MATERIALS & RESEARCH

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RESEARCH UPDATE U 2000-4

RECLAIMED BASE COURSE STABILIZED WITH CALCIUM CHLORIDE BRANDON-GOSHEN, VT ROUTE 73

REFERENCES:

Report WP 93-R-6, Research Report 95-3, U96-24, U97-13, U1999-6

INTRODUCTION:

This report describes the performance of a reclaimed base course stabilized with calcium chloride that was placed on VT Route 73 in the towns of Brandon and Goshen. The purpose of this study is to determine if the addition of calcium chloride to the subbase material is cost beneficial in extending pavement life. An analysis of pavement performance based on collected data is presented herein.

PROJECT DESCRIPTION:

Brandon-Goshen project STP 9405(1)S began at the intersection of VT Route 53 and VT Route 73 in Brandon and continued easterly along VT Route 73, 8.307 km to MM 3.610 in the town of Goshen. Constructed in 1994, the existing 75 mm to 140 mm of bituminous material was pulverized along with some gravel subbase to an average depth of 150 mm. A 30% solution of calcium chloride (CaCl) was sprayed onto and mixed with the pulverized material at an application rate of 3.4 L/m^2. After rolling the base course, an additional 1.3 L/m^2 of CaCl solution was sprayed over the surface before the placement of a 50 mm binder course of Type II (19.0 mm maximum) bituminous concrete. The project surface course was 38 mm Type III (12.5 mm maximum) bituminous concrete pavement.

Two sections of roadway, each 320 m in length, were selected for analysis. Three full width test sites, each 30 m in length, were established in each of the two sections. The test sections are located at MM 1.60 to MM 1.80 (Test Section 1) and MM 2.20 to MM 2.40 (Test Section 2). Each test site was constructed to have one lane with CaCl base stabilization and one lane without any chemical stabilization to enable a quick comparison. Each year these sites are examined and measured for cracking, rutting and ride roughness.

PRODUCT INFORMATION:

Calcium chloride additive is intended for use in full depth reclamation to improve the performance of a base receiving new bituminous concrete pavement. Results of data gathered from testing granular fill show the resilient modulus of materials treated in this way may increase by 30% compared to untreated material. AASHTO's guide for design of pavement structures equates this to an increase in service life of three years.

PERFORMANCE:

The following tables present six years of performance evaluations comparing reclaimed base (RCB) stabilized with calcium hloride and reclaimed base without chemical stabilization:

PAVEMENT PERFORMANCE EVALUATION
WESTBOUND LANE

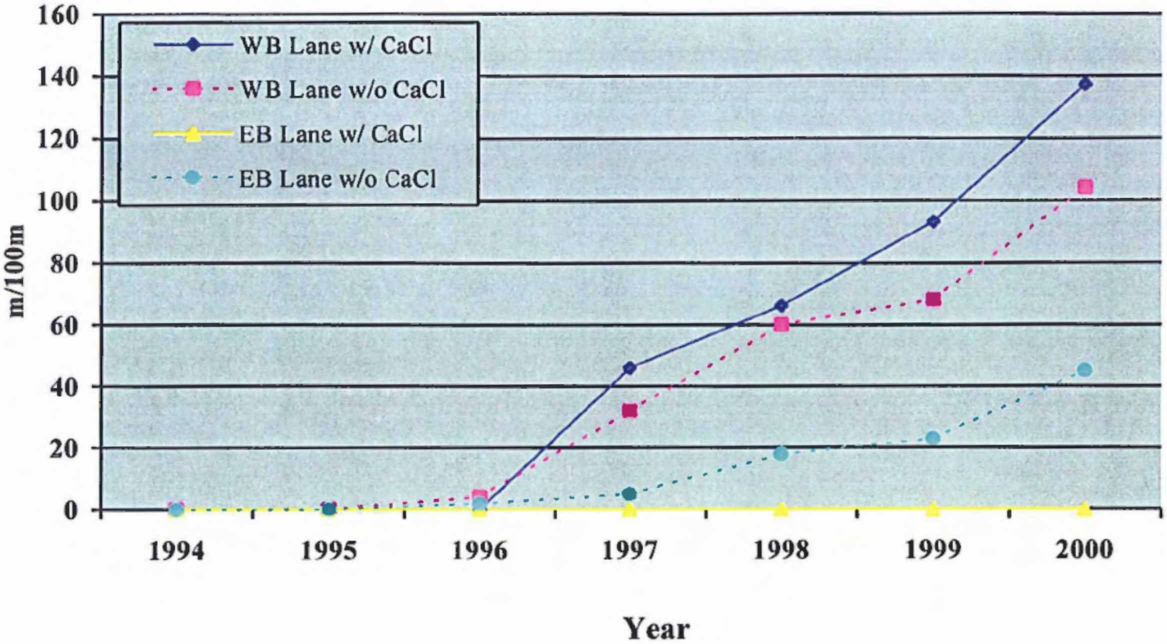
	With CaCl Treatment (Test Section 1)				Without CaCl Treatment (Test Section 2)			
	MM 1.60	MM 1.65	MM 1.72	Average w/ CaCl	MM 2.24	MM 2.33	MM 2.37	Average w/o CaCl
1994 Cracking	0	0	0	0	0	0	0	0
Rutting	0	0	0	0	0	0	0	0
IRI	*	*	*	1.8	*	*	*	1.7
1995 Cracking	0	0	0	0	0	0	0	0
Rutting	1.6	0	0	0.5	0	1.6	1.6	1.1
IRI	*	*	*	1.6	*	*	*	1.3
1996 Cracking	0	0	0	0	0	13	0	4
Rutting	1.6	1.6	1.1	1.4	1.1	1.6	3.2	2.0
IRI	*	*	*	1.6	*	*	*	1.9
1997 Cracking	82	57	0	46	30	20	45	32
Rutting	1.6	1.6	1.1	1.4	1.6	1.6	3.7	2.3
IRI	*	*	*	1.6	*	*	*	1.5
1998 Cracking	103	75	20	66	50	26	104	60
Rutting	4.8	2.6	1.6	3.0	1.6	3.2	6.9	3.9
IRI	*	*	*	1.5	*	*	*	1.6
1999 Cracking	107	110	62	93	50	26	128	68
Rutting	9.0	3.7	2.1	4.9	5.3	5.3	9.5	6.7
IRI	*	*	*	*	*	*	*	*
2000 Cracking	169	180	62	137	82	39	190	104
Rutting	9.0	4.8	2.6	5.5	5.3	5.3	10.6	7.1
IRI	*	*	*	1.7	*	*	*	1.6

