"	1"	3/4"	1/2"	3/8"	NO.4	NO.8	NO.16	NO.30	NO.50	NO.100	NO.200
				100	83	53	37	25	14	9.0	7.3
TOLERANCE: + OR -				98/100	7	5		4			2

75 BLOW MARSHALL DENSITY		2.38	
ASPHALT SOURCE AND APPROXIMATE VISCOSITY	KOCH - 1190 POISES		
PLASTICITY INDEX			
% ASPH. IN MIX	5.0	6.0	7.0
NUMBER OF MARSHALL BLOWS	50	50	50
MARSHALL STABILITY - LBS.	2582	2320	2203
FLOW - 0.01 IN.	8	8	9
SP.GR. BY DISPLACEMENT(LAB DENS.)	2.34	2.35	2.37
BULK SP. GR. COMB. DRY AGG.	2.673	2.673	2.673
SP. GR. ASPH. @ 77 F.	1.027	1.027	1.027
CALC. SOLID SP.GR.	2.50	2.47	2.43
VOIDS - CALC.	6.6	4.7	2.6
RICE SP. GR.	2.49	2.46	2.42
% VOIDS - RICE	6.0	4.6	2.1
% WATER ABSORPTION - AGGREGATE	1.04	1.04	1.04
% VOIDS IN THE MINERAL AGGREGATE	16.8	17.4	17.5
% V.M.A. FILLED WITH ASPHALT	60.9	72.3	85.8
CALCULATED ASPH.FILM THICKNESS(MICRONS)	6.9	8.5	10.1

A CONTENT OF 5.25% ASPHALT IS RECOMMENDED TO START THE JOB.
THE TEST RESULTS ON THIS REPORT ARE THE SAME AS ABD7-54
(POLK LRS-103)
COPIES:
ASPH. MIX DESIGN
PROJECTS LISTED ABOVE
D. ANDERSON
H. DOWDEN
B. ORTGIES
C. HUISMAN
L. ZEARLEY
D.M. ASPHALT
C. JONES
D. HINES

SIGNED: BERNARD C. BROWN
TESTING ENGINEER

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
ASPHALT CONCRETE MIX DESIGN
LAB LOCATION AMES

MIX, TYPE AND CLASS: TYPE A SURFACE LAB NO. ABD7-163

INTENDED USE:

SIZE 1/2" SPEC. NO. 802 DATE REPORTED 8/4/77

COUNTY CEDAR PROJECT FN-38-2(11)--21-16

CONTRACTOR CESSFORD-HODGMAN

PROJ. LOCATION FROM US 30 SOUTH 7.5 MI. INTO TIPTON

AGG. SOURCES 1/2" CR. LST. - BALLOU QR.-JONES CO., 3/8" LST. CHIPS-
BALLOU QR.-JONES CO., SAND-FLEMING PIT - JONES CO.
JOB MIX FORMULA AGGREGATE PROPORTIONS: 40% AAT7-484, 25% AAT7-485, 35% AAT7-48

JOB MIX FORMULA - COMBINED GRADATION

1/2"	1"	3/4"	1/2"	3/8"	NO.4	NO.8	NO.16	NO.30	NO.50	NO.100	NO.200
		100	99	91	67	46	38	26	12	8.1	7.0

TOLERANCE:	98/100	7	7	5	4	2
75 BLOW MARSHALL DENSITY			2.34	
ASPHALT SOURCE AND APPROXIMATE VISCOSITY		KOCH - 1300 POISES		
PLASTICITY INDEX				
% ASPH. IN MIX		4.75	5.75	6.75
NUMBER OF MARSHALL BLOWS		50	50	50
MARSHALL STABILITY - LBS.		1997	2422	2273
FLOW - 0.01 IN.		7	8	9
SP.GR. BY DISPLACEMENT(LAB DENS.)		2.25	2.32	2.35
BULK SP. GR. COMB. DRY AGG.		2.698	2.698	2.698
SP. GR. ASPH. @ 77 F.		1.029	1.029	1.029
CALC. SOLID SP.GR.		2.53	2.49	2.45
% VOIDS - CALC.		11.0	6.8	4.2
CE SP. GR.		2.49	2.44	2.41
% VOIDS - RICE		9.6	4.9	2.6
% WATER ABSORPTION - AGGREGATE		0.81	0.81	0.81
% VOIDS IN THE MINERAL AGGREGATE		20.6	19.0	18.8
% V.M.A. FILLED WITH ASPHALT		46.4	63.8	77.5
CALCULATED ASPH.FILM THICKNESS(MICRONS)		7.0	8.8	10.5

A CONTENT OF 5.50% ALSPHALT IS RECOMMENDED TO START THE JOB.

