EVALUATION OF RECYCLED RUBBER IN ASPHALT CONCRETE PLYMOUTH COUNTY

CONSTRUCTION REPORT
IOWA HIGHWAY RESEARCH BOARD
PROJECT HR-330A

AUGUST 1992

Highway Division

Iowa Department of Transportation

Construction Report
for
Iowa Highway Research Board
Project HR-330A

Evaluation of Recycled Rubber in Asphalt Concrete - Plymouth County

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August 1992

TECHNICAL REPORT TITLE PAGE

1. REPORT NO.	2. REPORT DATE
HR-330A	August 1992
3. TITLE AND SUBTITLE	**4. TYPE OF REPORT & PERIOD COVERED**
Evaluation of Recycled Rubber in Asphalt Concrete - Plymouth County	Construction Report October 1991 thru May 1992
5. AUTHOR(S)	**6. PERFORMING ORGANIZATION ADDRESS**
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7. ACKNOWLEDGEMENT OF COOPERATING ORGANIZATIONS

8. ABSTRACT

The Iowa Department of Transportation is evaluating the use of ground recycled crumb rubber from discarded tires in asphalt rubber cement. There were four projects completed during 1991 and another one constructed in 1992.

This project is located on IA 140 north of Kingsley in Plymouth County. The project contains one section with reacted asphalt rubber cement (ARC) used in both binder and surface courses, one with reacted ARC used in the surface course and a conventional binder course, and a conventional mix control section.

The reacted rubber binder course was placed on October 17, 1991 and the reacted rubber surface course was placed on October 17, 18, and 19.

Inclement weather caused a slight delay in placing or constructing the surface. There was a minor problem with shoving and cracking of the binder course. The construction went well otherwise.

Information included in this report consists of test results, construction reports, and cost comparisons.

9. KEY WORDS	10. NO. OF PAGES
Asphalt pavement, Crumb rubber Ground recycled rubber Discarded tires, Asphalt-rubber	31

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DISCLAIMER

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

INTRODUCTION

Disposal of discarded tires has become a problem. Recycling discarded automobile and truck tires into asphalt rubber cement (ARC) is currently being researched in Iowa.

The Iowa DOT currently has six projects using ARC which they are studying. Five of these have been completed.

This project in Plymouth County was constructed using ARC in the binder and surface courses in one section. A second section used the ARC in the surface course only. The third was a control section of conventional asphaltic concrete that will be compared to the ARC.

OBJECTIVE

The objective of this research project was to evaluate the use of finely ground recycled tire rubber as combined with asphalt cement to produce ARC.

CONTRACTOR

Brower Construction Company of Sioux City, Iowa was the contractor on this project. The ARC mixes were hauled from their stationary plant in Sioux City. The conventional mixes were produced at a portable plant adjacent to the job site.

PROJECT LOCATION

The project was located on IA 140 north of Kingsley in Plymouth County, Iowa. The test sections are listed in Table I.

TABLE I

Test Section	Sta. to Sta.	Lane	Type of Mix
#1	375+00 to 428+00	NB&SB	ARC Binder & Surface
#2	428+00 to 481+00	NB	ARC Surface Only
#3	555+00 to 582+00	NB&SB	Conventional Control Sec.

PRECONSTRUCTION SURVEY

The existing surface was a seal coat constructed in 1983. It was 22 ft. wide and has a daily traffic volume of 700 vehicles per day, with 14% trucks.

A crack survey was conducted on the roadway prior to construction. A Road Rater structural evaluation was also performed prior to construction and again shortly after construction. The results are in Appendix C.

The original roadway had major cracking and distressed areas.

MATERIALS

The ground tire rubber was provided by Rouse Rubber Products of Vicksburg, Mississippi. A GF-60 rubber was used on this project. Both the crushed aggregates and natural sand were purchased from L. G. Everist, Hawarden, Iowa. The AC-5 was from Jebro.

Gradation limits on the rubber and aggregates are shown in the Special Provisions in Appendix A. Actual aggregate and rubber gradations at the time of construction are given in Appendix B.

VISCOSITY TESTING

Viscosity testing on the ARC was done prior to construction and checked again with material obtained during production. This testing was done by the Iowa DOT Materials Laboratory. These results are in Appendix B. The viscosity requirements were 1500-4000 cp. The viscosity was also checked with a Brookfield viscometer at the job site by Rouse representatives.

The Rouse representative was concerned since the contractor was pumping the AC-5 directly out of the tanker into the blender-reactor, which is used to react and blend the crumb rubber and AC-5. It would be possible to suck air into the reactor and lower the viscosity. This did not prove to be a problem and the viscosity stayed within limits.

MIX DESIGN

Samples of all materials were obtained for preliminary testing by the Iowa DOT laboratory at Ames. The job mix data is located in Appendix B.

The intended AC content in the ARC binder mix was 6.6%. The laboratory originally recommended an AC content of 7.5% in the ARC surface mix, but after reviewing the mix design, it was lowered to 6.8% and again to 6.6%. On October 19, 1992 it was raised to 7.1% because of high air voids. The lab voids then dropped from 5.3% to 3.9%. All lab densities and voids are shown on the plant reports in Appendix B.

PLANT OPERATION

The asphalt rubber producer's setup was different from previous projects because the line to the reactor carrying the AC-5 was connected directly to the tanker. Rouse's technician thought this might cause a problem with viscosity but it did not seem to make a difference. They had also insulated the reactor since the Muscatine project completed earlier in the year. The Brower plant was producing the ARC mix at 170 ton/hr which was normal production for that plant.

PAVING OPERATION

Placement began on October 17, 1991. Brower was using a PF-180 H Blawknox paver on this project. The paving of the ARC was similar to conventional mixes.

This project had cracking and spreading of the mat as what was encountered on the Muscatine ARC project. Two of the other ARC projects that had been completed didn't have this problem. The mix was placed on a milled surface on those two projects where as it was not on this project or the Muscatine project. Whether or not it is placed on a milled surface could be a factor as to whether it spreads or not.

The weather was cooler, around 40°F, than when the Muscatine asphalt rubber mixture was placed, so the roller had to keep fairly close to the paver rather than the distance the roller maintained on the Muscatine project.

In general, the paving of the ARC mixture was no more difficult than conventional paving.

CONSTRUCTION TESTING

Samples were obtained during construction for viscosity testing and also creep and resilient modulus testing.

Shortly after construction the Road Rater structural testing was performed on the test and control sections. Friction testing was done at this time also. The results of all field tests are located in Appendix C and all lab test results are in Appendix B.

COST COMPARISON

A disadvantage to using ARC is the higher cost. On this project the conventional asphalt cement was bid at $118/ton and the asphalt cement (reacted rubber) was bid at $210/ton. The contract prices per ton of the different asphalt mixes are summarized in Table II.

TABLE II

Conventional Binder		Conventional Surface	
	$14.60		$15.70
AC-10	6.37	AC-10	6.49
(5.4%)	======	(5.5%)	======
	$20.97		$22.19

ARC Binder		ARC Surface	
	$17.50		$18.35
ARC	13.86	ARC	14.28
(6.6%)	======	(6.8%)	======
	$31.36		$32.63

EVALUATION

Friction testing, Road Rater testing, and crack and rut surveys were conducted immediately after construction and will be conducted annually.

In addition to the standard project testing of the mix, creep and resilient modulus testing were performed for evaluation.

