BOTTOM ASH H.M.A.C. SURFACE MIXES PLACED IN HOPKINS CO. in 1980

BY

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and

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ACKNOWLEDGEMENTS

David Buster Construction Company, Paris, Texas

Texas Utilities Generating Company, Dallas, Texas

The Materials and Test Division, Austin, Texas

District 11, Lufkin, Texas

District 1 Administration, Paris, Texas

Hopkins County Maintenance Section, Sulphur Springs, Texas

The above organizations are recognized for their contributions in helping make this report possible.

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I. INTRODUCTION:

In recent years, materials of good quality have become scarce and more difficult to locate. In order to continue to construct roads in the future, there is a need to utilize and investigate the use of sub-standard materials and manufactured by-products. This study was made to investigate the use of these materials in Hot Mix Asphaltic Concrete surface mixes.

The materials selected for this study included a siliceous gravel having a polish value average of 26 and a bottom ash material produced by Texas Utilities Generating Company located at the Monticello Plant, Mt. Pleasant, Texas.

II. OBJECTIVES:

The objectives of this study was to evaluate the characteristics of bottom ash when used with a low polish value siliceous aggregate and to study the laboratory data and field performance of these mixes. The utilization of substandard materials and manufactured waste products that could be developed into a satisfactory construction material was of primary importance. These materials are available for use in District I.

III. PROCEDURE:

A. Design Data:

Three different test sections were constructed in Hopkins County on June 4, 5, and 6th in 1980. The mixes used in each of the sections were based on preliminary design work as shown in Table I. The design was made

using 55% siliceous gravel from Frogville, Oklahoma and 45% bottom ash from the Monticello Plant at Mt. Pleasant, Texas. AC-20 asphalt from Dorchester at Mt. Pleasant was used in the design. The volumetric design method was used converting the aggregate to 62.6% siliceous gravel and 37.4% bottom ash by weight. The laboratory data is shown in Table II. Mixes in each of the three test sections were 60% siliceous gravel and 40% bottom ash by weight and asphalt contents of 10%, 11%, and 12% by weight were selected.

Laboratory results of mix taken from each of the test sections are shown in the Daily Construction Reports No. 1, 2, and 3.

B. Construction Method:

The mix was placed with a lay-down machine by the Hopkins County maintenance forces and David Buster Construction Company. A pneumatic and steel wheel roller were used in the compaction of the mix. Because the mix was very tender, the compaction was delayed until the mix cooled to approximately 200°F. The mix had a tendency to sometimes stick to the roller wheels before their temperature approached the mix temperature. This problem was solved by spraying the wheels of the rollers with a light coat of diesel at the beginning of the compaction operation.

A tack coat of RC-2 was placed under each test section. The amount of tack coat was varied on each section. Once the mix was compacted, it stabilized rapidly and traffic was placed on the test sections immediately without any displacement of the mix.

IV. TEST SECTIONS:

The three sections were selected on the basis of traffic counts and the existing section conditions.

The first test section was constructed on R.M. 1870 which is located

approximately one (1) mile southeast of the intersection of Interstate Highway 30 and F.M. 1870. The test section was placed over a lightweight seal coat that was in excellent condition.

The second test section was constructed on S.H. 11 located four (4) miles North of the intersection of S.H. 19 and S.H. 11 in Sulphur Springs. This test section was placed on an unstable existing section of roadway.

The third test section was placed on an existing stable concrete pavement in the east bound lane of I.H. 30 at Mile Post 128 east of Sulphur Springs.

Data Summary of Test Sections:

A. FM 1870: Located one mile S.E. of I.H. 30 intersection with FM 1870

Length of Section: 400 ft.

A.D.T.: 1850-3.2% Trucks

Date of Placement: June 4, 1980

Condition of Existing Section: Lightweight seal in good condition

% Asphalt: 10% by weight

% Lab Density: 95%

% Stability: 38

Depth: Approximately 1"

Skid Values:

July 10, 1980	September 3, 1981	September 13, 1982	January 21, 1983
52 avg.	45 avg.	44 avg.	44 avg.

B. S.H. 11: Located four miles North of the intersection of S.H. 19 and S.H. 11 on S.H. 11 in Hopkins County

Length of Section: 800 ft.

A.D.T.: 2300 - 18.6% Trucks

Date of Placement: June 5, 1980

Condition of Existing Section: Out of section and unstable

% Asphalt: 12% by weight

% Lab Density: 99%

% Stability: 35

Depth: Approximately 1"

Skid Values:

July 10, 1980	September 3, 1981	September 13, 1982	January 21, 1983
47 avg.	44 avg.	43 avg.	42 avg.

