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A New Methodology to Evaluate the Relative Performance of Various Coating Systems

By

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Introduction

The annual bridge maintenance and rehabilitation costs billions of dollars; therefore reducing corrosion is a critical task for bridge owners in order to save money. Any information on coating degradation rate at early stages is highly beneficial for making bridge maintenance plan. A number of literature papers have been published to estimate rate of coating degradations in terms of weight loss, film thickness reduction, surface blistering, surface rusting, and etc. However, no sensitive methods have been established for systematically comparing coating performance. In particular, numerous new bridge coatings have been formulated recently to meet the US Environmental Protection Agency's restriction on volatile-organic-compound (VOC) content allowed in the architectural and industrial maintenance coatings. Even though a significant number of studies have been conducted to investigate their performance; some of their performances are not thoroughly understood and it needs a long period of time to verify their field performance. Nevertheless, various accelerated laboratory test methods have been developed in order to predict the coating field performance in a relatively short time. Currently, the most popular program for coating evaluation is the AASHTO/National Transportation Product Evaluation Program (NTPEP) in which each coating system is tested in a certified laboratory and then its performance is judged by several criteria in the standard R31 method that includes an accelerated laboratory test method.

The Federal Highway Administration/Turner-Fairbank Highway Research Center (FHWA/TFHRC) has developed a fairly reliable methodology to determine the relative coating performance for various coating types. Most of the new coating systems are well formulated; they do not generally exhibit significant surface failures at early stage of the

* Retired in 2007.

laboratory test. The only failure observed at early test time is rust creepage at an intentionally made scribe that represents the worst kind of defects such as holidays, pinholes, cuts, and channels, etc. If a scribe is not made on the coated panels, it will take much longer time to evaluate coating performance even by accelerated laboratory testing. Therefore, making a scribe is a necessity to evaluate coatings within a reasonable amount of time. Several papers were published over the years, [1, 2, 3, 4] the rust creepage at scribe was plotted against test time to observe its growth rate, i.e., corrosion rate. In 1990, the FHWA/TFHRC followed the ASTM D 1654 to obtain rust creepage values that generally increase with test time, but the plot of rust creepage as a function of test time showed no particular mathematical pattern.[1] However, after the measurement technique was refined to take rust creepage measurements at equal time intervals along scribe line and creepage value were then averaged,[5] it is interesting and encouraging to see a linear relationship between mean accumulative creepage and test time. However, this method is tedious and time consuming. Later, the linearity was even more improved when the ASTM method D7087-05a was developed by the FHWA/TFHRC to measure rust creepage; it is a more quantitative and rapid method. This method includes tracing rust creepage area along a scribe, scanning trace, and saving scanned image on a computer. The creepage area was then integrated by computer software and divided by two times of scribe length to obtain mean rust creepage.[6] A linear correlation phenomenon has been found between rust creepage and test time for all the previously conducted tests, this evaluation technique is highly powerful for comparing coating performance. In this paper, some of representative test results of different coating systems are collected to show the consistency and advantage of this plotting method for determining corrosion rate and how soon corrosion starts to develop at the scribe for each coating system in a test. Ultimately, it is easy to identify which coating type performs better than others from the plot. Based on this plot, slope and/or the incubation time can be used to compare difference in coating degradation rate of each coating system at scribe under the **same** test conditions. This new technique would be highly beneficial for the State DOT laboratories to compare the performance of different coating systems. The detailed use of this technique is described and their advantages are discussed in this study.

Procedure to obtain the plot

1. A straight scribe was made on coated steel panel vertically or diagonally in accordance with ASTM D1654.
2. At equal test time intervals of any laboratory accelerated test method (such as 500 hours used in this paper) or outdoor exposure (such as 6 month) throughout the test period, a mean rust creepage distance is measured. The most popular measuring method contains (1) measurements at equal distance on both sides of the scribe and averaging all the measurements,[5] (2) tracing and integration of creepage area around the scribe and dividing by two length of the scribe line (ASTM D7087-05a). Usually a minimum of three replicate test panels are needed for each coating system in order to obtain statistically meaningful data. The mean scribe creepage of 2.2, 3.4, and 8.8 mm obtained by the same operator should be considered suspect for replicates if they differ by more than 12.3, 8.3, and 4.9 % respectively. As creepage increases, measuring error decreases.

3. Rust creepage should be measured at least at six test time intervals or test should be conducted for longer time if no significant failures can be observed.
4. The mean accumulative rust creepage is then plotted against test time intervals.
5. A straight line is achieved by applying linear regression analysis of the data points for each coating system. The slope of the line and the intercept (incubation time) at zero rust creepage are then obtained from the linear regression equation.

Results and Discussion

Several research studies on coating performance published previously by FHWA showed an excellent linear relationship between mean accumulative creepage at scribe and test time, for both laboratory tests and outdoor exposure within the predetermined test periods. Different coating systems showed different incubation times and slopes in the same test depending upon the coating types and formulations; therefore this plot is material and formulation dependent. It is speculated that water and electrolyte diffuse from the scribe line into the coating cross section at different rates that vary with paint system composition, coating porosity and probably coating adhesion strength, especially for primers. It is known that water and electrolytes induce corrosion. By looking at the incubation time and slope value of the linear line, coating performance can be compared if they are tested under the **identical** test conditions and at same test time. This plot technique obviously has a big advantage over the other evaluation methods; it is mathematical based and gives more quantitative results. Not like the most of other method that only measure the final rust creepage after the test is completed, this plot provides much more information on coating performance. It not only can differentiate the performance of various coating systems, but also can be used to distinguish the performance of the same generic coating materials made by different vendors. Some of such plots are shown in figures 1-4; the laboratory and outdoor test conditions are described in Tables 1 and 2, and the coating systems in the plots are listed in Table 3. These results are part of the research data published previously.[2] These plots demonstrate that the performance of moisture-cured urethanes formulated by different vendors can be distinguished in terms of rust creepage growth rate and incubation time. This technique can be applied to both laboratory tests and outdoors tests, and also to different surface conditions including SP 10, SP 3, chloride-contaminated steel surfaces; it is a great ranking tool for comparing generic coating systems.

Table 1. Laboratory condition of test A and test B for every 500-hour test cycle.

Test Cycle	Test A	Test B
	Modified ASTM D5894	Chong Cycle[7]
Freeze: 68 hour Temperature: -23 °C	X	X
UV-condensation: 216 hours Test cycle: 4-h UV/4-h condensation UV lamp: USA-340 UV temperature: 60 °C Condensation temperature: 40 °C Condensation humidity: 100 % RH	X	
Salt fog-dry air: 216 hours Test cycle: 1-h wet/1-h dry air Wet cycle: 0.35 wt% $(NH_4)_2SO_4$ 0.05 wt% NaCl at ambient Temperature Dry air cycle: at 35 °C	X	
Salt fog-dry air: 216 hours Test cycle: 1-h wet/1-h dry air Wet cycle: 5 % NaCl at 35 °C Dry air cycle: at ambient temperature		X

Table 2. Outdoor annual characteristics of Sea Isle exposure site.

Sunshine: 2840 hour Relative humidity: 51% Rainfall: 150 cm pH of rain water: 4.2 Conductivity of rain water: 163 microsiemens/cm Composition of rain water: 27 ppm Cl^-, 25 ppm SO_4^{-2} Water temperature: 9.1 °C (48.4 °F) Spray seawater: pH = 7.5 Salt content: 2.7 wt%

Table 3. Description of Moisture-cured Urethane Coating Systems.

System	Coating materials	Dry Film Thickness, mil (μm)	VOC, g/L
A	Zn[a]-rich urethane/MIO[b]-filled urethane/urethane	3/3/3 (75/75/75)	314/315/314
B	Zn-rich urethane/MIO-filled urethane /MIO-urethane	3/3/3 (75/75/75)	336/336/336
C	Zn-rich urethane/MIO&Al[c]-filled urethane/MIO-filled urethane	3/3/3 (75/75/75)	337/340/336
A1	MIO & Al filled Urethane/MIO-filled urethane/Urethane	3/3/3 (75/75/75)	315/315/314
B1	Zn&MIO-filed urethane/MIO-filled Urethane/MIO-filled Urethane	3/3/3 (75/75/75)	336/336/336
C1	MIO & Al-filled Urethane/MIO & Al-filled Urethane/MIO-filled Urethane	3/3/3 (75/75/75)	340/340/336

a: Zinc
b: Micaceous iron oxide
c: Aluminum

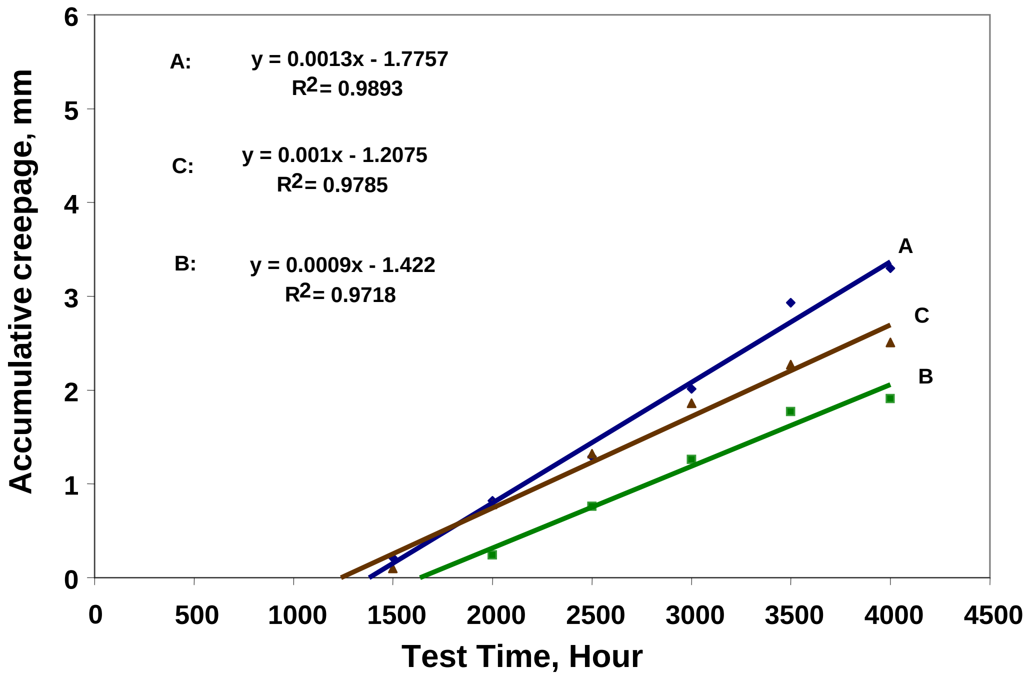

Figure 1. Plot of scribe creepage of moisture-cured urethane coating systems A, B, and C over SP 10 surfaces versus laboratory test time in Test A.

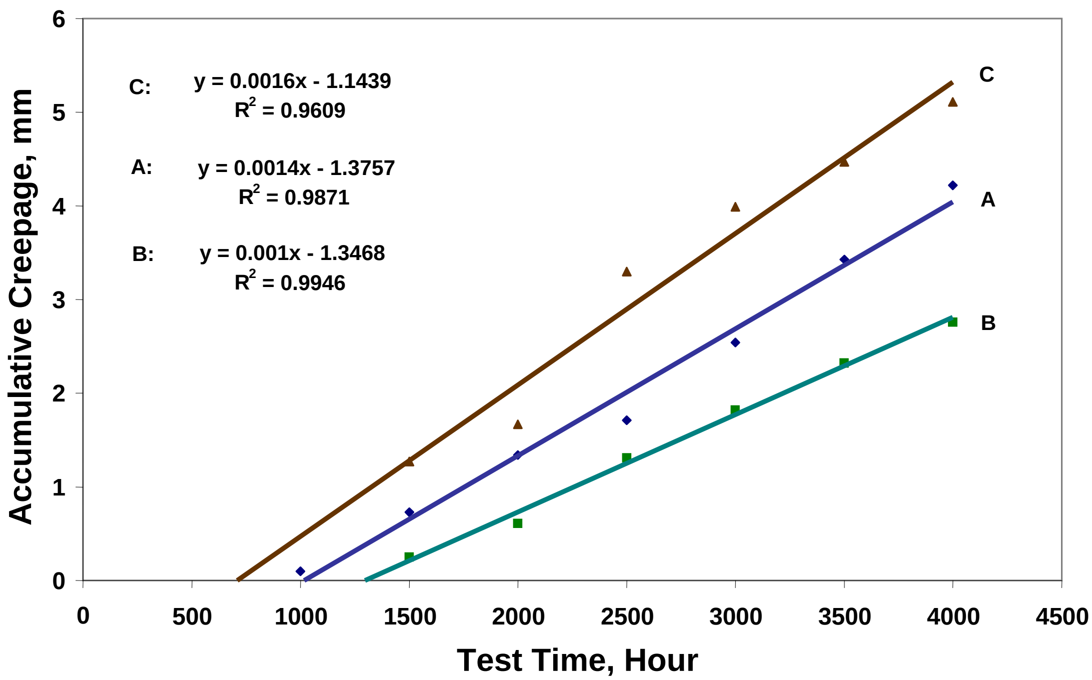

Figure 2. Plot of scribe creepage of moisture-cured urethane coating systems A, B, and C over 20 μg/cm^2 chloride-doped SP 10 surfaces versus laboratory test time in Test A.

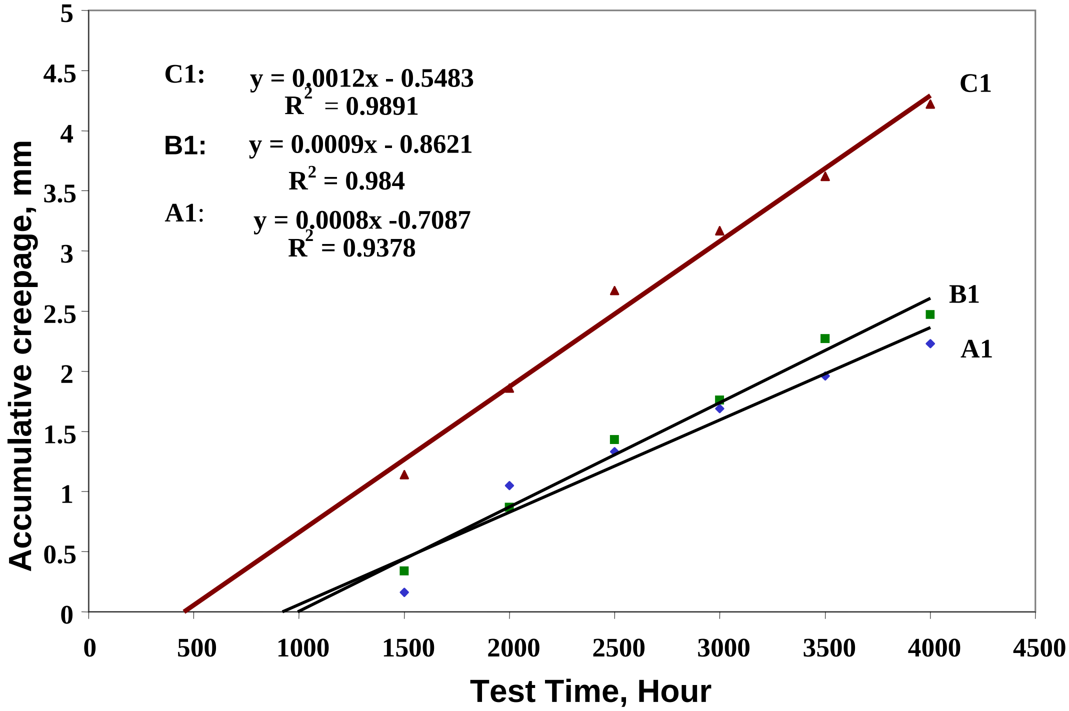

Figure 3. Plot of scribe creepage of moisture-cured urethanes over SP 3 surfaces versus laboratory test time in Test A.

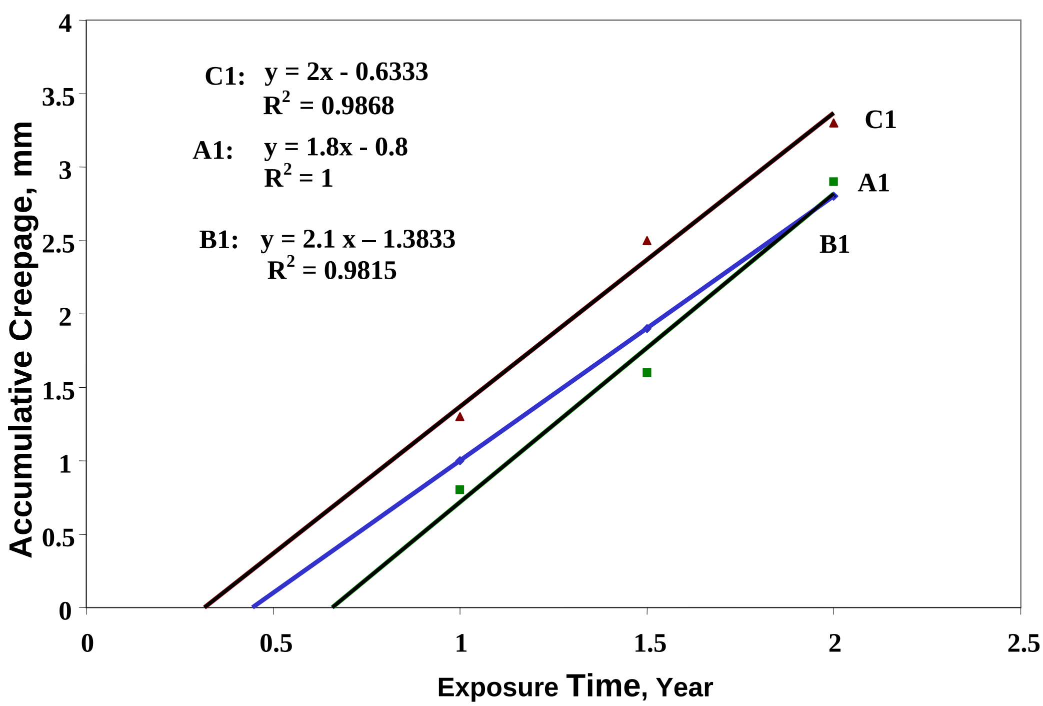

Figure 4. Plot of scribe creepage of moisture-cured urethanes over SP 3 surfaces versus outdoor exposure time.

All the time series data generated a linear regression equation as shown in the figures 1-4; it can be shown as a generic form in Equation 1. The coating durability (D) is proportional to the incubation time (T) that is the extrapolated test time when creepage equals to zero and inversely proportional to the line slope (S) as shown in Equation 1.

$y = ax - b$ …………………………………………………………..Equation 1

where slope = a
incubation time (T) = x = b/a when y = 0

There are three possible cases when comparing coating performance using this plot, the durability will be calculated as shown below.

Case 1 (most common case)
When T > 0, then $D \propto T/S$

Case 2
When T = 0 or same T values, then $D \propto 1/S$

Case 3
When T = 0 and S = 0, The coating performance is excellent at the end of test period in this case. Longer time is needed for estimating the relative durability since no value (D) can be obtained by this calculation.

The relative coating performance in Test A and outdoor exposure can be distinguished by the ratio value of incubation time (T, hour) to slope (S, mm/hour). The ratio value (T/S) is here considered as "durability index" for various coating systems listed in table 4. The higher the T/S ratio is, the better the coating performance becomes. The coating performance for SP 10 surface is in the decreasing order of B > C > A where durability index is 17.6, 12.1, and 10.5 respectively. Similarly, for chloride-doped surface System B (13.5) performs better than System A (7.0) that is better than System C (4.4) with durability index included in parathesis.

Table 4. Relative performance of different moisture-cured urethane coating systems in Test A.

System No.	Surface Condition	Slope (S), mm/hour	Incubation Time (T), hour	Durability Index (T/S) X 10^{-5}, $(hour)^2$/mm x 10^{-5}
A	SP 10	0.0013	1366	10.5
B	SP 10	0.0009	1580	17.6
C	SP 10	0.001	1208	12.1
A	Chloride Doped SP 10	0.0014	982	7.0
B	Chloride Doped SP 10	0.001	1347	13.5
C	Chloride Doped SP 10	0.0016	714	4.4
A1	SP 3	0.0008	886	11.0
B1	SP 3	0.0009	958	10.6
C1	SP 3	0.0012	457	3.8

To further demonstrate the usefulness of the technique presented in this paper, the performance of some different coating types (table 5) is here compared. Two summarized plots were made for various coating systems (figures 6 and 7). The linear regression analysis results from the plot data points obtained using Test A for 3,000 hours is shown in figure 5 and the data obtained after Test B for 3,000 hours is shown in figure 6. The R^2 values were all very high and most of them were found to be larger than 0.90; R^2 of 1.00 is defined to be the perfect linear fit. From the results listed in Table 5 and Table , the mean value and the standard deviation for R^2 were found to be 0.9628 and 0.0353 respectively. The minimum acceptable R^2 for this plot therefore is 0.9275.

The R^2 values for the plots of mean scribe creepage developed in Test A and Test B versus test time are presented in table 6 and table 7. The relative coating performance of various systems in Test A and Test B can be again compared by the Durability Index (T/S) as shown in table 8 and table 9.

Table 5. Description of Coating Systems in Different Types.

System No.	Coating Description	Nominal Dry Film Thickness, Micrometer (mil)	VOC Content[a], g/L
1	IOZ[b] Alkyl silicate/ Epoxy/Polyurethane	75/100/50 (3/4/2)	288/195/264
2	OZ[c] Epoxy/Epoxy/Polyurethane	100/125/50 (4/5/2)	325/180/260
3	IOZ Alkyl silicate/Epoxy/Fluorourethane	75/75/75 (3/3/3)	288/195/532
4	MCU[d] Zn[e]/MCU/MCU	75/75/75 (3/3/3)	340/340/420
5	IOZ Potassium-silicate/ Polysiloxane	75/125 (3/5)	0/120
6	OZ Epoxy/Polysiloxane	100/150 (4/6)	326/216
7	MCU Zn/Polyaspartics	75/200 (3/8)	340/289
8	OZ Epoxy/Polyurethane	100100 (4/4)	326/383
9	WB[f] Styrene Acrylic (3)[g]	50/50/50 (2/2/2)	67/67/56
10	Vinyl Acrylic/Acrylic	75/50 (3/2)	64/130
11	Elastomeric Acrylic (2)	150/150 (6/6)	0.01/0.01
12	WB Epoxy/Epoxy/Polyurethane	50/50/50 (2/2/2)	180/180/276
13	WB Polyurethane (3)	50/50/50 (2/2/2)	192/192/250
Additional Coating Systems[h] below were included in the calculations.			
14	OZ Epoxy/Epoxy/Polyurethane	100/50/50 (4/2/2)	326/195/264
15	MCU Zn/MCU/Polyurethane	75/100/75 (3/4/3)	340/340/335
16	MCU Zn/Polyaspartics II	75/175 (3/7)	320/172
17	WB Vinylidene (2)/Al-filled Acrylics (2)	50/50/50/50 (2/2/2/2)	35/35/237/ 237
18	WB Styrene Acrylic (3)	75/75/75 (3/3/3)	131/129/129
19	WB Epoxy/Polyurethane	75/50 (3/2)	193/31
20	WB Epoxy/Epoxy Acrylic Epoxy	125/100/50 (5/4/2)	83/83/274
21	WB Epoxy/Epoxy/Polyurethane II	75/75/75 (3/3/3)	72/143/66

a: Labeled by supplies.
b: Inorganic zinc.
c: Organic zinc.
d: Moisture-cured urethane.
e: Zinc.
f: Waterborne.
g: Number of coats.
h: The plots for these coatings systems are not shown in this paper.

Table 6. Linear regression fitting equation and R^2 values for various coating systems evaluated in Test A for 3,000 hours.

System No.	Coating system	Linear fit regression Equation	R^2
1	IOZ Alkyl silicate/Epoxy/Polyurethane	N*	N
2	OZ Epoxy/Epoxy/Polyurethane	y = 0.0007x - 0.2833	0.9615
3	IOZ Alkyl silicate/Epoxy/Fluorourethane	Flat line	NA
4	MCU Zn/MCU/MCU	y = 0.0015x – 2.39	0.9242
5	IOZ Potassium-silicate/Polysiloxane	y = 0.0003x - 0.3	0.9661
6	OZ Epoxy/Polysiloxane	N	N
7	MCU Zn/Polyaspartics	N	N
8	OZ Epoxy/Polyurethane	N	N
9	WB Styrene Acrylic (3)	y = 0.0015x - 0.5733	0.9806
10	Vinyl Acrylic/Acrylic	y = 0.0009x – 0.0733	0.9345
11	Elastomeric Acrylic	y = 0.0008x	0.9840
12	WB Epoxy/Epoxy/Polyurethane	y = 0.008x -0.1987	0.9709
13	WB Polyurethane (3)	y = 0.0015x – 0.02	0.9912
14	OZ Epoxy/Epoxy/Polyurethane	N	N
15	Zn MCU/MCU/Polyurethane	y = 0.0009x – 1.422	0.9718
16	MCU Zn/Polyaspartics II	N	N
17	Vinylidene (2)/Al-filled Acrylics	y = 0.0011x – 0.375	0.984
18	WB Styrene Acrylics (3) II	y = 0.00	
19	WB Epoxy/Polyurethane	y = 0.0008x – 0.5533	0.9826
20	WB Epoxy/Epoxy/Acrylic Epoxy	y = 0.0025x – 1.0867	0.9865
21	WB Epoxy/Epoxy/Polyurethane II	y = 0.0011x – 0.1277	0.9917

* Not tested.

Table 7. Linear regression fitting equation and R^2 values for various coating systems for Test B.

