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Chemical Sealers as Corrosion Inhibitors

Naselle River Bridge 101/24
WA-RD 302.1

Final Report
February 1993



Washington State Department of Transportation
Washington State Transportation Commission
Transit, Research, and Intermodal Planning (TRIP) Division
Department of Transportation in cooperation with
U.S. Department of Transportation
Federal Highway Administration

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
TECHNICAL REPORT STANDARD TITLE PAGE

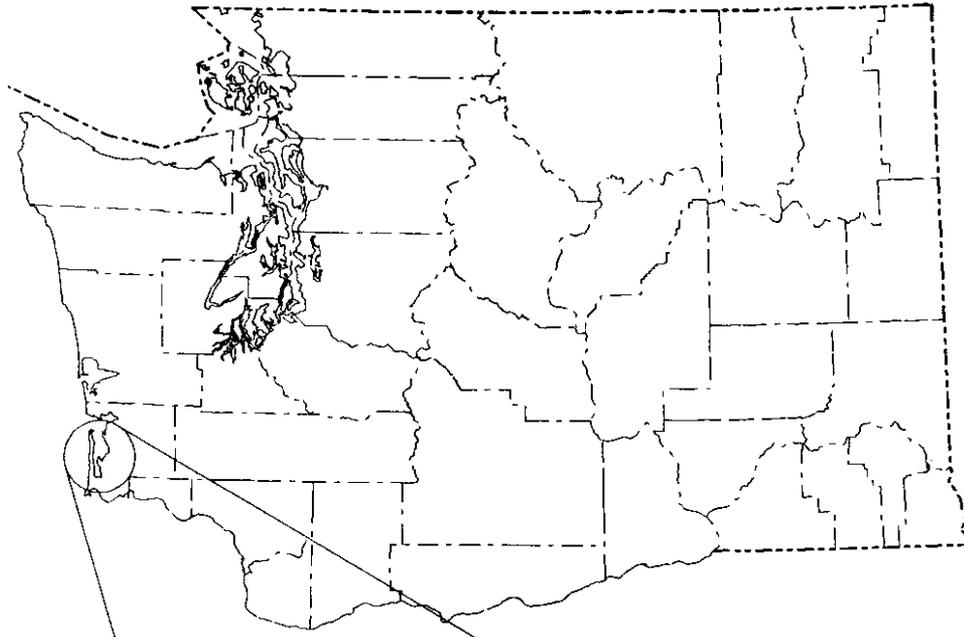
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16. ABSTRACT Chem-Trete Silane sealer was applied to the prestressed girders and precast piles of the newly constructed Naselle River Bridge 101/24 in Washington State in 1984. The purpose of the experiment was to gain experience with the use of the product and to measure its effectiveness over time in preventing the intrusion of chlorides into prestressed concrete girders and precast concrete piles in marine environments. Recent rapid chloride permeability tests and chloride testing indicate that this sealer has had little or no effect on reducing the intrusion of chlorides into the concrete.			
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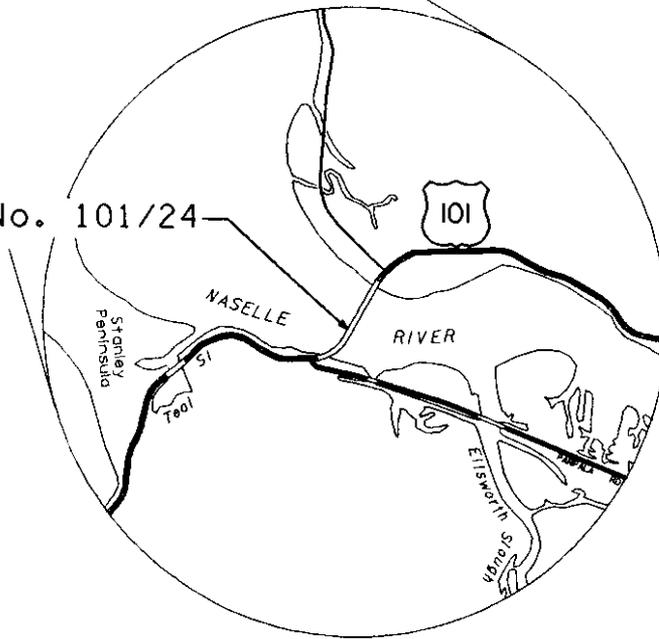
Table Of Contents