PAVEMENT PERFORMANCE EVALUATION
EASTBOUND LANE

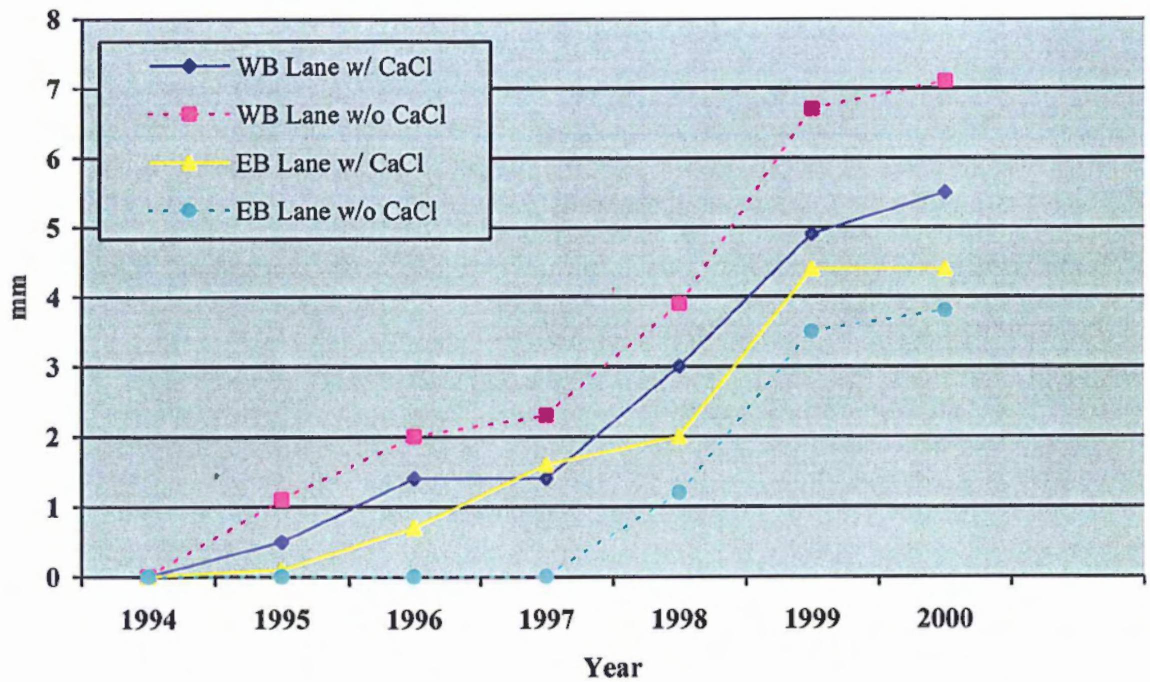
	Without CaCl Treatment (Test Section 1)				With CaCl Treatment (Test Section 2)			
	MM 1.60	MM 1.65	MM 1.72	Average w/o CaCl	MM 2.24	MM 2.33	MM 2.37	Average w/ CaCl
1994 Cracking	0	0	0	0	0	0	0	0
Rutting	0	0	0	0	0	0	0	0
IRI	*	*	*	1.5	*	*	*	1.7
1995 Cracking	0	0	0	0	0	0	0	0
Rutting	0	0	0	0	0	0	0.5	0.1
IRI	*	*	*	1.6	*	*	*	1.5
1996 Cracking	7	0	0	2	0	0	0	0
Rutting	0	0	0	0	0	0.5	1.6	0.7
IRI	*	*	*	2.2	*	*	*	1.7
1997 Cracking	16	0	0	5	0	0	0	0
Rutting	0	0	0	0	0	1.1	3.7	1.6
IRI	*	*	*	1.5	*	*	*	1.4
1998 Cracking	33	12	8	18	0	0	0	0
Rutting	2.6	1.1	0	1.2	0	1.1	4.8	2.0
IRI	*	*	*	1.4	*	*	*	1.4
1999 Cracking	38	17	14	23	0	0	0	0
Rutting	2.6	4.2	3.7	3.5	2.6	3.2	7.4	4.4
IRI	*	*	*	*	*	*	*	*
2000 Cracking	50	49	35	45	0	0	0	0
Rutting	3.7	4.2	3.7	3.8	2.6	3.2	7.4	4.4
IRI	*	*	*	1.5	*	*	*	1.6