System No.	Coating system	Linear fit regression Equation	R^2
1	IOZ Alkyl silicate/Epoxy/Polyurethane	y = 0.0012x - 1.6667	0.8710
2	OZ Epoxy/Epoxy/Polyurethane	y = 0.0011x – 2.2167	0.8811
3	IOZ Alkyl silicate/Epoxy/Fluorourethane	Flat line	NA*
4	MCU Zn/MCU/MCU	y = 0.0015x – 2.39	0.9242
5	IOZ Potassium-silicate/Polysiloxane	Flat line	NA*
6	OZ Epoxy/Polysiloxane	y = 0.001x – 2.1	0.8929
7	MCU Zn/Polyaspartics	y = 0.0026x – 6.2	1
8	OZ Epoxy/Polyurethane	y = 0.0005x – 0.7232	0.9242
9	WB Styrene Acrylic (3)	y = 0.0019x - 0.56	0.9931
10	Vinyl Acrylic/Acrylic	y = 0.0008x – 0.3733	0.9899
11	Elastomeric Acrylic	y = 0.002x - 0.44	0.9828
12	WB Epoxy/Epoxy/Polyurethane	y = 0.0014x – 0.4	0.9855
13	WB Polyurethane (3)0.0004	y = 0.0015x – 0.0134	0.994
14	OZ Epoxy/Epoxy/Polyurethane	y = 0.0004x – 0.6448	0.9324
15	Zn MCU/MCU/Polyurethane	y = 0.0005x -0.6074	0.9662
16	MCU Zn/Polyaspartics II	y = 0.0004x – 0.1083	0.942
17	Vinylidene (2)/Al-filled Acrylics	y = 0.0011x – 0.375	0.984
18	WB Styrene Acrylics (3) II	y = 0.0019x – 0.56	0.9931
19	WB Epoxy/Polyurethane	y = 0.0008x – 0.5533	0.9826
20	WB Epoxy/Epoxy/Acrylic Epoxy	y = 0.0025x – 1.0867	0.9865
21	WB Epoxy/Epoxy/Polyurethane II	y = 0.0011x – 0.1277	0.9917

* No data.

Table 8. Relative performance of different coating systems in test A.

System Type	System No.	Slope (S), mm/hour	Incubation time (T), hour	Durability Index.,T/S $(hour)^2/mm$ x 10^{-5}
Zinc-rich				
IOZ (3)	1	N*	N	N
OZ (3)	2	0.0007	404	5.8
WB IOZ (3)	3	0	NA**	NA
MCU (3)	4	0.0015	1593	10.6
WB IOZ (2)	5	0.0003	1000	33.3
OZ (3)	6	N	N	N
MCU (2)	7	N	N	N
OZ (2)	8	N	N	N
OZ (3)	14	0	N	N
MCU (3)	15	0.0009	1580	17.6
MCU (2)	16	N	N	N
Acrylics	9	0.0015	382	2.5
	10	0.0009	81	0.9
	11	0.0008	0	NA
	17	0.0011	341	3.1
	18	0.0014	0	NA
Epoxy	12	0.0008	24.8	3.1
	19	0.0008	691	8.6
	20	0.0025	435	1.7
	21	0.0011	116	1.1
Polyruethane	13	0.0015	13	0.09

* Not tested.

** No data.

Table 9. Relative performance of different coating systems in test B.

System Type	System No.	Slope (S), mm/hour	Incubation time (T), hour	Durability Index,T/S $(hour)^2/mm \times 10^{-5}$
Zinc-rich				
IOZ (3)	1	0.0012	1389	11.6
OZ (3)	2	0.0011	2015	18.3
WB IOZ (3)	3	0	NA	NA
MCU (3)	4	0.0015	1593	10.6
IOZ (2)	5	0	NA*	NA
OZ (3)	6	0.001	2100	21
MCU (2)	7	0.0026	2385	9.2
OZ (2)	8	0.0005	1446	28.9
OZ (3)	14	0.0004	1612	40.3
MCU (3)	15	0.0005	1215	24.3
MCU (2)	16	0.0004	270	6.8
Acrylics	9	0.0019	295	1.6
	10	0.0008	467	5.8
	11	0.002	220	1.1
	17	0.0011	341	3.1
	18	0.0018	295	1.6
Epoxy	12	0.0014	285	2.0
	19	0.0008	692	8.6
	20	0.0025	435	1.7
	21	0.0011	116	1.1
Polyurethane	13	0.0015	8.9	0.06

* No data.

The excellent linearity in the plots described above can be employed as a ranking tool for comparing coating performance of various coating types. Figures 5 and 6 collect linear plots for some of zinc-rich, acrylic, epoxy, and polyurethane coating systems; the test data came from two different accelerated laboratory test methods. It is very easy to differentiate the coating durability from this type of plot. The coatings on top perform poorer than the bottom ones; more specifically the coatings located at the bottom right region of the figures are more durable coatings for steel surfaces than those located at upper left region. Some systems in Tables 6 and 7 were not shown in figures 5 and 6 because they were not tested in either Test A or Test B. In addition, rust creepage at longer time may be extrapolated from the linear plot. In other words, an accelerated laboratory test may be shortened in terms of time since the failure at longer time can be predicted from the equation to a certain extent. From figures 5 and 6, it is apparent that majority of zinc-rich coating systems perform much better than barrier coatings including epoxy, acrylic, and polyurethane systems. In the recent FHWA overcoating study, the rust creepage also increased linearly with test time. However, these plots are not shown in this paper due to limited space. Furthermore, the durability index (T/S) values for zinc-rich coating systems are in general much higher than those for acrylic, epoxy, and polyurethane coatings. One acrylic and one epoxy coatings generated relative high T/S values such as 5.8 x 10^5 for System 10 and 8.6 x 10^5 for System 19; these high values suggest their unique good performance in their classes. On the contrary, some zinc-rich systems showed low T/S values (Systems 1, 6, and 16). In particular, two different batches of three-coat organic zinc-rich epoxy/epoxy/polyurethane system that were evaluated in Test B at different time performed somewhat dissimilar with T/S values of 18.3 x 10^5 and 40.3 x 10^5 for System 2 and System 14, respectively. This phenomenon of different coating performance for same coating system may explain some of the unknown early field performance. It is not known if the problem is caused by formulation or application technique.

It should be stated here that scribe creepage is only one parameter for predicting coating performance; however its early development under most of test conditions making coating evaluation possible in a relatively short time.

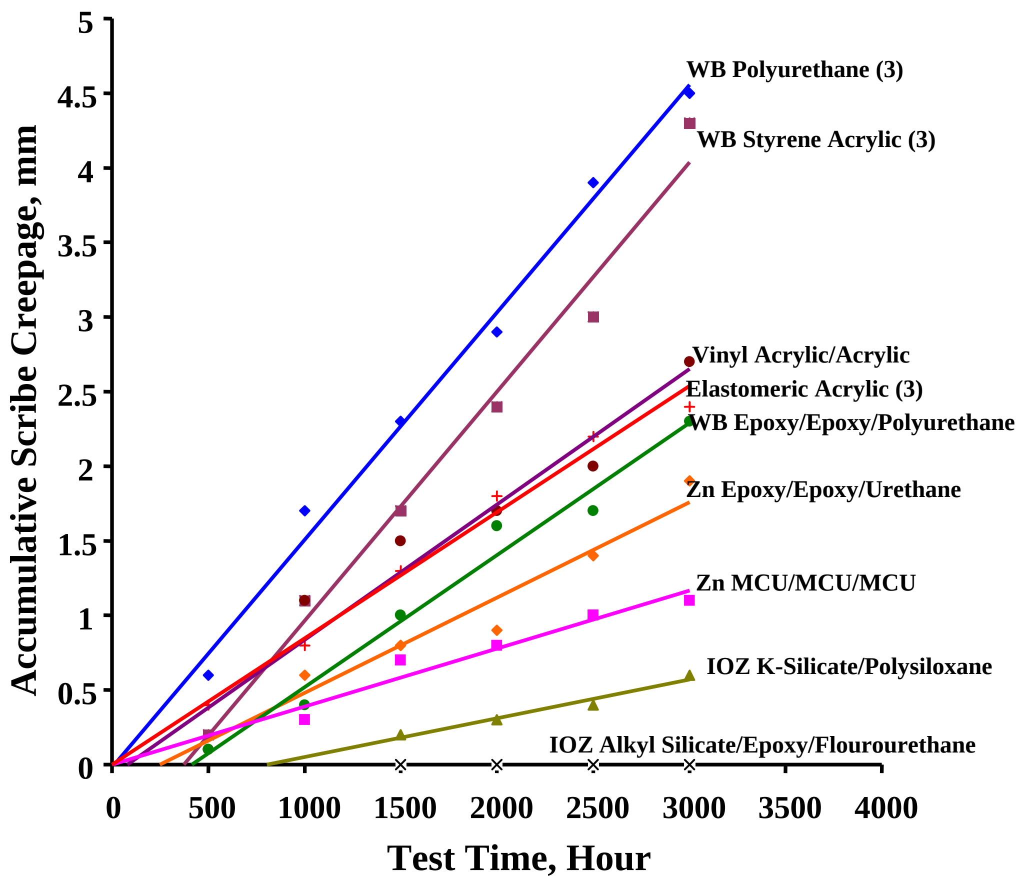

Figure 5. Plot of scribe creepage of various coating systems over SP 10 steel surface versus laboratory test time in Test A.

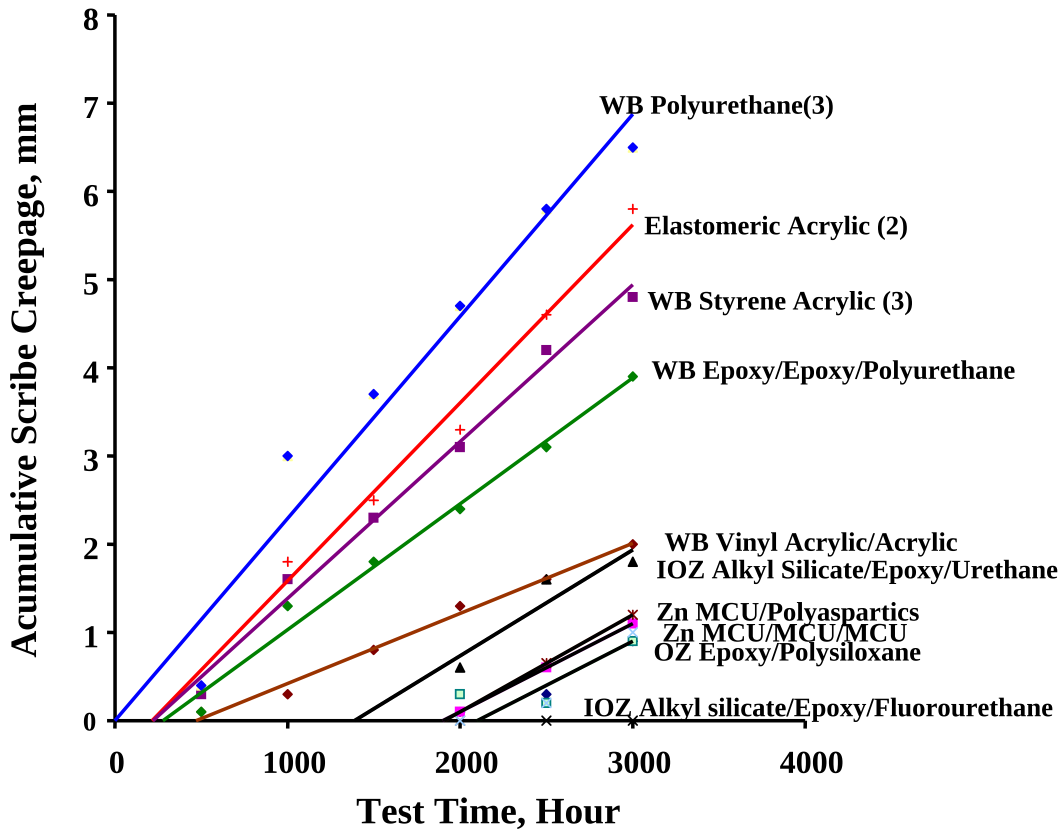

Figure 6. Plot of scribe creepage of various coating systems over SP 10 steel surface versus laboratory test time in Test B.

Summary and Conclusions

The new plot method developed in this paper generated a linear relationship between rust creepage at scribe and test time; the scribe creepage should be measured by tracing and area integration for creepage area by computer software or averaging the creepage distance at equal distance along the scribe. This method is a highly useful ranking tool for evaluating coating performance in the following cases.

1. Only under same test conditions and at same test time including laboratory tests as well as outdoor exposures.
2. For different coating formulations within same coating type.
3. For different coating types. (More than one test is needed to obtain more reliable performance conclusion since different systems may perform differently under different test conditions.)
4. For different steel surfaces including near white steel (SP 10), chloride contaminated SP 10 steel surface, and rusted and then power cleaned surface

(SP 3).

Rust creepage growth rate or durability can be calculated from the line slope in the plot. Based on the slope and incubation time, the relative performance of different systems (durability index) can be estimated with reasonable reliability under the same test conditions. These values are used for comparison purpose not absolute values for corrosion protection. There are three major advantages for this plot method: (1) More information such as coating degradation rate at scribe and incubation time can be obtained, (2) Laboratory test time can be shortened since the scribe creepage at longer time is obtainable from extrapolation, (3) Relative coating performance can be observed on the plot. In conclusion, this method is highly useful for determining relative coating performance in the laboratory within a short time.

References

1. Shuang-Ling Chong and John Peart, "Evaluation of Volatile Organic Compound (VOC) – Compatible High Solids Coating Systems for Steel Bridges," FHWA Publication No. FHWA-RD-91-054, 34pp, August 1991.
2. Shuang-Ling Chong and Yuan Yao, "Laboratory and Test-Site Testing of Moisture-cured Urethanes on Steel in Salt-Rich Environment", FHWA Publication No. FHWA-RD-00-156, 75 pp, December 2000.
3. Shuang-Ling Chong and Yuan Yao, "Laboratory Evaluation of Waterborne Coatings on Steel," FHWA Publication No. FHWA-RD-03-032, 44pp, April 2003.
4. Shuang-Ling Chong and Yuan Yao, "Performance of Two-coat Zinc-rich Rapid Deployment Systems on Steel Surfaces," Proceedings of PACE 2005, 12pp, Las Vegas, NV, January 2005.
5. Raymond E. F. Weaver, "Interpreting Scribe Undercutting Data in Cyclic Tests," JPCL, p. 17, September 1999.
6. Yuan Yao and Shuang-Ling Chong, "An Imaging Technique to Measure Rust Creepage at Scribe on Coated Test Panels," JPCL, Vol. 19, No.1, p. 67, January 2002.
7 M. A. Aragon and E. Frizzi, "Correlation Between Natural and Artificial Weathering of Anticorrosion Paints: Analysis of Some Artificial Weathering Cycles", Protective Coatings Europe, January 2002. Also printed in Journal of Protective Coatings and Linings, September 2002.

January Brings Hope for the New Year

For the last couple of years, I have stated my hopes for the New Year to the readers of *JPCL*. When you receive this issue, there will be approximately three weeks until we gather in New Orleans for PACE 2009. As I mentioned in my December editorial, there are a lot of exciting agenda items for this year's conference and training and educational programs. So my first hope for the New Year is that many of you will be able to come to New Orleans and I will be able to share a word with you all. One of the most enjoyable aspects of this job is meeting and interacting with our members, guests, and customers. PACE is the best venue for this interaction, and I always look forward to it. At every show or other event throughout the year, someone always approaches me and asks, "Why are you always smiling?" I smile because I like people and I enjoy talking with them. In this business and in this industry, I always learn something new. Why not smile at what you are doing? There is an old saying, "You only go around once in life, and this is not a dress rehearsal."

One of the highlights of PACE that I failed to mention in last month's editorial will be a visit to the New Orleans Superdome. A session on the reconstruction of New Orleans will be held on Monday, February 16, from 10:00 a.m. to noon. After the session, attendees will go on an exciting tour of the New Orleans Superdome. The tour will cover the mitigation and restoration efforts at the Superdome and the rehabilitation of the roof. The Superdome sustained significant damage during Hurricane Katrina, including two sections of the roof that were compromised. The dome's waterproof membrane had essentially been peeled off. The restoration of the Superdome to its glory is one of the symbols of the rebirth of New Orleans. You don't want to miss out on the session and tour.

My second hope for 2009 is for everyone to have good health throughout the year. I know we all are concerned about the economy, employment, health care, deficits, and the two conflicts in which the U.S. is engaged. But without good health, do other concerns really matter?

In my November editorial, I mentioned my hope that the next President will have Lee Iococa's nine "C" attributes and be able to tackle some of this nation's greatest problems. Now that the people have spoken, I hope President Obama can begin to make an impact and begin to tackle some of those problems that I mentioned in the paragraph above. It will not be an easy task. I also hope that he can bring the nation together in a bi-partisan manner, because in many ways it seems that our nation is more divided than ever. I wish him Godspeed as he begins his term as President.

I also hope that we all have success in our careers and can strive to meet the highest level of Maslow's hierarchy of needs—self-actualization. Self-actualization is the quest for reaching one's full potential as a person. It is written that this need is never fully satisfied; as one grows psychologically, there are always new opportunities for continued growth. So, if that need is seldom met, I hope all of you are able to achieve the next level below, which is esteem. Esteem can be internal or external. Internal esteem needs are those such as self-respect and achievement. External esteem needs are those such as social status and recognition. Of course, if you have achieved Maslow's level of esteem, it stands to reason that you have reached the other levels, which are the physiological, safety, and social needs.

So, if we were all together in a large room sharing a glass of the "bubbly" on New Year's Eve, I would raise it and wish you all health, wealth, and prosperity for the New Year, and thank you all for your support of SSPC.

Bill Shoup
Executive Director, SSPC

Sherwin-Williams Buys Euronavy

The Sherwin-Williams Company (Cleveland, OH) announced that it has closed an agreement to acquire Euronavy-Tintas Maritimas e Industriais S.A. of Portugal.

Euronavy is headquartered in Lisbon, Portugal, and manufactures marine and protective coatings applied to ships, offshore platforms, storage tanks, flooring, and other steel and concrete structures. The company was founded in 1981 and has approximately 40 employees and sales under $25 million (USD). Its coatings are currently sold in Brazil, Singapore, China, Vietnam, Dubai, Europe, Portugal, Canada, and the U.S.

The Sherwin-Williams Protective & Marine Coatings Division, part of the company's Global Finishes Group, manufactures coatings systems through 14 global locations.

More information on the acquisition can be found at www.sherwin-williams.com/protective or www.euronavy.net.

Automation USA Liquidated, Acquired

Automation USA Inc. (Gettysburg, PA) underwent a voluntary liquidation and acquisition at the end of December 2008, as mandated by its shareholders in Germany.

All U.S. business activities are being taken over by TestCoat Inc. in Gettysburg, PA. Until further notice, all business agreements will remain unchanged.

Automation USA Inc. was a global provider of hand-held coating thickness gauges.

Munters' Brown Heads Global Development

Russ Brown, the vice president of SSPC Board of Governors, was named global business development manager of temporary humidity control (THC) for Moisture Control Services (MCS), a division of Munters AB.

Russ Brown

Brown's responsibilities will include setting and executing the global marketing and sales programs as well as a long-term global THC marketing strategy. Munters is headquartered in Stockholm, Sweden; however, Brown will be based in the Indianapolis office.

Brown has served on the SSPC Board of Governors since 2003, and is currently serving as vice president. In 2009, he will serve as president-elect, and in 2010 as the president of the 12-member board that manages SSPC.

Brown was previously the national sales manager and national accounts manager for MCS and earned a bachelor's degree from the University of Illinois.

ASTM Offers Corrosion Testing Courses

Throughout 2009, ASTM International will be offering "Corrosion Testing: Application and Use of Salt Fog, Humidity, Cyclic, and Gas Tests," a two-day hands-on training course. The course will be offered May 12 and 13 at the University of Akron Polymer Training Center in Akron, Ohio; September 29 and 30 at the ASTM International headquarters in West Conshohocken, PA; and November 3 and 4 in Chicago, IL.

The course is designed to provide a clear understanding of the proper application of ASTM B117, the significance of the salt fog test, and how to operate a salt fog apparatus. It is intended for corrosion technicians, product test personnel, laboratory supervisors, and other users of B117.

For information on registering contact Eileen Finn at efinn@astm.org.

Silberline Buys Asian Pigment Maker

Silberline (Tamaqua, PA), a manufacturer of special effect and performance pigments, has announced its acquisition of Yasida and Aesthetic Color-Tech Co., Ltd. (ZhangQiu, ShanDong Province, China) from AArbor International Corp. Silberline and Yasida and Aesthetic Color-Tech Co., Ltd. both manufacture aluminum pigments under the Silverking brand name.

Yasida sells aluminum pigments used in paints, coatings, and inks to protect metal and plastic substrates and provide metallic effects. It sells its products in China and several other countries in Asia. Silberline's products are intended to enhance the visual appeal of coatings.

International Training Update

SSPC training is important to many companies, both in the U.S. and abroad. The following is a summary of December SSPC training reported to *JPCL*.

Instructor Rich Burgess taught 27 students, including 5 PCS students, at a Planning and Specifying Industrial Coatings Projects (C-2) course held in Mexico, on December 1–5, 2008, at COMEX Distribuidora-Mexico. The C-2 course provides those who understand coating fundamentals with an overview of the principles of planning, awarding, and monitoring the quality of new construction or maintenance painting projects. According to SSPC, this is the fourth SSPC training that COMEX has held.

Students of the Planning and Specifying Industrial Coatings Projects (C-2) course, held at COMEX Distribuidora-Mexico.

On Dec 1–5, 2008, the NAVSEA Basic Paint Inspector (NBPI) course was held at the Southwest Regional Maintenance Center in San Diego, CA. Twenty students attended the class, which was led by instructors Phil Parson and Gordon Kuljian. NBPI is a five-day QA course developed by Naval Sea Systems Command (NAVSEA) to train coatings inspectors to inspect critical coated areas as defined by U.S. Navy policy documents. These areas include (but are not limited to) cofferdams, decks for aviation and UNREP, chain lockers, underwater hull, tanks, voids, and well deck overheads.

Moody International in Shanghai, China, held a Protective Coatings Inspector (PCI) course on Dec 8–13. Eight students attended the course, which was led by instructor Tom Jones. This was the first offering of the PCI course in China, and it was also Moody's first course offering under its license agreement with SSPC. PCI is designed to train individuals in the proper methods of inspecting surface preparation and installation of industrial and marine protective coatings and lining systems on a variety of industrial structures and facilities. There are no prerequisites to take the PCI course.

United Coatings, a Division of Earl Industries, hosted a C-14 (Marine Plural Component Program; MPCAC) course on December 1–2 for ten students. Held at United Coatings in Portsmouth, VA, the course was taught by Frank Saunders. C-14 is designed to certify craft workers operating plural-component spray equipment and those applying protective coatings on steel in immersion service by airless spray using plural-component spray equipment.

Tikkurila Oy Names New President and CEO

Erkki Järvinen has been appointed president and CEO of Tikkurila Oy (Vantaa, Finland). He will take the position during the first quarter of 2009.

Järvinen currently works as president and CEO of Rautakirja Corporation, which belongs to Sanoma Oyj. He has held this position since 2001. Before then, he served as president and senior vice president of kiosk operations.

Tikkurila develops, markets, and produces paints and coatings for industrial users, professional painters, and the general public.

Students of the NAVSEA Basic Paint Inspector (NBPI) course, held at the Southwest Regional Maintenance Center in San Diego, CA.

EPA Tightens Limits on Airborne Lead: Are Changes in the Wind for Coating Work?

By Alison B. Kaelin, KTA-Tator, Inc.

On October 15, 2008, the Environmental Protection Agency (EPA) made the first revision to the National Ambient Air Quality Standards (NAAQS) for lead since the standard was established in 1978. The revised standard reduces the allowable ambient airborne lead level by a factor of 10: from 1.5 micrograms of lead per cubic meter of air ($\mu g/m^3$) to 0.15 $\mu g/m^3$. The revision is effective January 12, 2009. EPA's action established both the primary standard (intended to protect public health) and the secondary standard (designed to protect public welfare and the environment) at the same level.

Hear more about the revised NAAQS and the coatings industry at PACE 2009

Two speakers, including this author, will discuss this regulatory change in depth, along with its immediate effect and long-term impact on the painting industry at the SSPC/PDCA conference, PACE 2009 in New Orleans (Session 2: Lead, New Lead Regulations—Monday, February 16, 2009, 10 a.m.–noon). This article highlights the principal revisions to the NAAQS for lead and identifies some of the issues our industry will have to address.

What Are NAAQS?

NAAQS establish federal limits on six criteria pollutants, one of which is lead. State and local air quality agencies establish monitoring networks to measure these pollutants. When areas within a state exceed the NAAQS limits, the areas are designated as "non-attainment," and state or local air quality agencies must develop strategies for EPA approval to bring these areas into attainment with the NAAQS. The primary sources of lead in air (from 2002 data) include industrial processes (e.g., smelters, incinerators, etc.), non-road equipment, utilities (e.g., electricity and fossil fuel), road dusts, and miscellaneous (e.g., construction).

Why Revise the NAAQS for Lead?

The NAAQS reevaluation for lead was the first for which EPA specifically incorporated a review of (a) concentrations of lead in the environment; (b) multimedia lead exposure (via air, food, water, etc.); (c) characterization of lead health effects and associated exposure response relationships; and (d) delineation of environmental (ecological) effects of lead. The Clean Air Scientific Advisory Committee evaluated and summarized more than 6,000 scientific studies on lead for EPA.

EPA's Rationale for Final Decisions on the Primary Lead Standard (the "Rationale" provides the justification for the rulemaking) continually referred to the compelling evidence related to the scientific studies evaluated and to the new and emerging understanding of a more significant impact from lead exposures than previously thought. As a predominant factor in its revisions to the standard, EPA cited evidence of the effects that lower airborne lead and blood lead levels have on the IQ of children, as well as on the health of adults and children.

