THE VIRGINIA METHOD OF DETERMINING THE CEMENT CONTENT OF FRESHLY MIXED CEMENT-SOIL MIXTURES

A Manual Prepared for the Use of the Virginia Department of Highways

by

M. C. Anday
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Virginia Highway Research Council
(A Cooperative Organization Sponsored Jointly by the Virginia Department of Highways and the University of Virginia)

Charlottesville, Virginia

October 1971
VHRC 71-R9

PREFACE

The author developed the method outlined in this manual by making several significant changes in the new ASTM Method (D 2901), "Method of Test for Cement Content of Freshly Mixed Soil-Cement."

In 1966, realizing the difficulty agencies were having in measuring the cement content of cement stabilized mixtures, ASTM Committee D18.08.03 initiated a round robin testing program to develop a simple test method. As a member of the committee, the author participated in this program. The test method developed proved to be highly accurate (accuracy better than 5% of the design cement content in the laboratory). However, during the summer of 1971, when this method was used by the author to test the output of 10 plants producing cement stabilized aggregate, it was found to be very sensitive to gradation changes in the +No.4 material. Since most of the stabilized aggregates used in Virginia have appreciable amounts of +No.4 materials, it was decided that the method was not suitable for use by the Virginia Department of Highways. To overcome the sensitivity found and other shortcomings of the method, several changes were made. These changes relate to:

1. The sample size

2. The quantities of some of the reagents used

3. The methods of reporting and calculating test results

4. The accuracy of the equipment.

With the changes, the method became fairly accurate and even simpler. Not only is it applicable to soil-cement, as the ASTM title indicates, it is also applicable to all cement-soil mixtures.

It should be noted that the test does not require a knowledge of chemistry; it can be performed easily by the pug mill inspectors after about a day's training.

This manual was prepared for presentation to the Virginia Department of Highways for use in the implementation of this test method.

The cooperation received from the District Materials Engineers and their staffs in pretesting the method is gratefully acknowledged. The excellent field work performed by M. O. (Chub) Harris is also acknowledged.

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THE METHOD

1. Scope

1.1 This method of test is intended for determining the cement content of cement-soil mixtures sampled from the project under construction or at the pug mill.

2. Apparatus

2.1 Balance — A balance having a capacity of 1,000 g or more and a sensitivity of 0.1 or less.

2.2 Timer — A timer with a capacity of 10 minutes or more and a sensitivity of 0.1 second or less.

2.3 Glassware — 25-ml graduated cylinder, 1,000-ml graduated cylinder, 50-ml burettes, 10-ml volumetric pipettes, 250-ml Erlenmeyer flasks, medicine droppers.

2.4 Plasticware — 2 qt. polyethylene containers with snap-on covers, 12-in. diameter plastic funnel, 5-gal. polyethylene bottles for ammonium chloride, 5-gal. polyethylene bottles for distilled or demineralized water.

2.5 Burette Stand for 50-ml burette.

2.6 Magnetic Stirrer and Stirring Bar.

2.7 Stirring Rods — Glass stirring rods approximately 12 inches (250 mm) long.

2.8 Indicator Paper — Supply of indicator paper, pH range from 10 to 14.

2.9 Pipette Filler.

2.10 Sample Splitter — maximum size $1\frac{1}{2}$ inches.

3. Reagents

3.1 Ammonium Chloride Solution (10%) -- Transfer 1,893 g of U.S.P. granular ammonium chloride (NH_4Cl) to a 5-gal plastic bottle. Make up to 5 gal with distilled or demineralized water and mix well.

3.2 EDTA Solution (0.1 M) -- Dissolve 74.5 g of reagent grade disodium (ethylenedinitrilo) tetraacetate dihydrate ($Na_2C_{10}H_{14}N_2O_8 \cdot 2H_2O$) powder in about 1 liter of warm, distilled or demineralized water in a beaker. Cool to room temperature, transfer quantitatively to a 2-liter volumetric flask and make to the mark with distilled or demineralized water. Store in polyethylene bottle.

3.3 Cal Red may be used as the indicator.

3.4 Sodium Hydroxide Solution (50%) -- Cautiously add 500 g of reagent grade sodium hydroxide (NaOH) pellets in 600 ml of distilled or demineralized water and allow to cool to room temperature. Dilute to one liter with distilled or demineralized water. Store in a plastic bottle. Dilute 1:1 with distilled or demineralized water for use.