Hopefully, a conclusion can be reached to determine if using asphalt rubber cement will:

1. Improve performance
2. Extend the life of the roadway
3. Be of enough value from an environmental standpoint to compensate for its higher cost.

CONCLUSION

From the project the following conclusions can be made:

1. ARC mix can be constructed with little or no difference from a conventional mix.
2. ARC pavement appears to be in as good a condition as the conventional.

Appendix A
Contract & Special Provisions

County PLYMOUTH Project No. FN-140-2(6)--21-75
Res. Engr. TONY G. LAZAROWICZ Address SIOUX CITY RCE 523100
Letting Date JULY 16, 1991 Liquidated Damages $750 PER DAY
Special Prov. SP-1022 07/16/91, SS-1008 11/05/85, SS-1057 02/23/88,
SS-1061 05/10/88, SS-1062 08/01/88, SS-1083 06/27/89,
SS-1089 12/05/89, SS-1091 12/05/89, SS-1093 12/05/89,
SS-1094 12/05/89, SS-5014 12/11/90, SS-5015 12/11/90,
SS-5018 02/12/91, SS-5025 03/26/91

Date Started _____ Field Comp. _____ Cert. Comp. _____

Form 650019 4-88 H-6288

CONTRACT NO. 33391

County PLYMOUTH Project No. FN-140-2(6)--21-75
Type of Work ASPH CEMENT CONC RESURFACING Miles 15.7220
Cost Center 611000 Object Code 892 Milepost 9.64 TO 25.36
ON IOWA 140 FROM WITHIN THE CITY OF KINGSLEY, EAST AND NORTH TO THE JUNCTION OF IOWA 3.

This agreement made and entered by and between the IOWA DEPARTMENT OF TRANSPORTATION AUSTIN TURNER, DOUGLAS SHULL, ROBERT H. MEIER, SHELDA HERTZKE BEENER, SUZAN STEWART, CATHERINE DUNN & MARLIN VOLZ JR. Contracting Authority, and
BROWER CONSTRUCTION CO. OF SIOUX CITY, IOWA
00004250 Contractor.

It is agreed that the notice and instructions to bidders, the proposal filed herein, the general specifications of the Iowa Department of Transportation for 1984, together with supplemental specifications and special provisions, together with the general and detailed plans, if any, for said project FN-140-2(6)--21-75, together with Contractor's performance bond, are made a part hereof and together with this instrument constitute the contract. This contract contains all of the terms and conditions agreed upon by the parties hereto. A true copy of said plans and specifications is now on file in the office of the Contracting Authority under date of JULY 11, 1991.

Contractor, for and in consideration of $ **1,750,062.96, payable as set forth in the specifications constituting a part of this contract, agrees to construct various items of work and/or provide various materials or supplies in accordance with the plans and specifications therefor, and in the locations designated in the Notice to Bidders.

Contractor certifies by his signature on this contract, under pain of penalties for false certification, that he has complied with Iowa Code Section 324.17(8) (1985) as amended, if applicable.

In consideration of the foregoing, Contracting Authority hereby agrees to pay the Contractor promptly and according to the requirements of the specifications the amounts set forth, subject to the conditions as set forth in the specifications.

It is further understood and agreed that the above work shall be commenced or completed in accordance with the following schedule:

START. DATE	COMPL. DATE	WORK. DAYS
	10/25/91	40

Time is the essence of this contract.

To accomplish the purpose herein expressed, Contracting Authority and Contractor have signed this and four other identical instruments as of the _____ day of _____.

IOWA DEPARTMENT OF TRANSPORTATION

By _____
Contracting Authority

BROWER CONSTRUCTION CO. OF SIOUX CITY, IOWA

By _____ _____
Contractor

Form 650031 8-67 H-6288

CONTRACT PRICES

Proposal I.D. No. 911103 CONTRACT NO. 33391 Bid Order No. 64

Contractor's No. 0,4,2,5,0 County PLYMOUTH Page No. 1

Project No. FN-140-2(6)--21-75 Type of Work ASPH CEMENT CONC RESURFACING

Line No.	Item	Item Quantity and Units	Unit Price		Amount	
			Dollars X,XXX,XXX	Cents XXXX	Dollars XX,XXX,XXX	Cents XX
0010	PAVEMENT SCARIFICATION	1585.8 SQ. YDS.	5.0000		7,929.00	
0020	BASE, CLEANING & PREPARATION OF	15.774 MILES	500.0000		7,887.00	
0030	ASPHALT CEMENT CONCRETE, TYPE B WEDGE, LEVEL OR STRENGTH. COURSE	16867 TONS	14.9000		251,318.30	
0040	ASPHALT CEMENT CONCRETE, TYPE B BINDER COURSE, MIXT. SIZE 3/4 IN.	16870 TONS	14.6000		246,302.00	
0050	ASPHALT CEMENT CONCRETE, TYPE A SURFACE COURSE, MIXT. SIZE 1/2 IN.	16404 TONS	15.7000		257,542.80	
0060	ASPHALT CEMENT	2880 TONS	118.0000		339,840.00	
0070	PRIMER OR TACK-COAT BITUMEN	32516 GALLONS	0.8800		28,614.08	
0080	ASPH.CEM.CONC., TYPE B BINDER, 3/4 IN. (ASPHALT RUBBER CEMENT (A.R.C.) CONCRETE)	1125 TONS	17.5000		19,687.50	
0090	ASPH.CEM.CONC., TYPE A SURFACE, 1/2 IN. (ASPAHLT RUBBER CEMENT (A.R.C.) CONCRETE)	1667 TONS	18.3500		30,589.45	
0100	ASPHALT RUBBER CEMENT (A.R.C.)	210 TONS	210.0000		44,100.00	
0110	SHOULDERS, GRANULAR, TYPE B	8136 TONS	15.8000		128,548.80	
0120	PATCHES, FULL-DEPTH, BY COUNT	107 ONLY	50.0000		5,350.00	
0130	PATCHES, FULL-DEPTH, BY AREA	1058 SQ. YDS.	53.0000		56,074.00	
0140	RUMBLE STRIP PANEL	9 ONLY	300.0000		2,700.00	
0150	FIXTURES, ADJUSTMENT OF	4 ONLY	150.0000		600.00	
0160	SUBDRAIN, LONGITUDINAL, (SHOULDER) 4 IN. DIA.	25990 LINEAR FT	3.5300		91,744.70	
0170	SUBDRAIN OUTLET, CORRUGATED METAL PIPE, 6 IN. DIA.	106 ONLY	95.0000		10,070.00	
0180	EMBANKMENT-IN-PLACE	2064 CUBIC YDS	5.0000		10,320.00	
0190	PAVEMENT MARKINGS	2507 STAS.	9.8500		24,693.95	
0200	REMOVAL OF EXISTING HANDRAIL	1 LUMP SUM	1300.0000		1,300.00	