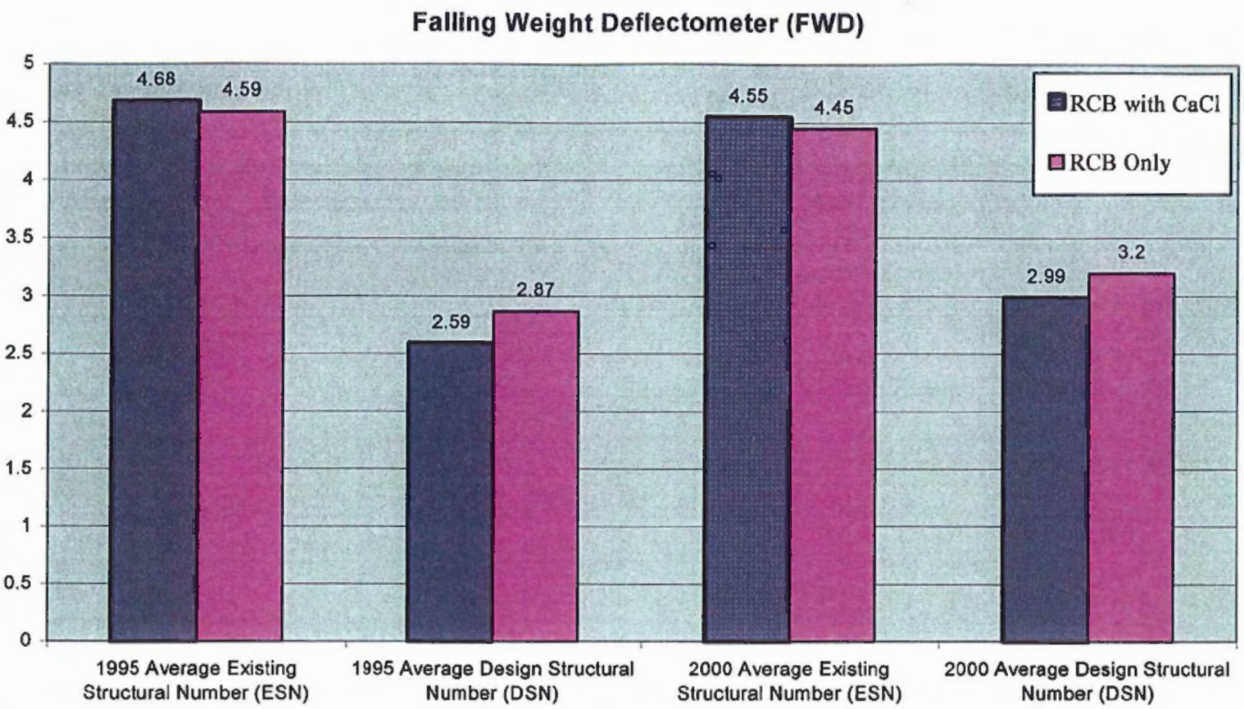
Cracking .... m/100m (average of longitudinal and transverse cracks, excluding center line cracks)
Rutting .... mm (average of inner and outer wheel paths)
Roughness (IRI) .... m/km (average for treatment area)
* .... average values provided

Average Cracking



Average Rutting





The Pavement Management Division conducted falling weight deflectometer (FWD) testing in June and July 1995, and again in August 2000. The process entailed testing one location at each test site in the eastbound lane and then repeating the procedure for the westbound lane. All of the structural numbers obtained during this testing were well above the original design structural number in both 1995 and 2000. There was no significant difference noted between the existing (present) structural numbers taken in 1995 and in 2000, between the sections stabilized with CaCl and those without a stabilization agent.

