CONFORMANCE TESTS ON REPEL WB40

by A Calder

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by A Calder (TRL Limited)

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1 Introduction

The Highways Agency requires that concrete highway structures are protected from chloride ingress by treatment with hydrophobic impregnants. BD 43/03 (2003) requires that the material used must be tested in accordance with BS EN 13579 (2002) and BS EN 13580 (2002). Acceptance criteria for each of the test methods are given.

Since publication of the BD 43/03, BS EN 1504-2 (2004) has been issued which gives the requirements of surface protection systems for concrete. These are identical to those given in BD 43/03 for surface impregnants. In addition, it is a requirement to measure the depth of penetration of the impregnants.

Bridgeseal Products Ltd supplied a water based silane for test. The product is to be called Repel WB40. This is formulated ready for site use by Bridgeseal Products Ltd from Linseal WB70, a concentrate supplied by Lindley Technologies of North Carolina, USA.. The product has been checked against the requirements given in BD43/90 and BS EN 1504-2 (2004). This report gives the results.

2 Method

Manufacture of the specimens and the drying and immersion tests were at carried at the Transport Research Laboratory. The depth of penetration was measured at the Technology Centre, Taylor Woodrow Technology.

2.1 Manufacture of test specimens

Twelve 100mm cubes were cast and cured from each of two batches of Type C (0.45) concrete in accordance with the method given in EN 1766 (2000). Nine of the cubes were used for the drying and water absorption tests and the depth of silane penetration was measured on the remaining three. Details of the concrete mix are given in Table 1.

Table 1: Details of concrete mixes

	Mix weights (kg/m^3)
Cement	360
Laleham flint gravel sand	647
Laleham coarse aggregate 20-5mm	1146
Free water	162

2.2 Drying and immersion tests

The drying and immersion tests were carried out in accordance with BS EN 13579 (2002) and BS EN 13580 (2002). The cubes were conditioned in a laboratory maintained at 20^o C after curing and the drying test was conducted using an Environmental Cabinet running at 30^o C in which the relative humidity was maintained at 40±5%.

2.3 Depth of silane penetration

The cubes allocated for measurement of the depth of penetration were conditioned and treated using the method described in BS EN 13579 (2002). Each cube was then sawn in half in a plane at right angles to the top cast face. The cut surface of each cube was marked at 10mm intervals along each edge and soaked in tap water for 10 minutes. The demarcation of silane within the concrete was evident as the border between wet and dry concrete visible on the cut face. The depth of silane penetration was measured to the nearest 0.5mm at each location.

3 Requirements for impregnants

The acceptance criteria for the results of the drying and water absorption tests given in BD43/03 (2003) and BS EN 1504-2 (2004) are identical:

Drying rate coefficient:	Class I	>30%
	Class II	>10%
Absorption ratio:		<7.5%
Absorption ratio (after immersion in alkali solution):		<10%

There are no acceptance criteria as such for the depth of penetration, however it is classified in BS EN 1504-2 (2004) as follows:

Depth of penetration:	Class I	<10mm
	Class II	>10mm

4 Test results

The results of the conditioning of the cubes, the drying and immersion tests are summarised in Table 2. The results demonstrate that there was good agreement in the results from the two batches. The mean value of the drying rate coefficient was in Class I acceptance, and the Repel WB40 passed the absorption test criteria in water and after immersion in alkali solution.

The mean, minimum and maximum depth of penetration of silane through each face of the cube are given in Table 3. At some locations along the face of the cubes, pieces of aggregate were present at the surface, and therefore it was not possible to measure the depth of penetration. Values of penetration recorded as being less than 0.5mm were assigned the value 0.5mm. Note that the average penetration of the silane into the cubes Batch C was 1.1mm compared with 0.6mm for batch B cubes.

Overall the depth of silane penetration was quite low. This can be attributed to the fact that BS EN 1504-2 (2004) requires the cubes to be close to saturation at the time of treatment. The moisture content of the cubes immediately prior to treatment was approximately 80 per cent of the saturated surface dry value. Nevertheless this was typical of the penetration into concrete with a water/cement ratio of 0.45.

The penetration of Repel WB40 is classified as Class I, as defined in BS EN 1504-2 (2004).

Table 2: Results of tests on Repel WB40

Property	Batch B	Batch C	Mean values
Date cast	1 Nov 04	7 Dec 04	
Mean saturated surface dry moisture content of test cubes (%)	5.88	5.98	
Mean moisture content of test cubes after conditioning (%)	4.69	4.60	
Mean consumption of impregnant (g)	130	162	
Drying rate coefficient (%)	58	51	55
Absorption ratio (%)	2.62	2.71	2.66
Absorption ratio (after immersion in alkali solution) (%)	3.61	3.39	3.50

Table 3 : Results of silane penetration measurements (mm)

Cube ID		Top	Bottom	LHS	RHS
B/4	Mean	0.64	1.13	0.50	0.50
	Min	0.50	0.50	0.50	0.50
	Max	1.00	3.00	0.50	0.50
	Overall mean	0.65			
B/5	Mean	0.83	0.50	0.58	0.50
	Min	0.50	0.50	0.50	0.50
	Max	1.00	0.50	1.00	0.50
	Overall mean	0.60			
B/6	Mean	0.50	0.50	0.50	0.50
	Min	0.50	0.50	0.50	0.50
	Max	0.50	0.50	0.50	0.50
	Overall mean	0.50			
C/1	Mean	1.50	1.50	0.75	1.17
	Min	0.50	0.50	0.50	0.50
	Max	2.50	3.00	1.50	2.00
	Overall mean	1.25			
C/2	Mean	0.70	0.75	0.58	1.83
	Min	0.50	0.50	0.50	0.50
	Max	1.00	1.00	1.00	3.50
	Overall mean	1.00			
C/3	Mean	0.50	0.67	1.36	1.58
	Min	0.50	0.50	0.50	0.50
	Max	0.50	1.00	3.00	4.00
	Overall mean	1.12			

5 Conclusions

Repel WB40 has tested in accordance with BS EN 13579 (2002) and BS EN 13580 (1980) and fully meets the requirements of BS EN 1504-2 (2003) and BD 43/03 (2003). Based on these results, Repel WP40 could be approved for use in protection of concrete highway bridges in the United Kingdom.

6 Acknowledgements

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