Will Monitoring Requirements Increase?

The new NAAQS dramatically increases the number of lead monitoring sites that the states must establish; moreover, the

Continued

Alison B. Kaelin, CQA, is the Corporate Quality Assurance Manager of KTA-Tator, Inc., Pittsburgh, PA. She is a Certified Quality Auditor (CQA) and a NACE-certified Coatings Inspector. Ms. Kaelin has over 20 years of public health, environmental, transportation, and construction management experience. She has written or co-authored more than 20 papers and articles, has previously co-chaired several SSPC committees, currently co-chairs the task group revising SSPC's QP 2 standard, and teaches widely in the industry. Ms. Kaelin received the SSPC Technical Achievement Award. She can be reached at akaelin@kta.com.

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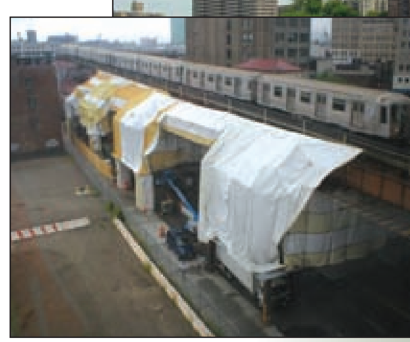

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standard specifically requires that monitors be placed near stationary sources emitting more than 1 ton per year of lead and in any population center of greater than 500,000 people. EPA estimates that at least 230 monitoring sites will be added because of the new requirements. More importantly, EPA expects the number of non-attainment areas across the country to increase once the new monitoring sites are operational. According to EPA, "the existing monitoring network for lead is not sufficient to determine whether many areas of the country would meet the proposed revised standards." The regulation requires that all source monitors be in place by January 1, 2010, and that all monitors (source and population-based) be in place no later than January 1, 2011.

State and Federal Actions

By October 2009, states are required to provide the EPA a list of areas designated as "non-attainment" with the new limit. EPA will evaluate state monitoring results from 2008–2010 (three-year average including the new source monitoring started in 2010) and will designate new non-attainment areas by October 2011. The states have five years from October 2011 to meet the new limits.

Each state with non-attainment areas will need to develop a State Implementation Plan (SIP) that outlines the proposed regulations and pollution controls it will implement to reduce airborne concentrations of lead to below the standard (i.e., bring the area into attainment). Some states may begin considering or initiating regulatory changes or additional pollution control measures as soon as they submit the October 2009 data to the EPA.

State changes typically include new or tougher regulations (such as requiring air pollution control equipment on previously unregulated lead emitting facilities), licensing or permitting programs, and other policies aimed at the types of facilities or operations performed in the non-attainment areas that are contributing to lead levels in ambient air. SIPs can even focus on a single source or a particular operation (e.g., maintenance activities such as abrasive blasting) within a non-attainment area.

The preamble of the revised Standard acknowledges it may be necessary to implement controls on non-industrial sources (e.g., construction projects) in order to achieve attainment.

It is reasonable to expect new regulatory requirements on smaller stationary sources of lead (e.g., small fabrication or blasting facilities) as well as fugitive, non-point sources of emission sources (e.g., field blast cleaning)—start-

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ing as early as 2010 and over the following five-year period (2015) as SIPs are fully implemented.

Preliminary discussions with a few state and local air quality agencies confirm that the revision of the NAAQS for lead will likely affect field painting operations, but none of the agencies consulted have had sufficient time to consider the impact of the reduction and have not even begun evaluating potential areas of non-attainment.

It is important to note that states have developed SIPs, including new regulations in response to other NAAQS revisions. For instance, the revision to the NAAQS for PM 2.5 in 2007 triggered state SIPs proposing regulation of sources of fugitive emissions that had previously fallen below regulatory thresholds. These included non-permitted blasting and painting facilities, mobile abrasive blast cleaning operations (temporary construction), and increased regulation of non-road equipment and engines in both attainment and non-attainment areas. Even though the PM 2.5 SIPs aren't required to go into effect until 2012, some states such as New York and California have already implemented regulations targeting these sources, and other states have developed draft standards.

Where Does the Painting Industry Fit in Now?

While the EPA does not impose NAAQS on individual painting projects, TSP-lead monitoring has often been incorporated into specifications as a way to measure the effectiveness of the containment system's control over emissions, with the NAAQS limits used as the acceptance criteria. Most specifications and many industry documents, training courses, and certifications refer to the NAAQS for lead. Accordingly, the implications of the new limits on current and future painting projects that invoke TSP-lead monitoring as well

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as training curricula and industry references, guidelines, and standards must be considered.

Can Our Industry Meet these Standards?

Our industry has been performing ambient air monitoring for lead using the NAAQS monitoring methods since the late 1980s and continues today. Data provided by Zamurs and Bass of NYSDOT ("Evaluation of Ambient Air Quality Monitoring Procedures Outside of Containment," *JPCL*, October 1998) indicated background TSP-lead results of 0.12 $\mu g/m^3$, average daily results (24-hour average) of 0.64 $\mu g/m^3$, and an average concentration during abrasive blast cleaning in a Class 1A containment of 1.85 $\mu g/m^3$. The latter two lead concentrations are above the new NAAQS. Additional data will be provided and discussed at PACE 2009.

What About Other Potential Effects on Industrial Painting?

This reduction of the NAAQS for lead to 0.15 $\mu g/m^3$ may have immediate and long-term impacts on the painting industry. While it is difficult to predict the impact, there are several scenarios and questions to be considered.

Other questions that will be discussed at PACE 2009 include the following.

- Should the painting industry at large, technical organizations such as SSPC, and facility owners continue to use the NAAQS for lead as a basis for evaluating containment and ventilation system performance and demonstrating that public welfare was not impacted?
- How does the new NAAQS for lead affect current specifications in 2009, especially if it is not yet established whether the background levels, irrespective of paint removal operations, will comply?
- Can our current level of controls (containment and ventilation) meet the new standard?

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Kenneth B. Tator, P.E.
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• Should we change how we do monitoring or eliminate it all together? If we continue to monitor, can we still use the same collection and analysis methods (high-volume TSP monitor and laboratory analysis)?
• Will the new standard affect fixed sites for abrasive blast cleaning and painting as well as other facilities that emit lead?
• What will the states' regulatory agencies do?
• Will the EPA and state actions (if any) increase costs of industrial coating projects?
• Does the health data have any impact on public or worker exposures?

Conclusions

Similar to the passage of the OSHA lead-in-construction standard in 1993, the revision to the NAAQS for lead has the potential to prompt changes in the control and monitoring of lead emissions from field paint removal operations and stationary sources that release lead into the ambient air. We should expect to see increases in state regulation and enforcement on both stationary and field sources of lead.

Professional organizations such as SSPC will need to address the changes brought by this regulation in existing training and certification programs and reference documents and standards. Owners and specification writers will need to consider on a short-term basis how to address contracts and specifications already in place for 2009 as well as their long-term approach. We all must consider the risk of tort litigation (alleging harm) if these lower levels are exceeded near sources of lead emissions and whether or not we can control emissions at this level.

We offer this article as an opening to stimulate discussion about the revised lead NAAQS. We expect that the above discussion is only the beginning. ■

More stories on regulations continue on p.14

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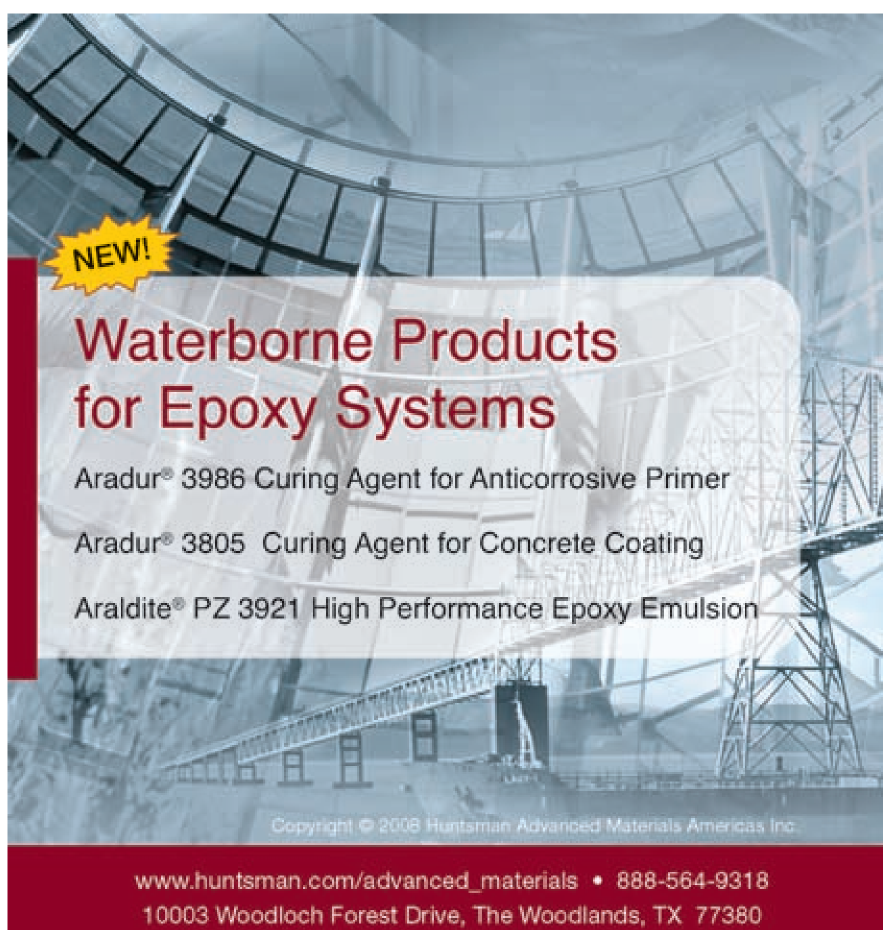

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Faulty Corrosion Control Figures in UST Violations

The Environmental Protection Agency (EPA) issued administrative complaints against three federal government entities over violations related to the management of underground storage tanks (USTs) in Puerto Rico. An 11-count complaint was issued to the Puerto Rico National Guard and the Army and Air Force Exchange Service for violations of the Resource Conservation and Recovery Act at Camp Santiago, a training center for military activities in Salinas, Puerto Rico. There was also a complaint issued against the U.S. Department of Agriculture (USDA) for alleged violations of the Solid Waste Disposal Act at two Puerto Rico facilities.

Violations at Camp Santiago were related to improper operation, testing, and maintenance of tanks. The complaint seeks a civil penalty of $209,264. At two Puerto Rico facilities, the USDA did not provide the required corrosion protection for its piping system and failed to conduct release detections of its tanks. The complaint seeks a civil penalty of $108,623 for violations that persisted for at least a year, according to the EPA.

Underground storage tank systems often store petroleum or hazardous wastes. There are about 625,000 USTs nationwide, and the contents, if released, can harm environment and human health.

EPA and Baltimore County Settle UST Violations

Baltimore County, Maryland, has settled alleged violations of regulations on underground storage tanks (USTs), according to the U.S. Environmental Protection Agency (EPA). The settlement resolves 13 alleged violations of regulations designed to prevent leaks of fuel and hazardous wastes at county-owned and operated locations.

The county will pay a civil penalty of $28,968 and perform a supplemental environmental project that will install a computerized system to monitor USTs at several locations, costing at least $90,000. This action concludes a 2006 multi-site agreement between the EPA and Baltimore County, which required the county to conduct environmental audits of the USTs at the 13 locations.

OSHA Proposes Crane and Derrick Construction Standard

The U.S. Department of Labor's Occupational Safety and Health Administration (OSHA) has published a proposed rule for cranes and derricks in construction. The proposal appears in the October 9, 2008 Federal Register. Comments are due January 22, 2009, and may be sent to www.regulations.gov.

The proposed rule addresses hazards associated with the use of cranes and derricks in construction, according to Edwin G. Foulke, Jr., the assistant secretary of labor for OSHA. The rule will protect construction employees and help prevent accidents by updating protections and requiring crane operators to be trained in the use of construction cranes.

The rule will apply to an estimated 96,000 cranes in the U.S. It addresses ground conditions, operation of cranes near power lines, certification of crane operators, inspections of cranes, assembly and disassembly of cranes, and the use of safety devices. The standard would establish four options for the qualification of crane operators: certification through an accredited third-party testing organization, qualification through an audited employer testing program, qualification issued by the U.S. military, and qualification by local or state licensing authority.

The proposed standard, Federal Register #73:59713–59954, is available through OSHA's website, www.osha.gov. Go to the site; click "Federal Register" on the righthand navigation bar; and search by text, "cranes and derricks."

Fall Hazards Top OSHA Citations on 46 NYC Sites

Fall hazards were the most common violations cited when the Occupational Health and Safety Administration (OSHA) conducted safety inspections of construction sites for two weeks in New York City this past summer. OSHA had 12 inspectors conduct 96 safety inspections on 46 randomly selected construction sites from June 23 to July 3, 2008. Sixty contractors were issued citations for 129 violations, with the majority cited for fall hazards. The violations total $247,400 in proposed fines. Citations for fall hazards numbered 39, while other frequently cited hazards included electrical safety (29), scaffolds (17), cranes and rigging (13), welding/gas (10), and 20 other categories that included personal protective equipment, tools, material handling, concrete, hoists, stairs, and ladders.

OSHA is taking efforts to enhance construction safety in New York City by implementing a cross-training alliance with the NYC Department of Buildings and sending copies of citations to project owners, developers, the employers' insurers, workers' compensation carriers, and union training funds in order to raise awareness of occupational hazards. OSHA also plans to conduct another round of inspections in the future.

Send news about regulations to kkapsanis@protectivecoatings.com.

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20-Year Performance of Bridge Maintenance Systems

By J. Peter Ault, P.E., Elzly Technology Corporation, and Christopher L. Farschon, P.E., Corrpro Companies Inc.

In the years 1986 and 1987, the New Jersey DOT applied 47 different coating systems to various individual spans of the Mathis Bridge. The eastbound Mathis Bridge carries Route 37 over the Barnegat Bay from Toms River to Seaside Heights, NJ. (The westbound span is a separate, newer, parallel structure, which was not coated at this time.) Each experimental system was applied to a complete span, with each span comprising approximately 4,000 square feet of steel. Experimental coating systems included metallizing, various zinc-based systems, various levels of surface preparation, and several overcoating strategies (e.g., an alkyd coating applied over a hand-tool-cleaned surface).

This article will present the results of an inspection conducted in 2007, nominally 20 years after the initial coating application. The inspection showed varied service lives associated with the different coating systems. Some of the systems were in excellent condition after 20 years, while others had completely broken down. In addition to the present condition of the test spans, the article will review the historical performance of the various coating systems as well as the applied cost. Finally, several important implications for

Editor's note: This article is based on a paper the authors presented at the SSPC-PDCA joint conference, PACE 2008, in Los Angeles, CA, January 27–30, 2008.

Photos courtesy of the authors.

maintenance planners will be presented. These will include cost-benefit calculations and risk-reduction strategies.

History and Maintenance of the Mathis Bridge

New Jersey DOT's ongoing evaluation of various bridge coatings on the Thomas Mathis Bridge involves evaluating 66 spans plus a lift span. Each span is approximately 73 feet long and contains five rolled I-beam stringers of A-36 steel spaced 8 feet apart. Each span contains approximately 4,000 square feet of painted surface area. The bridge is situated over the salt water of Barnegat Bay, with vertical clearances from 5 feet at the abutments to 33 feet at the lift span.

Upon construction in 1950, the structure was painted with three coats of an oil-based paint containing red lead pigment. The bridge was painted three times at various intervals over the next 28 years. The painting work preceding the 1986–87 experimental evaluation was performed in 1978. At that time, a basic lead-silico chromate, oil alkyd system was used with a pigmented fascia coating and "black graphite" on the interior steel.

In 1984, an inspection of the bridge noted that rust and corrosion were extremely heavy on the bearing assemblies, some stringer webs, and bottom flange of the stringers. Corrosion was especially concentrated on stringer ends located at the bridge piers (i.e., steel in the path of run-off water form the bridge deck expansion joints). Rust scale on the steel was as thick as ½-inch. The existing paint was 15 to 25 mils (380 to 635 microns) in thickness. Concentrated salt deposits were visible on the steel directly beneath the deck joints. The severe marine environment and road salt usage create a severely corrosive environment for the evaluation of different maintenance painting methods.

Subsequent to a laboratory evaluation of available maintenance coatings, NJDOT awarded contract 85-2, Painting of the Mathis Bridge. The bid documents contained specifications for each experimental paint system. Full containment of the blast abrasive and debris (using 1986-1987 technology) was required to comply with environmental regulations.

Coating Systems

Eighteen manufacturers donated coatings to be used on 47 of the 66 spans. The experimental systems consisted of inorganic and organic zinc coatings, epoxies, aluminum epoxy urethanes, vinyls, urethanes, oil-alkyds, zinc metallizing, aluminum metallizing, rust converters, and others. These systems represented the most feasible options for maintenance overcoating or coating replacement on a bridge. Table 1 (p. 22) provides a list of the coating systems tested along with surface preparation, application date, and span number. The remaining spans were coated with the standard NJDOT Zone 3B system, which consisted of a phenoxy organic zinc primer and vinyl intermediate and finish coats.

The surface preparations ranged from SSPC-SP 2, Hand Tool Cleaning, to SSPC-SP 5, White Metal Blast, depending on the coating manufacturer's recommendation. For systems requiring spot cleaning, only loose rust and peeling paint were removed. Containment was not erected during hand tool cleaning. Sand used for blasting was collected on corrugated steel containment floors so that it could be removed for proper disposal.

Seventeen of the eighteen coating manufacturers had a representative on site to approve surface preparation, give mixing instructions, and provide guidance regarding any potential problems. State inspectors worked closely with the paint contractor and manufacturers' representatives to assure compliance with the manufacturers' and NJDOT's minimum specification requirements. Painting began on October 11, 1986. Seven systems requiring spot cleaning were applied before mid-November, when weather conditions were no longer suitable for any of the systems. (Some of the systems were designed for application as low as 40 F.) Painting resumed in April, 1987, and was completed in October, 1987.

Inspections

In addition to the data presented in the original NJDOT report, the data presented in this article is also the result of visual inspections conducted by the authors in 1995 and 2007.

The NJDOT report included one-year performance evaluations conducted from a snooper tuck.[1,2] Visual ratings were given to each span based on the percent rusting of the bottom flange. This was deemed to be the harshest exposure and thus the best basis for ranking the systems after a short exposure period. The ratings were made in accordance with ASTM D610, *Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces*.

As part of a FHWA project, three inspectors performed a follow-up inspection of the structure in 1995.[3] The inspections consisted of assigning a 1–10 rating to the entire span in accordance with ASTM D610 based on visual assessment from a boat. The inspectors were 0 to 30 feet from the structure, depending on the span. Extensive photographs were taken during the inspections. The ASTM D 610 ratings provided by three individual inspectors were averaged to provide a composite rating. In most cases, the inspectors' ratings were within one unit of each other. For the purposes of this paper, the authors again rated the structures in 2007 using similar procedures to the 1995 inspection.

Understanding the Results

The results of the NJDOT test program after one year of exposure indicated mixed performance of overcoating systems.[4] Those systems applied over an SSPC-SP 2 (hand-tool cleaned) surface included alkyds, epoxies, and urethanes. The epoxy mastic systems exhibited a wide range of performance. Several different manufacturers' versions of this popular maintenance painting system were applied over SP 2 surfaces. Some of these systems had already failed at the one-year inspection, while others were among the best performers over "surface tolerant" conditions. Other systems performing well over SP 2 surfaces were a calcium borosilicate-pigmented alkyd system and an oil-alkyd system. The one-year results for systems applied over abrasive blasting were consistently good, showing little differences between systems.

Figure 1 presents the 2007 inspection data on the Y-axis (ASTM D610—10 = best, 0 = worst) versus the cost of the coating system ($/ft^2 in 1986/87 dollars) on the X-axis. The data suggests a trend toward increased performance with increasing cost, but the relationship has considerable scatter. Cost alone would not be a good basis to assess the overall value of a coating system simply because there are so many other criteria that play into the success of a coating system.

Each of the tested coating systems was a unique combination of coating and surface preparation. Because of the inherent variability in any coating system, the overall performance of a coating system is not reliably quantified with a single life expectancy. Quantifying a coating system life is better suited to a probabilistic or risk-based analysis. To make generalized conclusions, we grouped the 47 experimental systems into eight generic categories as shown in Table 1.

Table 2 (p. 24) shows the number of systems in each group meeting one of three classifications at two inspection times:

- Good condition—ASTM D610 rating better than "7" (less than 0.3% rusting)
- Maintenance candidate—D610 rating of "4" to "7" (from 0.3% to 10% rusting)
- Remove/recoat candidate—D610 rating of "4" or below (more than 10% rusting)

Figure 2 shows the likelihood of reaching each of the above defined conditions after 20 years for each coating system group. Notice how this figure ranks the groups of coating systems by performance, with the better performing

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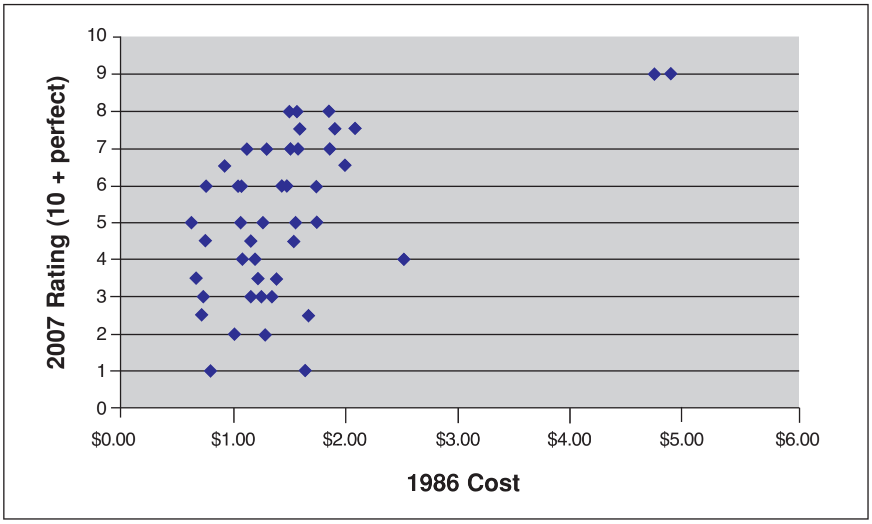

Fig. 1: Correlation between cost and condition after 20 years of service.

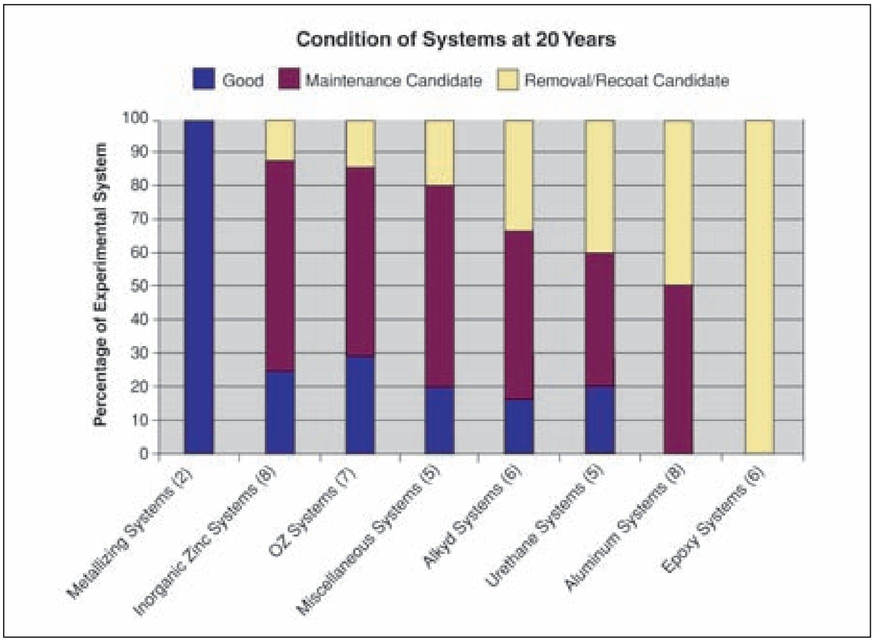

Fig. 2: Coating systems by category, showing the likelihood of their overall condition at 20 years.

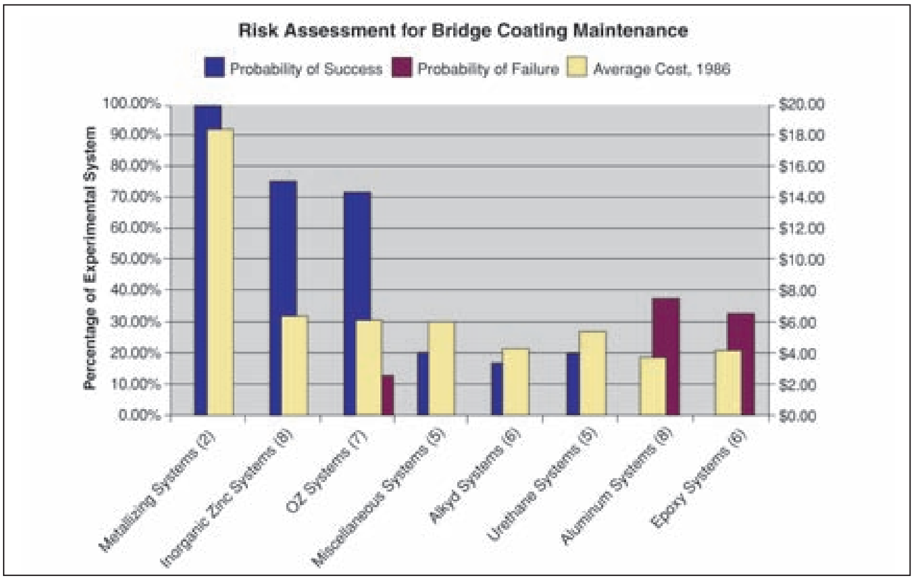

Fig. 3: Risk assessment evaluation for each group of coating systems

Photo 1: Close-up of bearings on metallized systems.

groups to the left and the poorer groups to the right.