	Page
Vicinity Map.....	1
Introduction.....	2
Study Site.....	2
Tests And Evaluations.....	3
Conclusions	4
Recommendations	4
Appendix A - Testing.....	5
Appendix B - General Layout	12
Appendix C - Testing Photographs.....	15

VICINITY MAP



Bridge No. 101/24



PROJECT SITE

Introduction

The Washington State Department of Transportation (WSDOT), in search of a method for protecting concrete structures from the intrusion of chloride ions, identified the following chemical sealers, from laboratory tested sealers reported in NCHRP Publication No. 244, as being the most effective in providing a chloride ion barrier:

- Chem-Trete Silane
- EA Sealer
- Penetrating Sealer 1854

This experimental project was designed to provide field experience, and an evaluation of the method of application and the effectiveness of one of the above sealers on newly constructed bridge girders and piles. The contract specifications allowed the use of any of these three sealers. Chem-Trete was selected by the contractor.

Study Site

The Naselle River Bridge (101/24) was selected as an appropriate structure for the chemical seal experiment, due to its marine environment location. The bridge is located on State Route 101, five miles north of the town of Naselle (see vicinity map).

Chem-Trete Silane sealer, manufactured by Dynanit-Nobel, Montville, NJ, was selected for this structure. This sealer was applied to the concrete in multiple

coats, as required to obtain the application rate recommended by the manufacturer.

The sealer was applied in 1984 under WSDOT Contract No. C2641. The preparation of the concrete surface, application method and rate of application, workability of the sealer, uniformity of appearance, and problems were monitored for post-construction reporting.

WSDOT Post-Construction Report entitled "Naselle River Bridge 101/24, Chemical Sealers as Corrosion Inhibitors," WA-RD 105.1, dated March 1987, describes the post-construction monitoring.

Tests and Evaluations

No control girders or piles were provided in this experimental project. Therefore, all field sampling had to be done on prestressed girders and precast piles that were treated with the silane sealer.

Core samples were taken in the field for permeability testing in the lab. The prestressed girder web of the south outside girder of Span 1 was selected because of its ease of accessibility from dry land. Four core samples were taken from the web of this girder. Also, eight chloride powder samples were taken from this girder.

It would have been desirable to take core samples from the columns of the piers for permeability testing, but the pneumatic suction devices for holding the core drill to the concrete will function only on flat surfaces. Therefore, the only field

sampling available was chloride sampling. Chloride samples were taken from the three columns of Pier 2. Two samples per column were taken, one above tide level and one below tide level, for a total of six samples at the pier.

The rapid chloride permeability test results are compatible with those for a high quality concrete exposed to a saltwater environment for eight years, but not one treated with a moisture intrusion protection system. The chloride content of the samples below the tide mark is extremely high, indicating that the protection system is not preventing the intrusion of chlorides. See Appendix A for complete test results.

Conclusions

The results of the testing indicate that the silane sealer has been ineffective at preventing the intrusion of chlorides into the concrete.

Recommendations

An attempt was made to contact the manufacturer of the product to obtain their evaluation and conclusions on the results of the Department's test data. The manufacturer could not be located at the address shown during the construction year or at any forwarding address.

Based upon the test results, it is recommended that this product not be used by WSDOT as a protective sealer on reinforced concrete structures.

Appendix A

Testing

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

INTRA-DEPARTMENTAL COMMUNICATION

DATE: Oct. 15, 1992

FROM: R. G. Finkle/Bob Allison *REA*
PHONE: Scan 234-4664

SUBJECT: Naselle River Bridge
Silane Sealer Testing

TO: A. H. Walley/O. R. George

Per your request we obtained 4 concrete core samples to determine chloride permeability and 8 powder samples to determine chloride content from Span 1 Girder E on the subject bridge. Additionally, 6 chloride samples were taken from the columns at pier 1. The results are attached.