Line No.	Item	Item Quantity and Units	Unit Price Dollars X,XXX,XXX	Unit Price Cents XXXX	Amount Dollars XX,XXX,XXX	Amount Cents XX
	(CONTINUED)					
0210	RAIL, CONCRETE BARRIER (CAST-IN-PLACE)	627.6 LINEAR FT	40.0000		25,104.00	
0220	GUARDRAIL, FORMED STEEL BEAM	600 LINEAR FT	8.0000		4,800.00	
0230	GUARDRAIL, FORMED STEEL THRIE BEAM	550 LINEAR FT	16.0000		8,800.00	
0240	GUARDRAIL, POSTS, BEAM	220 ONLY	45.0000		9,900.00	
0250	GUARDRAIL, END ANCHORAGES, BEAM, RE-52	16 ONLY	450.0000		7,200.00	
0260	GUARDRAIL, END ANCHORAGES, BEAM, RE-69	12 ONLY	200.0000		2,400.00	
0270	SPACER BLOCK ASSEMBLY - FOR GUARDRAIL	8 ONLY	50.0000		400.00	
0280	OBJECT MARKER, TYPE 3	16 ONLY	75.0000		1,200.00	
0290	OBJECT MARKER, TRIPLE YELLOW AS PER PLAN	24 ONLY	24.0000		576.00	
0300	DELINEATORS, SINGLE WHITE	42 ONLY	22.0000		924.00	
0310	SEEDING & FERTILIZING	0.5 ACRES	1500.0000		750.00	
0320	MULCHING	0.5 ACRES	1500.0000		750.00	
0330	SAMPLES	1 LUMP SUM	4369.2900		4,369.29	
0340	TRAFFIC CONTROL	1 LUMP SUM	15000.0000		15,000.00	
0350	CULVERT, UNCLASSIFIED ENTRANCE PIPE, 18 IN. DIA.	48 LINEAR FT	16.6000		796.80	
0360	APRONS, UNCLASSIFIED, 18 IN. DIA.	2 ONLY	180.0000		360.00	
0370	CULVERT, UNCLASSIFIED ENTRANCE PIPE, 15 IN. DIA.	46 LINEAR FT	15.5000		713.00	
0380	APRONS, UNCLASSIFIED, 15 IN. DIA.	2 ONLY	170.0000		340.00	
0390	CONCRETE, STRUCTURAL	3.9 CUBIC YDS	600.0000		2,340.00	
0400	STEEL, REINFORCING, EPOXY COATED	592 POUNDS	2.0000		1,184.00	
0410	FIELD LABORATORY	1 ONLY	5169.2900		5,169.29	
0420	FLAGGERS	175 DAYS	105.0000		18,375.00	
0430	PILOT CARS	40 DAYS	160.0000		6,400.00	
0440	MOBILIZATION	1 LUMP SUM	67000.0000		67,000.00	

TOTAL $1,750,062.96

LAST PAGE

SP-1022
(New)

Iowa Department of Transportation

SPECIAL PROVISIONS
for
ASPHALT RUBBER CEMENT (ARC) CONCRETE

FN-140-2(6)—21-75, Plymouth County

July 16, 1991

THE STANDARD SPECIFICATIONS, SERIES OF 1984, ARE AMENDED BY THE FOLLOWING MODIFICATIONS. THESE ARE SPECIAL PROVISIONS, WHICH SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

1022.01 DESCRIPTION.

The asphalt rubber cement (ARC) concrete mix composition will include the incorporation of ARC in the mixture, using the aggregates selected by the Contractor.

The Contractor shall have a representative of the rubber supplier available on the project site during the initial production of the ARC materials. The Contractor shall have a representative of the rubber supplier on call for technical assistance during production operations.

1022.02 GENERAL REQUIREMENTS.

The ARC concrete mixes shall conform to the requirements of the standard specifications for the standard asphalt cement concrete mixes as specified in the plans. The Standard Specifications are modified as follows:

A. **Mineral Aggregate for the ARC Concrete Mixes.**

Mineral aggregates shall meet Type "A" quality as specified in the plans and the standard specifications except the gradations for the concrete mixtures shall meet the following:

Sieve size	Percent passing 1/2" ARC Concrete Mixture	Percent passing 3/4" ARC Concrete Mixture
1"		100
3/4"	100	98-100
1/2"	94-100	76-92
3/8"	74-94	60-83
#4	47-69	40-62
#8	29-51	26-45
#30	12-27	11-24
#200	3-7	3-7

B. Asphalt Rubber Cement (ARC)

The ARC shall be a uniform mixture of compatible paving grade asphalt cement, ground reclaimed vulcanized rubber, and if required by the mixture design, a liquid anti-strip agent. The ARC shall meet the following physical parameters when reacted at 350 ±10 degrees Fahrenheit for 60 minutes.

Test	Requirements
Viscosity Brookfield, 350°F	1500 - 4000 CP
Resilience 77°F ASTM D3407	10% min.

C. Asphalt Extender Oil

An asphalt extender oil may be added, if necessary, to meet the requirements of Section 1022.02B of these special provisions. Extender oil shall be a resinous, high flash point, aromatic hydrocarbon meeting the following test requirements.

Viscosity, SSU, at 100 degrees F (ASTM D88)	2500 min.
Flash Point, COC, degrees F (ASTM D92)	390 min.
Molecular Analysis (ASTM D 2007):	
Asphaltenes, Wt. %	0.1 min.
Aromatics, Wt. %	55.0 min.

1022.03 GROUND RECLAIMED VULCANIZED RUBBER.

The rubber used shall be produced from the recycling of automobile and truck tires. Final grinding of the rubber shall be accomplished with processes performed at the ambient temperature. The use of ground rubber from multiple sources is acceptable provided the over-all blend of rubber meets the gradation requirements. The gradation of the rubber when tested in accordance with ASTM C136 using approximately 50 grams shall be in accordance with the following table.

Sieve Size	Percent passing
#10	100
#30	25-100
#50	10-100

Gradation of the rubber may be adjusted due to compatibility and reaction characteristics with the asphalt cement as required in the job mix formula.

Specific gravity of the rubber shall be 1.15 ± 0.05 and it shall be free from fabric, wire, or other contaminating materials. However, up to four percent calcium carbonate may be included to prevent the particles of rubber from sticking together.

The rubber shall be dry so as to be free flowing and not produce foaming when blended with hot asphalt cement. Not more than 1% of the particles shall exceed six times their minimum dimension.

1022.04 PACKAGING.

The ground rubber shall be supplied in moisture resistant disposable bags which weigh 50 ± 2 lbs. The bags shall be palletized into units each containing 50 bags to provide net pallet weights of 2500 ± 100 lbs. Glue shall be placed between layers of bags to increase the unit stability during shipment. Palletized units shall be double wrapped with ultra-violet resistant stretch wrap.

1022.05 CERTIFICATION.

The manufacturer shall ship with the rubber, certificates of compliance which certify that all requirements of these specifications are complied with for each production lot number of shipment.

1022.06 ASPHALT RUBBER CEMENT (ARC) MIXTURE DESIGN

The asphalt cement to be reacted with rubber shall be grade AC-5. The proportion of ground rubber shall be between 10 and 25 percent by weight of the asphalt cement.

The Contractor shall supply to the Engineer, for approval, a mix formulation at least 10 days before pavement construction is scheduled to begin. Mix design criteria for the ARC concrete mixes shall be the same for the non-rubber asphalt cement concrete (ACC) mixtures used on this project.

1022.07 ASPHALT RUBBER CEMENT (ARC) MIXING AND PRODUCTION EQUIPMENT

Unless otherwise authorized by the Engineer, all equipment utilized in production and proportioning of the ARC shall be described as follows:

A. An asphalt heating tank with a hot oil heat transfer system or retort heating system capable of heating asphalt cement to the necessary temperature for blending with the ground rubber.

B. An ARC mechanical blender with a two stage continuous mixing process capable of producing a homogeneous mixture of asphalt cement and ground rubber, at the mix design specified ratios, as recommended by the supplier of the ground rubber. This unit shall be equipped with a ground rubber feed system capable of supplying the asphalt cement feed system as not to interrupt the continuity of the blending process. A separate asphalt cement feed pump and finished product pump are required. This unit shall have both an asphalt cement totalizing meter in gallons and a flow rate meter in gallons per minute.