3.5 Triethanolamine Solution (20%) -- Dilute 100 ml of reagent grade triethanolamine $(HOCH_2CH_2)_3N$ to 500 ml with distilled or demineralized water.

4. Procedure for Preparing Calibration Curve

4.1 From the materials to be used for construction, prepare three sets of duplicate samples at the design moisture content and containing the following amounts of cement:

Set 1. Two samples at 75 percent of the design cement content

Set 2. Two samples at 100 percent of the design cement content

Set 3. Two samples at 125 percent of the design cement content.

Using a sample size of 600 g, for each sample compute the quantities of soil, cement and water as follows:

$$W_s \text{(total weight of soil, g)} = \frac{\text{Sample Size}}{(1 + M/100)(1 + C/100)}$$

$$W_r \text{(weight of material retained on No. 4 sieve)} = \frac{R}{100} \times W_s$$

W_f(weight of material passing No. 4 sieve) = $W_s - W_r$

W_c(weight of cement, g) = $\frac{C}{100} \times W_s$

V_w(volume of water, ml) = $\frac{M}{100} (W_s + W_c)$

where: M = design moisture content, percent by dry weight
C = cement content, percent by dry weight of soil
R = percent material retained on No. 4 sieve

For each sample mix the soil and cement thoroughly to a uniform color. Add the water and mix thoroughly.

Titrate each 600 g sample as described under Procedure for Titration. After titrating the six samples, construct a graph showing ml of EDTA solution vs. per cent cement by weight using average figures from Sets 1, 2 and 3.

5. Procedure for Test Samples

5.1 At the construction site or at the pug mill, samples of the soil-cement mixture shall be taken at the completion of mixing. The samples are tested immediately or placed in covered plastic containers and tested within one hour of the completion of mixing.

For testing, weigh a 600 g portion and titrate as described under Procedure for Titration.

Note 1 — If a correction is to be made for variations in moisture content, determine the moisture content, M', of a separate portion of the material passing a No. 4 (4.76 mm) sieve. Computations for the correction are given under Calculations, Note 4.

6. Procedure for Titration

6.1 Place each 600 g sample in a 2-qt. polyethylene container and add 1,200 ml ammonium chloride solution. Place cover on the container and shake the mixture for two minutes (±2 seconds). Allow the mixture to settle for four minutes (±2 seconds). Pipette a 10-ml aliquot of the supernatant

486 solution into a 250-ml Erlenmeyer flask and add 100 ml of distilled or demineralized water. While thoroughly mixing on a magnetic stirrer, add drops of sodium hydroxide solution until a pH between 13.0 and 13.5 is obtained as measured by the indicator paper. Use stirring rod to transfer drops of solution to indicator paper, add 4 drops of triethanolamine solution and then add about 0.2 g of the indicator powder. While the solution is being stirred on the magnetic stirrer, titrate with EDTA and record the quantity in ml to a pure blue endpoint.

Note 2 — A sharper endpoint may sometimes be obtained by adding approximately half of the anticipated quantity of EDTA solution before the addition of sodium hydroxide.

Note 3 — All equipment must be kept scrupulously clean by thorough rinsing with distilled or demineralized water. All reagents must be stored in polyethylene containers.

7. Calculations

Read the cement content by dry weight directly from the calibration curve corresponding to the titration results in ml of EDTA for the test sample.

Note 4 — Variations of moisture content (above 2%) will have slight effect on the accuracy of test. Correction for moisture variation may be computed as follows:

$$C' = \frac{1 + M'/100}{1 + M/100} \; C$$

where: C' = percent cement corrected for moisture variation

C = percent cement determined from test sample

M' = percent moisture of test sample as determined in paragraph 5, Note 1

M = design moisture content

GENERAL INFORMATION

8. Miscellaneous

8.1 Size of Sample -- Obtain a 10-lb. sample. Split this sample over a splitter until about a 600 g sample is obtained. Weigh exactly 600 g as sample size for testing.

8.2 Number of Samples — Due to the variabilities involved in the method itself, the cement, the aggregate and the production procedures, a single test will not be sufficient. Although the average of 2 tests can be used as a quick indication (plant calibration, etc.) for compliance purposes, 4 tests are necessary to determine the cement content within ±1 percentage point at the 95% confidence level. (After some training a test takes about 10 minutes.)

8.3 Sampling

8.3.1 In all cases samples shall be taken in a random manner and not be selected as "representative" samples. A table of random numbers is included in this manual as Appendix A.