C. I.H. 30: East-bound Lane, Mile Post 128 in Hopkins County

Length of Section: 300 ft.

A.D.T.: 11,940 - 26.3% Trucks

Date of Placement: June 6, 1980

Condition of Existing Section: Stable Concrete Pavement

% Asphalt: 11% by weight

% Lab Density: 91.7

% Stability: 44

Depth: Approximately 1"

Skid Values:

July 10, 1980	September 3, 1981	September 13, 1982	January 21, 1983
53 avg.	42 avg.	36 avg.	36 avg.

V. ADVANTAGES AND DISADVANTAGES:

1. Advantages:

   a. Only two aggregates were used instead of three that are normally required in our District for Type "D" surface mixes.

   b. A good supply of bottom ash is available for use in our District.

   c. Satisfactory skid values and stabilities were obtained in a siliceous gravel mix.

   d. When calculated on a volume basis the cost of the mix is competitive with conventional mixes.

2. Disadvantages:

   a. Asphalt contents in these test sections are somewhat high. Most mixes in our District require 6% asphalt by weight maximum.

   b. Low mix temperatures during compaction procedures could prove to be detrimental in the service life of the pavement.

   c. High internal voids in the mixes could cause some performance problems.

V. CONCLUSION:

The three test sections have remained in good condition and show no visual evidence of wear or reflective cracking. Skid tests conducted in January of 1983 remain high. Continued evaluation and study of the test sections over an extended period of time will provide additional information. More design work is needed using bottom ash with reduced

asphalt contents.

The use of bottom ash in patching mixes with other types of asphalt or emulsions could prove to be beneficial.

We expect to place another test section in our District using bottom ash in the near future.

TABLE I

ASPHALTIC CONCRETE BATCH DESIGN

Lab No.	Materials	Producer	Pit	Sp. Gr.
1-80-120	Siliceous Gravel	David Buster	Frogville, Okla.	2.496
1-80-116	Bottom Ash	Texas Utilities Co.	Monticello	1.824
	AC-20 Asphalt	Dorchester	Mt. Pleasant, Tx	1.032

	(55%)		(45%)		100%		(62.6%)		(37.4%)		100% Design
Sieve Sizes	Siliceous Gravel		Bottom Ash		Design Volume	Specifications	Siliceous Gravel		Bottom Ash		Weight
1/2"	0.0	0.0	0.0	0.0	0.0	(0)	0.0	0.0	0.0	0.0	0.0
1/2"-3/8"	5.0	2.8	1.6	0.7	3.5	(0-5)	5.0	3.1	1.6	0.6	3.7
3/8"-4	72.7	40.0	7.4	3.3	43.3	(20-50)	72.7	45.5	7.4	2.8	48.3
4-10	21.8	12.0	13.8	6.2	18.2	(10-30)	21.8	13.6	13.8	5.2	18.8
+10					65.0	(50-70)					70.8
10-40	0.3	0.2	31.5	14.2	14.4	(0-30)	0.3	0.2	31.5	11.8	12.0
40-80	0.1	0.0	23.5	10.6	10.6	(4-25)	0.1	0.1	23.5	8.8	8.9
80-200	0.1	0.0	16.4	7.4	7.4	(3-25)	0.1	0.1	16.4	6.1	6.2
-200	0.0	0.0	5.8	2.6	2.6	(0-6)	0.0	0.0	5.8	2.1	2.1
TOTAL %	100.0	55.0	100.0	45.0	100.0		100.0	62.6	100.0	37.4	100.0

CONVERSION FROM VOLUME TO WEIGHT

$$55.0 \times 2.496 = 137.280 = 62.6\%$$
$$45.0 \times 1.824 = \underline{82.080} = \underline{37.4\%}$$
$$219.360 \quad 100.0$$

TABLE II

DESIGN NO. 1-80-116

LABORATORY DATA

Mix No.	Asph. % by Vol.	Asph. % by Wt.	Actual Sp. Gr. of Specimen (Ga)	Theo. Sp. Gr. of Specimen (Gt)	Density of Spec.	Stability of Spec.	Cohesion	Tensile	Den. Spec. Lbs/CF	% Voids	% Moisture Absorpt.
1	11.5	6	1.814	2.063	87.9	47	38	60.8	108.19	24.85	6.24
2	13.4	7	1.814	2.041	88.9	45	55	59.4	111.30	21.66	6.28
3	15.4	8	1.842	2.020	91.2	43	58	62.7	112.76	19.62	5.81
4	17.3	9	1.857	1.999	92.9	41	82	78.5	114.41	17.38	5.12
5	19.2	10	1.892	1.979	95.6	40	98	85.8	115.86	15.29	4.46

Construction Form No. 404 Rev. (2)

DAILY CONSTRUCTION REPORT—ASPHALTIC CONCRETE PAVEMENT

County Hopkins Highway FM-1870 Project Req. 01-0-710L(1) Control 11953

Location of Plant Sulphur Springs Type of Plant Weigh Batch Contractor Netex Plant

Date 6-4-80 Specification Item 340... Type D Plant Started ____ M. Plant Stopped ____ M.