C. An ARC storage tank equipped with a heating system to maintain the proper temperature for pumping and adding of the binder to the aggregate and an internal mixing unit within the ground vessel capable of maintaining a proper mixture of asphalt cement and ground rubber.

D. An ARC supply system equipped with a pump and metering device capable of adding the ARC by volume to the aggregate at the percentage required by the job-mix formula.

An interlock of the ARC and aggregate feed systems will not be required. The Contractor shall accurately proportion the ARC into the mixture.

1022.08 ASPHALT RUBBER CEMENT MIXING AND REACTING PROCEDURE.

A. Asphalt Cement Temperature.

The temperature of the asphalt cement shall be between 290^{o} and 400 degrees F. at the addition of the ground rubber, as directed by the supplier.

B. Blending and Reacting.

The asphalt and ground rubber shall be combined and mixed together in a blender unit, pumped into the agitated storage tank, and then reacted for a minimum of 45 minutes from the time the ground rubber is added to the asphalt cement, or as directed by the supplier. Temperature of the ARC mixture shall be maintained between 290° and 375 degrees F. during the reaction period, or at a temperature specified by the supplier.

C. Transfer.

After the material has been reacted, the ARC shall be metered into the mixing chamber of the ARC concrete production plant at the percentage required by the job-mix formula.

D. Delays.

When a delay occurs in ARC use after its full reaction, the ARC shall be reheated slowly just prior to use to a temperature between 290° and 375 degrees F., and shall also be thoroughly mixed before pumping and metering into the hot mix plant for mixing with the aggregate. The viscosity of the ARC shall be checked by the supplier to assure specification compliance.

1022.09 COMPACTION REQUIREMENT.

The ARC concrete shall be compacted to 95% of laboratory density.

1022.10 COMPACTION EQUIPMENT.

A minimum of two rollers meeting Article 2001.05B shall be furnished. Pneumatic tired rollers will not be allowed.

1022.11 METHOD OF MEASUREMENT AND BASIS OF PAYMENT OF ASPHALT RUBBER CEMENT (ARC) CONCRETE.

The ARC Concrete Mix will be measured as per the standard specification, and be paid for in tons. ARC for use in the ARC Concrete Mix will be measured as per the standard specifications and be paid for in tons.

Appendix B
Lab Testing

IOWA DEPARTMENT OF TRANSPORTATION CORRECTED
OFFICE OF MATERIALS
TEST REPORT - ASPHALT MIX DESIGN
LAB LOCATION - AMES

LAB NO....:ABD1-0226

MATERIAL.....:TYPE B CL 1 ARC
INTENDED USE....:BINDER
PROJECT NO.....:EN-140-2(6)--21-75
COUNTY.....:PLYMOUTH
SPEC NO.....:5018.00
SUPP SPEC NO....:1022.00
SAMPLED BY.....:
DATE SAMPLED: DATE RECEIVED: DATE REPORTED: 10/16/91
PROJ. LOCATION: FROM WITHIN KINGSLEY TO IOWA 3

CONTRACTOR:BROWER
SIZE.....:3/4
SENDER NO.:

AGG SOURCES: CR. GRAVEL, GRAVEL & SAND- EVERIST,
HAWARDEN NORTH, SIOUX COUNTY
BINDER CONTAINS 15% REACTED RUBBER

JOB MIX FORMULA-COMB. 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
	100.0	99.0	88.0	71.0	53.0	41.0	31.0	18.0	9.1	5.3	4.1

TOLERANCE /100 :
98 7 7 7 6 5 3

MATERIAL MIX	A84510	A84510	A84510		
% AGGR. PROP.	45.00	30.00	25.00	0.00	0.00

ASPHALT SOURCE AND APPROXIMATE VISCOSITY POISES	JEBRO 0461			
% ASPHALT IN MIX	6.00	7.00	8.00	0.00
NUMBER OF MARSHALL BLOWS	50	50	50	0
MARSHALL STABILITY - LBS.	1330	1228	1137	0
FLOW - 0.01 IN.	7	7	11	0
SP GR BY DISPLACEMENT (LAB DENS)	2.361	2.362	2.349	0.000
BULK SP. GR. COMB. DRY AGG.	2.711	2.711	2.711	0.000
SP. GR. ASPH. @ 77 F.	1.033	1.033	1.033	0.000
CALC. SOLID SP. GR.	2.485	2.448	2.413	0.000
% VOIDS - CALC.	4.98	3.52	2.64	0.00
RICE SP.GR.	2.468	2.431	2.402	0.000
% VOIDS - RICE	4.34	2.84	2.21	0.00
% WATER ABSORPTION - AGGREGATE	0.52	0.52	0.52	0.00
% VOIDS IN MINERAL AGGREGATE	18.14	18.97	20.28	0.00
% V.M.A. FILLED WITH ASPHALT	72.54	81.45	87.00	0.00
CALC. ASPH. FILM THICK. MICRONS	12.64	14.85	17.05	0.00
FILLER/BITUMEN RATIO	0.00	0.60	0.00	0.00

NUC. CAL: NONE
COPIES TO:

CENTRAL LAB	W. OPPEDAL	BROWER
D. HEINS	J. ADAM	R. MONROE
DIST. 3	SIOUX CITY RES.	

DISPOSITION: A CONTENT OF 6.8% BINDER IS RECOMMENDED TO START THE JOB.

SIGNED: ORRIS J. LANE, JR.
TESTING ENGINEER

ooooo

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
TEST REPORT - ASPHALT MIX DESIGN
LAB LOCATION - AMES

LAB NO....:ABD1-0227

MATERIAL........:TYPE A ARC
INTENDED USE....:SURFACE
PROJECT NO......:FN-140-2(6)--21-75
COUNTY..........:PLYMOUTH CONTRACTOR:BROWER
SPEC NO.........:5018.00 SIZE......:1/2
SUPP SPEC NO....:1022.00
SAMPLED BY......: SENDER NO.:
DATE SAMPLED: DATE RECEIVED: DATE REPORTED: 10/11/91
PROJ. LOCATION: FROM WITHIN KINGSLEY TO IOWA 3

- -

AGG. SOURCES: 1/2" & 1/8" CR. GRAVEL & SAND - EVERIST, HAWARDEN NORTH, SIOUX CO.; QTZ. SAND - EVERIST, DEL RAPIDS, S.D.
BINDER CONTAINS 15% REACTED RUBBER

JOB MIX FORMULA-COMB. 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
		100.0	99.0	82.0	62.0	48.0	34.0	21.0	11.0	5.8	4.2

TOLERANCE /100 :