8.3.2 Compliance Testing — For compliance purposes, at the pug mill, 4 random samples shall be taken. This shall be accomplished by randomizing the tonnage. In addition, when sampling from a truck, the truck should be divided into 4 quadrants and the 4 samples should be taken from randomized quadrants. For uniformity of application, a sketch of a truck divided into quadrants is included in this manual as Appendix B.

9. Equipment and Reagent Sources

A list showing the agencies from which equipment and reagents can be purchased is included in the manual as Appendix C.

10. Forms

Forms for calculations, titrations and testing are given in Appendices D1, D2 and D3 respectively.

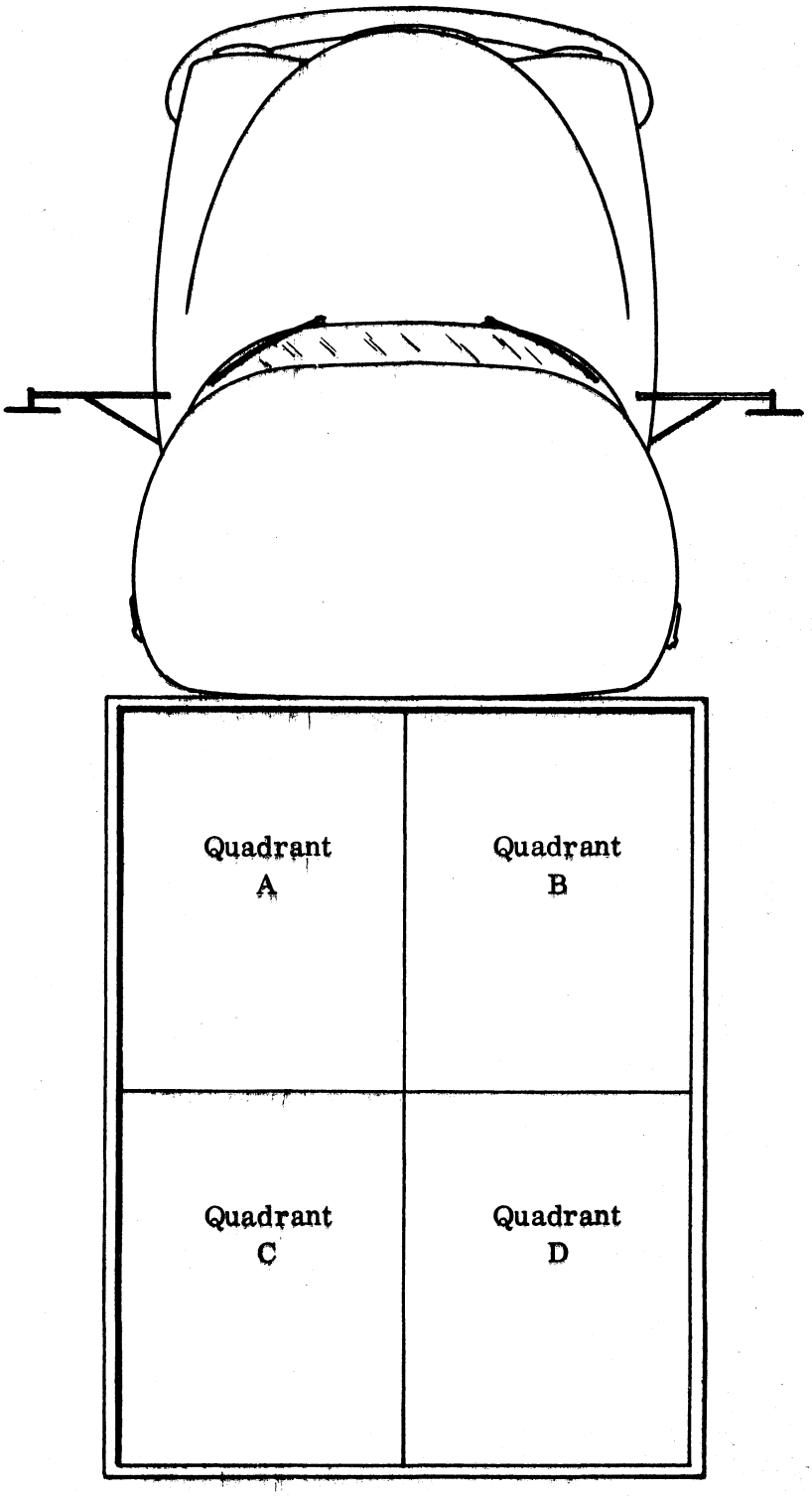
APPENDIX A

TABLE OF RANDOM NUMBERS

1	23 15	75 48	59 01	83 72	59 93	76 24	97 08	86 95	23 03	67 44
2	05 54	55 50	43 10	53 74	35 08	90 61	18 37	44 10	96 22	13 43
3	14 87	16 03	50 32	40 43	62 23	50 05	10 03	22 11	54 38	08 34
4	38 97	67 49	51 94	05 17	58 58	78 80	59 01	94 32	42 87	16 95
5	97 31	26 17	18 99	75 53	08 70	94 25	12 58	41 54	88 21	05 13
6	11 74	26 93	81 44	33 93	08 72	32 79	73 31	18 22	64 70	68 50
7	43 36	12 88	59 11	01 64	56 23	93 00	90 04	99 43	64 07	40 36
8	93 80	62 04	78 38	26 80	44 91	55 75	11 89	32 58	47 55	25 71
9	49 54	01 31	81 08	42 98	41 87	69 53	82 96	61 77	73 80	95 27
10	36 76	87 26	33 37	94 82	15 69	41 95	96 86	70 45	27 48	38 80
11	07 09	25 23	92 24	62 71	26 07	06 55	84 53	44 67	33 84	53 20
12	43 31	00 10	81 44	86 38	03 07	52 55	51 61	48 89	74 29	46 47
13	61 57	00 63	60 06	17 36	37 75	63 14	89 51	23 35	01 74	69 93
14	31 35	28 37	99 10	77 91	89 41	31 57	97 64	48 62	58 48	69 19
15	57 04	88 65	26 27	79 59	36 82	90 52	95 65	46 35	06 53	22 54
16	09 24	34 42	00 68	72 10	71 37	30 72	07 57	56 09	29 82	76 50
17	97 95	53 50	18 40	89 48	83 29	52 23	08 25	21 22	53 26	15 87
18	93 73	25 95	70 43	78 19	88 85	56 67	18 68	26 95	99 64	45 69
19	72 62	11 12	25 00	92 26	82 64	35 66	65 94	34 71	68 75	18 67
