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Sealer Comparison

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Project #: 11-102-1425(bis)

Test conducted by:

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Date: July 20, 2011



Background: The customer would like to perform a comparison of MCI sealers with the competing products from Evonik: Protectosil 300 and Protectosil CIT.

Sample Received: Two 1 liter samples of Protectosil 300 were received on May 16. A 5 gallon sample of Masterseal CP (a rebrand of Protectosil CIT) that the lab had on hand was used for these tests.

Sample(s) labeled: The Protectosil 300 bottle was labeled with lot number PRR042020115. The lot number of the Masterseal CP was 1027010805

Method: Immersion Test
Rilem Water Repellency Test

Materials:

Rilem tubes	Protectosil 300
Rilem putty	Masterseal CP (Protectosil CIT)
1 sq ft. masonry blocks	SAE 1010 steel panels
Concrete (0.46 w/c ratio)	8 oz sample jars
MCI-2018 batch #14568	

Procedure:

Immersion Test

1. Steel panels were cut into rectangles with the dimensions 11 × 3.8 cm.
2. The panels were then cleaned with methanol by submerging them for at least 20 minutes. Each panel was dried and then weighed.
3. 217.8 grams of 3.5% NaCl in water was added to each of the five sample jars.
4. Sealers were added at 1% by weight to each respective jar.
5. One of the steel panels was placed into each sample jar.
6. The jars were then stored at 40° C for 192 hours, after which the panels were removed, rinsed with water, and dried.
7. To remove heavier rust the panels were cleaned with a solution of 2 parts of hydrochloric acid to 1 part water with 5% S-11 inhibitor.
8. The panels were weighed and corrosion rates were determined using the formula below.

$$\text{Corrosion rate (mpy)} = (3.45 \times 10^6 \times W) / (A \times T \times D)$$

W = weight decrease in grams

T = duration of the test in hours

A = area of the panel in cm²

D = density of steel in g/cm³

9. A second immersion test that was qualitative was performed as above, except the concentration of each sealer used was 10% and the samples were allowed to sit at room temperature (20° C) for 2 months instead of heating for a shorter time.

Rilem Tube Water Repellency on Masonry Blocks

1. Masonry blocks that were used for the test were thoroughly cleaned with a nylon brush and an air compressor to remove any loose particles on the surface.
2. Each sealer was applied at the thickest level recommended by the data sheet. The volume of each is shown in the table below. Using a foam brush the first coat of sealer was applied vertically on the block and allowed to dry for 20-30 minutes. While the surface was still damp with sealer the second coat was applied horizontally across the face of the block.

	Suggested Application Rate (sq ft/gal)	Rate (ml/ft ²)	Rate (g/ft ²)	Rate (g/coat with 2 coats)
MCI-2018	125	30.28	27.1	13.55
MCI-2018	175	21.63	19.35	9.68
Masterseal CP	87.5	43.26	38.07	19.03
Protectosil 300	100	37.85	33.69	16.85

3. After two coats were applied to each block they were allowed to dry for 72 hours.
4. A Rilem tube was attached to the surface of each spot to be tested with a bead of Rilem putty. (See picture 1)
5. The Rilem tubes were filled to a level of 8.5 cm above the surface and the level was monitored over a 30 minute period.
6. Each brick was tested in 3 different places and the results were averaged.

Rilem Tube Water Repellency on Concrete Blocks

1. Concrete blocks with dimensions 12×4×1 inches were poured using the standard concrete mix for lollipop samples (67.3 % sand, 22.4% concrete, and 10.3% water). The blocks were allowed to cure for 28 days before the surface was prepared with a sealer
2. Each sealer was applied at the highest level recommended by the data sheet. The volume of each is shown in the table below. Using a foam brush the first coat of sealer was applied vertically on the block and allowed to dry for 20-30 minutes. While the surface was still damp with sealer the second coat was applied horizontally across the face of the block.

	Suggested Application Rate (sq ft/gal)	Rate (ml/ft ²)	Rate (g/ft ²)	Rate (g/0.33 ft ²)
MCI-2018	125	30.28	27.1	9.04
Masterseal CP	87.5	43.26	38.07	11.24
Protectosil 300	100	37.85	33.69	12.68

3. After two coats were applied to each block they were allowed to dry for 72 hours.
4. A Rilem tube was attached to the surface of each spot to be tested with a bead of Rilem putty.
5. The Rilem tubes were filled to a level of 13.5 cm above the surface and the level was monitored over a 4 hour period.
6. Each brick was tested in 3 different places and the results were averaged.