1 1/2"	1"	3/4"	1/2"	3/8"	NO.4	NO.8	NO.16	NO.30	NO.50	NO.100	NO.200
			92	7	7	5		4			2

MATERIAL MIX	A84510	A84510	A84510	ASD002	
% AGGR. PROP.	55.00	10.00	25.00	10.00	0.00

ASPHALT SOURCE AND	JEBRO			
APPROXIMATE VISCOSITY POISES	0461			
% ASPHALT IN MIX	6.00	7.00	8.00	0.00
NUMBER OF MARSHALL BLOWS	50	50	50	0
MARSHALL STABILITY - LBS.	1515	1673	1546	0
FLOW - 0.01 IN.	6	8	10	0
SP GR BY DISPLACEMENT (LAB DENS)	2.313	2.335	2.332	0.000
BULK SP. GR. COMB. DRY AGG.	2.716	2.716	2.716	0.000
SP. GR. ASPH. @ 77 F.	1.033	1.033	1.033	0.000
CALC. SOLID SP. GR.	2.486	2.450	2.414	0.000
% VOIDS - CALC.	6.98	4.69	3.40	0.00
RICE SP.GR.	2.450	2.423	2.392	0.000
% VOIDS - RICE	5.59	3.63	2.51	0.00
% WATER ABSORPTION - AGGREGATE	0.44	0.44	0.44	0.00
% VOIDS IN MINERAL AGGREGATE	19.95	20.05	21.01	0.00
% V.M.A. FILLED WITH ASPHALT	65.03	76.63	83.79	0.00
CALC. ASPH. FILM THICK. MICRONS	11.60	13.61	15.61	0.00
FILLER/BITUMEN RATIO	0.00	0.56	0.00	0.00

A CONTENT OF 7.5% BINDER IS RECOMMENDED TO START THE JOB.
NUC. CAL.: NONE
COPIES TO:

CENTRAL LAB	R. MONROE	J. ADAM
D. HEINS	BROWER	W. OPPEDAL
DIST. 3	SIOUX CITY RES.	

DISPOSITION:

SIGNED: ORRIS J. LANE, JR.
TESTING ENGINEER

ooooo

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
TEST REPORT - ASPHALT CONCRETE
LAB LOCATION - AMES

LAB NO....:ABC1-0482

MATERIAL........:UNCOMPACTED MIX (INT. AC 6.6%)
INTENDED USE....:3/4" TYPE B CLASS 1 BINDER (ARC)
PRODUCER........:EVERIST CONST.
PROJECT NO......:FN-140-2(6)--21-75 CONTRACT #:33391
COUNTY..........:PLYMOUTH CONTRACTOR:BROWER CONSTRUCTION
QUANTITY........:1 - 40 LB. BOX
SOURCE..........:SIOUX CO. 15/95/48/84
UNIT OF MATERIAL:SAMPLE TAKEN FROM STATION #385+00 TO 391+00 LT.
CL
SAMPLED BY......:B. HANNAH SENDER NO.:3BH1-647
DATE SAMPLED: 10/17/91 DATE RECEIVED: 10/30/91 DATE REPORTED: 11/04/91

PERCENT ASPHALT DIST. NUCLEAR: NOT RUN
SPECIFIC GRAVITY DIST. H.P.M.: 2.436
NOTE: BITUMEN CONTENT BY EXTRACTION IS WITH RUBBER REMOVED

SIEVE ANALYSIS PERCENT PASSING

SIEVE	GRAM RETAINED	PERCENT RETAINED	PERCENT PASSING	COLD-FEED GRADATION	TARGET GRADATION	SPEC LOW LIMIT	SPEC HIGH LIMIT
3/4	10.6	0.70	99.30	100.00			
1/2	225.6	14.10	85.20	76.00			
3/8	272.8	17.20	68.00	62.00			
4	248.0	15.80	52.40	49.00			
8	194.9	12.20	40.20	40.00			
16	159.6	10.00	30.20	30.00			
30	169.3	10.60	19.60	18.00			
50	155.4	9.70	9.90	7.90			
100	66.2	4.10	5.80	4.30			
200	23.2	1.50	4.30	3.20			
WASH	62.4						
PAN	7.0						

DRY WT.	1596.300
SUM OF RETAINED WTS.	1598.000

ASPHALT CONCRETE RESULTS

% AC INTENDED	6.600
% AGGREGATE BY EXTRACTION	94.500
% BITUMEN BY EXTRACTION	5.500
SPECIFIC GRAVITY	2.367
MARSHALL STABILITY/LBS	1607
MARSHALL FLOW 0.01 IN.	9
SPECIFIC GRAVITY RICE METHOD	2.439

COPIES TO:
CENTRAL LAB
SIOUX CITY RES.

B. HANNAH

DIST. 3

DISPOSITION:

SIGNED: ORRIS J. LANE, JR.
TESTING ENGINEER

ooooo

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
TEST REPORT - ASPHALT CONCRETE
LAB LOCATION - AMES

LAB NO....:ABC1-0483

MATERIAL........:UNCOMPACTED MIX (ARC) (INT. AC 7.0%)
INTENDED USE....:1/2" TYPE A SURFACE
PRODUCER........:L. G. EVERIST
PROJECT NO......:FN-140-2(6)--21-75 CONTRACT #:33391
COUNTY..........:PLYMOUTH CONTRACTOR:BROWER CONSTRUCTION
QUANTITY........:1 - 40 LB. BOX
SOURCE..........:SIOUX CO/MINNEHAHA CO., SD.;15/95/48/84;10/104/49
UNIT OF MATERIAL:SAMPLE TAKEN FROM STATION #405+00 TO 400 LT. CL
SAMPLED BY......:B. HANNAH SENDER NO.:3BH1-659
DATE SAMPLED: 10/18/91 DATE RECEIVED: 10/30/91 DATE REPORTED: 11/04/91

PERCENT ASPHALT DIST. NUCLEAR: NOT RUN
SPECIFIC GRAVITY DIST. H.P.M.: 2.441
BITUMEN CONTENT BY EXTRACTION IS WITH RUBBER REMOVED.

SIEVE ANALYSIS PERCENT PASSING

SIEVE	GRAM RETAINED	PERCENT RETAINED	PERCENT PASSING	COLD-FEED GRADATION	TARGET GRADATION	SPEC LOW LIMIT	SPEC HIGH LIMIT
3/4			100.00	100.00			
1/2	18.2	1.20	98.80	97.00			
3/8	168.3	10.70	88.10	87.00			
4	273.7	17.30	70.80	69.00			
8	266.6	16.90	53.90	54.00			
16	248.5	15.70	38.20	38.00			
30	225.7	14.30	23.90	23.00			
50	177.4	11.30	12.60	12.00			
100	79.5	5.10	7.50	7.70			
200	35.0	2.20	5.30	5.80			
WASH	69.4						
PAN	14.6						

DRY WT.	1572.500
SUM OF RETAINED WTS.	1576.900

ASPHALT CONCRETE RESULTS

% AC INTENDED	7.000
% AGGREGATE BY EXTRACTION	93.670
% BITUMEN BY EXTRACTION	6.330
SPECIFIC GRAVITY	2.331
MARSHALL STABILITY/LBS	2152
MARSHALL FLOW 0.01 IN.	8
SPECIFIC GRAVITY RICE METHOD	2.423

COPIES TO:
CENTRAL LAB B. HANNAH DIST. 3
SIOUX CITY RES.