20	61 02	07 44	18 45	37 12	07 94	95 91	73 78	66 99	53 61	93 78
21	97 83	98 54	74 33	05 59	17 18	45 47	35 41	44 22	03 42	30 00
22	89 16	09 71	92 22	23 29	06 37	35 05	54 04	89 88	43 81	63 61
23	25 96	68 82	20 62	87 17	92 65	02 82	35 28	62 84	91 95	48 83
24	81 44	33 17	19 05	04 95	48 06	74 69	00 75	67 65	01 71	65 45
25	11 32	25 49	31 42	36 23	43 86	08 62	49 70	67 42	24 52	32 45
1	64 75	58 38	85 84	12 22	59 20	17 69	61 56	55 95	04 59	59 47
2	10 30	25 22	89 77	43 63	44 30	38 11	24 90	67 07	34 82	33 28
3	71 01	79 84	95 51	30 85	03 74	66 59	10 28	87 53	76 56	91 49
4	60 01	25 56	05 88	41 03	48 79	79 65	59 01	89 78	80 00	36 66
5	37 33	09 46	56 49	16 14	28 02	48 27	45 47	55 44	55 36	50 90
6	47 86	98 70	01 31	59 11	22 73	60 62	61 28	22 34	69 16	12 12
7	38 04	04 27	37 64	16 78	95 78	39 32	34 93	24 08	43 43	87 06
8	73 50	83 09	08 83	05 48	00 78	36 66	93 02	95 50	46 04	53 36
9	32 62	34 64	74 84	06 10	43 24	20 62	83 73	19 32	35 64	39 69
10	97 59	19 95	49 86	63 03	51 06	62 06	99 29	75 95	32 05	77 34
11	74 01	23 19	55 59	79 09	69 82	66 22	42 40	15 96	74 90	75 89
12	56 75	42 64	57 13	35 10	50 14	90 96	63 36	74 69	09 63	34 88
13	49 80	04 99	08 54	83 12	19 98	08 52	82 63	72 92	93 36	50 26
14	43 58	48 96	47 24	87 85	66 70	00 22	15 01	93 99	59 16	23 77
15	16 65	37 96	64 60	32 57	13 01	35 74	28 36	36 73	05 48	72 29
16	48 50	26 90	55 65	32 25	87 48	31 44	68 02	37 31	25 29	63 67
17	96 76	55 46	92 36	31 68	62 30	48 29	63 83	52 23	81 66	40 94
18	38 92	36 15	50 80	35 78	17 84	23 44	41 24	63 33	99 22	81 28
19	77 95	87 16	94 25	22 50	55 87	51 07	30 10	70 60	21 86	19 61
20	17 92	82 80	65 25	58 60	87 71	02 64	18 50	64 65	79 64	81 70
21	94 03	68 59	78 02	31 80	44 99	41 05	41 05	31 87	43 12	15 36
22	47 46	06 04	79 56	23 04	84 17	14 37	28 51	67 27	55 80	03 60
23	47 85	65 60	88 51	99 28	24 39	40 64	41 71	70 13	46 31	82 88
24	57 61	63 46	53 92	29 86	20 18	10 37	57 65	15 62	98 69	07 56
25	08 30	09 27	04 66	75 26	66 10	57 18	87 91	07 54	22 22	20 13