Results:

Immersion Test Results (192 hours)

Product	Initial Weight	Final Weight	Percent Protection	Corrosion Rate (mpy)
Control	24.2112	24.1808	-	1.65
MCI-2018	24.1347	24.1224	59.5	0.66
Protectosil 300	23.9205	23.895	16.1	1.38
Protectosil CIT	25.9514	25.9323	37.2	1.04

Immersion Test Results (2 months)

Material	% of corrosion on the panel	Comments	Condition of electrolyte
Control (3.5% NaCl)	100	-	A lot of corrosion products
10% MCI 2018	<2	Corrosion only on the edge	Two layers; Very little corrosion products
10% Protectosil 300	100	-	Two layers; a lot of corrosion products in both layers
10% Masterseal CP	5	Severe local corrosion	Two layers; corrosion products in water part

Rilem Test on Masonry

		Time Elapsed (minutes)										
		0	0.5	1	2	3	4	5	10	20	30	
Graduation Level of Water in Rilem Tube (centimeters)	Control Sample											
	1	8.5	2	0	0	0	0	0	0	0	0	0
	2	8.5	1.8	0	0	0	0	0	0	0	0	0
	3	8.5	1.7	0	0	0	0	0	0	0	0	0
	Average	8.5	1.8	0	0	0	0	0	0	0	0	0
	MCI-2018 (175 ft ² /gal)											
	1	8.5	2.8	2.5	2	1.5	1.2	1.2	1	0.5	0	
	2	8.5	2.5	2.3	2	1.8	1.4	1.4	1	0.3	0	
	3	8.5	5	3	2.5	2.5	2.3	2	1.5	0.4	0	
	Average	8.5	3.4	2.6	2.2	1.9	1.6	1.5	1.2	0.4	0	
	MCI-2018 (125 ft ² /gal)											
1	8.5	5.7	3	2.4	2.1	1.7	1.7	0.6	0	0		
2	8.5	5.6	3.1	2.6	2.3	1.9	1.7	1	0.5	0		
3	8.5	7.5	6.7	5.8	5.5	4.4	3.4	3	2.7	2		
Average	8.5	6.3	4.3	3.6	3.3	2.7	2.3	1.5	1.1	0.7		
Protectosil CIT (87.5 ft ² /gal)												
1	8.5	3.4	2.9	2.3	1.9	1.6	1.4	0.3	0	0		
2	8.5	3.5	3	2.7	2.3	2.1	1.5	0.4	0.2	0		
3	8.5	3.1	2.5	2.1	1.6	1.5	1.3	0.2	0	0		
Average	8.5	3.3	2.8	2.4	1.9	1.7	1.4	0.3	0.1	0		
Protectosil 300 (100 ft ² /gal)												
1	8.5	8.5	7.4	6	5.2	4.2	2.4	1.9	1.6	1.4		
2	8.5	8.3	7	3.7	3	2.5	2.3	1.8	0.5	0		
3	8.5	8.2	6.5	3.6	3	2.7	2.4	1.6	0.2	0		
Average	8.5	8.3	7.0	4.4	3.7	3.1	2.4	1.8	0.8	0.5		

Rilem Test on Concrete

Time Elapsed (minutes)	0	5	10	20	30	60	120	180	240	18 hours
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Graduation Level of Water in Rilem Tube (centimeters)

Control Sample

1	13.5	13.1	12.8	12.1	11.7	9.3	7.7	5.7	3	0
2	13.5	12.7	12	11.1	10.4	8.9	5.1	3	3	0
3	13.5	12.3	11.5	10.2	8.7	5.2	3	3	3	0
Average	13.5	12.7	12.1	11.1	10.3	7.8	5.27	3.9	3	0

MCI-2018 (125 ft²/gal)