The samples on test report Lab #CL-4051 were taken from the columns. The odd numbered samples being taken below the high tide mark and the even numbered samples above the high tide mark. The "A" designation represents a sample taken from 0" to 3/4" depth and the "B" represents a sample taken from 3/4" to 1-1/2" depth. Samples on Lab #CL-4052 were taken on the girder at the approximate same locations as the permeability cores. The "A" and "B" samples were taken on the outside of the girder and the "C" and "D" samples were taken on the inside (non-exposed side) of the girder. Note that chloride content below the tide mark is extremely high.

The rapid chloride permeability test results shows numbers that you would typically expect of a high quality concrete, but certainly not one treated with some sort of moisture intrusion protection.

My conclusion is the stuff didn't work.

REA

Handwritten notes:
DIR [unclear]
IN [unclear]
OCT 16 1992
DEPT. OF TRANSPORTATION
COMMUNICATIONS SECTION

BRIDGE AND STRUCTURES	
WALLEY	
CURTIS	
HOBBS	
SEBERT	
VAISELL	
LWIN	
CHAU	
NELSON	
SWAFER	
KIRKER	
STODDARD	
<i>Handwritten:</i> [unclear]	
GEORGE	
WHITNEY	
WALLEY	

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION - MATERIALS LABORATORY
PO Box 167 Olympia/ 1655 S 2nd Ave Tumwater/ WA 98504
Chemistry Section

Test of: Chlorides
Date Logged In: 08/21/92
Date Logged Out:
SR: 101
Section: NASELLE R. BR.

Lab. No: CL-04051
Lab ID No: 0000028740
District: 4

=====
Bridge Number: 101/24
Bridge Name: NASELLE R. BR.
Number of samples: 12

*** Test report attached ***

=====
Mat. File X General File X Material: INFORMATIONAL
Dist Administrator: 4 Remarks:
Project Engineer:
ALLISON X(2)
Chem Lab: X
Bridge: X

0132 F2B2- 12
F2L0-
F2K9-

Rodney G. Finkle, P.E.
Materials Engineer
by: C. L. Sherrell RLS
Date 09/25/92 Telephone 234-7064

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
HEADQUARTERS MATERIALS LABORATORY

LAB NUMBER CL-4051

MS1654

BRIDGE NUMBER

DATE TESTED 091692

CONTROL FIELD

DATE SAMPLED 080492

SAMPLE

STATION

OFFSET

CHLORIDE

ASPHALT

1A			53.0
1B			22.5
2A			6.21
2B			.6
3A			11.3
3B			3.99
4A			11.4
4B			2.41
5A			30.8
5B			21.6
6A			10.9
6B			2.5

~~F262 12~~ 0132.

MATLS.....X
GENL.....X

PAGE 1 OF 1

PROJ ENG..ALLISON
BRIDGE.....X
CHEM LAB.....X

X(2)

DATE 09-17-1992

Rodney G. Finkle, P.E.
MATERIALS ENGINEER

by C. L. Sherrell

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION - MATERIALS LABORATORY
PO Box 167 Olympia/ 1655 S 2nd Ave Tumwater/ WA 98504
Chemistry Section

Test of: **Chlorides**
Date Logged In: 08/21/92
Date Logged Out:
GR: 101
Section: NASELLE R. BR.

Lab. No: **CL-04052**
Lab ID No: 0000028741
District: 4

=====
Bridge Number: 101/24
Bridge Name: NASELLE R. BR.
Number of samples: 8

*** Test report attached ***

=====
Mat. File X General File X Material: INFORMATIONAL
Dist Administrator: 4 Remarks:
Project Engineer:
~~ALLISON~~ X(2)
Chem Lab: X
Bridge: X

0132 T282- 16
T2LO-
T2K9-

Rodney G. Finkle, P.E.
Materials Engineer
by: C. L. Sherrell CLS
Date 10/08/92 Telephone 234-7064

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION
HEADQUARTERS MATERIALS LABORATORY

LAB NUMBER CL-4052

MS1654

BRIDGE NUMBER 101

DATE TESTED 100292

CONTROL FIELD

DATE SAMPLED 080492

SAMPLE	STATION	OFFSET	CHLORIDE	ASFHALT
*****	*****	*****	*****	*****
1A			.29	
1B			.27	
1C			.21	
1D			.17	
2A			.51	
2B			1.02	
2C			.2	
2D			.19	
3A			.34	
3B			.35	
3C			.27	
3D			.31	
4A			.25	
4B			.22	
4C			.05	
4D			.29	