A reasonable definition of a successful coating system might be one that is "good" at 8 years and only a "maintenance candidate" at 20 years. A reasonable definition of "failure" might be a system that requires complete replacement after 8 years. Using these definitions, we can determine a probability of success and a probability of failure for each generic maintenance strategy. Figure 3 shows the probability of success, probability of failure, and the average applied cost for each of the coating system groups.

Obviously, there are nuances in each of the broad categories. Certainly the high cost and high probability of success associated with the metallizing are expected. However, there is also a high probability of success with the inorganic and organic zinc-based systems. The aluminum and epoxy systems show a low probability of success and are most likely to be in poor condition after eight years. The following paragraphs will explore some of the coating groups in more detail. In particular, the performance of the individual systems with time is shown graphically. Note that the inspection basis at one year was only the bottom flange. This explains the apparent improvement of some systems from year one to year eight.

Metallizing Systems

The two metallizing systems are performing extremely well, even after 20

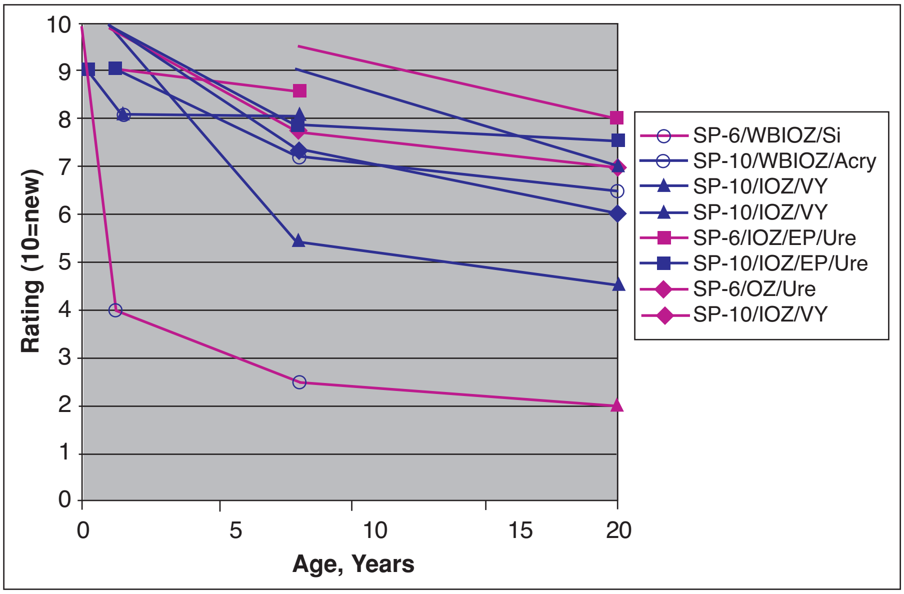

Fig. 4: 20-year performance of inorganic zinc systems.

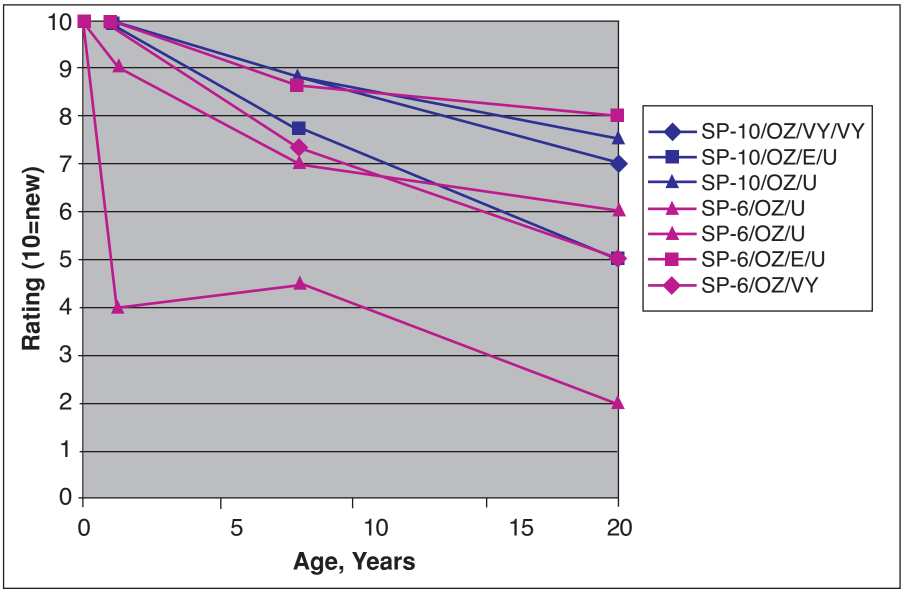

Fig. 5: 20-year performance of organic zinc systems

Table 1. Summary of Test Coating Systems

Span	Coating System	Surface Preparation	Application Date	1986 Cost ($/ft^2)
	Alkyd Systems (6)			
7E	Alkyd Oil Base/Si Alkyd	SP-2	Nov. 86	$0.71
11E	Alkyd/Epoxy/Urethane	SP-2	Oct. 86	$1.04
21W	Alkyd/Epoxy/Urethane	SP-6	Aug. 87	$1.56
43W	Oil - Alkyd	SP-6	Oct. 87	$1.11
13W	Oil Alkyd - 3 Cts	SP-2	June 87	$0.73
31W	Oil-Alkyd	SP-6	Oct. 87	$1.37
	Aluminum Systems (8)			
41W	Alum. Urethane/Acryl.	SP-6	Sept. 87	$1.58
12E	Alum. Epoxy/Urethane	SP-7	Oct. 86	$1.00
9E	Alum. Epoxy/Urethane	SP-2/3	Nov. 86	$0.63
8E	Alum. Epoxy/Urethane	SP-2	Nov. 86	$1.07
6E	Alum. Epoxy/Urethane	SP-2	April 87	$0.60
5W	Alum. Epoxy/Urethane	SP-2	May 87	$0.70
45W	Alum. Epoxy/Urethane	SP-6	Oct. 87	$0.82
24W	Alum. Ureth/Urethane	SP-6	Sept. 87	$1.28
	Epoxy Systems (6)			
9W	Epoxy Mastic/Epoxy Mast.	SP-6	June 87	$1.00
17W	Epoxy Mastic/Urethane	SP-6	July 87	$1.25
18W	Epoxy/Urethane	SP-6	July 87	$1.29
32W	Epoxy/Urethane	SP-6	Oct. 87	$1.12
27W	One Coat Epoxy	SP-6	Sept. 87	$0.69
29W	One Coat Epoxy	SP-6	Oct. 87	$0.99
	Inorganic Zinc Systems (8)			
34W	H_20 Inorg. Prime/Silicone	SP-6	Oct. 87	$1.67
30W	H_20 Inorg. Zinc/Acryl	SP-10	Oct. 87	$1.99
42W	Inorg. Zinc/Vinyl	SP-10	Oct. 87	$1.56
46W	Inorg. Zinc/Vinyl	SP-10	Oct. 87	$1.26
14W	Inorg. Zinc/Epoxy/Ur.	SP-6	June 87	$1.85
35W	Inorg. Zinc/Epoxy/Ure.	SP-10	Oct. 87	$1.94
39W	Inorg. Zinc/Urethane	SP-6	Oct. 87	$1.07
12W	Inorg. Zinc/Vinyl	SP-10	June 87	$1.75
	Metallizing Systems (2)			
37W	100% Metallizing Zinc	SP-5	Sept. 87	$4.72
38W	85% ZN - 15% Al Metallize	SP-5	Sept. 87	$4.85
	Miscellaneous Systems (5)			
4E	Calcium Boro-Silicate - 3Cts	SP-2	May 87	$0.90
16W	Calcium Boro-Silicate - 3Cts	SP-6	July 87	$1.42
10W	Latex - 3 Cts	SP-10	June 87	$1.85
26W	Thermoplastic Rubber	SP-10	Sept. 87	$2.45
40W	Vinyl/Acrylic	SP-6	Oct. 87	$1.20
	Organic Zinc Systems (7)			
7W	Org. Zinc/Epoxy/Uret.	SP-10	May 87	$1.75
28W	Org. Zinc/Urethan	SP-6	Oct. 87	$1.33
20W	Org. Zinc/Epoxy/Urethane	SP-6	Aug. 87	$1.50
23W	Org. Zinc/Urethane	SP-6	Sept. 87	$1.48
25W	Org. Zinc/Urethane	SP-10	Sept. 87	$2.09
11W	Org. Zinc/Vinyl	SP-6	June 87	$1.75
15W	Org. Zinc/Vinyl/Vinyl	SP-10	July 87	$1.50
	Urethane Systems (5)			
33W	Urethane 3-Coat	SP-6	Oct. 87	$1.71
44W	Urethane/Epoxy	SP-6	Oct. 87	$1.19
10E	Urethane/Epoxy/Urethane	SP-2	Nov. 86	$1.01
5E	Urethane/Epoxy/Urethane	SP-2	Nov. 86	$1.55
19W	Urethane/Epoxy/Urethane	SP-6	Aug. 87	$1.55

Table 2: Distribution of Condition Ratings for Coating within Each Category

	D610 Rating at 8 Years			D610 Rating at 20 Years		
	> 7	7-4	<4	>7	7-4	<4
Metallizing Systems (2)	2	0	0	2	0	0
Inorganic Zinc Systems (8)	7	0	1	2	5	1
OZ Systems (7)	5	2	0	2	4	1
Miscellaneous Systems (5)	3	2	0	1	3	1
Alkyd Systems (6)	4	2	0	1	3	2
Urethane Systems (5)	2	3	0	1	2	2
Aluminum Systems (8)	1	4	3	0	4	4
Epoxy Systems (6)	0	4	2	0	0	6

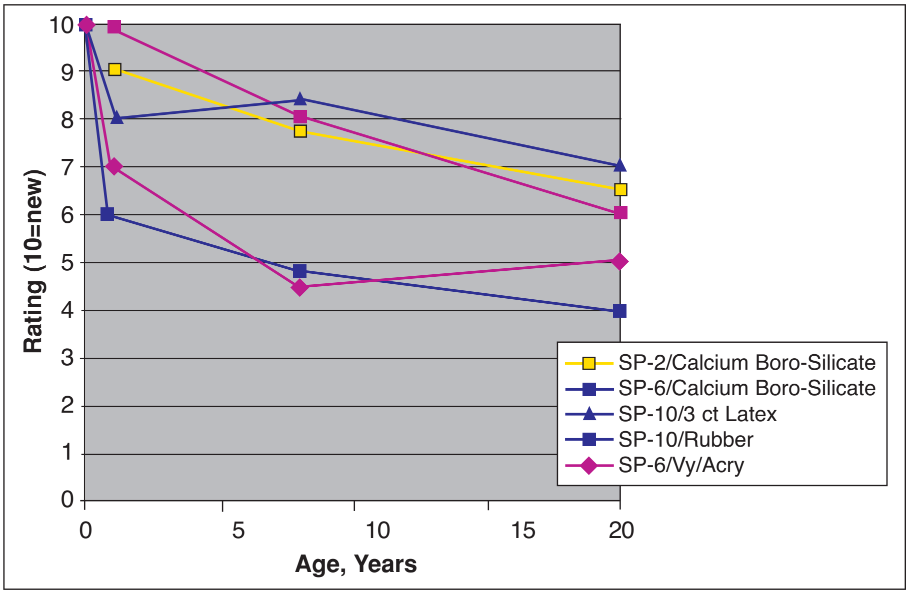

Fig. 6: 20-year performance of miscellaneous (not categorized) systems.

years. At the 20-year inspection, the first signs of rusting were noted on both the zinc and 85 Zn-15 Al metallized spans. For both systems, the rusting was at the crevice between the bearings and the stringer flange, and on isolated lower flange spots (Photo 1) likely to be containment hanger locations. It appeared that the steel was not rusting at any place where the surface preparation and metallizing thickness were attainable.

Inorganic Zinc Systems

The inorganic zinc systems performed quite well as a class. Of the eight inorganic zincs tested, only one system performed unacceptably as defined by the authors. This system was a waterborne inorganic zinc with a silicone topcoat applied over an SP 6 (Commercial Blast) surface. The performance of the inorganic zinc systems is quite interesting because of the variety of systems evaluated. Figure 4 (p. 21) shows the ratings over time for each of the individual systems. The dark blue lines correspond to systems applied over an SP 10 surface and the pink lines correspond to systems applied over an SP 6 surface. Comparable coating systems have similar symbols. It is interesting to note that the waterborne inorganic zinc performed poorly over the SP 6 surface, while the solvent-borne systems performed as well or better over the SP 6 versus the SP 10 surfaces. This performance is in contrast to the standard industry requirement that an inorganic zinc coating should be applied over an SP 10 surface to optimize coating performance.

Organic Zinc Systems

The organic zinc systems performed quite well as a class. Of the seven systems tested, the only system that did not perform well was one of the organic zinc systems with a urethane topcoat over an SP 6 prepared surface. Figure 5 (p. 21) shows the performance versus time of the individual organic zinc systems. Again, the dark blue lines represent systems over an SP 10 surface, while the pink lines represent systems over an SP 6 surface. Except for the organic zinc/urethane system, the data suggest that equivalent performance can be achieved over an SP 6 and SP 10 surface.

Photo 2: WBIOZ system with good condition of web, but poorer condition of bottom flanges

Continued on p. 26

Photo 3: SP 2/Alkyd/epoxy/urethane coated span after 20 years.

Miscellaneous Systems
Figure 6 presents the performance over time of the five miscellaneous systems. All of the systems were candidates for maintenance after 20 years. Worth noting is the performance of the calcium boro-silicate over the SP 2 surface. This system was the second-best performing system over an SP 2 surface. At an applied cost of $0.90 per square foot in 1986, it was the best performing of the low-cost (less than $1 per square foot) systems.

Alkyd Systems
Figure 7 shows the performance of the six alkyd systems over time. As a class, the alkyd systems generally performed well over the first eight years. One of the systems over SP 2 had an unacceptable level of failure on the flange during NJDOT's one-year inspection. However, considering all of the alkyd systems, there seems to be relatively little benefit to an SP 6 surface preparation versus an SP 2 surface preparation. (See photo 3.)

Urethane Systems
As a group, the urethane systems performed adequately during the first eight years. Of particular note, the SP 2 surface preparation performed as well as the SP 6 surface preparation. Another observation is that the two-coat system was one of the poorest performers. Of the five systems tested, the three better performing urethane systems were all three coats with an epoxy intermediate coat. While consistent data on applied thickness was not available for this study, the authors have found through other overcoating research that when surface preparation is minimal, more coating thickness over the "bare" spots equated to better performance.[5]

Aluminum Systems
Figure 9 shows the performance of the eight individual aluminum systems tested. As a class, these systems did not perform well. Of note, the SP 7 surface preparation seemed to perform better than the SP 6 and SP 2. Also notice that the abrasive blasting surface preparations tended to perform better to the eight-year mark, and then performance across all surface preparations tends to even out. This observation emphasizes the

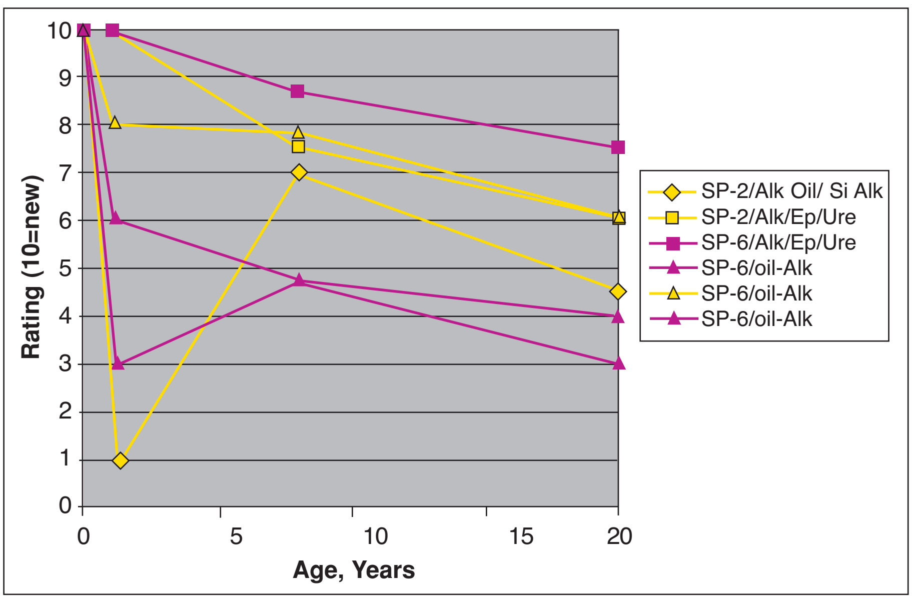

Fig. 7: 20-year performance of alkyd systems.

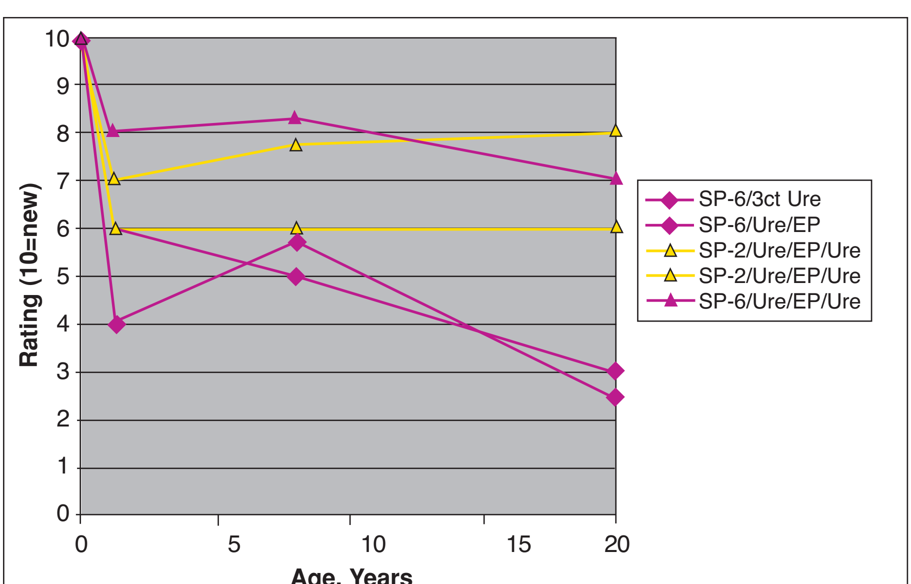

Fig. 8: 20-year performance of urethane systems.

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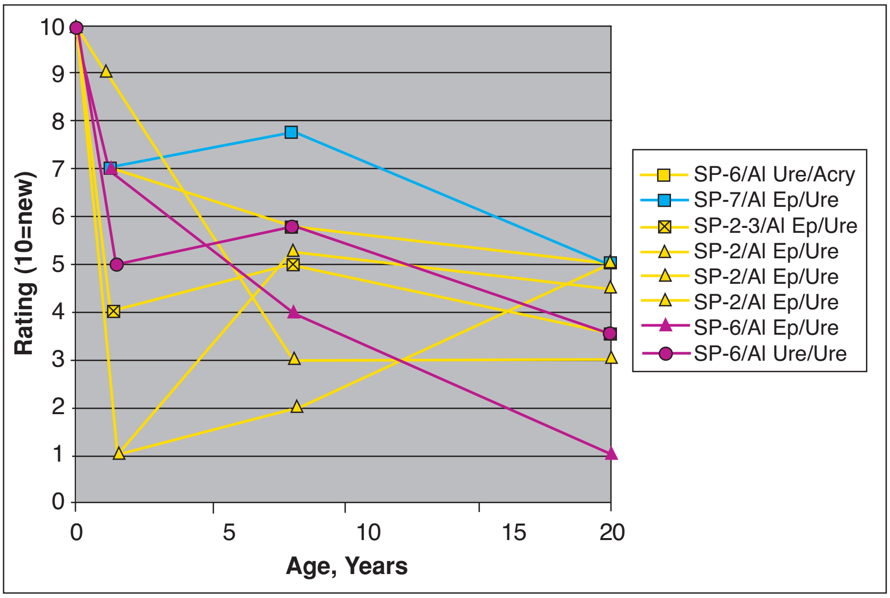

Fig. 9: 20-year performance of aluminum-based systems

rather difficult-to-predict situation in which the replacement coating system may not perform over the long-term as well as a "maintained" original coating system may perform. While this observation is interesting, note also that all of these systems are D610 of 5 or less, very close to the D610 rating of 4, selected as the "coating system replacement" level of performance.

Epoxy Systems (6)

Figure 10 shows the performance over time for the various epoxy systems. These systems were among the worst performers at the 8-and 20-year inspections. Notice that all of these systems were applied to an SP 6 surface preparation—where most of the existing lead-based coating would have been removed and where visible amounts of corrosion should be removed before painting. Also notice that all of these systems are only two coats.

Barrier Coatings

This study included 30 barrier type coatings and 17 coatings with some kind of zinc metal in the primer. Barrier coatings essentially protect the substrate by separating the environment from the surface. Although some of the barrier systems contained inhibitive pigments, we grouped all barrier coatings together for this analysis. The zinc-containing coatings arguably impart some sacrificial protection to a steel substrate and were not considered in this analysis.

Figure 11 shows averaged data for the number of coats in a barrier coating system versus 20-year performance. The trend indicates that applying more coats will tend to improve performance. Although this trend seems obvious, it is important to consider the nature of the troublesome areas on a bridge (i.e., those spots that routinely cause low performance ratings). These areas/spots, when maintenance painted, are typically rusted and have no prior coating, so they become "bare spots" after surface preparation. If we look at this data with coverage of "bare spots" in mind, it is

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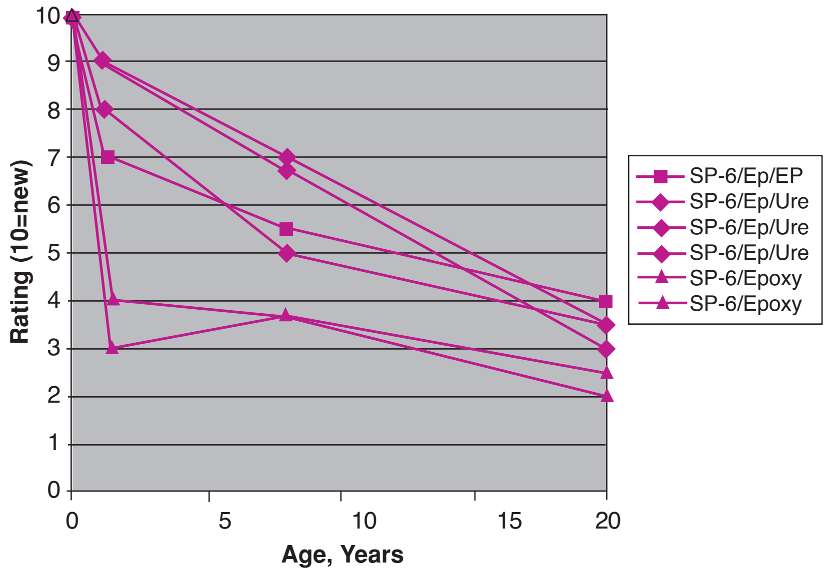

Fig. 10: 20-year performance of epoxy-based systems.

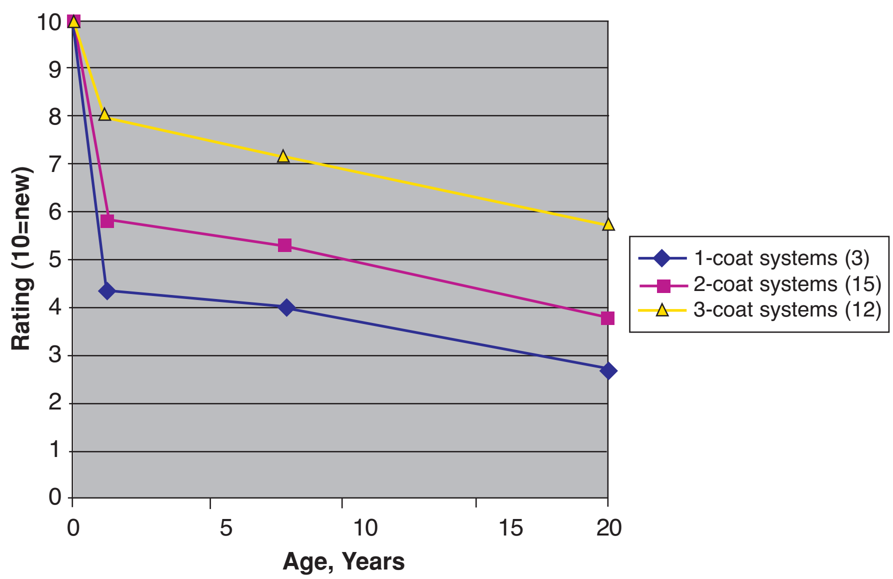

Fig. 11: Performance by number of coats (non-zinc, non-metal systems).

clear that the number of coats applied increased the longevity of the coating system. This data re-affirms the maintenance painting practice of applying spot primers to areas of a prepared bridge with missing coating. It even suggests that more than one spot primer may be appropriate for a longer lasting maintenance overcoating system.

Conclusions

The original project provides an excellent comparative study of various maintenance-painting strategies. While coating technologies have changed over the 20 years since the test coatings were applied, inspections provide excellent data to form the basis for risk-based decisions regarding maintenance of bridge coatings. The following general conclusions can be made.