COPIES:
ASPH. MIX DESIGN
FN-38-2(11)--21-16, CEDAR
R. C. HENELY
K. MAHONEY
R. KAUTZ
C. HUISMAN
B. ORTGIES
L. ZEARLEY
CESSFORD
HODGMAN
C. JONES
D. HINES

SIGNED: BERNARD C. BROWN
TESTING ENGINEER

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
ASPHALT CONCRETE MIX DESIGN
LAB LOCATION AMES

MIX, TYPE AND CLASS: TYPE A SURFACE LAB NO. ABD7-190

INTENDED USE:

SIZE 1/2" SPEC. NO. 802 DATE REPORTED 8/24/77

COUNTY CERRO GORDO & WORTH PROJECT FN-18-5(27)--21-17
FN-65-8(16)--21-17
FN-65-8(17)--21-17
FN-65-9(5)--21-98

CONTRACTOR EVERDS

PROJ. LOCATION FROM I-80 E. 5.8 MI. TO MASON CITY; FROM MASON CITY N. TO WORTH CO. LINE; FROM FRANKLIN CO. TO MASON CITY; FROM CERRO GORDO CO. LINE N. TO MINN.

AGG. SOURCES 1/2" CR. LST. - QUIMBY QR. - CERRO GORDO CO., SAND - SUGAR BEET PIT - CERRO GORDO CO.

JOB MIX FORMULA AGGREGATE PROPORTIONS: 65% AAT7-571, 35% AAT7-572

JOB MIX FORMULA - COMBINED GRADATION

1-1/2"	1"	3/4"	1/2"	3/8"	NO.4	NO.8	NO.16	NO.30	NO.50	NO.100	NO.200
			100	92	70	54	41	29	17	9.7	6.2
TOLERANCE: +OR-			98/100	7	7	5		4			2
75 BLOW MARSHALL DENSITY								2.40			2.42
ASPHALT SOURCE AND APPROXIMATE VISCOSITY							KOCH	KOCH	KOCH		KOCH
XXXXXXXXXXXXXXX NO. POISES							1300	1300	1300		1970
% ASPH. IN MIX							4.25	5.25	6.25		5.25
NUMBER OF MARSHALL BLOWS							50	50	50		50
MARSHALL STABILITY - LBS.							2203	2147	2068		2270
FLOW - 0.01 IN.							8	8	11		8
SP.GR. BY DISPLACEMENT(LAB DENS.)							2.33	2.37	2.40		2.38
BULK SP. GR. COMB. DRY AGG.							2.713	2.713	2.713		2.713
SP. GR. ASPH. @ 77 F.							1.029	1.029	1.029		1.029
CALC. SOLID SP.GR.							2.54	2.51	2.47		2.51
% VOIDS - CALC.							8.4	5.4	2.8		5.0
RICE SP. GR.							2.53	2.49	2.46		2.49
% VOIDS - RICE							7.8	4.7	2.5		4.4
% WATER ABSORPTION - AGGREGATE							0.27	0.27	0.27		0.27
% VOIDS IN THE MINERAL AGGREGATE							17.8	17.2	17.1		16.9
% V.M.A. FILLED WITH ASPHALT							52.5	68.5	83.7		70.2
CALCULATED ASPH.FILM THICKNESS(MICRONS)							6.2	7.8	9.4		7.8

A CONTENT OF 5.0% ASPHALT IS RECOMMENDED TO START THE JOB.
PROJECT FN-18 REQUIRES THE USE OF AC-20 ASPHALT.

COPIES:
~~ASPH.~~ MIX DESIGN
PROJECTS LISTED ABOVE
R. I. BORTLE
R. GOTSCHALL
B. ORTGIES
C. HUISMAN
L. ZEARLEY
EVERDS
C. JONES
D. HINES

SIGNED: BERNARD C. BROWN
TESTING ENGINEER

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
ASPHALT CONCRETE MIX DESIGN
LAB LOCATION AMES

MIX, TYPE AND CLASS: TYPE B SURFACE LAB NO. ABD7-192

INTENDED USE:

SIZE 802 & SPEC. NO. DATE REPORTED 8/24/77
ADDENDUM TO PROPOSAL
COUNTY DIST. 4 (POTT.) PROJECT MP-4531--69-D4

CONTRACTOR E. C. HENNINGSEN
ON US 59 FROM JCT. WITH IA. 244 NORTH 10.0 MILES TO
PROJ. LOCATION NEAR JCT. WITH US 6 AT OAKLAND

AGG. SOURCES 3/8" CR. LST. - ATLANTIC QR. - CASS CO.,
SAND - ATLANTIC - CASS CO.
JOB MIX FORMULA AGGREGATE PROPORTIONS: 60% AAT7-547, 40% AAT7-548

JOB MIX FORMULA - COMBINED GRADATION

1 1/2"	1"	3/4"	1/2"	3/8"	NO.4	NO.8	NO.16	NO.30	NO.50	NO.100	NO.200
			100	98	76	57	44	31	15	8.8	7.4
TOLERANCE: +OR-				98/100	7	6		5			3

ASPHALT SOURCE AND APPROXIMATE VISCOSITY	PHILLIPS - 1280 POISES	
PLASTICITY INDEX	1	
% ASPH. IN MIX	5.75	6.75
NUMBER OF MARSHALL BLOWS	50	50
MARSHALL STABILITY - LBS.	1753	1727
FLOW - 0.01 IN.	8	8
SP.GR. BY DISPLACEMENT(LAB DENS.)	2.24	2.26
BULK SP. GR. COMB. DRY AGG.	2.644	2.644
SP. GR. ASPH. @ 77 F.	1.011	1.011
CALC. SOLID SP.GR.	2.44	2.41
% VOIDS - CALC.	8.3	6.1
CE SP. GR.	2.41	2.36
% VOIDS - RICE	7.1	4.3
% WATER ABSORPTION - AGGREGATE	0.84	0.84
% VOIDS IN THE MINERAL AGGREGATE	20.2	20.3
% V.M.A. FILLED WITH ASPHALT	58.9	70.0
CALCULATED ASPH.FILM THICKNESS(MICRONS)	7.8	9.4

A CONTENT OF 6.25% ASPHALT IS RECOMMENDED TO START THE JOB.