DISPOSITION:

SIGNED: ORRIS J. LANE, JR.
TESTING ENGINEER

ooooo

HR-330A
Plymouth County

RESILIENT MODULUS

	Conventional Surface		ARC Surface	
Lab Mixed	50 Blows	75 Blows	50 Blows	75 Blows
	340,000	440,000	930,000	1,630,000
Plant Mixed	410,000	450,000	400,000	410,000
Cores	990,000		1,240,000	

CREEP

	Conventional Surface		ARC Surface	
Lab Mixed	50 Blows	75 Blows	50 Blows	75 Blows
	58	78	12	22
PLant Mixed	55	66	49	80
Cores	10		.7	

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
TEST REPORT - ASPHALT
LAB LOCATION - AMES

LAB NO....:AB 1-0410

MATERIAL........:AC-5 6F 60 RUBBER
INTENDED USE....:ARC OVERLAY
PRODUCER........:BROWER
PROJECT NO......:FN-140-2(6)--21-75
COUNTY..........:PLYMOUTH CONTRACTOR:BROWER
UNIT OF MATERIAL:AC 5 & RUBBER FOR VISCOSITY
SAMPLED BY......:C. ANDERSON SENDER NO.:CA1-36
DATE SAMPLED: 10/17/91 DATE RECEIVED: 11/07/91 DATE REPORTED: 11/07/91

ASPHALT & RUBBER SUBMITTED FOR JOB

MIXED @ 15% BY TOTAL WGT. OF ASPHALT RUBBER MIX
BROOKFIELD VIS., SPINDLE 3, 12 RPM
SP-1028 SPECS FOR VIS. ARE 1000-4000 CPS.

3 MIN. = 9500 @ 347 F.
10 MIN.= 1100 @ 347 F.
30 MIN.= 1400 @ 347 F.
1 HR. = 1900 @ 347 F.

COPIES TO:
CENTRAL LAB C. ANDERSON V. MARKS

DISPOSITION:

SIGNED: ORRIS J. LANE, JR.
TESTING ENGINEER

ooooo

HR-330A

AAT1-1518
00

IOWA DEPARTMENT OF TRANSPORTATION
OFFICE OF MATERIALS
TEST REPORT - BITUMINOUS AGGREGATES
LAB LOCATION - AMES

LAB NO....:AAT1-1518

MATERIAL.....:GF-50 RUBBER
COUNTY.....:PLYMOUTH
UNIT OF MATERIAL:ROUSE RUBBER FOR PLYMOUTH CO. FN-140
SAMPLED BY.....:
DATE SAMPLED:

CONTRACTOR:BROWER
SENDER NO.:
DATE RECEIVED: 10/31/91
DATE REPORTED: 11/07/91

SIEVE ANALYSIS %

#30	100.0
#50	96.0

COPIES TO:
CENTRAL LAB
W. OPPEDAL

GEOLOGY

V. MARKS

DISPOSITION:

.....

SIGNED: ORRIS J. LANE, JR.
TESTING ENGINEER

Form 820007 11/87 H-1789

Iowa Department of Transportation

DAILY PLANT REPORT

BITUMINOUS TREATED BASE, ASPHALT TREATED BASE, ASPHALT CONCRETE

County: Plymouth
Project: FN-140-2(6)-21-75
Contract No.: 33391
Date: 10-17-91
Report No.: 1933-01 ARCB

Contractor: Brower Const. Co. Plant Location: 2020 Illinois Ave Sioux City, Ia
Plant Type: Batch Make: Barber Greene Pollution Equipment: Dust Bag House Resident Engineer: T. Lazarowicz
Mix Type: Binder-ARC Class: 1 Size: 3/4" Crushed Aggr. Sources: L.G. Everist - Hawarden Dell Rapids Recycle Source: —
Asphalt Source & Grade: Jebro AC-5 (ARC) Sand Sources: L.G. Everist - Hawarden Plant Operated 7:40 A.M. to 5:30 P.M. Mix No. ABD1-0226

SIEVE ANALYSIS OF COMBINED AGGREGATES

Spl. ID	Time	Compl.	1½	1	¾	½	⅜	4	8	16	30	50	100	200
JOB MIX FORMULA - LIMITS			100	100	98-100	81-95	64-78	46-60	33-47	—	13-23	—	—	1.1-7.1
4-1	A.M.	NO			100	77	59	47	38	28	18	3.9	1.2	3.1
4-2	P.M.	Yes			100	86	68	52	41	30	20	8.9	4.8	3.6
4-3	P.M.	Yes			100	87	73	55	44	33	23	12	6.4	5.0
Avg		Yes			100	83	67	51	41	30	20	8.3	4.1	3.9

SAMPLES SUBMITTED

Materials	Senders No.	Materials	Senders No.
AC-1017-1	Hot Box	Cores	
1 Box	AC-1017-2		
1 Box	AC-1017-3		
1 Cold feed	AC-1017-4		

Intended Added ______ % A.C.
Intended Total 6.6 % A.C. Tank Meas. 6.63 % A.C.

LAB. DEN. 2.363 **DENSITY RECORD** SOLID DEN. 2.436

Course Laid	Station	¢ Refer	Date Laid	* (1)	Density	% Density	% Voids
Binder	380+00	4' RT	10-17-91	2 1/4	2.340	99.027	3.9
"	390+00	6' RT	"	2"	2.309	97.715	5.2
"	395+00	8' RT	"	1 1/2	2.330	98.603	4.4
"	420+00	4' RT	"	1 5/8	2.279	96.445	6.4
"	381+00	6' LT	"	1 3/4	2.254	95.387	7.5
"	390+00	8' LT	"	1 3/8	2.259	95.599	7.3 — 7.27
"	405+00	4' LT	"	1 1/2	2.297	97.207	5.7

TEMPERATURE RECORD

Time	7	9	11	1	3	5
Air	70°	75°	80°	82	82	81
A.C.	300	340	315	325	320	310
Aggr.	350	350	348	357	350	340
Mix	325	320	325	330	340	320
Mat	290	275	275	270	270	270

RECYCLED MIX ONLY

Total RAP Used Tons ______
Total Aggr. Used Tons ______ NA
RAP Used % ______
Aggr. Used % ______

MATERIALS DELIVERIES

Type	Ticket No.	Quantity
AC5	2557	5666
AC5	1769	9052
AC5	2421	9047
AC5	2474	9044

Avg. Field Density Lot #1 2.295 5.79
Avg. Field Density Lot #2

Fines/Bitumen Ratio = 3.9/6.63 = 0.59
Ave. % Field Voids = 5.8
Lab % Voids = 3.00
Q.I. (Density) = 1.516
(Show Calculation)

$$\frac{97.140 - 95.00}{1.412} = 1.516$$

PRODUCTION AND PLACEMENT RECORD

* (2)	Side	Course Laid	From Station to Station	Tons Today	Tons To Date
1 1/2	RT	3/4" ARC Binder	375+00 To 428+00	686.40	1316.16
1 1/2	LT	3/4" ARC Binder	375+00 To 428+00	629.76	
		Sprinkle			

COMMENTS Acceptance Gradation

	1	¾	½	⅜	4	8	16	30	50	100	200
Non-Compl		100	81	60	48	39	29	17	7.5	3.7	2.6
Comply		100	86	69	53	41	29	17	6.7	3.0	1.9
Comply		100	87	71	55	43	32	19	8.9	4.8	3.3
Average Comply		100	85	67	52	41	30	18	7.7	3.8	2.6

Acceptance Fines/Bitumen Ratio = 2.6/6.63 = 0.39

COMMENTS: Delays, Breakdowns, Corrective Action, etc.
*Thickness: (1) Actual, (2) Intended
Bituminous Treated Base: Enter % Moisture in % Voids Column

Signed Carl Zavadil D.O.T. / [signature] Inspector #1243 Cert. No.