- In many of the instances, surface preparation had less impact on the coating system life than might be expected. Given that surface preparation is a primary cost driver, the opportunity may exist to reduce cost with acceptable (per-

Continued on p. 32

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haps even negligible) changes in performance.

- By far the best performing systems were the metallizing systems. These systems are only just beginning to show rusting after 20 years. Of course, these systems were considerably more expensive to apply. Currently, the cost disparity between metallizing and liquid coatings is less than it was in 1987, although the metallizing systems still carry a cost premium.
- Of the liquid-applied coating systems, those containing an inorganic zinc or organic zinc primer performed best. The epoxy systems and aluminum-mastic systems performed worst.
- The coating systems that are considered traditional overcoating materials (i.e., non-zinc barrier type coatings) had better performance when multiple coats were applied.
- The range of expected performance, risk, and cost associated with bridge coatings dictates that cost-benefit analysis be performed when selecting a suitable system.

Acknowledgements

The authors would like to acknowledge the excellent work and innovative project conducted by NJDOT. The authors would also like to acknowledge Fred Lovett of NJDOT and Bob Kogler of Rampart, LLC for their help during different phases of this project.

Notes

1. A. Chmiel, V. Mottloa, and J. Kauffman, “Research on Structural Coatings Performance by New Jersey Department of Transportation,” presented at the 6th International Bridge Conference and Exhibition, Pittsburgh, PA, 1989.
2. A. Chmiel, V. Mottloa, and J. Kauffman, Structural Coating Evaluation in New Jersey, Research News, *JPCL*, January 1989, pp. 23–26.
3. C.L. Farschon, R.A. Kogler, and J.P. Ault, *Guidelines for Repair and Maintenance of Bridge Coatings: Overcoating*, August 1997, FHWA-RD-97-092.
4. Ibid.
5. “Field Testing Maintenance Overcoating Systems for Bridges,” C.L. Farschon and R.A. Kogler, *JPCL*, January 1997, Volume 14, Number 1, pp. 56–67.

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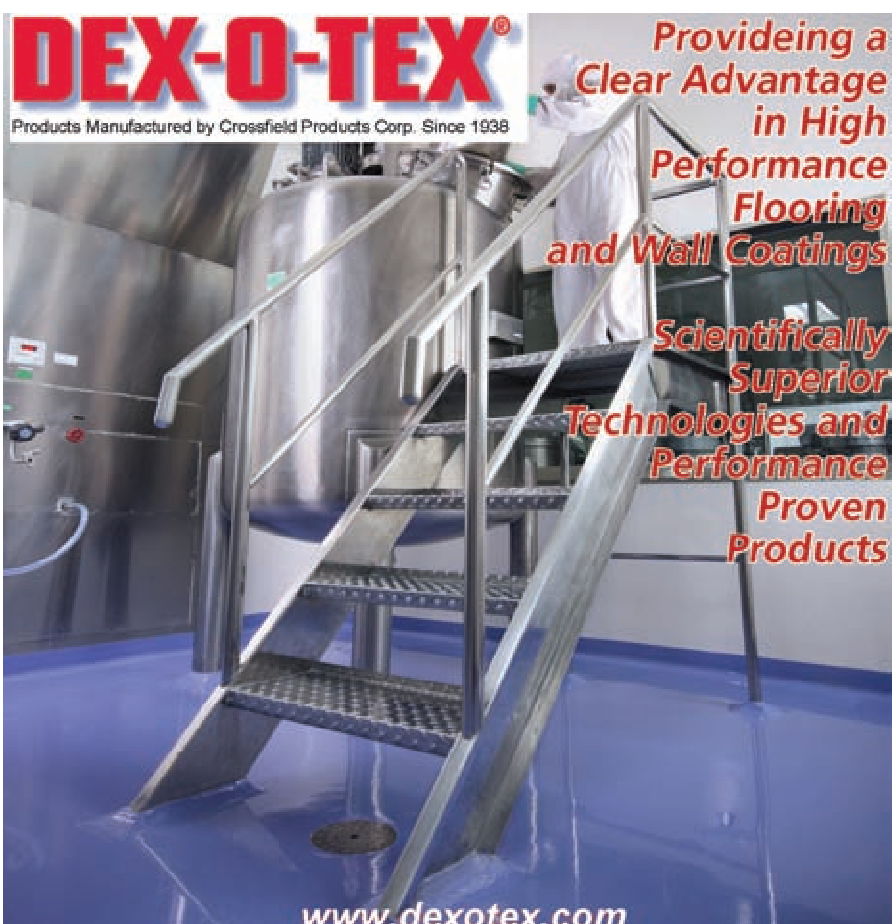

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By Lake Barrett and Heather Ramsey, Sauereisen, Inc.

Many regard the selection of floor coatings as an uncomplicated process. One can simply go to the nearest big box store and ask for a recommendation or just pick up what looks like it will work. Others realize there is more to the coating selection process and therefore develop specifications—some good, some not so good. Weak specs often result when key steps in the selection process are overlooked.

This article discusses the key steps that should be taken while developing the protocol for a concrete flooring project. Within these steps are criteria that need to be addressed by one or all parties involved with the job. Some of these criteria may include substrate degradation, moisture within the substrate, surface preparation, application considerations, and chemical resistance and physical properties of the flooring material. Additionally, standardized references should play a role throughout the entire job process. Finally, case histories of differing applications are presented and discussed. This article gives an overview of the subject, not a comprehensive discussion.

Selecting Flooring for Concrete:

An Overview of What Not to Overlook

Background

Many times the difference between a successful floor-lining project (i.e., one with a good service life) and an unsuccessful one (that fails prematurely) can be reduced to five steps. The following steps are instrumental in the development and completion of the floor-coating project.

- Pre-project inspections of existing facilities
- Specification development
- Development of an appropriate floor coating selection process
- Selection of a qualified and well-trained applicator
- Establishment of and adherence to an appropriate quality control /quality assurance (QC/QA) process, including technical service from the lining system manufacturer

Each step will be discussed briefly.

Pre-project Inspections of Existing Facilities

All parties associated with the project should inspect the facility before the project begins. All of the parties—design engineers, architects, contractors, and a representative of the lining manufacturer—are stakeholders in the project and must exhibit the required commitment to its success. Their inspection of the site is a beneficial first step to understanding the scope and magnitude of what is required for a successful project.

The areas to be lined should be examined for abnormalities such as obvious surface defects and areas of contamination. Failed linings that may still be in place can be looked at closely and potential problem areas can be noted. Particular attention should be paid to evidence of moisture or ground water infiltration. Detailed questions can be asked of the operators regarding these aforementioned items and others. Information pertaining to the exposure conditions for the lining system, such as exposure frequencies, spill procedures, and general cleanup methods, should be obtained. All parties should also develop an overall view of the work to be performed.

Specification Development Is Critical

A poorly written specification, or, equally bad, an inappropriate specification, can doom the project to a premature failure before the first craftsman appears on the site. The specification development process must take into consideration the substrate along with its condition and history. The quality and age of the concrete are vital factors to address. Potential problems such as ground water and substrate settlement or movement (including excessive vibration) must also be examined.

Additionally, choosing an inappropriate reference standard or a test method, such as an ASTM test method, for a given material can preclude a successful installation. The mechanical properties of the material used not only have to be project specific, but must also have appropriate limits set for the expected physical forces. For example, specifying 20,000-psi compressive strength for a 45-mil coating on a floor subjected to significant thermal changes and abrasion, but not subject to a compressive load is inappropriate. The appropriate properties to evaluate for this example are coefficients of thermal expansion of the floor and the lining materials, flexural strength, flexural modulus of elasticity (MOE), tensile strength, bond strength, and abrasion resistance. In fact, a high compressive strength may be indicative of a material that is too rigid to perform as required.

The specification must include not only material requirements, but requirements on the abilities and training of all applicators. It must also delineate the required inspections, inspection points, test methodologies to be used, and pass/fail criteria of those tests.

Floor Coating Selection Process

The selection process may involve more than the specifier alone choosing material. It may not be possible for the specifier to determine the suitability of a given material based upon published chemical resistance data or from anecdotal claims. ASTM test methods and standards for chemical resistance of these materials do not specify pass/fail criteria. One manufacturer may interpret the results very conservatively and cautiously; however, another may be less conservative. The best recommendation may well be difficult to discern.

The specifier needs to not only ask for the above types of information, but also request the case histories of previous projects where similar exposures or application conditions existed. A reputable manufacturer or applicator will provide this information.

Sometimes, however, you will be, as the old saying goes, "The first to eat the oyster." That is, periodically the product that appears to be best suited has no relevant track record or it is so new that is has no track record at all. This situation is where the selection process must require verification of all relevant properties. The lining manufacturer should provide the data, their pass/fail limits, and the test methods used. Finally, the selection process must ensure that the test methods used are those prescribed by ASTM and other authorities for those material types. For example, do not allow plastic test methods for a coating and do not use steel substrate test methods for the evaluation of a concrete substrate.

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Photos courtesy of the authors

Beyond meeting FDA requirements, the need for long-term performance was paramount; $10,000 worth of product is produced per hour so shutdown is extremely costly. The facility dedicated a small team of managers to explore the product offerings of the largest flooring manufacturers in North America. They looked at multiple resins systems, including urethane mortars and epoxy flooring systems. After a critical analysis, a 100% solids hybrid epoxy lining was selected for its physical strength, chemical resistance, and the quality reputation of the manufacturer.

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Organic Systems

Thin- and thick-film organic systems are the most commonly used materials for protecting floors. The available chemistries include bis A epoxies, bis F epoxies, novolak epoxies, polyesters, bis A vinyl esters, novalak vinyl esters and polyurethanes. (Inorganic alkali silicates, calcium aluminates and furans do not make good candidates for thin film linings.) Organic linings are typically applied at thicknesses ranging from a few mils to one inch and are bonded to the concrete either by direct bond or a primer. The systems can be formulated into trowelable toppings, sprayable linings, pour and spreads, or even for brush or roller application. The organic systems above offer ease of use, low permeance, excellent chemical resistance and, depending upon the thickness and the particular formula-

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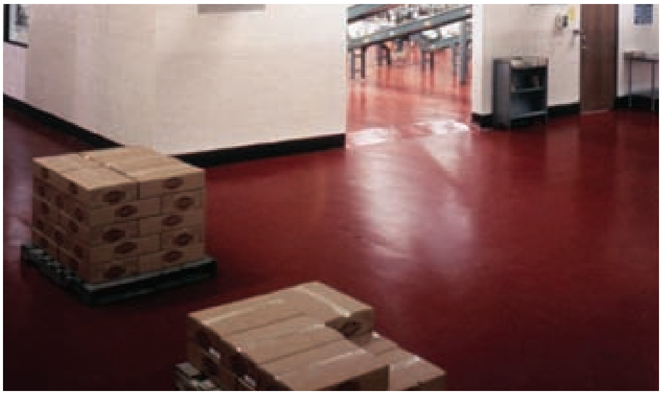

Finished Floor (Red)

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A 100%-solids penetrating primer was applied with a rubber squeegee and back-rolled with a short mohair roller to ensure complete wet-out of the concrete substrate. The areas subjected to heavy forklift abuse in conjunction with the organic acids received a one-quarter-inch-thick overlay of a hybrid novolac epoxy system, which was applied by hand and power troweling. The finely blended aggregate within the floor topping system was intended to provide exceptionally consistent compaction, which would result in superior abrasion and impact resistance. The proprietary mix of rounded and angular constituents provided a surface that exceeds OSHA's slip resistance requirements (coefficient of friction) while preserving the system's ease of cleanliness.

Finished Floor (Grey)

The flooring systems were recently inspected after their 15th year, and although the system has lost its gloss, and areas subject to UV rays have faded a bit, the flooring system is fully functional, and the customer continues to be very pleased.

tion, good to excellent physical abuse protection as well.

Masonry

Masonry brick and masonry flooring systems have been used for centuries. When combined with 21st century technology, the systems provide excellent long-term durability in a number of physical and chemically demanding environments. This flooring type utilizes brick or tile and a setting-bed, grout, and/or mortar material to bond the masonry unit and floor. Both the masonry unit and setting material are chosen specifically for the chemical environment of the job.

Several types of brick are commonly used, such as Type I, II, and III acid-resistant brick and carbon brick. These brick materials must conform to the physical requirements of ASTM C279: *Standard Specification for Chemical Resistant Masonry Units*. The differences among Type I, II and III acid-proof brick are their chemical resistance and degree of absorption, though all three are made from clay, shale, or mixtures of the two. Type II and III brick are used mostly for acids, whereas carbon brick is employed when hydroxides and hot alkalis make up the chemical environment (see ASTM C1160: *Standard Specification for Chemical-Resistant Carbon Brick)*.

The specifications regarding tile, however, cannot be assumed to be the same as brick. The physical and chemical requirements of tile are listed in ASTM C126: *Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units*. Several grades and types of tile may suit the contractor's needs. Tile is usually never thicker than three-quarters of an inch, whereas brick is greater than three-quarters of an inch. Tile is installed over a setting-bed and then grouted into place where the setting-bed and grout do not have to be the same material and usually are not. When brick is being used, however, the setting bed and grout are usually always the same material.

Furthermore, when using brick, a membrane material is first applied

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directly over the floor before the setting bed to ensure better chemical resistance. There commonly is no membrane under the setting-bed when applying tile due to the decreased load bearing ability of tile as compared to brick. There are also several different types of setting-beds, grouts, and mortars one can use that include furan resins, asphaltic membranes, epoxies, vinyl esters, and even inorganic silicate based cements. Again, the chemical environment as well as the intended use and application all play a part in choosing a material.

Polymer Concretes

Polymer concretes can be formulated with inorganic ceramic-based poly-

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Rehabbing an Unloading Area for a Petrochem Plant

Along the Gulf of Mexico, a Fortune 500 petrochemical facility processes extremely aggressive chemicals in an effort to maximize profits and minimize environmental impact. The truck unloading area where the raw materials are received was in very poor condition, as evidenced by a degraded coating and the chemically attacked concrete beneath it. This dilapidation created a dangerous situation because forklifts and other vehicular traffic would pass over the potholes in the slab several times throughout the day.

To provide a remedy, plant and environmental compliance engineers met to devise a procedure for rehabilitating the chemical unloading slab. A list was prepared, with each chemical cataloged including its storage temperature and concentration. The chemical configuration resembled a "witches brew," but, fortunately, the blend of acids, solvents, and caustics were stored at ambient temperatures below 110 F (43 C). In addition to frequent splash and spill of chemicals, the slab is exposed to physical abuse in the form of forklift and 18-wheel truck traffic. Also, the material hoses that many of the chemicals are pumped through are frequently dropped directly on the slab. Due to the variety of chemicals used in the area, a vinyl ester polymer was chosen. Because of the unique nature of this application and the aggressive chemicals, only three manufacturers were considered and the list of qualified contractors was even shorter.

Constructing forms after surface preparation
Photos courtesy of the authors

A project-specific specification was drafted. Input from the manufacturer, contractor, and a third-party inspector were all incorporated. A pre-job site meeting was held 30 days prior to the start of the installation to finalize all project plans. At this point, a tentative project schedule was devised, which included the number of workers required each day, along with contingency plans and a defined safety protocol. A primary goal on this project was to minimize downtime. The installation began with a pressure wash, followed by cleaning with an industrial cleaner/degreaser to ensure no contaminants would be forced into the slab during the abrasive blasting operation. The floor slab was blasted using an aluminum oxide aggregate to aggressively prepare the surface. A cementitious concrete repair material was chosen to fill in several large depressions (>3 inches deep) in the concrete slab. Fortunately, petrographic analysis was conducted and the results, although not perfect, were very promising overall. The petrographic analysis revealed inherit weakness not visible to the eye. Each crack and joint was routed out with an electric chipping gun and filled with a flexible, chemical-resistant joint filler.

Finished flooring project

Once the cracks and joints were properly addressed, refractory anchors were set into the prepared concrete on 12-inch centerlines. The purpose of the anchors is to help secure the chemical-resistant castable polymer overlay to the substrate. The entire slab area was then formed up into 12 ft x 12 ft sections. Each section would receive a 1.5-inch thickness of a wet-applied polymer overlay. Figure 1 illustrates the surface preparation and forming. Between the slabs, a chemical-resistant expansion joint material would be applied.

The vinyl ester polymer was installed next. A resin and hardener were pre-mixed, then transferred into a mortar mixer, where a select blend of aggregates were added and mixed until a uniform consistency was achieved. The mixed material was poured into the forms, then screed and finished with steel trowels. These materials handle very similarly to Portland cement concrete mixes, but do not require a protective coating.

Before pouring the slab, workers used the same polymer material to pour in place a sump, which collects all spills. The sump hardened in two hours and the contractor proceeded to pour the slab. Thus far, after three years, no problems, failures, cracks, or deteriorations have been reported.

Table 1: Relative Comparison of General Properties of Various Flooring Types*

	CHEMICAL RESISTANCE				PHYSICAL PROPERTIES				
	Acids		Caustics	Solvents	Abrasion resistance	Compressive strength	Flexural strength	Longevity	Cost
FLOORING TYPE	**Organic**	**Inorganic**							
Portland-Based Cement	F	F	C	C	B	B	D	C	$
Bisphenol A Epoxy	C-A	C-A	A	C	A - C	A-C	B	B	$$
Bisphenol F Epoxy	B-A	B-A	A	B	A-C	A-C	B	B	$$
Novolac Epoxy	A	A	A	A	A-C	A-C	B	B	$$$
Bisphenol A Vinyl Ester	C-A	C-A	B	B	A-C	A-C	B	B	$$$
Novolac Vinyl Ester	A	B	B	A	A-C	A-C	C	A	$$$$
Polymer Concrete	A	A	A-B	A	A	A	B	A	$$$
Brick	A	A	B	A	A	A	B	A	$$$$

*** Key** **A** – Best **B** – Better **C** – Good **D** – Marginal **F** – Not Recommended $$$$ - Most Expensive $$$ - $$ - $ - Least Expensive
This rating system is relative and not intended to be quantitative.

mers, such as potassium silicate, or from organic resins, such as epoxies, vinyl esters, polyesters, and even furans. These products offer several advantages over masonry linings and coatings. Installation of polymer concretes is similar to Portland cements and, therefore, polymer concretes are faster and easier to install than masonry linings. Polymer concretes offer equal or even superior physical properties and service lives compared to masonry. The chemical resistance of polymers is equivalent to or better than masonry and their permeance is extremely low. Due to their mass and composition, polymer concretes are far more durable then coatings and linings. Using polymer concretes, usually at one-third to one-half of the thickness required for Portland concrete, eliminates the need to line or coat concrete in order to protect it, so

Continued on p. 45

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there is no subsequent need for shutdowns for re-lining floors, waste disposal, or downtime costs. Without being coated, the polymer concrete can have a service life of 20 or more years. Two possible concerns with polymer concretes are the cost per cubic foot and the weight per cubic foot.

Table 1 on p. 42 gives a relative and broad comparison of the properties, performance, and costs of the representative systems from the types discussed above. The purpose of this table is to provide a broad overview of generic types. Multiple factors need to be examined before to making a recommendation.

Summary

Applying a chemically resistant floor coating over concrete can be a complicated project. It requires attention to detail in the following five key steps outlined in this paper.

- Pre-project inspections
- Specification development
- Coating selection process
- Applicator selection process
- Establishment of and adherence to an appropriate QC/QA program

The design engineer has many options open to him or her in regards to a flooring system. He should make that choice in consultation with the coating manufacturer. Some systems will be inappropriate selections for one reason or another. The manufacturer can help sort through the various alternatives and help make a final coating selection.

When choosing a flooring system, there are several crucial elements that must be factored into the decision making process. Cost is simply not the only issue that one can use when deciding what is the most economical and beneficial flooring system for the facility owner. Factors such as the degree of substrate degradation, surface preparation, everyday mechanical stresses imposed on the floor, chemical attack, and contractor competency play an ever-increasing role in proper specification writing.

Choosing a trained and qualified contractor is also critical to the project's success. A poorly trained or unqualified applicator can result in problems all along the process and

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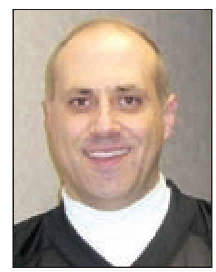
jeopardize the project's chance of success. A poorly written specification can ensure failure. The QC/QA process must be in place and fully operative before the project begins and it must be adhered to and enforced.

With a precise specification calling for proper preparation, testing, and flooring material, all parties involved in the flooring coating job will walk away knowing another long-lasting and quality floor was installed.



Lake H. Barrett, Sales Manager of Sauereisen Inc. (Pittsburgh, PA), is responsible for Sauereisen's domestic and international sales and service. He is a graduate of Penn State University in mechanical engineering and has completed graduate work at Worcester Polytechnic Institute. He has over 20 years of experience with organic and inorganic polymer materials. Mr. Barrett has held positions in field services, technical support, sales and marketing. He is a member of SSPC, ASME, and NACE.

Heather M. Ramsey, chemist for Sauereisen, Inc., has been with the company for a little over two years. She received her M.S. in chemistry from The University of Pittsburgh in 2006. Ms. Ramsey is involved in the research and development of both inorganic and organic corrosion-resistant materials as well as technical cements. She is a member of SSPC, Federation of Societies for Coatings Technology (FSCT), ASTM and the American Chemical Society (ACS).

Recommended Standards

- ASTM D4541, “Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers”
- ASTM C579, “Standard Test Method for Compressive Strength of Chemical-Resistant Mortar, Grouts, Monolithic Surfacings, and Polymer Concretes”
- ASTM C307, “Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings”
- ASTM C580, “Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings and Polymer Concretes”
- ASTM D2240, “Standard Test Method for Rubber Property—Durometer Hardness”
- ASTM D4060, “Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser”
- ASTM D2047, “Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine”
- ASTM D635, “Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position”
- ASTM D 4263, “Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method”
- ASTM D4261, “Standard Practice for Surface Cleaning Concrete Unit Masonry for Coating”
- ASTM C279, “Standard Specification for Chemical-Resistant Masonry Units”
- ASTM C1160, “Standard Specification for Chemical-Resistant Carbon Brick”
- ASTM C126, “Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units”
- SSPC-SP 12/NACE No. 5, “Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating” (*although designed for steel, it is very informative for concrete applications)
- International Concrete Repair Institute (ICRI) No. 03732, “Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays”
- International Concrete Repair Institute (ICRI) No. 03730, “Guideline for Surface Preparation for the Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion”

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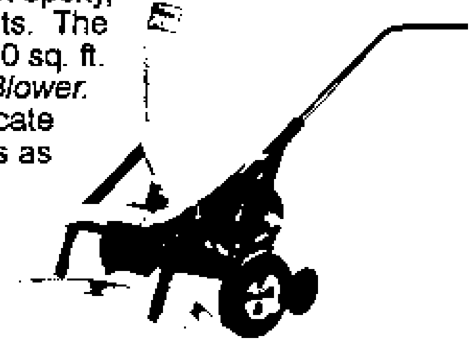

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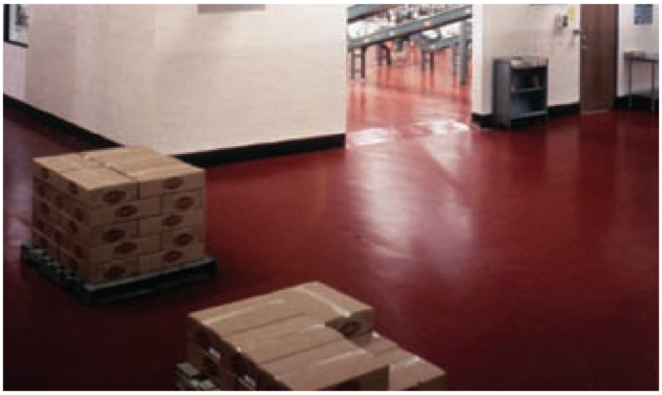

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Rehabbing an Unloading Area for a Petrochem Plant

Along the Gulf of Mexico, a Fortune 500 petrochemical facility processes extremely aggressive chemicals in an effort to maximize profits and minimize environmental impact. The truck unloading area where the raw materials are received was in very poor condition, as evidenced by a degraded coating and the chemically attacked concrete beneath it. This dilapidation created a dangerous situation because forklifts and other vehicular traffic would pass over the potholes in the slab several times throughout the day.

To provide a remedy, plant and environmental compliance engineers met to devise a procedure for rehabilitating the chemical unloading slab. A list was prepared, with each chemical cataloged including its storage temperature and concentration. The chemical configuration resembled a "witches brew," but, fortunately, the blend of acids, solvents, and caustics were stored at ambient temperatures below 110 F (43 C). In addition to frequent splash and spill of chemicals, the slab is exposed to physical abuse in the form of forklift and 18-wheel truck traffic. Also, the material hoses that many of the chemicals are pumped through are frequently dropped directly on the slab. Due to the variety of chemicals used in the area, a vinyl ester polymer was chosen. Because of the unique nature of this application and the aggressive chemicals, only three manufacturers were considered and the list of qualified contractors was even shorter.

Constructing forms after surface preparation
Photos courtesy of the authors

A project-specific specification was drafted. Input from the manufacturer, contractor, and a third-party inspector were all incorporated. A pre-job site meeting was held 30 days prior to the start of the installation to finalize all project plans. At this point, a tentative project schedule was devised, which included the number of workers required each day, along with contingency plans and a defined safety protocol. A primary goal on this project was to minimize downtime. The installation began with a pressure wash, followed by cleaning with an industrial cleaner/degreaser to ensure no contaminants would be forced into the slab during the abrasive blasting operation. The floor slab was blasted using an aluminum oxide aggregate to aggressively prepare the surface. A cementitious concrete repair material was chosen to fill in several large depressions (>3 inches deep) in the concrete slab. Fortunately, petrographic analysis was conducted and the results, although not perfect, were very promising overall. The petrographic analysis revealed inherit weakness not visible to the eye. Each crack and joint was routed out with an electric chipping gun and filled with a flexible, chemical-resistant joint filler.