COPIES:
ASPH. MIX DESIGN
MP-4531--69-D4, POTTAW.
V. R. SNYDER
T. MCDONALD
B. ORTGIES
C. HUISMAN
L. ZEARLEY
E. C. HENHINGSEN
C. JONES
D. HINES

SIGNED: BERNARD C. BROWN
TESTING ENGINEER

EXHIBIT I

Supplemental Specification

for

Sprinkle Treatment of Asphalt Concrete Surfaces

.01 Description: Sprinkle Treatment shall consist of properly graded aggregate, precoated with asphalt cement applied as designated in these specifications and elsewhere in the contract documents.

.02 Materials: Aggregate for Sprinkle Treatment shall be composed of hard, durable crushed rock or crushed gravel free of objectionable coatings meeting the following requirements.

A. Abrasion Loss: The percentage of wear as determined by AASHTO T-96, Method C shall not exceed 35.

B. Freezing and Thawing Test: When the particles retained on the No. 4 sieve are subjected to the freezing and thawing test, Laboratory Test Method 211, Method A, the loss shall not exceed 10 percent.

C. Size of Particles: When tested by means of laboratory sieves, Sprinkle Treatment aggregate shall meet the following limits. The percentage passing the No. 200 sieve shall be determined by washing followed by dry sieving. Any mudballs present shall be completely broken up and dissolved.

Sieve Size	Percent Passing
3/4	100
3/8	20 - 55
No. 4	0 - 10
No. 8	0 - 5
No. 200	1.5

D. Source Approval: All aggregate sources and production procedures shall be subject to the approval of the engineer.

E. Aggregate Types: Unless otherwise specified sprinkle treatment aggregate shall be crushed quartzite, crushed granite, or crushed gravel. Crushed gravel shall be produced as a separate operation by crushing gravel to the extent that 100 percent or more will pass the 3/4 inch sieve; the aggregate shall be prescreened prior to crushing on a screen at least 1/4 inch larger. The prescreen size shall be adjusted to compensate for screening efficiency, material variability, and carryover.

.03 Precoating of Aggregate: The aggregate shall be precoated with 1 percent asphalt cement as directed by the engineer. The asphalt cement shall meet the requirements specified for the material used on the project. Equipment and procedures for precoating shall comply with the requirements of sections 2001.22 and 2303.04 as modified by applicable modifications.

.04 Storage of Precoated Aggregate: The precoated aggregate shall be stored so as to prevent contamination and deterioration. The engineer may require the stockpile be covered.

.05 Application of Precoated Sprinkle Treament Aggregate: The delivery and application of the aggregate shall be performed as set out in the contract documents and subject to approval of the engineer.

.06 Method of Measurement: Aggregate for sprinkle treatment will be measured in tons. Asphalt cement required for precoating shall be considered incidental and will not be measured for payment.

Measurement of the quantities will be performed in accordance with the requirements of 2303.19A as modified by the applicable modifications.

.07 Basis of Payment: The contractor will be compensated for the number of tons of precoated treatment aggregate furnished and applied as specified in the contract documents as provided in 2303.20 as modified by applicable modifications.

EXHIBIT II August, 1977

REQUIREMENTS FOR SPRINKLE SURFACE TREATMENTS

I. Description of Work:

The work shall consist of a single pass placement each lane; of a sprinkle surface treatment of precoated chips placed uniformly by an appropriate spreader, immediately behind the paver and preceeding the breakdown roller. Work to be completed during placement of the asphaltic concrete surface course of A.C. surfacing projects.

II. *Material:

1. A durable 3/4" x 3/8" clean aggregate chip.
   (See Tentative Special Provision attached)
   (Consult District Materials Engineer on source and material quality.)
2. Pre-coat with 0.75% to 2.0% of binder bitumen used in the mix. (Central Materials Lab will recommend A.C. content.)
3. Application rate is 5 to 7 lb./s.y. or 35 to 50 ton per **two-lane mile of roadway (including waste, est. usage @ 50 ton/mi.)**

III. Equipment:

1. Iowa D.O.T. has arranged with the E.D. Etnyre Co., the rental use of an imported Bristowes chip spreader. (It will be rented on a job by job basis from the Etnyre Co. The Etnyre contact is: Mr. Warren Shetter, Sales Manager, E.D. Etnyre Co., Oregon, Illinois PH. 815-732-2116.) The contractor must arrange for spreader rental on a cost per ton basis. (Etnyre will furnish rental agreement and invoice contractor for rental costs upon job completion.)
2. Nurse truck equipment for chips.
   a. Includes hauling trucks from stockpile to spreader on road.

b. Loader or conveyor to transfer chips from hauling truck to spreader unit.