APPENDIX B

DESIGNATION OF TRUCK QUADRANTS



APPENDIX C

EQUIPMENT AND REAGENT SOURCES

Balance	Equipment Depot, Richmond	$194.11 ea.
Timer	Equipment Depot, Richmond	12.41 ea.
Sample Splitter	Equipment Depot, Richmond	65.00 ea.
Glassware:		
One — 100-Ml Graduated Cylinder	Equipment Depot, Richmond	$2.97 ea.
One — 1000-Ml Graduated Cylinder	Equipment Depot, Richmond	5.05 ea.
One — 50-Ml Burette	Phipps & Bird, Richmond	8.48 ea.
One — 10-Ml Volumetric Pipette	Phipps & Bird, Richmond	1.73 ea.
One — 250-Ml Erlenmeyer Flask	Phipps & Bird, Richmond	.77 ea.
One — 1-Liter Flask Beaker	Phipps & Bird, Richmond	1.94 ea.
One — 2-Liter Flask Beaker	Phipps & Bird, Richmond	2.10 ea.
One — 2-Liter Flask	Phipps & Bird, Richmond	4.65 ea.
One — 1-Liter Flask	Phipps & Bird, Richmond	3.30 ea.
Medicine Droppers	Phipps & Bird, Richmond	1.14 doz.
Plasticware:		
Two — 2 qt. Plastic Container	Phipps & Bird, Richmond	$2.05 ea.
Three — 16 oz. Plastic Container	Phipps & Bird, Richmond	.80 ea.
One — 6" diameter Plastic Funnel	Phipps & Bird, Richmond	2.55 ea.
Three — 5-gal. Plastic Container	A & N Store, Charlottesville	4.10 ea.
One – Burette Stand for 50-Ml Burette	Phipps & Bird, Richmond	$13.40 ea.
One – Magnetic Stirrer and Stirring Bar	Phipps & Bird, Richmond	$35.00 ea.
Stirring Rods	Phipps & Bird, Richmond	$1.17 lb.
One – Indicator Paper (pH range 10 to 14)	Phipps & Bird, Richmond	$2.00 ea.
Reagents:		
Ammonium Chloride (U.S.P. granular) (NH_4Cl) 5# Jar	Phipps & Bird, Richmond	$6.36 ea.
EDTA ($NaC_{10}H_{14}N_2O_8 \cdot 2H_2O$)	Phipps & Bird, Richmond	12.00 lb.
Cal Red Indicator Powder	Instru-Chem, Inc. 204 S. Haskell Avenue Dallas, Texas 75226	5.35 per 100 grams
Sodium Hydroxide Solution (NaOH) Pellets 5# Jar	Phipps & Bird, Richmond	8.80 ea.
Triethanolamine Solution ($HOCH_2CH_2)_3N$	Phipps & Bird, Richmond	5.52 per pt.

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APPENDIX D1

CEMENT CONTENT DETERMINATION
CALIBRATION CALCULATIONS

District: _____	Date: _____
Plant: _____	Tester: _____

Mix Design Constants

C (Design cement content, %) =	F (% Passing No. 4 sieve) =
M (Opt. Moist. content, %) =	C_X = 75%, 100%, 125% of C
R (% Retained on No. 4 sieve) =	

Mix Design

Mix	$W_s = \frac{\text{Sample Size}}{(1+M/100)(1+C_X/100)}$	$W_r = \frac{R}{100} \times W_s$	$W_f = \frac{(100-R)W_s}{100}$
75%	=	=	=
100%	=	=	=
125%	=	=	=