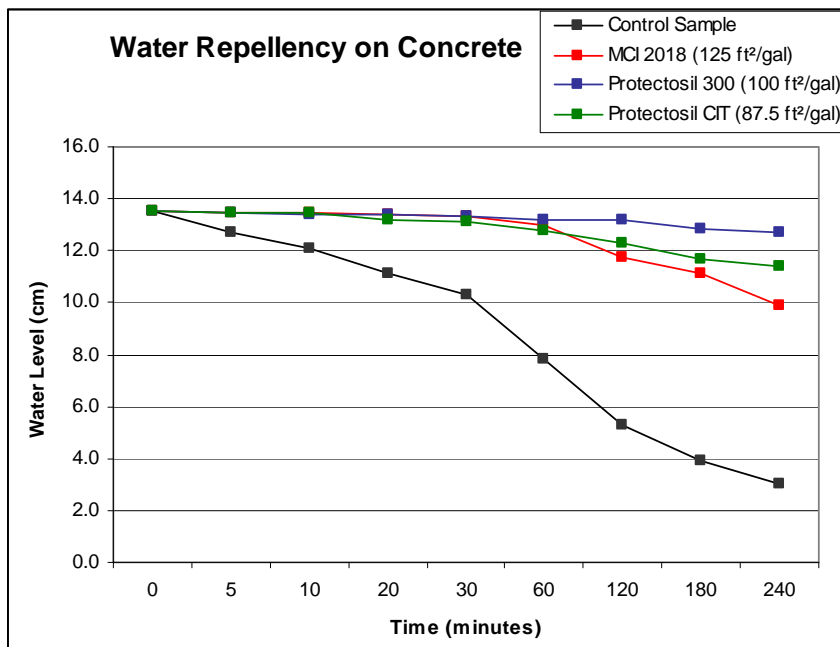
1	13.5	13.5	13.5	13.4	13.1	12.1	8.5	6.7	3	3
2	13.5	13.4	13.3	13.3	13.3	13.3	13.3	13.2	13.2	5.9
3	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	4.8
Average	13.5	13.5	13.4	13.4	13.3	13.0	11.8	11.1	9.9	4.6

Protectosil 300 (100 ft²/gal)

1	13.5	13.5	13.5	13.5	13.5	13.5	13.5	12.6	12.1	1.4
2	13.5	13.5	13.4	13.4	13.3	13.2	13.2	13.1	13.1	12.4
3	13.5	13.4	13.3	13.3	13.1	12.9	12.9	12.9	12.9	12.1
Average	13.5	13.5	13.4	13.4	13.3	13.2	13.2	12.9	12.7	8.6

Protectosil CIT (87.5 ft²/gal)

1	13.5	13.5	13.5	13.4	13.4	13.2	12.6	12.3	12	7.9
2	13.5	13.4	13.4	13.1	13.1	12.7	12.5	11.6	11.4	4.8
3	13.5	13.4	13.4	13.1	12.9	12.5	11.8	11.2	10.8	3
Average	13.5	13.4	13.4	13.2	13.1	12.8	12.3	11.7	11.4	5.233



Interpretations:

1. The immersion tests showed that the lowest corrosion rate was measured in the solution containing MCI-2018.
2. In the water repellency test with the masonry blocks Protectosil 300 and MCI-2018 performed near the same level. MCI-2018 at the lowest recommended dosage rate, 175 ft²/gallon vs. 87.5 ft²/gal, performed similarly to Protectosil CIT. Each of these sealers made an improvement over the control but as shown in the chart they could not repel water at a measureable rain force, the pressure dropped from an 80 mph to below the level of 55.9 mph in less than 30 seconds.
3. Protectosil 300 was the sealer that showed the lowest level of water permeability over the full length of the test. Over the first hour MCI-2018 and Protectosil 300 perform similarly both repelling water at forces above 100 mph.
4. The advantages of MCI-2018 are:
 - a) Lower dosage rate (125 ft²/gal) vs. Protectosil CIT (87.5 ft²/gal) and Protectosil 300 (100 ft²/gal)
 - b) MCI-2018 provides better corrosion inhibition properties than Protectosil 300 & Protectosil CIT
 - c) Provides water repellency similar to Protectosil 300

Height of water in Rilem Tube (cm)	Force of Wind Driven Rain (mph)
13.5	100.7
12.6	99.9
11.7	98
10.8	92
9.8	87.7
8.8	83.3
7.7	78.8
6.8	73.6
5.8	68.2
4.9	62.4
3.9	55.9

Photos:
Rilem Test



Picture 1: Rilem tube attached to the surface of a masonry block

Two Month Immersion Test



Picture 2: Aligned from left to right are MCI-2018, Protectosil CIT, Protectosil 300, and the control.