IV. Manpower:

1. One man (additional) to operate Bristowes spreader.
2. One or two nurse truck drivers (for chips).
3. One loader or conveyor operator.

V. Estimate of Total Cost per Ton on Road:

A. Price for Surface Sprinkle Treatment should be quoted "per ton, on the road", and include all incidentals.

Suggested

1. For work using the rented Bristowes spreader $45 - 50 per ton.
   a. Cost per ton quote should include:
      (1) Cost of pre-coated chips complete & delivered to roadway.
      (2) Nurse trucks as necessary (1 or 2).
      (3) Drivers as necessary (1 or 2).
      (4) Spreader rental (est. $10/ton spread).
      (5) Operator for chip spreader.
      (6) Small loader (Bob cat) and operator.

B. A price per ton for pre-coated chips in stockpile should be quoted as payment for materials not used on the roadway.

C. A cost for pickup and return of the trailer mounted (pintle hitch). Bristowes spreader from the J.W. Bell Co., the Etnyre dealer, Cedar Rapids Office, should also be included.

*Note:
See Tentative Specification attached.

Appendix C
"1977 Sprinkle Treatment Aggregate Data"

AGGREGATES USED FOR SPRINKLE TREATMENT - 1977

Project: Pottawattamie - MP-4531--69-D4

Aggregate Used -		Haydite 3*
% Asphalt		1.5
Freeze & Thaw "A"		1.1
Abrasion		22
Application Rate		3.6 lbs/sq. yd.
Cost		$0.144/sq. yd.
Gradation	3/4	100
	1/2	99
	3/8	64
	4	3.7
	8	1.8
	200	1.3

Project: Cedar - FN-38-2(11)--21-16

Aggregate Used -		Quartzite (Dell Rapids)	2* Cr. Stone-Ballou Qr. 4*
% Asphalt		0.75	1.25
Freeze & Thaw "A"		0.4	1.0
Abrasion		28	35
Application Rate		5.5 lbs/sq.yd.	7.9 lbs/sq. yd
Cost		$0.182/sq.yd	$0.190/sq.yd.
Gradation	3/4	100	100
	1/2	99	95
	3/8	77	49
	4	25	8.7
	8	6.9	1.0
	200	0.5	0.2

Project: Polk - MP-1319--69-77

Aggregate Used -		Haydite 3*	Cr. Stone-Ferguson Qr. 4*
% Asphalt		1.5	1.0
Freeze & Thaw "A"		1.1	2.0
Abrasion		22	31
Appication Rate		3.8 lbs/sq. yd.	9.1 lbs/sq. yd.
Cost		$0.119/sq. yd.	$0.229/sq. yd.
Gradation	3/4	100	100
	1/2	99	81
	3/8	64	33
	4	3.7	1.1
	8	1.8	-
	200	1.3	0.6

Project: Buchanan - FN-20-7(10)--21-10

Aggregate Used -	Cr. Stone Weston Qr. 4*	
% Asphalt	1.25	
Freeze & Thaw "A"	1.0	
Abrasion	42	
Application Rate	7.2 lbs/sq. yd.	
Cost	$0.147/sq. yd.	
Gradation 3/4	100	
1/2	99	
3/8	70	
4	15	
8	4.6	
200	0.3	

Project: Jefferson - FN-1-2(11)--21-51

Aggregate Used -	Haydite 3*	Haydite 3*	Cr. Stone-Columbus Jct.4*
%Asphalt	2.12	1.5	2.0
Freeze & Thaw "A"	1.1	1.1	1.0
Abrasion	22	22	33
Application Rate	4.6 lbs/sq. yd.		7.54 lbs/sq. yd.
Cost	$0.147/sq. yd.		$0.158/sq. yd.
Gradation 3/4	-	100	100
1/2	100	99	99
3/8	98	64	85
4	32	3.7	24
8	6.0	-	8.7
200	1.2	1.8	3.0

Project: Cerro Grodo - FN-18-5(27)--21-17

Aggregate Used -	Quartzite (New Ulm) 2*	
%Asphalt	1.00	
Freeze & Thaw "A"	1.0	
Abrasion	24	
Application Rate	6.4 lbs/sq. yd.	
Cost	$0.185/sq. yd.	
Gradation 3/4	100	
1/2	79	
3/8	43	
4	9.6	
8	4.6	
200	1.1	

Appendix D
"Aggregate Frictional Quality Classification"

The five skid resistant types are listed and defined in order of descending quality as follows.

Type I
Aggregates which are generally a heterogeneous combination of minerals with coarse grained microstructure of very hard particles (Generally a Mohs Hardness range of 7 to 9) bonded together by a slightly softer matrix.

These aggregates are typified by those developed for and used by the grinding-wheel industry such as calcined bauxite (synthetic) and emery (natural). They normally are not available from Iowa sources. Due to the high cost, these aggregates would be specified only for extremely critical situations.