Location No.								
	1 Main Lane	3 Decel. Lane	5 Entr. Ramp	7				
	2 Fr. Rd. Lane	4 Accel. Lane	6 Exit Ramp	8				

Combined Bin Analysis										Extractions		
Sieve Size	Design No. 1	1	2	3	4	5	6	7	8	1	2	3
1¾" - ⅞"												
⅞" - ⅝"												
1/2	0	0	0							0		
½" - ⅜"	5.2	5.1	5.8							4.3		
⅜" - 4	29.4	33.6	26.2							32.6		
¼" - 10												
4 - 10	19.6	21.6	22.2							12.9		
+ 10	54.2	60.3	54.2							49.8		
10 - 40	12.0	10.7	13.9							10.0		
40 - 80	8.7	6.1	8.4							12.1		
80 - 200	9.8	8.0	8.8							13.9		
Pass 200	5.3	4.9	4.7							6.7		
Asphalt	10.0	10.0	10.0							7.5		
Total	100.0	100.0	100.0							100.0		

Bin Analy. No.	Extr. No.	Time	Location No.	Course of Courses	Station No.	Mix Temp. °F. Plant	Mix Temp. °F. Road	Specimen Nos.	Lab Dens.	% Stab.
1		1:40				325°				
2		2:10								
3		3:40								
	1	4:00						1-80-493	95.0	38

Materials Used	Asphalt (Tons)	Aggregate (Tons)
Previous Report	0.00	
This Report	48.29	
Total To Date	48.29	

Percent Complete-Asphaltic Concrete Pavement	
Percent Complete—This Type	%
Percent Complete—All Types	%

Days Run					Rate of Application					
Location No.	Course of Courses		Station to Station	Width (Feet)	____ Inches ____ Lbs/Sq. Yd. Sq. Yds.	Tons	____ Inches ____ Lbs/Sq. Yd. Sq. Yds.	Tons	____ Inches ____ Lbs/Sq. Yd. Sq. Yds.	Tons
1			Test section located approximately one mile S. E. of IH-30 on FM-1870 in Hopkins							
			Co.							
					Pea Gravel - Buster Matls., Frogville, Okla.					
					Bottom Ash - Monticello Plant, Mt Pleasant, Texas					
					AC-20 Asphalt - Dorchester, Mt. Pleasant, Texas					
			Total Today							
			Previous Report							
			Total To Date							
			Avg. Rate To Date		Lbs/Sq. Yd.		Lbs/Sq. Yd.		Lbs/Sq. Yd.	

Weather Clear

Min. Temp. ____ °F.

Max. Temp. ____ °F.

Remarks Material composed of approximately 60% pea gravel and 40% bottom ash by weight.

Richard W. Floyd
Inspector

Type "D" Date 6-4-80 Report No. 1

Texas Highway Department
Construction Form No. 404 Rev. (2)

TEXAS HIGHWAY DEPARTMENT
DAILY CONSTRUCTION REPORT—ASPHALTIC CONCRETE PAVEMENT

County Hopkins Highway SH-11 Project Req. 01-0-710L(1) Control 11953
Location of Plant Sulphur Springs Type of Plant Weigh batch Contractor Netex plant
Date 6-5-80 Specification Item 340... Type D Plant Started ____ M. Plant Stopped ____ M.

Location No.	1	Main Lane	3	Decel. Lane	5	Entr. Ramp	7	
	2	Fr. Rd. Lane	4	Accel. Lane	6	Exit Ramp	8	

Combined Bin Analysis										Extractions		
Sieve Size	Design No. 2	1	2	3	4	5	6	7	8	1	2	3
1¾" - ⅞"												
⅞" - ⅝"												
1/2	0	0	0							0		
½" - ⅜"	5.2	3.9	6.0							3.5		
⅜" - 4	29.4	31.1	31.8							29.3		
¼" - 10												
4 - 10	19.6	22.5	22.0							16.3		
+ 10	54.2	57.5	59.8							49.1		
10 - 40	11.1	18.4	10.2							11.8		
40 - 80	8.6	6.1	6.9							12.7		
80 - 200	9.8	4.4	7.2							13.1		
Pass 200	4.3	1.6	3.9							5.0		
Asphalt	12.0	12.0	12.0							8.3		
Total	100.0	100.0	100.0							100.0		