MATERIALS OFFICE – RECORDS CENTER COPY

Form 820007 11/87 H-1789

(ARC)

Iowa Department of Transportation

DAILY PLANT REPORT

BITUMINOUS TREATED BASE, ASPHALT TREATED BASE, ASPHALT CONCRETE

County: Plymouth
Project: FN-140-2(6)-21-75
Contract No.: 33391
Date: 10-17-91
Report No.: 1933-02 (ARC-5)

Contractor: Brower Const. Co. Plant Location: 2020 Illinois Ave Sioux City, Ia
Plant Type: Batch Make: Barber Greene Pollution Equipment: Dust Bag House Resident Engineer: T. Lazarowicz
Mix Type: A-Surface Class ____ Size: 1/2" Crushed Aggr. Sources: L.G. Everist - Hawarden - Dell Rapids Recycle Source: ——
Asphalt Source & Grade ____ Sand Sources: L.G. Everist Hawarden Plant Operated: 7:30 A.M. to 5:30 P.M. Mix No. ABD1-0227

SIEVE ANALYSIS OF COMBINED AGGREGATES

SAMPLE			SIEVE NO. - % PASSING											
JOB MIX FORMULA - LIMITS					100	92-100	78-89	55-69	43-53	—	17-25	—	—	2.2-6.2
Spl. ID	Time	Compl.	1½	1	¾	½	⅜	4	8	16	30	50	100	200
4-4	P.M.	Yes	100	100	100	99	86	68	53	37	25	13	7.1	5.6

SAMPLES SUBMITTED

Materials	Senders No.	Materials	Senders No.
1 Hot Box	AC-1017-1		
1 Box	AC-1017-2		
1 Cold Feed	AC-1017-4-4		

Intended Added ____ % A.C.
Intended Total 7.0 % A.C. Tank Meas. 6.82 % A.C.

LAB. DEN. 2.311 **DENSITY RECORD** SOLID DEN. 2.441

Course Laid	Station	¢ Refer	Date Laid	*(1)	Density	% Density	% Voids
Surface							
"							
"							
"							
"							
"							
"							

NO CORES (SMALL QUANTITY)

TEMPERATURE RECORD

Time	7	9	11	1	3	5
Air						62
A.C.						340
Aggr.						350
Mix						325
Mat						270

RECYCLED MIX ONLY

Total RAP Used Tons
Total Aggr. Used Tons
RAP Used %
Aggr. Used %

NA

MATERIALS DELIVERIES

Type	Ticket No.	Quantity

Avg. Field Density Lot #1
Avg. Field Density Lot #2
Fines/Bitumen Ratio = 5.6/6.82 = 0.82
Ave. % Field Voids = ——
Lab % Voids = 5.33
Q.I. (Density) = ——
(Show Calculation)

PRODUCTION AND PLACEMENT RECORD

*(2)	Side	Course Laid	From Station to Station	Tons Today	Tons To Date
1½	RT	Surface (ARC)	481+00 To 462+60	179.24	179.24
		~~Sprinkle~~			

COMMENTS: Acceptance Gradation

1	¾	½	⅜	4	8	16	30	50	100	200
	100	98	88	69	52	35	22	11	6.2	4.3

Page 24

Acceptance FINES/Bitumen Ratio = 4.3/6.82 = 0.63

COMMENTS: Delays, Breakdowns, Corrective Action, etc.
*Thickness: (1) Actual, (2) Intended
Bituminous Treated Base: Enter % Moisture in % Voids Column

Signed [signature] D.O.T. [signature] #1243
Inspector Cert. No.

MATERIALS OFFICE — RECORDS CENTER COPY

Form 820007 11/87 H-1789

(ARC)

Iowa Department of Transportation

DAILY PLANT REPORT

BITUMINOUS TREATED BASE, ASPHALT TREATED BASE, ASPHALT CONCRETE

County Plymouth
Project FN-140-2(67)--2175
Contract No. 33391
Date 10-18-91
Report No. 1933-03 ARC-S

Contractor Brower Const. Co. Plant Location 2020 Illinois Ave. Sioux City Ia
Plant Type Butch Make Barber Greene Pollution Equipment Resident Engineer T Lagrowitz
Mix Type A-Surface Class Size 1/2" Crushed Aggr. Sources L.6. Everist - Hgwarden - Dell Rapids Source
Asphalt Source & Grade Jebro - AC-5 Sand Sources L.6. Everist Hewarden Plant Operated 7:30 A.M. to 1:10 P.M. Mix No. ABD1-0227

SIEVE ANALYSIS OF COMBINED AGGREGATES

SAMPLE			SIEVE NO. - % PASSING												
JOB MIX FORMULA - LIMITS					100	92-100	75-89	57-69	43-53		17-25			22-62	
Spl. ID	Time	Compl.	1½	1	¾	½	⅜	4	8	16	30	50	100	200	
S-1	A.M.	Yes			100	98	84	64	50	35	22	10	5.4	3.9	

SAMPLES SUBMITTED		SAMPLES SUBMITTED	
Materials	Senders No.	Materials	Senders No.

Intended Added ____ % A.C.
Intended Total 7.0 % A.C. Tank Meas. 7.02 % A.C.

LAB. DEN. 2.335 DENSITY RECORD SOLID DEN. 2.422

Course Laid	Station	¢ Refer	Date Laid	*(1)	Density	% Density	% Voids
SURFACE	395+00	4' RT	10-18-91	1 3/8	2.200	94.218	9.2
"	405+00	6' RT	"	1 1/4	2.214	94.818	8.6
"	415+00	8' RT	"	2 3/4	2.269	97.173	6.3
"	425+00	4' RT	"	1 1/2	2.226	95.332	8.1
"	435+00	6' RT	"	1 1/2	2.267	97.088	6.4
"	445+00	8' RT	"	1 1/2	2.261	96831	6.6
"	450+00	4' RT	"	1 3/8	2.234	96.531	6.9

7.43

TEMPERATURE RECORD

Time	7	9	11	1	3	5
AM	44	42	42	40		
A.C.	320	310	310	325		
Aggr.	330	340	340	340		
Mix	310	320	325	320		
Mat		270	290	290		

MATERIALS DELIVERIES

Type	Ticket No.	Quantity

RECYCLED MIX ONLY

Total RAP Used Tons
Total Aggr. Used Tons
RAP Used %
Aggr. Used %

N A.

Avg. Field Density Lot #1 2.242
Avg. Field Density Lot #2

Fines/Bitumen Ratio = 3.9/7.02 = 0.56
Ave. % Field Voids = 7.4
Lab % Voids = 3.6 3.59
Q.I. (Density) = 0.84
(Show Calculation)

$$\frac{95.999 - 95.00}{1.194} = 0.84$$

PRODUCTION AND PLACEMENT RECORD

*(2)	Side	Course Laid	From Station to Station	Tons Today	Tons To Date
1 1/2	RT	½ SURFACE (ARC)	426+60 TO 389+60	685.62	864.86
		~~Sprinkle~~			

1	¾	½	⅜	4	8	16	30	50	100	200
	100	99	85	66	51	36	22	12	6.7	4.5

COMMENTS Acceptance Gradation

FBR = 45/7.02 = 0.64

Carl Fenceby 941 D.O.T.

COMMENTS: Delays, Breakdowns, Corrective Action, etc.
*Thickness: (1) Actual, (2) Intended
Bituminous Treated Base: Enter % Moisture in % Voids Column

Signed Alex Crosgrove 1243
Inspector Cert. No.