Type II
Natural aggregates in this class are crushed quartzite and granites. The mineral grains in these materials generally have a Mohs hardness range of 5 to 7.

Synthetic aggregates in this class are some aircooled steel furnace slags and others with similar characteristics.

Type III
Natural aggregates in this class are crushed traprocks, crushed gravels or those crushed from dolomitic ledges in which 80 percent or more of the grains have diameters of 120 microns or larger. The mineral grains in the approved dolomitic ledges generally have a Mohs hardness range of 3.5 to 4. The crushed gravels shall not contain more than 30 percent of carbonate stone as defined in the Type V classification.

Synthetic aggregates in this class are the expanded shales with a Los Angeles abrasion loss less than 35 percent.

Type IV
Aggregates crushed from dolomitic or limestone ledges in which 80 percent of the grains are 30 microns or larger. The mineral grains in the approved ledges for this classification generally have a Mohs hardness range of 3 to 4. The gravels shall not contain more than 60 percent of carbonate stone as defined in the Type V classification.

Type V
Aggregates crushed from lithographic and sublithographic limestone ledges and natural gravels containing more than 60 percent lithographic and sublithographic limestone particles. Grain sizes will predominately be below 30 microns for the crushed stone.

Ia. 1 from Fairfield south to the Van Buren Co. Line

Project FN-1-2(11)--21-51 Jefferson Co.

Section 1 - Station 1+00 - 39+50 1/2" Dolomite

	30 mph	40 mph	55 mph	30-55 mph
Southbound	54	46	43	
Speed Grad.	0.8	0.2		0.4

Section 1 - Station 63+50 - 111+50 1/2" Dolomite

	30 mph	40 mph	55 mph	30-55 mph
Southbound	55	49	43	
Speed Grad.	0.6	0.4		0.5

Section 2 - Station 282+50 - 353+78 3/4" Haydite

	30 mph	40 mph	55 mph	30-55 mph
Southbound	49	44	38	
Speed Grad.	0.5	0.4		0.4

Section 3 - Station 282+50 - 353+78 1/2" Haydite

	30 mph	40 mph	55 mph	30-55 mph
Southbound	55	49	42	
Speed Grad.	0.6	0.5		0.5

Section 4 - Station 63+50 - 111+50 A.C. Control

	30 mph	40 mph	55 mph	30-55 mph
Northbound	48	43	34	
Speed Grad.	0.5	0.6		0.6

Section 5 - Station 1+00 - 39+50 A.C. Control

	30 mph	40 mph	55 mph	30-55 mph
Northbound	49	42	34	
Speed Grad.	0.7	0.5		0.6

U.S. 20 from Independence to Jct. with Ia. 187

Project F-20-7(10)--20-10 Buchanan Co.

Control Section West End

	30 mph	40 mph	55 mph	30-55 mph
Eastbound	50	42	37	
Speed Grad.	0.8	0.3		0.5
Westbound	45	39	33	
Speed Grad.	0.6	0.4		0.5

Station 870+00 - 286+00 EB - 287+00 WB 1/2" Limestone 1.1% A.C.

	30 mph	40 mph	55 mph	30-55 mph
Eastbound	54	47	40	
Speed Grad.	0.7	0.5		0.6
Westbound	46	43	39	
Speed Grad.	0.3	0.5		0.3

Control Section East End

	30 mph	40 mph	55 mph	30-55 mph
Eastbound	49	42	35	
Speed Grad.	0.7	0.5		0.6
Westbound	43	41	34	
Speed Grad.	0.2	0.5		0.4

U.S. 69 from I-80 (Des Moines) north to Jct. Ia. 160

Project MP-1319--69-77 Polk County

Section 1 - Station 226+10 - 172+85 NB -152+47 SB

1/2" Haydite

	30 mph	40 mph	55 mph	30-55 mph
Northbound	48	48	43	
Speed Grad.	0.0	0.3		0.2
Southbound	47	46	40	
Speed Grad.	0.1	0.4		0.3

Section 2 - Station 152+47 SB - 144+25 NB - 63+97 3/4" Limestone

	30 mph	40 mph	55 mph	30-55 mph
Northbound	36	35	33	
Speed Grad.	0.1	0.2		0.1
Southbound	36	36	33	
Speed Grad.	0.0	0.2		0.1

Section 3 - Station 150+00 - 172+85 Control

	30 mph	40 mph	55 mph	30-55 mph
Northbound	36	35	33	
Speed Grad.	0.1	0.1		0.1

U.S. 18 From just east of I-35 to Mason City.

Project FN-18-5(27)--21-17 Cerro Gordo Co.

Section 1 - 35 mph speed zone

	30 mph	40 mph	55 mph	30-55 mph
Westbound	47			
Eastbound	45			

Section 2 - P.C. Concrete, not resurfaced

	30 mph	40 mph	55 mph	3-055 mph
Westbound	33	29	23	
Speed Grad.	0.4	0.4	0.4	0.5
Eastbound	35	31	24	
Speed Grad.	0.4	0.5	0.4	0.5

Section 3 Quartzite

	30 mph	40 mph	55 mph	30-55 mph
Westbound	60	54	54	
Speed Grad.	0.6	0.0	0.3	0.3
Eastbound	56	52	49	
Speed Grad.	0.4	0.2	0.3	0.3

U.S. 59 from Jct. with Ia. 244 North to near Oakland

Project MP-4531-69-D4 Pottawattamie Co.