Mix	W_c	V_w
75% C	$W_s \times \frac{C}{100} \times 0.75$ = _____ =	$(W_s + W_c)\frac{M}{100}$ = _____ =
100% C	$W_s \times \frac{C}{100} \times 1.00$ = _____ =	$(W_s + W_c)\frac{M}{100}$ = _____ =
125% C	$W_s \times \frac{C}{100} \times 1.25$ = _____ =	$(W_s + W_c)\frac{M}{100}$ = _____ =

Data for Mixing

	75% C =	100% C =	125% C =
Weight of Container	----------	----------	----------
+4 Material	_____	_____	_____
Sub Total	----------	----------	----------
-4 Material	_____	_____	_____
Sub Total	----------	----------	----------
Cement	_____	_____	_____
TOTAL			

Sheet No. _____

APPENDIX D2

CEMENT CONTENT DETERMINATION
CALIBRATION TITRATIONS

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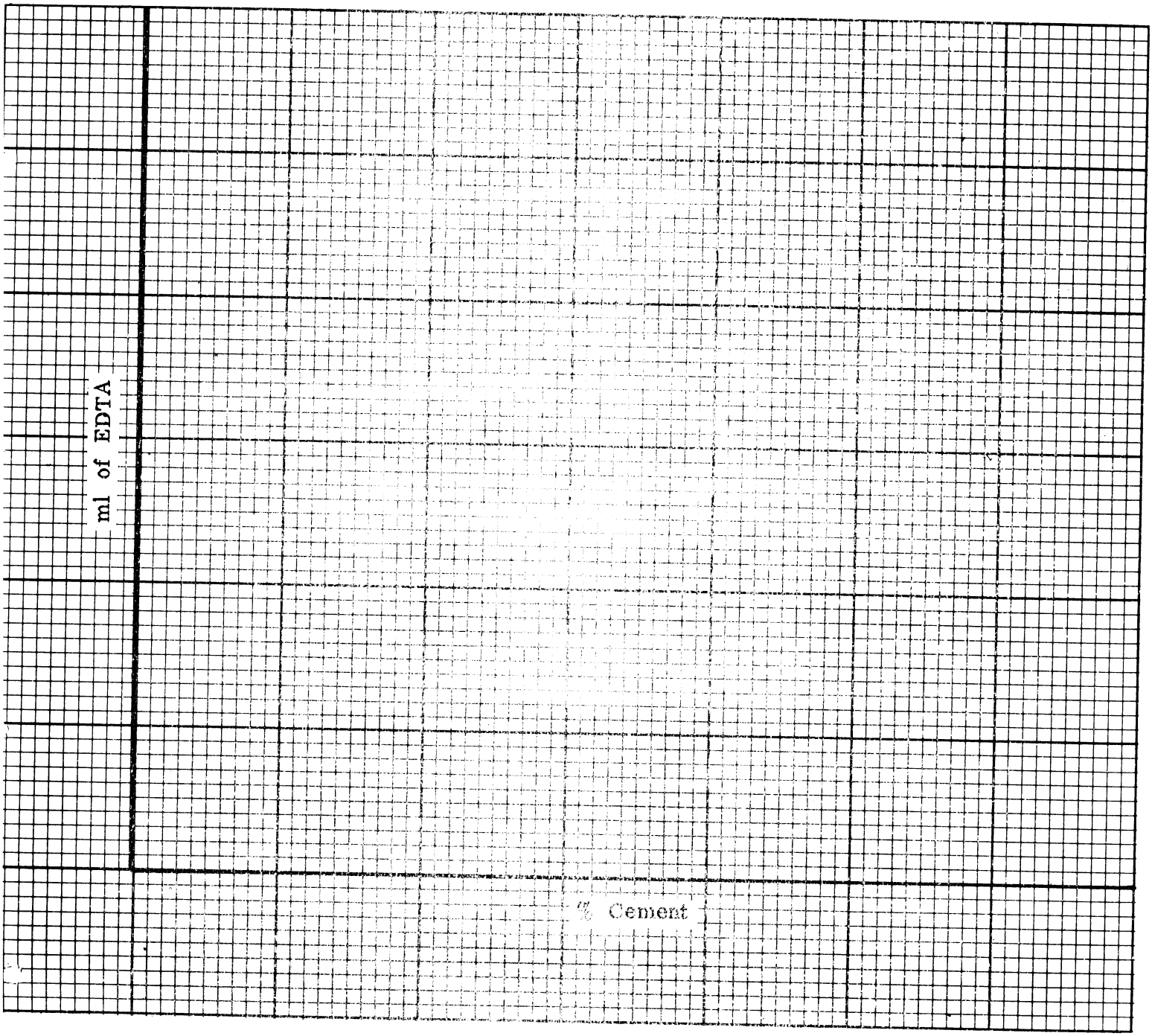
Calibration