~~7282 10~~ 0132
MATLS.....X
GENL.....X

PAGE 1 OF 1

PROJ ENG..ALLISON
BRIDGE.....X
CHEM LAB.....X

X(2)

DATE 10-02-1992

Rodney G. Finkla, P.E.
MATERIALS ENGINEER

by C. L. Sherrell

NO. 50455

MATERIAL: 4" PCC Cores			CONTRACT NO. MS 1654			HDOTRS. LAB. NO. M-9118, 9119, 9120 & 9121		
ACCEPTANCE SAMPLE NO. 1 thru 4		ASSURANCE SAMPLE NO.		LA S. NO.		SR NO. 101		DIST. LAB. NO.
BRAND			HEAT NO.			SECTION Naselle R. Br. 101 / 24 24		
ID NO./LOT NO.			REEL NO.			COUNTY Pacific		CITY/COUNTY/AGENCY CONT. NO.
CERTIFICATE NO.			TRUCK/CAR NO.			CONTRACTOR		
STOCKPILE NO.			PIT NO.			SUBCONTRACTOR		
USED AT STATION			TO STATION			SAMPLED AT Span 1 E		BY Special Projects
FIELD <input type="checkbox"/> ACCEPT <input type="checkbox"/> REJECT			BASED ON FIELD TEST NO.			TESTED AT		DATE 8/4/92
LON DATE			LON DATE			LON DATE		LON DATE
0000027880			0000027881			0000027882		Asph. Max. Density
FIELD M-9118			M-9119			M-9120		
DIST. LAB.			0000027883					
SPEC'S.								

REMARKS: Mix Design Desired Yes No Run Report Chloride Permeability on both ends of cores

DOT FORM 350-034 7/87 DISTRIBUTION: WHITE - With Sample CANARY - Project Files Project Engineer R. Allison 8/6/92 Organization Code 346010 Phone: (SCAN)

10 AUG 06 '92

TEST OF Rapid Chloride Permeability

Lab. No. M-9118, 19, 20 & 21

Coulombs

M-9118 Top = 1,713
Bottom = 3,463

M-9119 Top = 2,206
Bottom = 2,014

M-9120 Top = 1,623
Bottom = _____

M-9121 Top = 1,908
Bottom = 2,152

Distribution of Report
Mat'l Files
Gen'l Files
Dist. Admin _____
Proj. Engr. Alison
Phys. Testing
Chem. Lab. _____