Station 1398+00 - 2154+50 3/4" Haydite

	30 mph	40 mph	55 mph	30-55 mph
Northbound	56	52	52	
Speed Grad.	0.4	0.0		0.1
Southbound	54	49	46	
Speed Grad.	0.5	0.2		0.3

Ia. 38 from Tipton to U.S. 30

Project FN-38-2(11)--21-36 Cedar Co.

Section 2 - Station 10+78 - 88+91 1/2" Quartzite

	30 mph	40 mph	55 mph	30-55 mph
Northbound	58	52	51	
Speed Grad.	0.6	0.1		0.3
Southbound	56	51	47	
Speed Grad.	0.5	0.3		0.4

Section 2 - Station 122+51 - 271+00 1/2" Quartzite

	30 mph	40 mph	55 mph	30-55 mph
Northbound	59	52	47	
Speed Grad.	0.7	0.3		0.5
Southbound	57	52	48	
Speed Grad.	0.5	0.3		0.4

Section 1 - Station 271+00 - 402+80 3/4" Limestone

	30 mph	40 mph	55 mph	30-55 mph
Northbound	59	50	46	
Speed Grad.	0.9	0.3		0.5
Southbound	56	50	46	
Speed Grad.	0.6	0.3		0.4

$$\text{Speed Gradient} = \frac{SN_2 - SN_1}{S}$$

IOWA DEPARTMENT OF TRANSPORTATION

Ames, Iowa

Supplemental Specification

for

SPRINKLE TREATMENT OF ASPHALT CEMENT CONCRETE SURFACES

February 28, 1978

THE STANDARD SPECIFICATIONS, SERIES OF 1977, ARE AMENDED BY THE FOLLOWING ADDITIONS. THESE ARE SUPPLEMENTAL SPECIFICATIONS, AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

824.01 DESCRIPTION. Sprinkle Treatment shall consist of properly graded aggregate, precoated with asphalt cement and applied to the surface of hot-mix asphalt cement concrete pavement as designated in these specifications and elsewhere in the contract documents.

824.02 MATERIALS. The materials used in sprinkle treatments of asphalt cement concrete surfaces shall meet the following requirements.

A. Aggregate shall be composed of a Type III crushed gravel or a Type IV crushed stone as classified in Materials Instructional Memorandum T-203 or lightweight aggregate (expanded shales).

Crushed gravel shall be produced as a separate operation by crushing gravel to the extent that 100 percent will pass the 3/4-inch sieve; the aggregate shall be prescreened prior to crushing on a screen at least 1/4 inch larger. The prescreen size shall be adjusted to compensate for screening efficiency, material variability, and carryover.

All limestone and gravel aggregates shall be washed products.

All aggregate sources and production procedures shall be subject to approval of the engineer, and the aggregate shall meet the following requirements.

1. Freezing-and-Thawing Test. The freezing-and-thawing test loss, when tested according to Laboratory Test Method 211, Method A, shall not exceed 10 percent.
2. Abrasion Loss. The percentage of wear, as determined by AASHTO T 96, shall not exceed 40.
3. Size of Particles. When tested by means of laboratory sieves, the aggregate shall meet the following limits. The percentage passing the No. 200 sieve shall be determined by washing followed by dry sieving. Any mudballs present shall be completely broken up and dissolved.

Sieve Size	Percent Passing
3/4	100
3/8	20 - 55
No. 4	0 - 5
No. 200	- 1.5

B. Asphalt. The asphalt cement used to coat the aggregate shall be the grade used in the asphalt surface course.

C. Aggregate Coating. Aggregates to be used for sprinkle treatment shall be submitted to the Central Laboratory prior to precoating. The Laboratory will designate the proper coating, and this may be modified by the engineer. The designated coating will be between 0.75 percent and 2.0 percent, expressed as percent by weight of asphalt cement in the total mixture. The designated coating shall be considered a target value.

824.03 EQUIPMENT. The equipment used for spreading the precoated aggregate shall be a Bristowes Chip Spreader. An equivalent spreader may be approved by the engineer.

Initial rolling shall be with a self-propelled, smooth, steel-tired roller meeting requirements of 2001.05B.

824.04 PRECOATED AGGREGATE. The equipment and procedures for precoating shall comply with the applicable requirements of 2001.22 and 2303.04.

The aggregate shall be precoated at a temperature between 240F and 275F and shall have a uniform, complete coating. The aggregate should be coated at the lowest temperature that insures complete coating. If coated aggregate is stockpiled, it shall be stockpiled on a clean, paved surface. Stockpiling methods which minimize segregation shall be used. Provisions should be made for manipulation or wetting of the coated aggregate if crusting of the aggregate occurs. The engineer may require the stockpile to be covered.