Finished flooring project

Once the cracks and joints were properly addressed, refractory anchors were set into the prepared concrete on 12-inch centerlines. The purpose of the anchors is to help secure the chemical-resistant castable polymer overlay to the substrate. The entire slab area was then formed up into 12 ft x 12 ft sections. Each section would receive a 1.5-inch thickness of a wet-applied polymer overlay. Figure 1 illustrates the surface preparation and forming. Between the slabs, a chemical-resistant expansion joint material would be applied.

The vinyl ester polymer was installed next. A resin and hardener were pre-mixed, then transferred into a mortar mixer, where a select blend of aggregates were added and mixed until a uniform consistency was achieved. The mixed material was poured into the forms, then screed and finished with steel trowels. These materials handle very similarly to Portland cement concrete mixes, but do not require a protective coating.

Before pouring the slab, workers used the same polymer material to pour in place a sump, which collects all spills. The sump hardened in two hours and the contractor proceeded to pour the slab. Thus far, after three years, no problems, failures, cracks, or deteriorations have been reported.

EVALUATION OF RESISTANCE TO CRACKING OF CONCRETE REPAIR MATERIALS

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Cracking of concrete repair materials is a critical and costly factor affecting the service life of a repaired structure. Cracks in repair materials provide a pathway for moisture to carry deleterious materials into the concrete and accelerate corrosion of imbedded reinforcement. Existing cracks can also fill with water and cause further crack propagation as well as accelerated deterioration due to freezing and thawing conditions. While shrinkage is a significant factor contributing to cracking, the impact of other properties such as tensile strength, creep, and modulus needs to be considered.

One of the greatest challenges facing the successful performance and durability of a repair is its dimensional compatibility. Dimensional compatibility refers to the volume changes of the repair material and the concrete (i.e., the existing concrete is done shrinking and the repair material is still undergoing shrinkage between the existing concrete and repair material). The dimensional compatibility can affect the repair material's bond, ability to carry loads, and ability to resist cracking. Shrinkage, modulus of elasticity, thermal coefficient of expansion, and creep are all material properties that influence dimensional compatibility. Unfortunately, information on how these material properties interrelate, and the values that should be specified as performance criteria is very limited. This article focuses on the key material properties that influence cracking in cementitious repair materials and the test methods that can aid the selection of repair materials with a low likelihood of cracking.

Costs and Modes of Cracking in Repair Materials

The total annual cost for repairing and maintaining concrete structures in the United States is estimated at $18-$21 billion.[1] The millions of dollars each year spent on repairs may become part of a cycle of repairing the repairs. A Con Rep Net study which investigated 215 case histories of repairs made to reinforced concrete structures found that after 5 years, 80% of the repairs were performing satisfactorily; after 10 years, 30% were satisfactory; and after 25 years, only 10% were still performing satisfactorily.[2] In G.P. Tilly's analysis of bridge repairs, Tilly concluded that 20 to 25% of the repairs failed in the first 5 years, 65 to 75% failed between 6 and 10 years, and 95% failed within 25 years.[3] Figure 1 summarizes the performance of repairs documented in the study by Tilly.

The principal modes of repair failure were cracking, continued corrosion of the imbedded reinforcement, and delamination of the repair. Figure 2 shows the types of repair failures found in the Con Rep Net study.

Furthermore, any cracking of the repair material can provide a pathway for carbonation, moisture, and chlorides into the concrete and accelerate further corrosion of the imbedded reinforcing steel. Corrosion of the imbedded reinforcing steel creates an expansive force that can cause further cracking and eventual spalling of the concrete and repair material.

Other moisture related reactions that result in cracking include sulfate attack and alkali aggregate reaction. Exposure to sulfate containing water or soils can cause the formation of ettringite, a mineral with a volume significantly larger than the reactants that formed it. Ettringite that forms within the hardened cementitious material first occupies any voids present and then generates an expansive force sufficient to cause cracking within the cementitious material. Alkali aggregate reaction (AAR) occurs when certain types of aggregate react with sodium and potassium (usually present in the cement) and water to form expansive alkali gels that promote cracking (Fig. 3).

Causes of Cracking

Why do cementitious repair materials crack? The simple answer is that a repair will crack when the induced tensile stresses from volume change exceed the tensile strength of the repair material. The magnitude of the induced tensile stresses depends on the differential changes in temperature and humidity of the environment, absorptivity of the concrete substrate, temperature of the repair and substrate, geometry of the repair, and characteristics of the repair material (e.g., modulus of elasticity, shrinkage, creep, tensile strength gain).

Key Repair Material Properties that Influence Cracking

Tensile Strength

Tensile strength is an indication of the repair material's ability to withstand tensile stresses. A crack results when the tensile or flexural forces exceed the repair material's tensile strength. The rate of tensile strength gain of the repair material is a critical requirement to reducing cracking tendencies. In general, the material's rate of tensile strength development must be rapid enough to exceed the tensile stresses that develop within the repair material (such as from plastic and drying shrinkage) to resist cracking. Increasing the tensile strength of the repair material improves cracking resistance.

- Test Method(s): Historically, ASTM C190 is used for direct determination of the tensile strength of cement and fine aggregate mortars; however, ASTM has withdrawn this method without replacement.[4] Several indirect methods are currently used to characterize tensile strength properties of cementitious materials. ASTM C496 is used to determine the splitting tensile strength of cement-based materials by applying a diametral compressive force along the length of cylindrical specimens.[5] Tensile failure occurs because of the lack of restraint except along the direction of loading.

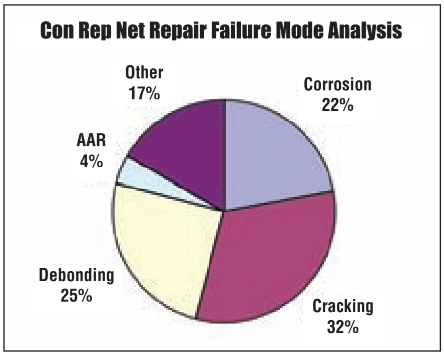


Fig. 2: Repair failure modes from Con Rep Net Study

Bond Strength

Achieving bond between the repair material and existing concrete is a primary requirement for durable repairs. A properly prepared substrate described in ICRI 03732 will almost always provide sufficient bond strength.[6] Instances of bond failure between the repair material and concrete substrate are frequently caused by poor surface preparation, stress buildup due to drying shrinkage, or differential thermal strains. Volume changes in the repair material are restrained by the bond of the repair material to the substrate concrete and can lead to cracking and delamination at

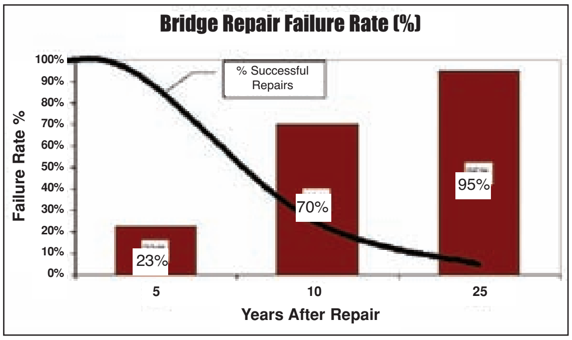


Fig. 1: Performance of concrete repairs made to bridges
Figures courtesy of the authors

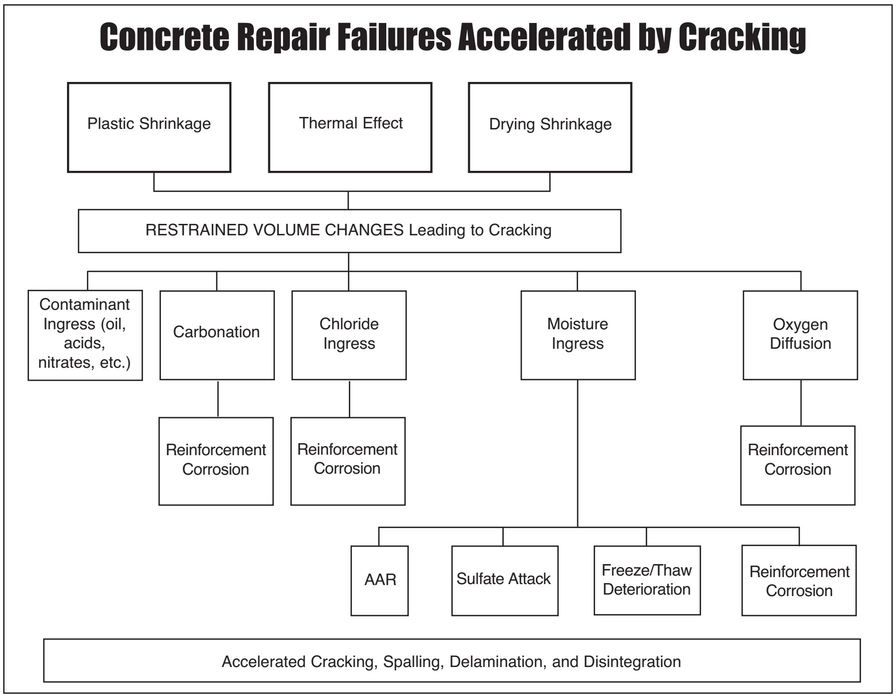


Fig: 3: Concrete repair failures accelerated by cracking

the bond line. Any loss of bond between the repair material and the substrate allows curling of the repair, which then causes flexural cracking. If the repair material has no or poor bond to the concrete substrate, cracking becomes more likely due to the loss of load transfer between the repair and substrate.

- Test Method(s): ASTM C1583 is a relatively new test that can be used to determine the near-surface tensile strength of concrete repair materials.[7] A similar procedure is also described in ICRI 03739.[8] A core is drilled through the repair material into the concrete substrate. A steel disk is adhered to the top surface of the core and a tensile load is applied until failure. Failure occurs at the weakest point, which could be in the adhesive used for the steel disk, within the repair material, at the interface of the repair material to the substrate, or within the concrete. Both methods are often used to determine the adequacy of surface preparation before application of a repair or overlay material. If failure occurs in the upper surface of the concrete substrate, damage caused by surface preparation (bruising) or residual contamination in the concrete should be investigated. ASTM C1583 and ICRI 03739 are also useful for characterizing the internal bond of the composite system of a repair material and substrate concrete because the weakest link in the composite system produces failure.

Modulus

Although there are many types of modulus (Young's, elastic, dynamic, etc.), they all represent a measure of the ductility or brittleness of a material as shown by the deformation or the material with respect to loading. Lower modulus materials resist cracking because they can absorb more loads through deformation.

- Test Method(s): ASTM C469 is the current standardized test method to evaluate the static elastic modulus of concrete, concrete repair mortars, and polymer-modified Portland cement repair mortars.[9] The modulus is determined based on the slope on a stress-strain plot between the applied load at 40% of the ultimate load and when the longitudinal strain is 50 millionths of the gage length, which is preferred to be one-half of the height of the cylindrical specimen.

Creep

Creep is the time-dependent material deformation under sustained load. High creep is usually associated with lower modulus materials. Creep can be compressive, torsional, axial, flexural, or tensile. It is debatable whether correlations exist between the types of creep. High compressive creep is usually not desirable for concrete repair materials because the compressive load is relieved by creep within the repair, which transfers the load into the substrate (In other words, the repair literally doesn't carry its share of the weight.) However, tensile creep can be useful for accommodating shrinkage volume changes that would otherwise produce cracking.

- Test Method(s): ASTM C512 is the only standardized test for creep.[10] The test determines compressive creep, which is a useful property for load transfer in compressive members, but is not a good indicator of the tensile stress-relieving mechanism to reduce cracking potential. There does not appear to be a correlation between compressive creep and tensile creep. Ideally a concrete repair material would have low compressive creep to promote load distribution and high tensile creep to minimize stress-induced cracking.

Plastic Volume Changes

Cement-based materials undergo volume changes from the moment of mixing throughout the life of the placement. The plastic volume change that occurs before the repair material hardens is caused by chemical shrinkage, water evaporation, absorption, segregation, bleeding, and thermal change. Stress concentrations due to this volume change can result in plastic shrinkage cracking. Water can evaporate, be absorbed, or separate from the mixture (bleeding). Rapid evaporation of water from the surface results in partial depth cracks that are roughly perpendicular to the direction of the air flow and/or parallel to the restraint (such as changes in placement depth or imbedded reinforcing steel). Bleeding and segregation carry water and the finest materials in the mixture to the top surface. This high water-to-cement ratio from bleeding and/or high fines content material from segregation usually has higher shrinkage than the underlying layers and is also lower in strength. The hydration of the cement can result in chemical and autogenous shrinkage when the hydration reaction products' volume is less than the minerals before hydration.

Cement also generates heat during the hydration reaction. More rapidly hardening materials tend to generate heat more rapidly. If the repair material is placed in a sufficiently thick section, the heat stresses between the cooler exterior and hot interior can also cause cracking. One function of aggregate is to act as a heat sink; therefore, larger aggregates are used in thicker placements. An ideal repair material would be free from chemical shrinkage and thermal stress (which is a function of the cement and aggregate contents), be free from bleeding, retain water, and remain homogeneous before, during, and after placement.

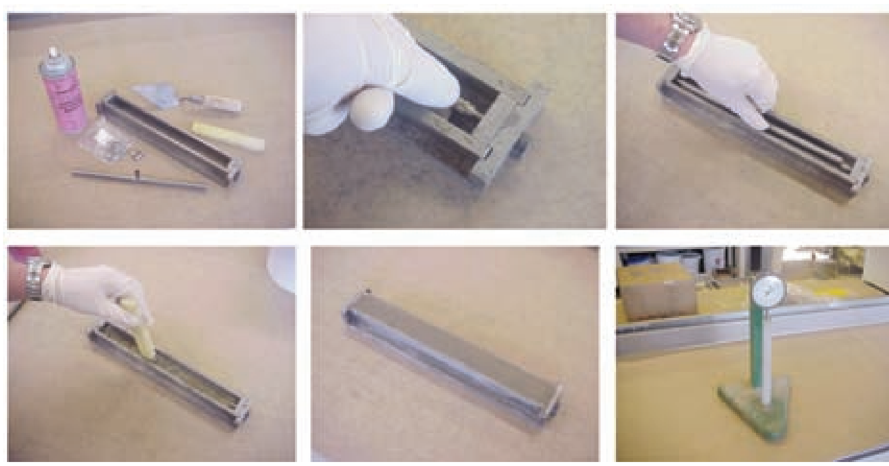
• Test Method(s): Plastic shrinkage can be evaluated using several standardized methods, including ASTM C827 and ASTM C1579.[11,12] ASTM C827 can be used to compare the expansion or shrinkage of plastic, flowable, or fluid mortars or concretes. The comparison is based on the height change of a "not completely unrestrained" cylindrical specimen that is prevented from drying throughout the test. The lack of drying and the amount of restraint, depending on the viscosity and degree of hardening, limit ASTM C827's usefulness for concrete repair materials.

ASTM C1579 is a relatively new test. It compares the surface cracking of fiber-reinforced concrete panels with the surface cracking of control concrete panels subjected to prescribed conditions of restraint and moisture loss. The prescribed conditions are severe enough to produce cracking before final setting of the concrete. This test method can be used to compare the plastic shrinkage cracking behavior of different concrete mixtures containing fiber reinforcement. The test involves exposing a fiber-reinforced specimen, 355 x 560 mm (14 x 22 in.) in surface area and 160 mm (6 in.)-thick, containing restraining "stress risers" to localize cracking to controlled conditions of humidity, temperature, and air flow (based on the evaporation rate). The average crack width is compared to a non-fiber reinforced control specimen. This test is useful for characterizing plastic shrinkage cracking of repair materials, although many repairs are less than 6 in. thick.

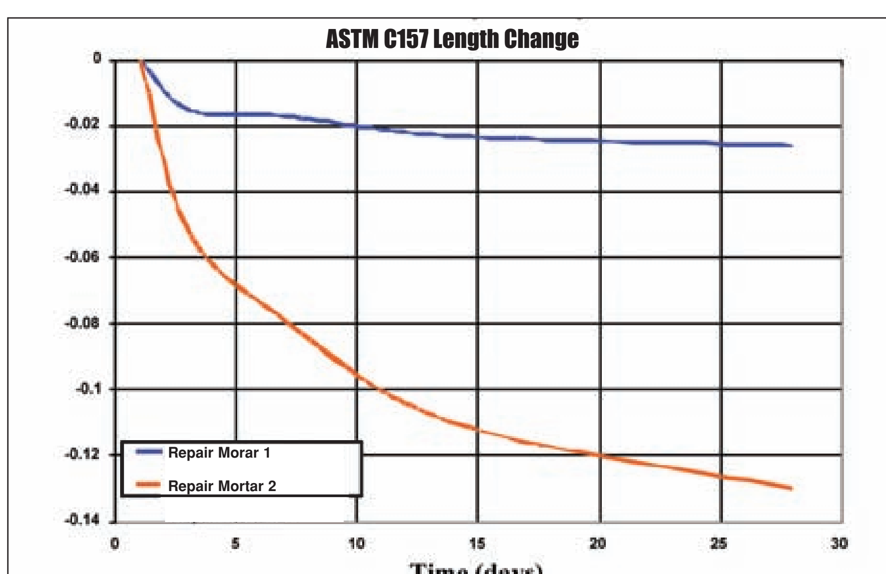
Hardened Volume Changes

Hardened volume changes also occur for many reasons. In concrete repair materials, drying shrinkage is usually blamed for most of the cracks forming after the material placement. Drying shrinkage results from the evaporation of extra water added to cementitious materials to make them easier to mix and place. A stoichiometrically correct amount of water to completely react with cement produces

ASTM C157, C596 Length Change
Drying Shrinkage



Figs. 4 (above) and 5 (below): ASTM C157, "Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete"



a mixed consistency that (even with additives) cannot be used in conventional applications. Drying shrinkage is usually reduced by using a water-to-cementitious ratio that is as low as possible but still produces a workable mixture, reduced cement content that still yields suitable strengths, and shrinkage compensation additives.

Shrinkage compensation uses additives that expand while the cement is shrinking. The amount and rate of expansion should be approximately equal to the rate of shrinkage. These additives can result in excessive expansion if not properly controlled or restrained and also tend to have different reaction rates depending on moisture, temperature, and cement reactivity. Excessive expansion or expansion at a rate greater than the amount of creep and shrinkage also causes cracking and delamination. Although useful to reduce the total amount of drying shrinkage, shrinkage compensation has only limited success in controlling cracking.

- Test Method(s): Drying shrinkage is commonly determined using measurements in length change of unrestrained specimens. The magnitude of the shrinkage and volume changes is commonly stated in linear (in./in. or m/m) rather than volumetric units ($in.^3/in.^3$ or l/m^3) because test data are usually generated by measuring along the longest dimension of a specimen. The units of these length change measurements are dimensionless because they are a ratio of the change in length to the original length. The term "strain" or "micro strain" (i.e., millionths of an inch per inch) is usually used to express this ratio. Percentage length change can be converted to micro strain by dividing the percent by 0.0001. The most common shrinkage test is based on ASTM C157 and uses equipment described in ASTM C490. ASTM C490 allows use of either 25.4 x 25.4 x 280 mm (1x1x10 in.) or 76.2 x 76.2 x 280 mm (3x3x10 in.) or 100 x 100 x 280 mm (4x4x10 in.) prism specimens, depending on aggregate size.[13] Specimens are removed from the mold in which they were cast after initially curing for 24 hours. The specimens are then stored both immersed in water and surrounded by a relative humidity of 50%. They are measured at specified intervals through an age of 64 weeks. Volume (or length) change that occurs during the first 24 hours is not considered in the test (Figs. 4 and 5).

Other similar ASTM methods using length change measurements of prismatic specimens include:

- ASTM C341 (used to determine unrestrained length change of specimens extracted from sawed or cored materials),[14]
- ASTM C596 (used to determine the unrestrained ultimate drying shrinkage of mortars following curing for 72 hours before taking the initial reading),[15] and
- ASTM C 806 (used to determine the restrained expansion of expansive cement mortars in immersed conditions).[16]

A great deal of data has been reported using ASTM C157 and similar methods, but if shrinkage as determined by these tests were the determining factor in cracking resistance, the problems with cracking would be solved.

Thermal Properties

Rapid setting time and high temperatures reached during curing can also cause cracking because of the difference between internal and exterior temperatures of repair materials. However, no standard test method exists for quantifying or comparing the rate of change and magnitude of hydration temperature for concrete repair materials. The application conditions and repair geometry as well as the chemical exothermic reaction of the repair material affect these thermal compatibility properties during the first few hours of hardening of the repair material.

- Test Method(s): ASTM C531 is typically used to determine the coefficient of thermal expansion (CTE) of concrete repair materials.[17] A completely cured prism of 25.4 x 25.4 x 280 mm (1x1x10 in.) is

Continued on page 56

ASTM C1581
Instrumented Restrained Shrinkage Ring

ASTM C 1581, Cracking Potenial, Classification

Net Time-to Cracking T_{cr} Net	Stress Rate at Cracking, S (psi/day)	Stress Rate at Cracking, S (MPa/day)	Potential for Cracking
$0 < t_{cr} \leq 7$	S ≥ 50	S ≥ 0.34	High
$7 \leq t_{cr} \leq 14$	25 ≤ S < 50	0.17 ≤ S < 34	Moderate-High
$14 < t_{cr} \leq 28$	15 ≤ S ≤ 25	0.10 ≤ S < 0.17	Moderate-Low
$t_{cr} > 28$	S < 15	S < 10	Low

Figs. 6 and 7 (above): ASTM C1581, "Standard Test Method for Determining Age at Cracking and Induced Tensile Stress Characteristics of Mortar and Concrete under Restrained Shrinkage" dried to constant length at a specified elevated temperature and then returned to room temperature when an initial length measurement is taken. The specimen is then heated to the elevated temperature and another length measurement taken. The coefficient of thermal expansion (CTE) is then calculated from the difference in length between these two temperatures and divided by the difference in the temperatures. Polymer-based systems (such as epoxy, polyester, and acrylate binders) typically have a CTE sufficiently greater than the substrate concrete, so much so that large temperature changes after placement can result in cracking and/or delamination. For cement-based materials, the aggregate content and type mainly control the thermal expansion of the hardened materials, and for normal aggregates, the CTE is usually quite close to typical values for concrete. Caution should be exercised interpreting the results of ASTM C531 for cementitious materials—the effects of drying and CTE at different relative humidities can cause difficulties in interpretation of the results.

Cracking and Resistance of Repair Mortars

Assessment of the cracking performance of the repair mortar needs to be based on a combination of properties, including plastic shrinkage, drying shrinkage, curing time, tensile creep, modulus, and tensile strength.

ASTM C1581 takes into account combinations of these material properties and can be used to select materials with a low likelihood of cracking.[18] In this method, a concrete repair mortar is cast around an instrumented (fitted with strain gauges and of known axial strain characteristics) steel ring. The steel ring is stiff enough to act as a spring so that any shrinkage of the cast outer repair material causes compression of the restraining ring. Any shrinkage of the repair mortar causes compression on the ring, which is continuously monitored by strain gauges. The stress development rate and the time to cracking are recorded and used to classify the potential for cracking of the repair mortar (Figs. 6 and 7, p. 54).

The tensile strength can also be measured based on the amount of compression on the inner ring when cracking occurs. ASTM C1581 is conducted in a standard laboratory controlled temperature and humidity environment, so thermal effects are not measured. This test is not appropriate for evaluation of expansive materials due to the lack of development of restraint by the steel ring. This test provides an indication of the composite properties of plastic shrinkage, drying shrinkage, curing time, tensile creep, modulus, and tensile strength related to cracking.

Conclusions

Selecting materials for concrete repair is a complex process involving an understanding of the root cause(s) of the deterioration, the expected service and exposure conditions, installation requirements, and the owner's (or user's) and the engineer's (or specifier's) requirements for the repair. Successful repairs require careful diagnosis of the problems and consideration of many factors to arrive at a satisfactory, economical, and durable solution.

For a long time, difficulties with selecting cementitious repair materials occurred as a result of a lack of reliable laboratory tests to accurately predict cracking behavior in repair materials. Progress has been made with the adoption of ASTM C1581, "Standard Test Method for Determining Age at Cracking and Induced Tensile Stress Characteristics of Mortar and Concrete under Restrained Shrinkage." This test method quantifies the restrained shrinkage and cracking behavior of repair mortars accounting for the interactions of the repair material's tensile strength, tensile creep, and drying shrinkage as shown in Fig. 8. The test method and analysis procedure provide a rational basis for assessing the relative performance of repair mortars with respect to resistance to cracking.

ASTM C1581 Agent Cracking vs. Induced Tensile Stress under Restrained Shrinkage

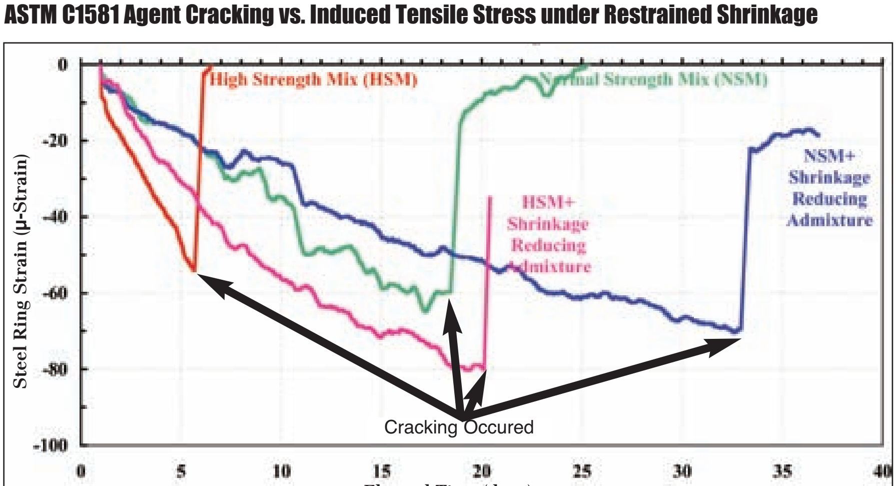


Fig. 8: Data obtained from four materials tested according to ASTM C1581 showing stress development (vertical axis) with respect to time (horizontal axis) as well as when cracking occurred.