Material: Informational

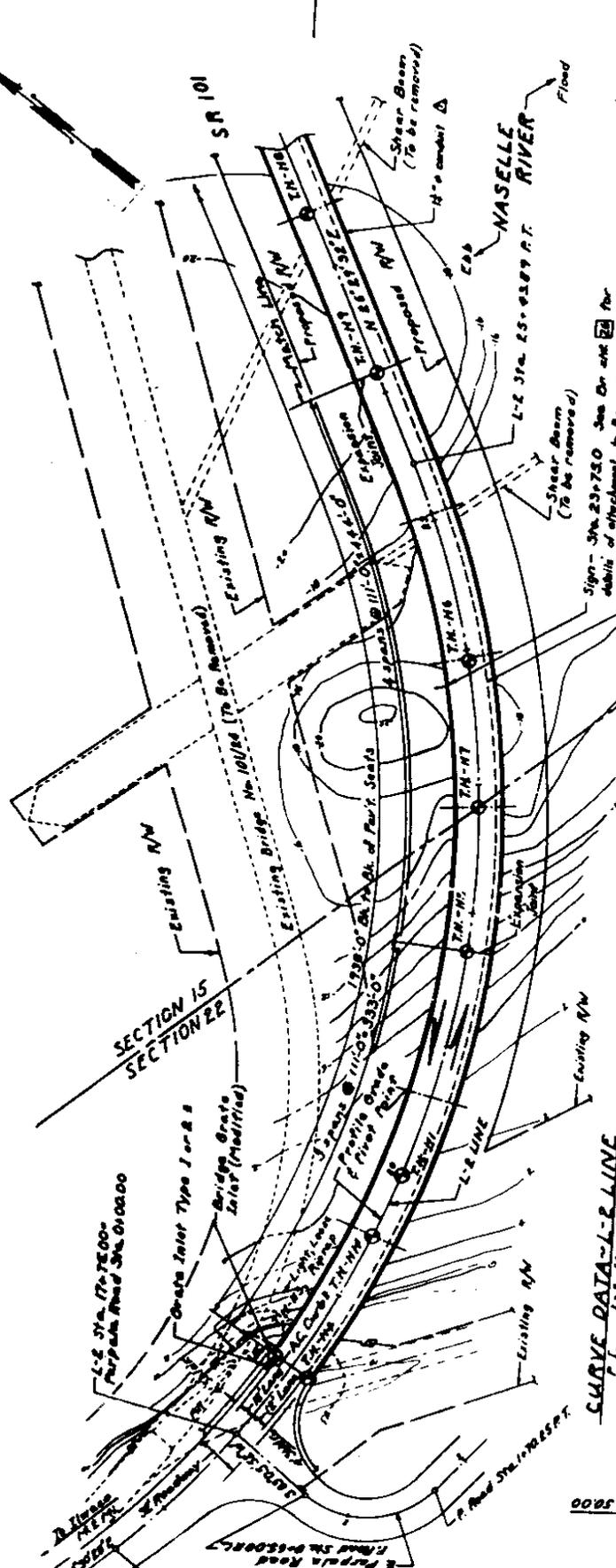
T464-12

Date AUG 18 1992 By LEP

RODNEY G. FINKLE, P.E.
MATERIALS ENGINEER
BY: [Signature]

Appendix B General Layout

SECTION 15 & 22, T. 11 N., R. 10 W., W.M.



8.0000% 4.0000% 900'VC

L-2 STA. 18+58.00	Elev 14.00
P.V.C.	
L-2 STA. 18+59.00	Gr. Elev 28.67
Pier 1	
DR of Pav't Surf	
L-2 STA. 19+50.00	Gr. Elev 28.25
Pier 2	
L-2 STA. 20+61.00	Gr. Elev 30.44
Pier 3	
L-2 STA. 21+72.00	Gr. Elev 34.44
Pier 4	
L-2 STA. 22+83.00	Gr. Elev 37.71
Pier 5	
L-2 STA. 23+94.00	Gr. Elev 40.25
Pier 6	
L-2 STA. 25+05.00	Gr. Elev 42.08
Pier 7	
L-2 STA. 26+16.00	Gr. Elev 43.14
Pier 8	
L-2 STA. 27+27.00	Gr. Elev 43.67
Pier 9	
P.V.C.	
L-2 STA. 28+38.00	Elev 44.00
4.0000%	
1200'VC	
-3.1200%	

CURVE DATA - L-2 LINE

4	L-2 STA. 21+70.00
5	75+00'00" - L-2
6	700.00'
7	317.97'
	871.86'

Sign - 3/4" x 2 1/2" See On and 2" details of attachment to Barrier.
 2" x 3" electrical conduit full length of bridge (Not included in Bridge Quantities)

PLAN
 2 Piers normal to L-2 LINE
 * Not included in Bridge Quantities.

2:1 Max. Fill Slope
 Original Ground Line
 17' Right of L-2 LINE

L-2 STA. 18+59.00	Gr. Elev 28.67
Pier 1	
L-2 STA. 19+50.00	Gr. Elev 28.25
Pier 2	
L-2 STA. 20+61.00	Gr. Elev 30.44
Pier 3	
L-2 STA. 21+72.00	Gr. Elev 34.44
Pier 4	
L-2 STA. 22+83.00	Gr. Elev 37.71
Pier 5	
L-2 STA. 23+94.00	Gr. Elev 40.25
Pier 6	
L-2 STA. 25+05.00	Gr. Elev 42.08
Pier 7	
L-2 STA. 26+16.00	Gr. Elev 43.14
Pier 8	
L-2 STA. 27+27.00	Gr. Elev 43.67
Pier 9	
M.H.M. Elev 36	
M.L.M.	

DEVELOPED ELEVATION
 Grade elevations shown are finish grades on L-2 LINE and are

DATUM
 Nat'l. Geod. Unit

Reference Elev 130.0

Appendix C

Testing Photographs



Column Chloride Sampling
at Pier 2



Core Drilling the Web of
Span 1 South Outside Prestressed Girder