	Time	75% C =			100% C =			125% C =		
		1	2	Ave	1	2	Ave.	1	2	Ave.
EDTA	Finish									
	Start									
	Difference									



Sheet No. ______

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APPENDIX D3

CEMENT CONTENT DETERMINATION TESTING

District: ______________________ Date: ______________

Plant: ______________________ Tester: ______________

Date	Sample No.	EDTA ml	Percent Cement	Project No.

MEMORANDUM REPORT

AN EVALUATION OF TWO BRIDGE DECK OVERLAY SYSTEMS ON THE RTE. 85 BRIDGES OVER THE ROANOKE RIVER

by

M. H. Hilton
Highway Research Engineer

Virginia Highway Research Council
(A Cooperative Organization Sponsored Jointly by the Virginia Department of Highways and the University of Virginia)

Charlottesville, Virginia

October 1971
VHRC 71-R11

MEMORANDUM REPORT

AN EVALUATION OF TWO BRIDGE DECK OVERLAY SYSTEMS ON THE RTE. 85 BRIDGES OVER THE ROANOKE RIVER

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Highway Research Engineer

BACKGROUND

Because of exposed reinforcing steel in some areas of the decks, the interstate route 85 bridges over the Roanoke River were treated with overlays in August 1969. In order to evaluate two different materials on a comparative basis, the Department of Highways decided to apply a Guardkote 250 (epoxy) mortarmix overlay to the SBL deck, and a latex (DOW SM-100) modified portland cement overlay to the NBL deck. By memorandum to Mr. W. S. G. Britton dated August 1, 1969, the Maintenance Division requested that the Research Council review and evaluate the overlay treatments periodically. In accordance with this request, inspections have been conducted on a semiannual basis, and on other occasions, by the Structures Section of the Research Council.

GENERAL EVALUATION

Guardkote 250 Mortarmix

The Guardkote 250 material is an oil extended epoxy which, in this instance, was mixed with a sand aggregate to form an epoxy mortar. The preparation of the surface of the bridge deck, the materials requirements, and the application procedures used were in accordance with the recommendations and specifications [1] of the supplier.

After the first winter, the epoxy overlay performed satisfactorily; but by the fall of 1970 signs of impending failure were apparent. Failures in the bond between the deck and the overlay occurred at several locations during the latter part of 1970 — requiring patches of from less than one square foot to several square feet in area (Figure 1). Since all material necessary for repairs was to be supplied by the Shell Oil Company for a period of two years, a field inspection was held in April 1971. Additional patching, which was required at a half dozen locations, was installed several weeks after the field inspection. Subsequently, on

September 21, a new failure on one span was noted as shown in Figure 2. Several other spans have small areas where failure in bond has occurred but the unbonded area has not broken out from the overlay. It is apparent that the overlay will be a continuous maintenance problem.

In addition to the SBL of Rte. 85 over the Roanoke River, Guardkote 250 mortar overlays have been applied to two other bridge decks — one in the Bristol District and one in the Fredericksburg District. As reported earlier by McKeel [2] neither of these have performed satisfactorily due to bond failures such as that described above.

DOW SM-100 Latex Modified Portland Cement

Like the overlay on the SBL, the latex mortar overlay on the NBL bridge deck was applied in accordance with the specifications [3] and procedures recommended by the product developer and supplier.

The DOW SM-100 is a film forming polymer emulsion which is designed to upgrade the physical properties of bonded portland cement overlays. Latex modified mortars are produced by adding 3.5 gallons of the SM-100 latex material for each bag of portland cement used in a mortar mix. Data developed by the Dow Company [4] indicate that the modified composition is more flexible, more impermeable to water, less susceptible to chemical attack, and more resistant to abrasion than is a regular portland cement mortar. Microscopic studies by Isenburg, et al [5], indicate that latex modified mortar overlays have greater bond to concrete than do mortar overlays without the latex additive.