At the option of the contractor, precoated aggregate remaining at the completion of the work will be purchased and paid for by the contracting authority. The precoated aggregate shall be hauled and stockpiled at a site designated by the engineer. The haul may be as far as the nearest maintenance garage of the contracting authority. The engineer may limit the quantity of aggregate to be precoated to assure this quantity is reasonable.

824.05 CONSTRUCTION. The precoated aggregate may be spread hot or cold. It shall be uniformly applied to the surface of the asphalt surface course as soon as possible after laydown and before initial rolling of the surface. The spreader shall span the lane to be spread. Provisions should be made for wetting the coated aggregate if crusting or unusual adherence of aggregate particles occurs.

The precoated aggregate shall be applied to the surface at a target rate of 7 1/2 pounds per square yard when crushed stone or gravel is used, and the contract quantities are based on this rate. When lightweight aggregate is used, the coated aggregate shall be applied at the rate of 5 pounds per square yard. These target rates may be adjusted by the engineer to insure proper coverage of the surface area.

Rolling shall commence immediately after the coated aggregate is applied unless otherwise directed by the engineer. The initial rolling shall be done with a steel roller. Compaction shall be in accordance with the requirements for the type of surface course being laid. Pneumatic-tired rollers, when used for intermediate compaction, shall not be used if tire pick up of sprinkle aggregate is encountered.

Any nonuniform distribution of coated aggregate shall be corrected with lutes or brooms before initial rolling.

Traffic will not be permitted on the finished surface until the pavement has cooled to such a level that the coated aggregate will not pick up under the tires. Sprinkling the pavement surface with water may be required, as directed by the engineer, to promote cooling of the pavement prior to opening the roadway to traffic.

824.06 LIMITATIONS. Sprinkle Treatment of asphalt cement concrete surfaces shall not be placed after October 1 except by authorization of the Construction Engineer.

824.07 METHOD OF MEASUREMENT. The quantity of Aggregate for Sprinkle Treatment will be computed from weights of precoated aggregate that is applied to the asphalt surface course, in accordance with appropriate requirements of 2303.19A.

When payment is to be made for precoated aggregate remaining at the completion of the work, precoated aggregate will be measured separately in the same manner.

824.08 BASIS OF PAYMENT. For the number of tons of Aggregate for Sprinkle Treatment, satisfactorily applied to the asphalt surface course and measured as provided above, the contractor will be paid the contract price therefor.

For the number of tons of precoated aggregate remaining at the completion of the work and hauled and stockpiled according to 824.04, the contractor will be paid 25 percent of the contract price for Aggregate for Sprinkle Treatment.

These payments shall be full compensation for furnishing, precoating, and applying the precoated aggregate to the asphalt surface course and for furnishing, precoating, hauling, and stockpiling the precoated aggregate remaining at the completion of the work. Asphalt cement used for precoating will be considered incidental.

Water, when required, will be considered incidental.

Article 1109.03 shall not apply to Aggregate for Sprinkle Treatment when the change in quantities is due to use of lightweight aggregate.

Specification 863
Supersedes 842

Appendix G
"1980 Supplemental Specifications"

IOWA DEPARTMENT OF TRANSPORTATION
Ames, Iowa

Supplemental Specification
for

SPRINKLE TREATMENT OF ASPHALT CEMENT CONCRETE SURFACES

April 22, 1980

THE STANDARD SPECIFICATIONS, SERIES OF 1977, ARE AMENDED BY THE FOLLOWING ADDITIONS. THESE ARE SUPPLEMENTAL SPECIFICATIONS, AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

863.01 DESCRIPTION. Sprinkle treatment shall consist of properly graded aggregate, precoated with asphalt cement and applied to the surface of hot-mix asphalt cement concrete pavement as designated in these specifications and elsewhere in the contract documents.

863.02 MATERIALS. The materials used in sprinkle treatments of asphalt cement concrete surfaces shall meet the following requirements.

A. Aggregate shall be composed of a Type III crushed gravel or a Type II, III or IV crushed stone as classified in Materials Instructional Memorandum T-203 or lightweight aggregate (expanded shales).

Crushed gravel shall be produced as a separate operation by crushing gravel to the extent that 100 percent will pass the 3/4-inch sieve; the aggregate shall be prescreened prior to crushing on a screen at least 1/4 inch larger. The prescreen size shall be adjusted to compensate for screening efficiency, material variability, and carryover.

All limestone and gravel aggregates shall be washed products.

All aggregate sources and production procedures shall be subject to approval of the engneer, and the aggregate shall meet the following requirements.

1. Freezing-and-Thawing Test. The freezing-and-thawing loss, when tested according to Laboratory Test Method 211, Method A, shall not exceed 10 percent.
2. Abrasion Loss. The percentage of wear, as determined by AASHTO T 96, shall not exceed 35 for lightweight aggregate and 40 for all other aggregate.
3. Size of Particles. When tested by means of laboratory sieves, the aggregate shall meet the following limits. The percentage passing the No. 200 sieve shall be determined by washing, followed by dry sieving. Any mudballs present shall be completely broken up and dissolved.