References

1. Vision 2020 Report, October 2004, ACI Strategic Development Council, Farmington Hills, MI: ACI.
2. *Con Rep Net Network Newsletter*, Building Research Establishment, Bucknalls Lane, Watford Great Britain, Issue #3 May 2004, http://projects.bre.co.uk/conrepnet/pages/dissem.htm

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3. G. P. Tilly, "Performance of Repairs to Concrete Bridges," *Bridge Engineering*, 157 September 2004 Issue BE3 pp. 171-174, Institute of Civil Engineers.
4. ASTM C190 (latest revision), "Standard Method of Test for Tensile Strength of Hydraulic Cement Mortars," West Conshohocken, PA: ASTM.
5. ASTM C496 (latest revision), "Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens," West Conshohocken, PA: ASTM.
6. ICRI 03732, "Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays," International Concrete Repair Institute, 2004, Farmington Hills,MI.
7. ASTM C1583 (latest revision), "Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)," West Conshohocken, PA: ASTM.
8. ICRI 03739, "Guideline to Using In-Situ Tensile Pull-Off Tests to Evaluate Bond of Concrete Surface Materials," International Concrete Repair Institute, 2004, Farmington Hills, MI.
9. ASTM C469 "Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression," West Conshohocken, PA: ASTM.
10. ASTM C512 (latest revision), "Standard Test Method for Creep of Concrete in Compression," West Conshohocken, PA: ASTM.
11. ASTM C827 (latest revision), "Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures," West Conshohocken, PA: ASTM.
12. ASTM C1579 (latest revision), "Standard Test Method for Evaluating Plastic Shrinkage Cracking of Restrained Fiber Reinforced Concrete," West Conshohocken, PA: ASTM.
13. ASTM C157 (latest revision), "Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete," West Conshohocken, PA: ASTM.
14. ASTM C341 (latest revision), "Standard Practice for Length Change of Cast, Drilled, or Sawed Specimens of Hydraulic-Cement Mortar and Concrete," West Conshohocken, PA: ASTM.
15. ASTM C596 (latest revision), "Standard Test Method for Drying Shrinkage of Mortar Containing Hydraulic Cement," West Conshohocken, PA: ASTM.
16. ASTM C806 (latest revision), "Standard Test Method for Restrained Expansion of Expansive Cement Mortar," West Conshohocken, PA ASTM
17. ASTM C531 (latest revision), "Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes," West Conshohocken, PA: ASTM.
18. ASTM C 1581 (latest revision), "Standard Test Method for Determining Age at Cracking and Induced Tensile Stress Characteristics of Mortar and Concrete under Restrained Shrinkage," West Conshohocken, PA: ASTM.

General References

Alexander M. Vaysburd, "Performance Criteria for Concrete Repair Materials, Phase II Laboratory Results," Structural Preservation Systems, Inc., Baltimore, Md., June 3, 1998

N. P King, "Efficient Concreting Practice: A Review of Current Procedures," Concrete 2000, E & FN Spon.1993.

Daniel Cusson and Noel Mailvaganam, "Durability of Repair Materials," Concrete International ACI International, March 1996, pp. 34-38.

Ernest K. Schrader, "Mistakes, Misconceptions, and Controversial Issues Concerning Concrete and Concrete Repairs: Part 1," Concrete International, ACI International September 1992, pp. 52-56.

Ernest K. Schrader, "Mistakes, Misconceptions, and Controversial Issues Concerning Concrete and Concrete Repairs: Part 2," Concrete International, October 1992, pp. 48-52.

Ernest K. Schrader, "Mistakes, Misconceptions, and Controversial Issues Concerning Concrete and Concrete Repairs: Part 3," Concrete International, ACI International November 1992, pp. 54-59.

Guide for Selecting and Specifying Materials for Repair of Concrete Surfaces, ICRI Technical Guideline No. 03733, International Concrete Repair Institute, Sterling, VA, 1996

ACI 546.3, *Guide for the Selection of Materials for the Repair of Concrete*, 2006, ACI International, Farmington Hills, MI.

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SSPC and PDCA Issue Updates to PACE 2009

Updates to sessions, meetings, and the exhibition are given below for the joint SSPC-PDCA convention, PACE 2009, to be held February 15–18 in New Orleans, LA. All changes listed are those known to *JPCL* as of press time. Check www.pace2009.com for further updates.

PDCA Business Program

Executive Sessions

- "Leveling the Playing Field: Women in the Paint and Coatings Arena," 1:00–3:00 p.m., Feb. 15 (was 3:00–5:00 p.m.)
- "Beyond Your Website—Creating and Online Strategy," 3:00–5:00 p.m., Feb. 15 (was 1:00–3:00 p.m.)
- "2009 Human Resources Primer," 4:00–5:00 p.m., Feb. 18 (new)

Management and Sales

- "Is Your Sales Team Recession Proof?" 4:00–5:00 p.m., Feb. 15 (was Wednesday, Feb. 18, 10:00–11:00 a.m.)

Products and Production

- "Boosting Your Customers' Color Confidence Quotient," 4:00–5:00 p.m., Feb. 15 (was Management and Sales)
- "Trick of the Trade: Paint Tech," 9:00–10:00 a.m., Feb. 17 (was Sunday, Feb. 15, 4:00–5:00 p.m.)
- "Estimating and Defining the Scope of Work for Historic Restoration Projects," cancelled
- "The Healthy Wallcovering Sandwich, Featuring the Next Generation of Wallcovering Adhesives and Primers," Feb. 17, 11:00 a.m.–Noon (was Feb. 18, 10:00–11:00 a.m.)

SSPC Committees and Task Groups

- SSPC Government Affairs Committee, 8:00–10:00 a.m., Feb. 17 (was 9:00 a.m.–Noon)
- Procedure for Determining Surface Profile Committee Meeting, 1:00–3:00 p.m., Feb. 17 (was 10:00 a.m.–Noon)
- C.6, SSPC Education Committee, 8:00 a.m.–10:00 a.m., Feb. 18 (was 10:00 a.m.–Noon)
- SSPC/NACE STG 323, Wet Blasting Cleaning (Report) Committee, 8:00 a.m.–10:00 a.m., Feb. 18 (was 10:00–Noon)
- C.1.9, Polyurea Coatings Committee, 10:00 a.m.–Noon, Feb. 18 (was 8:00–10:00 a.m.)
- C.5.3.A, Containment of Hazardous Surface Preparation, 10:00 a.m.–Noon, Feb. 18 (was 8:00–10:00 a.m.)

Naval Shipyard Meeting Added

The Naval Shipyard Coating Group will meet from 8:00 a.m. to 5:00 p.m., Feb. 19 and 20. Attendance is by invitation only. Discussion topics include submarine preservation processes and documentation at public and private facilities. For details, contact Martha Bowman, martha.bowman@navy.mil, or Anita Adams, anita.adams@navy.mil.

Exhibitors

Daich Coatings and The Cardinal Group have cancelled their exhibits. Newly registered exhibitors are described below.

- Advanced Polymer Coatings, Ltd. manufactures corrosion-resistant industrial coatings, serving the bulk road/rail/marine transportation; petrochemical; pharmaceutical manufacturing; pulp and paper; wastewater treatment; and chemical processing industries. P.O. Box 269, 951 Jaycox Rd., Avon, OH 44011; 800-334-7193; fax: 440-937-5046; www.adv-polymer.com. Booth 330
- Brand Energy and Infrastructure Services provides maintenance, new construction, and turnaround industrial coating, blasting, tank lining, scaffolding, insulation, refractory, fireproofing, and CUI services to industrial facilities throughout North America. 1325 Cobb International Dr., Ste. A-1, Kennesaw, GA 30152; 678-285-1400; fax: 770-514-0285; www.beis.com. Booth 342
- Chevron Phillips Chemical Company LP offers the TZ-904 performance epoxy coating, a high-build coating with excellent adhesion, flexibility, and toughness. 10001 Six Pines Dr., The Woodlands, TX 77380; 832-813-4900; fax: 832-813-1859; www.cpchem.com. Booth 922
- EnTech Industries has been manufacturing high-performance and quality dust collectors for 15 years, offering machines in sizes ranging from 2,000 to 60,000 cfm. 2211 Central Ave. NW, East Grand Forks, MN 56721; 218-773-6602; fax: 218-773-6607; www.entechindustries.biz. Booth 246
- GMA Garnet (USA) Corp. provides surface preparation and water jet cutting abrasives through its worldwide distribution network and warehouses. 480 N. Sam Houston Pkwy. E., Ste. 130, Houston, TX 77060; 832-243-9300; fax: 832-343-9301; www.garnetsales.com. Booth 739
- International Decorative Artisans League (IDAL) is an international association of artisans, businesses, and educators that provides inspiration, public awareness, and member growth through education, philanthropy, and preservation of the decorative arts. 110D-H Brandywine Blvd., Zanesville, OH 43701; 740-452-4541; fax: 740-452-2552; www.decorativeartisans.com. Booth 921

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SSPC Individual Member Update

Below are individuals who joined or renewed their SSPC membership in October and November 2008. For information about joining, contact Terry McNeill, mcneill@sspc.org.

- Francisco Alvarado, Singapore, Singapore
- John Ballun, Elmhurst, IL
- Mel Barron, Calgary, AB, Canada
- Abdullah Bin Bawamarican, Choa Chu Kang Drive, Singapore
- Cynthia Berecz, Alexandria, VA
- Eugene Bleimann, Staten Island, NY
- Bertie Blowers, Glenville, NY
- Kim Borle, St Albert, AB, Canada
- Wayne Brady, Oldcastle, ON, Canada
- Tommy Brooks, Missouri City, TX
- Joseph Brown, Dayton, OH
- Paul Carter, Edmonton, AB, Canada
- Pete Casarez, Tomball, TX
- Charles Clowers, Tullahoma, TN
- Ricardo Colon, Carolina, Puerto Rico
- Sid Dickerson, Austin, TX
- Phillip S. Davis Jr., Newport News, VA
- Jerry Denbow, Buford, GA
- Douglas G. Dixon, Mississauga, ON, Canada
- Phil Do, York , PA
- Greg Dunbar, Airdrie, AB, Canada
- Claude Dupont, QC, Canada
- Pierre Escutary, Hialeah, FL
- Tiberio Esparza, Westmorland, CA
- Juan Espinoza, Smyrna, GA
- Bryan Evans, Grayson, GA
- Mike Fairley, Langley, BC, Canada
- Michael Fischer, Ramsey, NJ
- Craig Fraser, Norton, OH
- Daniel J. Friedman, Poughkeepsie, NY
- Michael Funk Hobart, IN
- George J. Gervais, Benalto, AB, Canada
- Alan R. Goodwin, North Richland Hills, TX
- Prakash Gopalakrishnan, Singapore, Singapore
- Alan Gow, Auckland, New Zealand
- Ravi R. Gupta, King of Prussia, PA
- Mohammad Hajjar Shuaiba, Kuwait, Kuwait
- Jerry Hanfland, Sigel, IL
- Mason E. Harms, Scottsdale, AZ
- Michael Herrig, Kingsport, TN
- Anthony Hightower, Sacramento, CA
- Keith Hill, Red Wing, MN
- John Martin Hobbs, Houston TX
- William Holm, Tucson, AZ
- Randy Horsley, Marysville, OH
- Randall A. Houska, Kent OH
- Lucian N. Hunt, Safat, Kuwait
- Oswald Jacob, Calgary, AB, Canada
- Thomas Jeffords, Florence, SC
- Agus Jubaidi, Selatan, Jakarta, Indonesia
- Dennis H. Justice, Sedro Woolly, WA

- Chauncy Karow, Hugo, MN
- Lyn Kearns, Cumberland, ON, Canada
- John Kerpelis, Campbell, OH
- Charles Kucherka, Seguin, TX
- Jerome Lazar, Cooper City, FL
- Eugene Lee, Huntington Beach, CA
- Kristin Leonard, Houston, TX
- David Lidberg, Howell, NJ
- Barbara Lincoln, Houston, TX
- Jeff Lord, Louisville, KY
- Greg Lovell, Bourg, LA
- Michael Lynch, Grand Rapids, MI
- Paul Machado, Hugo, MN
- Shomendra Mann, Noida, India
- Steven E. Martin, Irving, TX
- Selva Shekeran Mathavan, Pasir, Gudang Johor Bahru, Malaysia
- Dave McCartney, Edmonton, AB, Canada
- Shane McCoy, Mesa, AZ
- Shawn E Menard, Agawam, MA
- Barry Mohon, Beechmont, KY
- James J. Mullen, Pinehurst, NC
- P. Narenthiren, Singapore, Singapore
- Mark Nichol, Burnaby, BC, Canada
- Blaine Okada, Honolulu, HI
- Sherri Olson, Brookshire, TX
- Rafael Ortega, El Paso, TX
- Matthew Paladino, Morrilton, AR
- Nolan J. Parrenin III, Geismar LA
- Tiffany Patrick, Englewood, CO
- Haiqing Peng, Houston, TX
- James Pereira, Palmer, AK
- Maria Pereira, Taboao da Serra, Brazil
- David Prindall, Augusta, ME
- Clint Russell, Muscle Shoals, AL
- Ashari Salikin, Pasir, Gudang Johor, Malaysia
- Geungseob Shin, Seoul, Republic of Korea
- Karen Shufflebarger, Topeka, KS
- Lam Kim Sir, Johor, Bahru Johor, Malaysia
- Rich Stegen, Aiken, SC
- Donald Stephens, Bluffton, SC
- Carl Swalls, West Union, IL
- Travis Tatum, College Station, TX
- Mark Tenbroek, Surrey, BC, Canada
- Lim Ah Terh, Singapore, Singapore
- George Thomas, Inola, OK
- Ken Tittle, Detroit, MI
- Joventino Alves Trindade, Rio De Janeiro, Brazil
- Lafayette Turner II Plattsburg, NY
- Odysseus T Tzikas, Baltimore, MD
- Howell Underwood, Montgomery, TX
- Rennie VanWyk, The Woodlands, TX
- Rick Ward, Pedricktown, NJ
- James Wiggins, Gardena, CA
- George Williams, Monroe, VA
- Patrick Winkler, Coraopolis, PA
- Thomas Young, Everett, WA
- Elcio Zaharko, Newark, NJ
- John Zhang, Zhangjiang Hi-Tech Park, China

Two New Protective Coatings Specialists Named

SSPC has announced that Bruce E. Nelson and Antonio Isais have became certified as SSPC Protective Coatings Specialists.

Bruce E. Nelson, of Hanover, MD, has been in the protective coatings industry for over 22 years and has been trained in the evaluation and selection of coatings, linings, and non-metallic materials. His knowledge and responsibilities include failure analysis in coating and lining systems, on-site audits for coating/lining work, and writing of technical specifications for offshore maintenance coating work.

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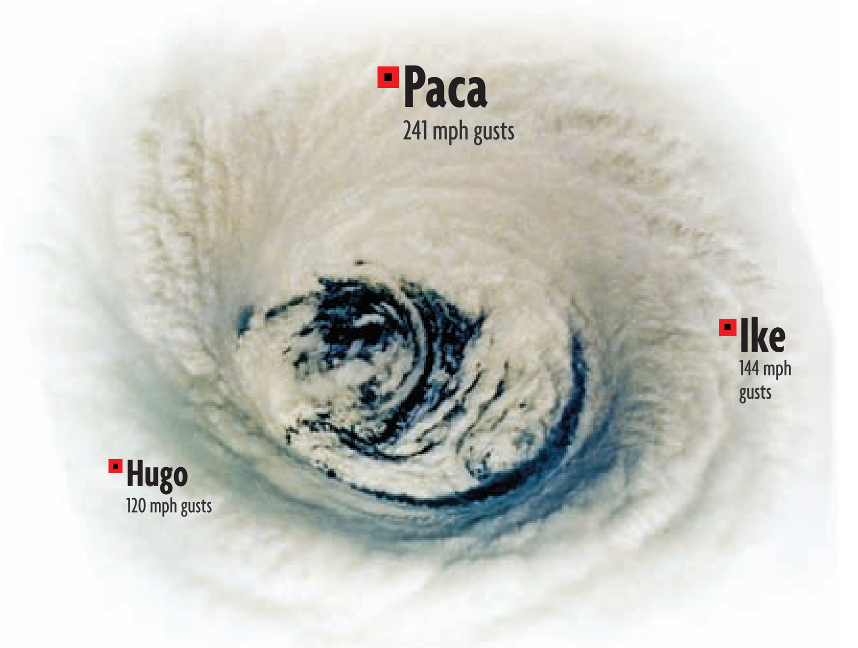

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Antonio Isais, of San Diego, CA, has been in the protective coatings industry for over nine years and has been trained in the evaluation and selection of coatings, linings, and non-metallic materials. His knowledge and responsibilities include failure analysis in coating and lining systems, on site audits for coating/lining work, and writing of technical specifications for offshore maintenance coating work.

SSPC's Protective Coatings Specialist (PCS) Certification recognizes industrial coating professionals for their extensive knowledge in the principles and practices specific to industrial coatings technology.

Each coatings professional is evaluated for a mastery of coatings type, surface preparation, coatings application and inspection, contract planning/management, development of specifications, and the economics of protective coatings work.

To be certified under the PCS Certification Program, each industrial coatings professional is first evaluated for their education and work experience to determine the extent of training to be completed before taking the comprehensive written exam. The training courses are SSPC C-1, Fundamentals of Protective Coatings for Industrial Structures, and SSPC C-2, Specifying and Managing Protective Coating Projects, or courses of a similar content. The final step in certification is taking a comprehensive examination.

SSPC Launches eLearning Program

SSPC has introduced its new eLearning program, an all-new, interactive, web-based system.

The new system, which completely replaces the previous e-course site, features embedded multimedia, interactive quizzes, and real-time exams that enable students to receive instant feedback.

Currently, Fundamentals of Protective Coatings (C-1) and Planning and Specifying Industrial Coatings Projects (C-2) are available. The Quality Control Supervisor (QCS) course will be available in January 2009.

Other features of the new web site include full-motion video of jobsites, equipment, and techniques; flash animations demonstrating key concepts; the ability to email other students taking the course; and a bookmarking tool to save specific sections of the course.

The new system is available at www.sspcelearning.org.

For more information, contact Jennifer Miller at miller@sspc.org or 877-281-7772. ■

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Bristles Blast Away Corrosion: An Alternative for Surface Preparation

By the *JPCL* Staff

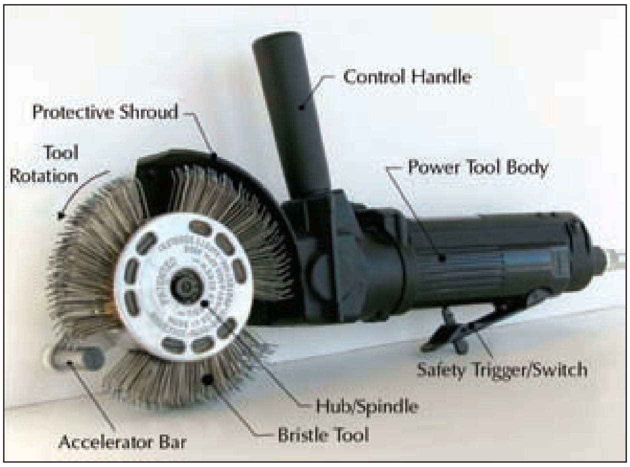
The MBX® Bristle Blaster, a new type of hand-held power tool, was developed to provide an alternative method to more commonly used surface cleaning processes such as grit blasting. The new product comes from Monti Werkzeuge GmbH (Bonn, Germany), a manufacturer of equipment and systems for surface treatment and the parent company of Monti Tools, Inc (Ramsey, NJ).

According to the company, the bristle blaster is a specially designed rotary bristle tool, which is tuned to a power spindle that operates at approximately 2,500 rpm. Utilizing a standard electric power source or compressed air, the hand-held tool is comprised of heat-treated steel wires that are bent forward and protrude through a fiber-reinforced polymeric belt. The parts are precisely tuned so that the bristle tip immediately retracts after impact, resulting in a crater and anchor profile similar to that obtained through grit blasting, the company says.

The tool is used for a cleaning method dubbed bristle blasting by the manufacturer. This method is mainly justified when a project involves "spot repair," but the company says that it may also be applied to large surface areas when other cleaning processes are impractical. The company notes that the bristle blasting process does not generate hazardous waste and is ideal for the removal of corrosion, mill scale, protective coatings, and for post-weld cleaning operations.

Case Study of API 5L Piping

Monti Werkzeuge partnered with Marquette University in Milwaukee, WI, to conduct testing with the bristle blasting tool on severely corroded API 5L piping. Robert J. Stango, Ph.D., P.E., and graduate student Piyush Khullar, both from the mechanical engineering department, reported on the research in "Introduction to the Bristle Blasting Process for Simultaneous Corrosion Removal/Anchor Profile," an article published in the *ACA Journal* in October 2008. The following summarizes some of their findings.



Courtesy of Robert J. Stango, Ph.D., P.E., and Piyush Khullar, of Marquette University

The API 5L piping sample had an internal diameter of six inches with uniform corrosion distributed along the inner and outer surfaces, which the researchers classified as SSPC Condition D, 100% rust with pits. Using scanning electron micrographs at various magnification levels, the researchers show that the surface becomes corrosion-free and has a uniform pattern of micro-indentations after the impact of the bristle tips. The researchers at Marquette also noted that the base material has been removed, which must be monitored on a case-by-case basis.

Stango and Khullar also examined the progressive wear on the bristle tips in relation to the removal of material after three periods. Measuring the amount of material removed by weighing the pipe after 5, 25, and 72 minutes, researchers said the results indicated that removal capabilities of the tool decrease with usage, but the tool can still remove material.

Final Observations

In regards to the visual standards of a surface prepared by bristle blasting, the researchers stated the following.

- Compared to power tools cited in SSPC-VIS 3, "Guide and Reference Photographs for Steel Surfaces Prepared by Hand and Power Tool Cleanings," the bristle blaster produces surfaces that exceed the cleanliness the currently cited tools achieve.
- Compared to surface treatment methods cited in SSPC-VIS 1, "Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning," the bristle blasting process exceeds the cleanliness of surfaces prepared to Brush-Off Blast Cleaning (SP 7), Industrial Blast Cleaning (SP 14), and Commercial Blast Cleaning (SP 6). It is commensurate with Near-White Blast Cleaning (SP 10) and White Metal Blast Cleaning (SP 5).

For more information on the new product and its research, contact Michael Fischer at Monti Tools, Inc. at 201-962-8372, or visit www.monti-tools.com.

Editor's Note: In the June 2008 issue of JPCL, *on pages 60-61, the development of the product was incorrectly attributed to Marquette University. The correct developer is Monti Werkzeuge GmbH and its subsidiary, Monti Tools, Inc.* JPCL *regrets the error.*

Associations

PDA Celebrates 10-Year Anniversary at Annual Conference

Courtesy of Albuquerque Convention & Visitors Bureau

The Polyurea Development Association (PDA) will celebrate its 10th Anniversary at the 2009 Annual Conference, to be held January 20–23 at the Embassy Suites in Albuquerque, NM. With a theme of "Get Your Mix on Route 66," the conference features an exhibition of products and services as well as an educational program. The intended audience for the event includes personnel from raw material suppliers, equipment suppliers, formulators, consultants, and contractors. The exhibition will be open each day of the conference. For more information, or to register, visit www.pda-online.org.

Educational Courses

• Introduction to Polyurea for the Applicator and Contractor, Tuesday, January 20, 8 a.m.–noon

This course, designed specifically with the applicator and contractor in mind, will expand on topics of physical properties of polyurea, testing procedures, surface preparations, application procedures and techniques, and advances in and types of equipment.

• Surface Preparation Concrete, Wednesday, January 21, 8 a.m.–noon

Introduced three years ago through the PDA Conference, this course provides state-of-the-art information and technology on the proper surface preparation of concrete to receive polyurea applications.

Project Showcase Presentations

Three sessions will be held on Thursday, January 22, from 11 a.m.–noon.

• "The Ups and Downs of Coating an Amusement Park Ride," Lou Frank, *CoatingsPro Magazine*, San Diego, CA

• "An Aliphatic Polyurea Case Study: Polyaspartic Coating Over Decorative Concrete at Ave Maria University," Steven Reinstadtler, Bayer MaterialScience LLC, Pittsburgh, PA

• "Polyurea in China," Weibo Huang, Qingdao Technological University, Qingdao, China

Concurrent Track Sessions

Two sessions will be held on Thursday, January 22, from 12:45–1:30 p.m.

• Technical Track 1: "New Aliphatic Curing Technology," William Brown and Peter Schreiber, Albemarle Corporation, Baton Rouge, LA

• Contractor Track 1: "Chemistry for Contractors," Kelin Bower, PolyVers International, Houston, TX

Two sessions will be held on Thursday, January 22, 1:45–2:30 p.m.

• Technical Track 2: "Evaluation of Applied Film Thickness for Polyurea Thick-Film Elastomeric Coating/Lining Systems Over Concrete Substrates," Dudley Primeaux, PCS, CCI, Primeaux Associates LLC, Elgin, TX

• Contractor Track 2: Contractor's Forum (Contractors Only)

General Session Speakers

• "'PRIMERS' The Foundation of a Coatings System," David W. Preston, Advanced Resin Coatings, LLC,

Continued

Millersville, MD, Thursday, January 22, 3–3:45 p.m.