After two years of service the DOW SM-100 overlay is performing satisfactorily. No failures in bond to the concrete deck have been observed to date and no maintenance repair work has been required. A network of hairline cracks, however, has developed throughout the overlay. As shown in Figure 3, the crack patterns can be easily detected as water evaporates from a wetted deck surface. The cracking is the most extensive in the transverse direction; but shorter length longitudinal cracking, propagating outward from the transverse cracks, is present also. The longitudinal cracking is more random and of shorter length than the transverse cracking, but often spans the distance between transverse cracks. While in some areas the cracking is beginning to resemble a fine pattern type cracking, it can best be described at this time as fine transverse cracking as defined and illustrated in the ACI guide for concrete condition surveys [6].

On several DOW SM-100 overlays placed on bridge decks in Kentucky, Crace [7] has reported that fine cracking had been observed when the overlays were wet and were in the process of drying. The cracking on the Kentucky bridge decks

Figure 1. Typical areas requiring patches after slightly more than a year's service. (Guardkote 250 epoxy mortar overlay, SBL Rte. 85 bridge over the Roanoke River.)

Figure 2. A failure (foreground) which developed three months after the repair shown in the background. (Guardkote 250 epoxy mortar overlay after two years' service, SBL, Rte. 85 bridge over the Roanoke River.)

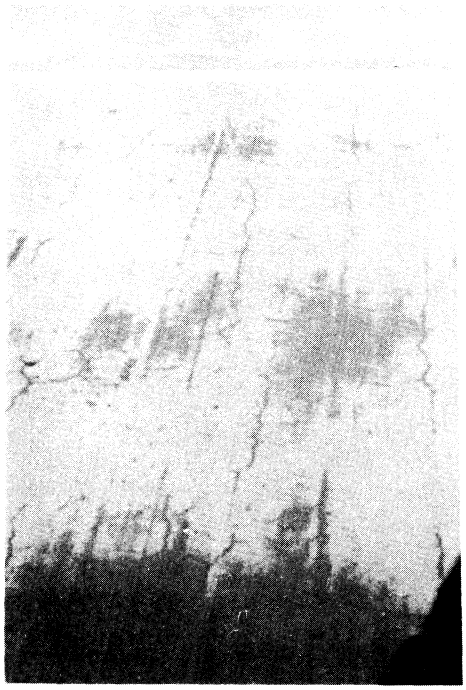

Figure 3. Typical fine transverse cracking in the DOW SM-100 latex modified mortar overlay. (NBL Interstate Rte. 85 bridge over the Roanoke River.)

was not considered to be detrimental to the bond between the old concrete and the latex mortar, but an evaluation of the long-term durability of the overlays had not been made. While bond does not appear to be a problem on the Rte. 85 NBL study bridge at this time, the origin, degree, and effects of the cracking should be investigated further. Accordingly, sample cores will be taken from some randomly selected cracked and non-cracked areas of the deck and examined petrographically in the laboratory.

Since the long-term durability of the DOW SM-100 is still questionable, widespread use of the material for overlaying bridge decks should await more conclusive laboratory and field evaluations. Based on a comparison of the current results with earlier studies, [2] however, the modified latex mortar appears to be a better alternative than an epoxy mortar system for use where urgent repair of a deteriorated bridge deck is necessary.

CONCLUSIONS

After two years of service the following conclusions can be drawn from the comparison of the Guardkote 250 epoxy mortar overlay with the DOW SM-100 latex modified mortar overlay.

1. The performance of the Guardkote 250 epoxy mortar overlay on the SBL bridge deck has been unsatisfactory and will be a continuous maintenance problem due to failures in bond to the concrete deck. It can further be concluded that the poor performance of the Guardkote 250 overlay on the SBL of the Rte. 85 bridge over the Roanoke River is not an isolated case since similar distress has occurred on two additional bridge decks in Virginia.

2. The DOW SM-100 latex modified portland cement mortar has performed satisfactorily and no failures in bond to the concrete deck have occurred to date.

3. The performance of the DOW SM-100 latex modified overlay has been vastly superior to that of the Guardkote 250 epoxy mortar overlay.

4. The long-term durability of the SM-100 latex mortar is questionable at this time due to the development of extensive hairline cracking in the overlay. On the basis of its performance to date, however, the material shows promise and should be investigated further.

RECOMMENDATIONS

1. The Guardkote 250 epoxy mortar overlay as used for bridge deck repairs is a failure and no further use of the material is recommended.

2. While the performance of the SM-100 latex modified mortar has been satisfactory to date, it is recommended that widespread use of the material for repairing bridge decks await the outcome of a laboratory analysis of sample cores to be taken from the study overlay. In the interim, where urgent repairs of deteriorated bridge decks are necessary, a latex mortar overlay is a better alternative than a Guardkote 250 epoxy mortar overlay.

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