Bin Analy. No.	Extr. No.	Time	Location No.	Course of Courses	Station No.	Mix Temp. °F. Plant	Mix Temp. °F. Road	Specimen Nos.	Lab Dens.	% Stab.
1						300°				
2										
	1							1-80-501	99.0	35

Materials Used

	Asphalt (Tons)	Aggregate (Tons)
Previous Report	48.29	
This Report	102.46	
Total To Date	150.75	

Percent Complete-Asphaltic Concrete Pavement

Percent Complete—This Type	%
Percent Complete—All Types	%

Days Run

Location No.	Course of Courses	Station to Station	Width (Feet)	Rate of Application: ____ Lbs/Sq. Yd. Sq. Yds.	Tons	____ Lbs/Sq. Yd. Sq. Yds.	Tons	____ Lbs/Sq. Yd. Sq. Yds.	Tons
2		Test section located approximately four miles from the intersection of SH-19							
		and SH-11 on SH-11 in Hopkins County.							
				Pea Gravel - Buster Matls., Frogville, Okla.					
				Bottom Ash - Monticello Plant, Mt. Pleasant, Texas					
				AC-20 Asph. - Dorchester, Mt. Pleasant, Texas					
		Total Today							
		Previous Report							
		Total To Date							
		Avg. Rate To Date		Lbs/Sq. Yd.		Lbs/Sq. Yd.		Lbs/Sq. Yd.	

Weather Clear
Warm
Min. Temp. ____ °F.
Max. Temp. ____ °F.

Remarks Material composed of approximately 60% pea gravel and 40% bottom ash by weight.

Richard W. Flood

Type D Date 6-5-80 Report No. 2

Texas Highway Department
Construction Form No. 404 Rev. (2)

TEXAS HIGHWAY DEPARTMENT
DAILY CONSTRUCTION REPORT—ASPHALTIC CONCRETE PAVEMENT

County Hopkins Highway IH-30 Project Req. 01-0-710L(1) Control 11953
Location of Plant Sulphur Springs Type of Plant Weigh batch Contractor Netex plant
Date 6-6-80 Specification Item 340... Type D Plant Started ____ M. Plant Stopped ____ M.

Location No.							
1	Main Lane	3	Decel. Lane	5	Entr. Ramp	7	
2	Fr. Rd. Lane	4	Accel. Lane	6	Exit Ramp	8	

Sieve Size	Design No. 3	Combined Bin Analysis 1	2	3	4	5	6	7	8	Extractions 1	2	3
1¾" - ⅞"												
⅞" - ⅝"												
1/2	0	0								0		
½" - ⅜"	5.2	3.7								1.8		
⅜" - 4	29.4	27.8								25.9		
¼" - 10												
4 - 10	19.6	23.1								20.0		
+ 10	54.2	54.6								47.7		
10 - 40	12.1	15.6								12.6		
40 - 80	8.6	7.6								12.9		
80 - 200	9.8	7.5								13.4		
Pass 200	4.3	3.7								5.3		
Asphalt	11.0	11.0								8.1		
Total	100.0	100.0								100.0		

Bin Analy. No.	Extr. No.	Time	Location No.	Course of Courses	Station No.	Mix Temp. °F. Plant	Road	Specimen Nos.	Lab Dens.	% Stab.
1						280°				
	1							1-80-503	91.7	44

Materials Used

	Asphalt (Tons)	Aggregate (Tons)
Previous Report	150.75	
This Report	51.61	
Total To Date	202.36	

Percent Complete-Asphaltic Concrete Pavement

Percent Complete—This Type	%
Percent Complete—All Types	%

Days Run

Location No.	Course of Courses	Station to Station	Width (Feet)	Rate of Application: ____ Lbs/Sq. Yd. Sq. Yds.	Tons	____ Lbs/Sq. Yd. Sq. Yds.	Tons	____ Lbs/Sq. Yd. Sq. Yds.	Tons
3		Test section located mileage		marker 128.5 E.B. L. on IH-30 in Hopkins Co.					
				Pea Gravel - Buster Matls., Frogville, Okla.					
				Bottom Ash - Monticello Plant, Mt. Pleasant, Texas					
				AC-20 Asph. - Dorchester, Mt. Pleasant, Texas					
		Total Today							
		Previous Report							
		Total To Date							
		Avg. Rate To Date		Lbs/Sq. Yd.		Lbs/Sq. Yd.		Lbs/Sq. Yd.	

Weather Clear
Warm
Min. Temp. ____ °F.
Max. Temp. ____ °F.

Remarks Material composed of approximately 60% pea gravel and 40% bottom ash by weight.

Richard W. Floyd

Type D Date 6-6-80 Report No. 3