Performance Comparison: RCB with CaCl vs. RCB only

(based on averaged data for 2000)

		RCB with CaCl	RCB only	% difference
Cracking (m/100m)	Test Section 1	137	45	-204%
	Test Section 2	0	104	104%
Rutting (mm)	Test Section 1	5.5	3.8	-45%
	Test Section 2	4.4	7.1	61%
IRI (m/km)	Test Section 1	1.7	1.5	-13%
	Test Section 2	1.6	1.6	0%

Traffic Data

A summary of the average annual daily traffic (AADT) for the project area is presented in the table below.

Year	AADT		Volume Differential Between Test Sections
	Test Section 1 MM 0.06 – MM 1.80	Test Section 2 MM 1.80 – MM 3.61	
1994	550	550	0
1996	750	550	200 (36 %)
1998	770	570	200 (35 %)

COSTS:

The cost for the reclamation process on this project was $1.07/m^2$, with additional costs of $5.28/m^2$ for the bituminous concrete and $0.50/m^2$ for the CaCl stabilizer. This resulted in a total cost of $6.85/m^2$ for the road rehabilitation.

SUMMARY:

After six years of service, the westbound lane is exhibiting more stress, both in cracking and rutting, than the eastbound lane (Figure 1). This is the case in both the treated and untreated sections. Since the test sites were set up with three treated and three untreated sections in each travel lane, it may be assumed that the stresses are not related to the treatment or lack thereof, but rather factors such as traffic loading and road terrain.

The dominant type of cracking on the project is longitudinal. Large polygons, generating from the primary cracks, are beginning to take form (Figure 2). This cracking is developing both within and outside the wheel paths. This type of cracking, typically associated with a weakened subbase, may be caused by the intrusion of water through existing cracks. This cracking may also be load related, especially in the wheel path areas.

Longitudinal cracking is also occurring along the centerline. Two sites have significant centerline cracks up to 25mm wide (Figure 3). Faint centerline cracking is beginning to appear at a third test site. This type of crack is likely due to construction practices and pavement joint construction.

Cracking has developed at all the test site areas without the CaCl treatment. Only three test site areas, all with the CaCl treatment, remain free of cracks (Figure 4). These test sites are located at the most easterly end of the project (Test Section 2) and experience an estimated 35% less traffic volume than the untreated section in the same travel lane; hence possibly contributing to its performance.

Although all the performance factors between the treated and untreated areas are comparable, the cost difference between the RCB with CaCl and RCB without any chemical stabilization is not. Based on the increased unit costs for the addition of CaCl, there would need to be an 8% increase in the service life of the RCB with CaCl in order to be equal in value to the RCB without chemical stabilization. The RCB with CaCl on the Brandon-Goshen project has yet to show superior performance when compared to RCB without chemical stabilization.

FOLLOW UP:

Pavement surveys will continue on an annual basis until firm conclusions can be drawn as to the anticipated service life of the RCB with CaCl and its relative cost effectiveness.

Figure 1. **Distress in westbound lane treated with CaCl at MM 1.65.**

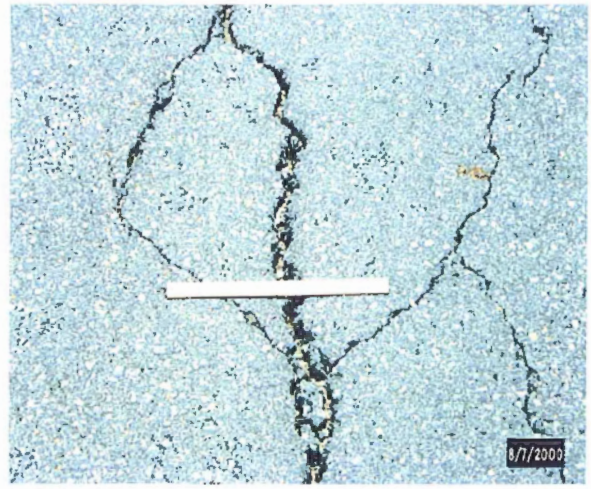


Figure 2. **Formation of polygon cracks from existing longitudinal crack in westbound lane (RCB) at MM 2.33.**

Figure 3. **25 mm centerline crack at MM 1.72.**

Figure 4. **Vermont Route 73, looking east at MM 2.24.**