MATERIALS OFFICE – RECORDS CENTER COPY

Form 820007 11/87 H-1789

Iowa Department of Transportation

DAILY PLANT REPORT

BITUMINOUS TREATED BASE, ASPHALT TREATED BASE, ASPHALT CONCRETE

County: Plymouth
Project: FN-140-2(6)-21-75
Contract No.: 33391
Date: 10-19-91
Report No.: 1933-03 ARC(5)

Contractor: Brower Const. Co. Plant Location: 2020 Illinois Ave. Sioux City Ia
Plant Type: Batch Make: Barber Greene Pollution Equipment: Dust Bag House Resident Engineer: T Lazarowicz
Mix Type: A Surface Class: Size: 1/2" Crushed Aggr. Sources: L.G. Everist Hawarden - Dell Rapids Recycle Source:
Asphalt Source & Grade: Sand Sources: L.G. Everist Hawarden Plant Operated 10:30 A.M. to 5:00 P.M. Mix No. ABD1-0227

SIEVE ANALYSIS OF COMBINED AGGREGATES — SIEVE NO. - % PASSING

Spl. ID	Time	Compl.	1½	1	¾	½	⅜	4	8	16	30	50	100	200
JOB MIX FORMULA - LIMITS			100	100	100	92-100	75-89	52-69	48-53	–	17-25	–	–	2.2-6.2
6-1	A.M.	Yes				95	79	57	44	30	18	8.7	4.7	3.3

SAMPLES SUBMITTED

Materials	Senders No.	Materials	Senders No.
5 AC-5	AC1019-1-5		
1 Cold Feed	AC1019-6-1		
1 Hot Box	AC1019-1		
1 Box	AC1019-2		
1 Box	AC1019-3		

Intended Added ______ % A.C.
Intended Total 7.0 % A.C. Tank Meas. 7.07 % A.C.

LAB. DEN. 2.335 **DENSITY RECORD** SOLID DEN. 2.430

Course Laid	Station	¢ Refer	Date Laid	* (1)	Density	% Density	% Voids
SURFACE	377+00	4' RT	10-19-91	1 3/8	2.188	93.704	10.0
"	385+00	6' RT	"	1 1/4	2.190	93.790	9.9
"	425+00	6' LT	"	2 3/4	2.238	95.846	7.9
"	410+00	8' LT	"	1 1/2	2.208	94.561	9.14
"	395+00	4' LT	"	1 1/2	2.264	96.959	6.8
"	385+00	6' LT	"	1 1/2	2.247	96.231	7.53
"	378+00	4' LT	"	1 1/2	2.250	96.360	7.4

TEMPERATURE RECORD

Time	7	9	11	1	3	5
Air	38	38	42	45	46	45
A.C.	325	340	330	330	330	340
Aggr.	357	360	352	350	340	340
Mix	325	350	335	330	335	330
Mat		[redacted]	295	295	290	290

MATERIALS DELIVERIES

Type	Ticket No.	Quantity

RECYCLED MIX ONLY

Total RAP Used Tons
Total Aggr. Used Tons
RAP Used %
Aggr. Used %
NA

Avg. Field Density Lot #1 2.226
Avg. Field Density Lot #2
Fines/Bitumen Ratio = 3.3/7.07 = 0.47
Ave. % Field Voids = 8.4
Lab % Voids = 3.91
Q.I. (Density) = 0.27*
(Show Calculation)

$$\frac{95.350 - 95.00}{1.316} = 0.27^*$$

PRODUCTION AND PLACEMENT RECORD

2.40

* (2)	Side	Course Laid	From Station to Station	Tons Today	Tons To Date
[redacted] 1/2"	RT	Surface	389+60 To 374+50	160.38	
[redacted] 1/2"	LT.	Surface	428+25 To 368+50	746.03	1771.27
		Sprinkle			

1	¾	½	⅜	4	8	16	30	50	100	200

COMMENTS

* NON-COMPLIANCE ISSUED

COMMENTS: Delays, Breakdowns, Corrective Action, etc.
*Thickness: (1) Actual, (2) Intended
Bituminous Treated Base: Enter % Moisture in % Voids Column

This completes (ARC) MIX

Carl [signature] D.O.T.
Signed [signature] Inspector # 1243 Cert. No.

MATERIALS OFFICE – RECORDS CENTER COPY

IOWA DEPARTMENT OF TRANSPORTATION

TO OFFICE: DATE: December 6, 1991

ATTENTION: REF. NO.: 435.204

FROM: Chris Anderson

OFFICE: Materials - Research

SUBJECT: Friction Testing on Hwy 140 in Plymouth County from Station 375+00 to Station 580+00

Friction testing was conducted on Hwy 140 on November 20, 1991 All testing was performed at 40 mph with standard tread (ASTM E-501-76) test tire. The results are as follows:

		NB	SB
Section #1	A.R.C. in binder & surface courses	41	45
Section #2	A.R.C. in surface course	38	
Section #3	Control Section	34	33

CA:kmd

HR-330A Rut Depths
Plymouth County
November 20, 1991

	NORTHBOUND			SOUTHBOUND	
	STA.	OWT	IWT	OWT	IWT
MP 13	375+00	.02	.00	.01	.00
	380+00	.00	.01	.01	.00
	385+00	.00	.00	.00	.00
	390+00	.01	.01	.00	.00
	395+00	.00	.03	.02	.02
	400+00	.02	.02	.01	.01
	405+00	.00	.01	.01	.02
	410+00	.03	.06	.01	.01
	415+00	.00	.01	.02	.00
	420+00	.01	.03	.00	.01
	425+00	.00	.01	.00	.02
	430+00	.00	.01		
	435+00	.00	.02		
	440+00	.03	.02		
	445+00	.01	.01		
	450+00	.00	.01		
	455+00	.01	.03		
	460+00	.02	.01		
	465+00	.00	.01		
	470+00	.01	.01		
	475+00	.00	.00		
	480+00	.01	.00		
	555+00	.00	.00	.01	.02
	560+00	.01	.02	.01	.01
	565+00	.01	.01	.00	.02
	570+00	.00	.01	.01	.01
	575+00	.00	.00	.01	.01
	580+00	.01	.01	.01	.01

HR-330A - Plymouth County
Rut Depths
April 6, 1992

		Northbound		Southbound	
	Station	OWT	IWT	OWT	IWT
MP 13	375+00	.02	.01	.02	.01
	380+00	.01	.01	.03	.02
	385+00	.02	.01	.02	.02
	390+00	.01	.01	.02	.01
	395+00	.02	.03	.02	.02
	400+00	.02	.02	.02	.02
	405+00	.01	.02	.02	.02
	410+00	.03	.06	.02	.01
	415+00	.02	.05	.02	.00
	420+00	.02	.03	.01	.01
	425+00	.02	.02	.00	.02
	430+00	.01	.01		
	435+00	.01	.02		
	440+00	.03	.02		
	445+00	.02	.01		
	450+00	.01	.01		
	455+00	.04	.03		
	460+00	.02	.01		
	465+00	.02	.04		
	470+00	.03	.02		
	475+00	.03	.01		
	480+00	.01	.02		
	555+00	.01	.02	.01	.02
	560+00	.02	.02	.02	.01
	565+00	.01	.01	.01	.02
	570+00	.01	.01	.02	.02
	575+00	.02	.00	.01	.01
	580+00	.05	.02	.03	.09

Road Rater Results

Pre-Construction	9-23-91
	Avg. S.R.
Section #1	2.88
Section #2	2.23
Section #3	2.24
Post-Construction	**11-20-91**
Section #1	4.24
Section #2	4.07
Section #3	3.87
Spring of 1992	**3-23-92**
Section #1	4.24
Section #2	4.02
Section #3	3.77