Sieve Size	Percent Passing
3/4	100
3/8	0 - 15
No. 4	0 - 5
No. 200	- 1.5*

*The maximum percent passing the No. 200 sieve may be increased to 2.5 percent provided the documented production limit agreed to and maintained is 1.0 percent or less and any increase up to 2.5 percent is due to degradation of the parent material and not to contamination by other material.

B. Asphalt. The asphalt cement used to coat the aggregate shall be the grade used in the asphalt surface course.

C. Aggregate Coating. Samples of aggregates to be used for sprinkle treatment shall be submitted to the Central Laboratory for testing prior to precoating. The Laboratory will designate the proper coating, and this may be modified by the engineer. The designated coating will be between 0.75 percent and 2.0 percent, expressed as percent by weight of asphalt cement in the total mixture. The designated coating shall be considered a target value.

863.03 EQUIPMENT. The equipment used for spreading the precoated aggregate shall be a Bristowes Chip Spreader. An equivalent spreader may be approved by the engineer. The spreader shall be capable of uniformly distributing the chips without degradation. The drum flutes of the Bristowes spreader shall be of the 3/4-inch flute dimension, as defined by the manufacturer.

The equipment and method used for charging the chip spreader shall be subject to approval of the engineer. Charging shall be accomplished without damaging or degrading the chips.

Initial rolling shall be with a self-propelled, smooth, steel-tired roller meeting requirements of 2001.05B.

863.04 PRECOATED AGGREGATE. The equipment and procedures for precoating shall comply with the applicable requirements of 2001.22 and 2303.04.

The aggregate shall be precoated at a temperature between 240F and 275F and shall have a uniform, complete coating. The aggregate should be coated at the lowest temperature that insures complete coating. If coated aggregate is stockpiled, it shall be stockpiled on a clean, paved surface. Stockpiling methods which minimize segregation shall be used. Provisions should be made for manipulation or wetting of the coated aggregate if crusting of the aggregate occurs. No water shall be applied to the freshly coated aggregate until it has cooled sufficiently to prevent the possibility of stripping. The engineer may require the stockpile to be covered.

At the option of the contractor, precoated aggregate remaining at the completion of the work will be purchased and paid for by the contracting authority. The precoated aggregate shall be hauled and stockpiled at a site designated by the engineer. The haul may be as far as the nearest maintenance garage of the contracting authority. The engineer may limit the quantity of aggregate to be precoated to assure this quantity is reasonable.

863.05 CONSTRUCTION. The precoated aggregate may be spread hot or cold. It shall be uniformly applied to the surface of the asphalt surface course as soon as possible after laydown and before initial rolling of the surface. The spreader shall span the lane to be spread. Provisions should be made for wetting the coated aggregate if crusting or unusual adherence of aggregate particles occurs.

The precoated aggregate shall be applied to the surface at a target rate of 7 1/2 pounds per square yard when crushed stone or gravel is used, and the contract quantities are based on this rate. When lightweight aggregate is used, the coated aggregate shall be applied at the rate of 5 pounds per square yard. These target rates may be adjusted by the engineer to insure proper coverage of the surface area.

Rolling shall commence immediately after the coated aggregate is applied unless otherwise directed by the engineer. The initial rolling shall be done with a steel roller. Compaction shall be in accordance with the requirements for the type of surface course being laid. Pneumatic-tired rollers, when used for intermediate compaction, shall not be used if tire pick up of sprinkle aggregate is encountered.

Any nonuniform distribution of coated aggregate shall be corrected with lutes or brooms before initial rolling.

Traffic will not be permitted on the finished surface until the pavement has cooled to such a level that the coated aggregate will not pick up under the tires. Sprinkling the pavement surface with water may be required, as directed by the engineer, to promote cooling of the pavement prior to opening the roadway to traffic.

863.06 LIMITATIONS. Sprinkle treatment of asphalt cement concrete surfaces shall not be placed after October 1 except by authorization of the Construction Engineer.

863.07 METHOD OF MEASUREMENT. The quantity of Aggregate for Sprinkle Treatment will be computed from weights of precoated aggregate that is applied to the asphalt surface course, in accordance with appropriate requirements of 2303.19A.

When payment is to be made for precoated aggregate remaining at the completion of the work, precoated aggregate will be measured separately in the same manner.

863.08 BASIS OF PAYMENT. For the number of tons of Aggregate for Sprinkle Treatment, satisfactorily applied to the asphalt surface course and measured as provided above, the contractor will be paid the contract price therefor.

For the number of tons of precoated aggregate remaining at the completion of the work and hauled and stockpiled according to 863.04, the contractor will be paid 25 percent of the contract price for Aggregate for Sprinkle Treatment.

These payments shall be full compensation for furnishing, precoating, and applying the precoated aggregate to the asphalt surface course and for furnishing, precoating, hauling, and stockpiling the precoated aggregate remaining at the completion of the work. Asphalt cement used for precoating will be considered incidental.

Water, when required, will be considered incidental.

Article 1109.03 shall not apply to Aggregate for Sprinkle Treatment when the change in quantities is due to use of lightweight aggregate.