- "Collecting on Accounts Receivable," Barbara Font, Profiles International, Inc., Missoula, MT, Friday, January 23, 9–9:45 a.m.
- "Concrete Surface Preparation, ICRI Guideline 03732 and Lessons Learned," Fred Goodwin, BASF Corporation, Beachwood, OH, Friday, January 23, 10:15–11 a.m.
- "A Comparison of Polyurea, Polyurethane, Hybrid Polyurethane-polyurea, and Epoxy Coatings and Sealants," Jay Johnston, BayerMaterialScience, Pittsburgh, PA, Friday, January 23, 11–11:45 a.m.
- Post Conference Presentation—"Collecting on Accounts Receivable: Q&As," Barbara Font, Profiles International, Inc., Missoula, MT, Friday, January 23, 1–3 p.m.

FSCT & NPCA to Hold Marine Coatings Conference

The Federation of Societies for Coatings Technology (FSCT) and the National Paint and Coatings Association (NPCA) will present the International Marine and Offshore Coatings Conference on May 18–20, 2009. The three-day conference will take place at Wyndham Virginia Beach in Virginia Beach, VA.

The conference provides an opportunity for a wide variety of coatings professionals to hear global experts and thought leaders discuss technology advances in marine coatings. The conference is intended for persons who specify and use marine coatings; coating and raw material manufacturers, including formulators and R&D personnel; U.S. Navy and U.S. Coast Guard personnel; members of classification societies and standards-setting organizations; and EPA representatives.

Tabletop exhibits and sponsorships will also be featured.

The International Marine and Offshore Coatings Conference is part of FSCT's ACSeries (Advancements in Coatings Series), which focuses on the latest technological innovations in the coatings field and allied industries. The series is geared towards a global audience and aims to provide detailed analysis on specific areas of coatings technology.

For more information on exhibitor and sponsorship opportunities, contact Lisa McGlashen, FSCT Exhibits and Sponsorship Coordinator, at 610-940-0777, ext. 4947, or exhibits@coatingstech.org. More information on the conference, including travel and hotel details, will be available soon. Check www.coatingstech.org for updates.

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China's 8th CoatExpo Scheduled

The 8th International (Guangzhou) Coating, Printing Ink, and Adhesive Exhibition, also known as CoatExpo China 2009, is scheduled for May 18–20, 2009, at the Guangzhou International Convention and Exhibition Center. Four groups are hosting the convention: Guangdong Coatings Industrial Association, Shunde Coating Chamber of Commerce, Wise International (H.K.) Co., Ltd., and Wise Exhibition (Guangdong) Co., Ltd.

Planned events include the Peak Forum of Asian Coating Development, the 20th Anniversary Celebration of the Guangdong Coating Industry Association, and a forum themed "International Adhesive Development and Application." Those who wish to exhibit have until April 10 to register. Attendance is recommended for representatives of companies that manufacture coatings, chemicals, raw materials, packaging machinery, and quality control instruments. Representatives of companies that supply occupational safety are also encouraged to attend.

CoatExpo attracted 413 exhibitors and 14,876 buyers from over 20 countries in 2007. Conference hosts expect 500 exhibitors and 20,000 visitors in 2009.

For more information on CoatExpo China 2009 and a registration application, visit www.coatexpo.cn.

Coating West 2009 Program Announced

Coating West 2009, the first of two regional conference and trade shows co-sponsored by the Powder Coating Institute (PCI) and the Chemical Coaters Association International (CCAI), will be held on March 2–3 at Planet Hollywood in Las Vegas, NV. The program will focus on architectural, agriculture and construction equipment, aerospace and military, custom coaters, and general finishing markets. Additional sponsorship support comes from The Electrocoat Association, Porcelain Enamel Institute, and the IRED Division of the Industrial Heating Equipment Association.

Special events will include a virtual spray painting competition, an evening concert with the Rat Pack Tribute, and plant tours of AR Iron's new powder coating installation and the Nellis Air Force Base's corrosion facility. The entire schedule for Coating West 2009, abstracts, current exhibitors, and registration information can be found at www.thecoatingshow.com.

PCI and CCAI will co-sponsor a second regional conference and trade show, Coating East, in September 2009.

Continued

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ICRI Names Project Award Winners for 2008

The International Concrete Repair Institute (ICRI) announced the winners of the 2008 Project Awards at the ICRI 2008 Fall Convention in St. Louis, MO.

The Project of the Year award was presented to C-Probe Systems, Ltd. for its restoration of the Arkwright House, a historic landmark in Manchester, UK. The 81-year-old building was suffering from corrosion of its steel frame. C-Probe removed the building's stone and brick cladding to treat the embedded steel frame underneath.

ICRI also handed out 11 Awards of Excellence. Winners for industrial, transportation, and special projects awards included the following.

• A submission by Structural Preservation Systems in the industrial category for "Concrete Dock Repair: Removal and Replacement of Concrete Slab" in Port Arthur, TX, and in the special projects category for concrete repair and cathodic protection of the Calvert Cliffs Nuclear Power Plant in Lusby, MD

• Electro Tech CP in the transportation category for "Chesapeake Bay Bridge Tunnel Pile Repair and Protection" in Cape Charles, VA and

• Sika Corporation, also in the transportation category, for "Sunshine Skyway Bridge Trestle Span Repairs" in Tampa Bay, FL.

Above and inset: Chesapeake Bay Bridge, Electro Tech CP
Courtesy of ICRI

M4 Elevated Freeway, Mott MacDonald
Courtesy of ICRI

Concrete dock, Structural Preservation Systems
Courtesy of ICRI

Above and inset: Sunshine Skyway Bridge, Sika Corporation
Courtesy of ICRI

Sixteen Awards of Merit were presented, including submissions from

• Chiang, Patel, & Yerby, Inc. in the special projects category for "Epoxy Overlay at Terminal C Elevated Sidewalk and Roadway at Dallas-Fort Worth International Airport" in Tarrant County, TX;

• Structural Preservation Systems, Inc. in the strengthening category for "Strengthening of Overloaded Pre-stressed Concrete Beams" in Suitland, MD;

• Sika Colombia, also in the strengthening category, for "Strengthening of Two Bridges in Bogota City" in Bogota City, Colombia; and

• Mott MacDonald in the transportation category for "M4 Elevated Freeway Repair" in London, England.

The Arkwright House, C-Probe Systems, Ltd.
Courtesy of ICRI

Detailed descriptions of all winning projects were published in the November/December 2008 issue of *Concrete Repair Bulletin* and can be found on www.icri.org.

ASSE Announces Newly Approved Standard

The American Society of Safety Engineers (ASSE) announced that the American National Standards Institute

(ANSI) approved the reaffirmation of the American National Standard ANSI/ASSE Z244.1-2003 (R2008) "Control of Hazardous Energy-Lockout/Tagout and Alternative Methods." This standard aims to protect workers from hazardous energy.

The standard establishes requirements for methods to protect workers where injury can occur due to unexpected releases of energy, which includes any unintended motion or start-up or release of stored energy. Lockout/tagout is the main method of hazardous energy control, but the standard indicates that when lockout/tagout prohibits the completion of tasks, alternative methods of control that provide effective personal protection and are based on risk assessment shall be used.

ASTM Releases New Publications

ASTM International has announced the release of a new publication, "ASTM Standards for Welding." It includes 59 active ASTM International standards referenced by the American Welding Society: Structural Welding Code D1.1, which covers any type of welded structure made from carbon and low-alloy steels.

The "ASTM Standards for Welding" is considered a companion for AWS Code D1.1 and helps interpret the specification and test methods used in the AWS industrial code.

ASTM is also offering "ASTM Standards for Maintenance, Repair, and Operations in the Chemical Process Industry: 3rd Edition" online only. It features 210 ASTM standards compiled from three volumes of the "Annual Book of ASTM Standards."

Topics covered include steel, stainless steel, metallic-coated iron and steel, iron castings, non-ferrous metals and alloys, copper, light metals, and more.

For more information on either publication, visit www.astm.org.

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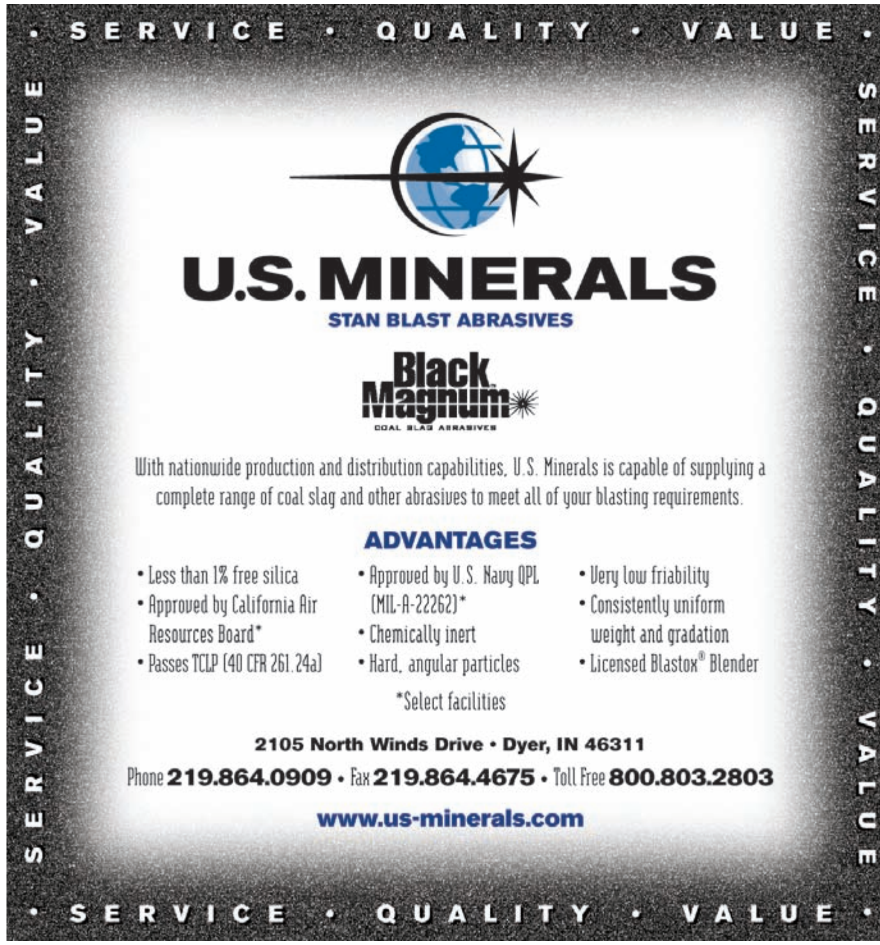

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Companies

World of Concrete Sets Up in Vegas

The World of Concrete returns on February 2–6 to the Las Vegas Convention Center in Las Vegas, NV, for the event's 35th anniversary. More than 1,700 exhibitors will be on hand to display their products and services, while an education program of more than 150 seminars will be held in conjunction with the event. Hanley Wood is once again producing the show, which is cosponsored by more than 20 organizations, including the International Concrete Repair Institute, The American Concrete Institute, and the Portland Cement Association. The intended audience for the event includes architects and engineers; general, repair, and specialty concrete contractors; dealers and distributors; designers and specifiers; and producers of precast or prestressed concrete.

This preview of the World of Concrete consists of a list of exhibitors that deal with the surface preparation and coating of concrete, as well as descriptions of several seminars relevant to coatings professionals.

For more information, or to register, visit www.worldofconcrete.com.

Courtesy of the Las Vegas News Bureau/LVCVA

Seminars

The following seminars are among those that address topics relevant to preparing, coating, preserving, and repairing concrete.

• FR56, Coating Masonry—Choosing the Best Coating for the Job

This presentation is designed to help field personnel better understand the application and performance aspects of masonry coatings. Topics include primers and sealers as well as elastomeric wall coatings applied to vertical wall substrates. Test methods used in the industry to qualify performance of the coatings will also be discussed.

• MO18, Concrete Repair Part I: Evaluation and Repair Strategies

This seminar offers a review of evaluation techniques, tools for testing concrete, and ways to properly estimate repair quantities. Repair options and their durability are analyzed.

• MO44, Construction Details, Means and Methods to Avoid Floor Moisture Problems

This session will discuss the following: how to minimize problems caused by moisture; construction details designed to maximize resistance to moisture infiltration; using the best concrete mix designs; how finishing techniques impact drying schedules; the newest high-performance vapor retarders; and curing and drying conditions to shorten waiting time.

• MO19, Repair and Maintenance of Industrial Floors

Attendees will learn how to reduce the need for more costly or frequent repairs by making the right design and construction decisions. Proactive measures to minimize long-term wear are covered, as are step-by-step repair procedures and

Continued

material recommendations for repair of random cracks, joints, surface delamination, slab removal, and replacement.

• MO52, Preventing and Handling Efflorescence

Attendees will learn about the different types of efflorescence, lime runs, and white silicate deposits. Discussions will include the sources of efflorescence, its causes, different types, practices that will reduce or eliminate efflorescence, and cleaning procedures for removing it.

• MO20, Concrete Repair Part II: Surface Preparation, Reinforcement Repair, Material Basics & Placement Techniques

This session will focus on how to repair deteriorated concrete surfaces and corroding reinforcing steel. Topics discussed will include chipping hammers, hydro demolition, abrasive blasting, trowels, dry packing, and vibration. Also covered are the basics of repair material compatibility, including drying, shrinkage, permeability, deformability, and tensile strength.

• MO148, Shotcrete: A Versatile Construction Solution

As an introduction to wet and dry process shotcreting, the speakers, using case histories, will describe the use of these processes to more quickly and economically construct a variety of concrete structures. Infrastructures, seismic retrofits, walls, tanks, domes, architectural elements, swimming pools, and underground construction projects will be discussed.

• WE23, Concrete Repair Part IV: Protection and Waterproofing Systems

This session will cover different protection and waterproofing systems available for concrete structures. Proper surface preparation and safety issues during the installation will be reviewed. Additional topics include strategies for controlling corrosion on new and existing concrete, sealers, coatings, overlays, and cathodic protection systems.

• TH26, Repairing Concrete Cracks

In this seminar, attendees will learn how to choose the best repair procedure for different types of cracks and see how to make each repair. Various repair methods will be covered, including routing and sealing, stitching, grouting, drypacking, gravity filling, epoxy injection, crack arresting, penetrating sealers, overlays, and surface treatments.

Exhibitors

As of press time, exhibitors of special interest to the protective coatings industry include the following.

Coatings Companies

- Abatron, Inc. S11608
- Advanced Coatings Inc. S14726
- Aquafin Building Products System S12705
- BASF Construction Chemicals S10139
- Bayer Material Science S14121
- Benjamin Moore Paints S10417
- C.I.M. Industries Inc S11709
- ChemMasters Inc S11908
- Concrete Coatings Inc. O40727
- Concrete Sealants, Inc. S11305
- Cortec Corporation S20531
- Crown Polymers ...S14327, SG22625
- Denso S21518
- Dur-A-Flex Inc. S10807
- Euclid Chemical Co. S10107
- Exousia Advanced Materials S21910
- Five Star Products Inc S10949
- Flowcrete North America S11751
- Fox Industries Inc S12655
- Integument Technologies S22028
- International Coatings S22210
- Key Resin Company S21329
- Krylon Products Group S21231
- Neogard S11308
- Pacific Polymers International, Inc. S11545
- Polycoat Products S12654
- Polyguard Products, Inc. S11551
- Polymax / Milamar Coatings LLC S21326
- PPG Commercial Coatings N2067
- PROSOCO Inc S12939
- Quikrete Companies-The S10427
- Rhino Linings S14415
- Sherwin-Williams ..S11439, O40737
- Sika Corporation S10115
- Soprema, Inc. S13508
- SureCrete S10349
- Surtec System S12904
- Tennant Co. S11019
- Tnemec Company, Inc. S11309
- Tremco Commercial Sealants & Waterproofing S10839
- United Coatings S10748
- VersaFlex O30751
- Vexcon Chemicals S11127
- W.R. Meadows, Inc. S10406, O30638
- Xypex Chemical Corp S11519

Application and Surface Preparation Equipment Companies

- Aqua Blast Corp S13415
- ARAMSCO S11119
- Aurand Manufacturing & Equipment Co S14826
- Blastrac S10123, O30548
- BW Manufacturing Inc. S10843
- CDC Larue O30622
- Clemco Industries Corp. S14521
- Cucamonga Tool & Equip Co Inc S20737
- DeFelsko Corporation S21332
- EDCO & CONTRx Systems S10827, O30631, O30637
- Goff S10549
- Graco Inc S13339
- Innovatech S10907
- Midwest Rake Co LLC S11355
- Mi-T-M Corp S14309
- Nelson Industrial Services ...S11153
- Nilfisk-Advance (Advance-American-Lincoln) S12151
- NLB Corp S11805, O31535
- Novatek Corporation S13827
- SASE Company Inc. S10517
- SPE–USA S11639
- Therma-Stor LLC N1077
- VIC International Corp S10251, O31617

Altana Reports Economy's Impact

Altana AG (Wesel, Germany) has stated that in recent weeks the volume of orders and sales in most of the company's divisions has declined more than expected. The company says it no longer expects to achieve sales and earnings targets for 2008 and will not give any further outlook for the business year due to uncertain economic conditions.

According to CEO Dr. Matthias L. Wolfgruber, the company is preparing itself for difficult times but believes that the company will have profitable growth in the future.

Altana makes products for coatings and other applications.

DuPont Cutting 2,500 Jobs

DuPont (Wilmington, DE) has announced it will be eliminating approximately 2,500 jobs, primarily in the Western Europe and the United States markets that support motor vehicles and construction. It also plans to reduce contractors by 4,000 by the end of 2008, with more reductions in 2009. More than 400 employees will be redeployed to productivity projects aimed at accelerating reductions of working capital and operating costs.

The company is attempting to increase its free cash flow from the estimated $1.3 billion for 2008 to $2.5 billion in 2009.

DuPont was founded in 1802 and operates in more than 70 countries, serving markets such as home and construction, coatings, safety and protection, and agriculture.

Dow Drops Thousands of Jobs

The Dow Chemical Company, headquartered in Midland, MI, announced that it plans to cut 5,000 full-time positions and close 20 facilities in high-cost locations. The job reductions represent approximately 11% of Dow's global workforce.

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Matcor Appoints Manufacturing Director

Matcor, Inc., located in Doylestown, PA, appointed Calvin Krusen as director of manufacturing. He is responsible for overseeing all aspects of manufacturing, quality control, and customized system manufacturing. Krusen has been working at Matcor since 2007 and holds a BS in electrical engineering from Drexel University.

Matcor was established in 1975 and provides comprehensive corrosion control and corrosion protection materials, including cathodic protection systems.

The company also plans to temporarily idle 180 plants and reduce its contractor workforce by 6,000. Other actions include moving to a lean corporate center, a shared business services group, and three business operating models by January 2009.

The company estimates that these actions will result in a savings of $700 million in operating costs by 2010. Specific details on business structures will be outlined in early 2009.

Dow's products include materials for high-performance coatings.

Valspar Reports Increase in Sales

The Valspar Corporation, headquartered in Minneapolis, MN, reported that its results for the fourth quarter and fiscal year, ending October 31, 2008, increased from 2007.

Fourth-quarter sales totaled $923.2 million, which was an 8.3% increase from fourth quarter 2007. However, the fourth quarter in 2008 consisted of 14 weeks, while 2007 had 13 weeks. Excluding the 14th week, sales were still up by 3.8%. Net income for the fourth quarter was $38.9 million.

The fiscal year sales totaled $3,482.4 million, an increase of 7.2%. Net income for the year was $150.8 million.

The chairman and CEO of Valspar, William L. Mansfield, stated that the company was pleased with its performance in "difficult market conditions," and he anticipates that in 2009, the company will "meet the challenges of the weak global economy."

Valspar provides products to several industries, including high-performance industrial floor coatings.

Rhodia Revises 2008 Outlook

Rhodia, based in Paris, France, announced that it has changed its 2008 outlook due to a worsened economic environment. According to the company, there is a decline in demand, which is also preventing the company from taking advantage of declining raw material and energy costs. The company says that it is particularly affected in its Polyamide, Silcea, and Novecare sectors, causing temporary closure or slowdown of some production facilities.

After revising the 2008 objectives, Rhodia expects its recurring EBITDA to be about 10% below the 2007 level. According to CEO Jean-Pierre Clamadieu, the company is focused on stringent cash management.

Rhodia is an international chemical company that employs approximately 15,000 people worldwide. Its products are used in coatings and other materials.

RPM Expects Low Results for 2008

Frank C. Sullivan, chairman and CEO of RPM International Inc., stated at the 19th Annual Citi Chemicals Conference in New York that results for the 2008 fiscal year are expected to be lower than the prior year. He discontinued the company's current guidance for the fiscal year ending May 31, 2009.

Sullivan stated that volatility in core markets makes it "nearly impossible to provide any definitive guidance for our fiscal 2009 results." However, he also said that the company's debt/capitalization ratio is at a lower level and there is still a strong cash generation, making the company confident that it can take advantage of growth opportunities, including acquisitions.

RPM International Inc. is a holding company headquartered in Medina, OH. It owns subsidiaries in specialty coatings and sealants for both industrial and commercial markets, including products for corrosion control coatings, flooring coatings, specialty chemicals, sealants, and roofing systems.

Eliokem Nominates New CEO

Eliokem International (Villejust, France) has named Philippe Carabin as the new CEO. He replaces Jacques Collonge, who plans to retire in the beginning of 2009.

Carabin joined Goodyear's Le Havre plant in 1971 and was later named administration and accounting manager of Goodyear Specialty Chemicals. In 2001, he was appointed chief financial officer of Eliokem, and since 2005 has also been responsible for IT, general administration, supply chain, and the purchase of non-strategic raw materials.

Eliokem was formed in 2001, after the divestiture of the specialty chemicals business of The Goodyear Tire & Rubber Company. The company manufactures products such as resins and elastomeric modifiers.

Nordson Opens Customer Lab in China

Nordson Corporation, headquartered in Westlake, OH, has opened a new customer lab near Shanghai, China, as part of the nearly half-a-million dollars invested in global upgrades to the firm's Industrial Coating customer demonstration labs. The facility in China is 86,000 square feet and operates as a Center of Excellence to demonstrate the company's capabilities in several industries.

The company produces precision dispensing equipment for applying coatings, sealants, and adhesives to customer and industrial products during manufacturing. The company employs approximately 4,100 people worldwide and has offices in 34 countries.

Products

Portable Vacuum Senses Full Tank

CDCLarue Industries, located in Tulsa, OK, has released the Pulse-Bac® PB-2150 vacuum. Weighing approximately 200 lb, the portable vacuum detects and notifies the user when the collection tank is full. The vacuum allows the user to empty dust and debris into a bag while the vacuum keeps operating. If the user fails to empty the tank, the vacuum shuts off automatically to help prevent damage. According to the company, the new product will collect particles as small as 0.1 micron and is ideal for use with surface preparation equipment.

For more information, visit www.cdclarue.com.

New Right Angle Vacuum Disc Sander

Dynabrade, Inc. (Clarence, NY) has introduced its new 5-inch diameter, right angle vacuum disc sander. The tool removes coatings while capturing the contaminants in the vacuum source with the assistance of brushes.

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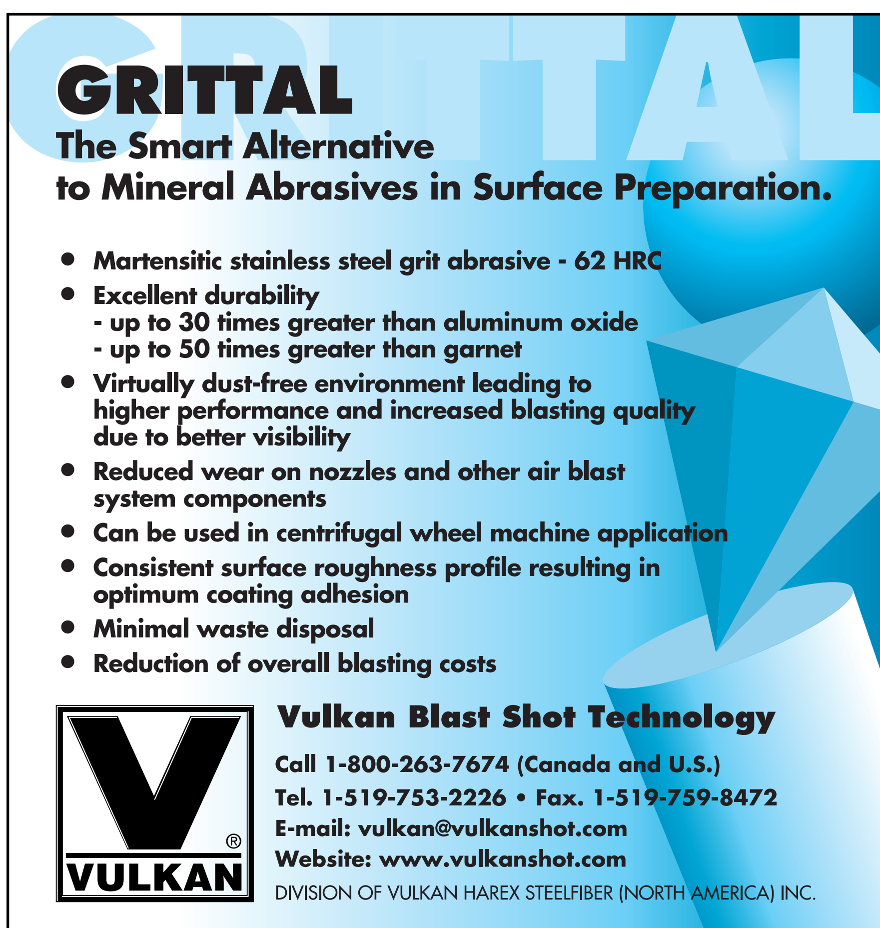

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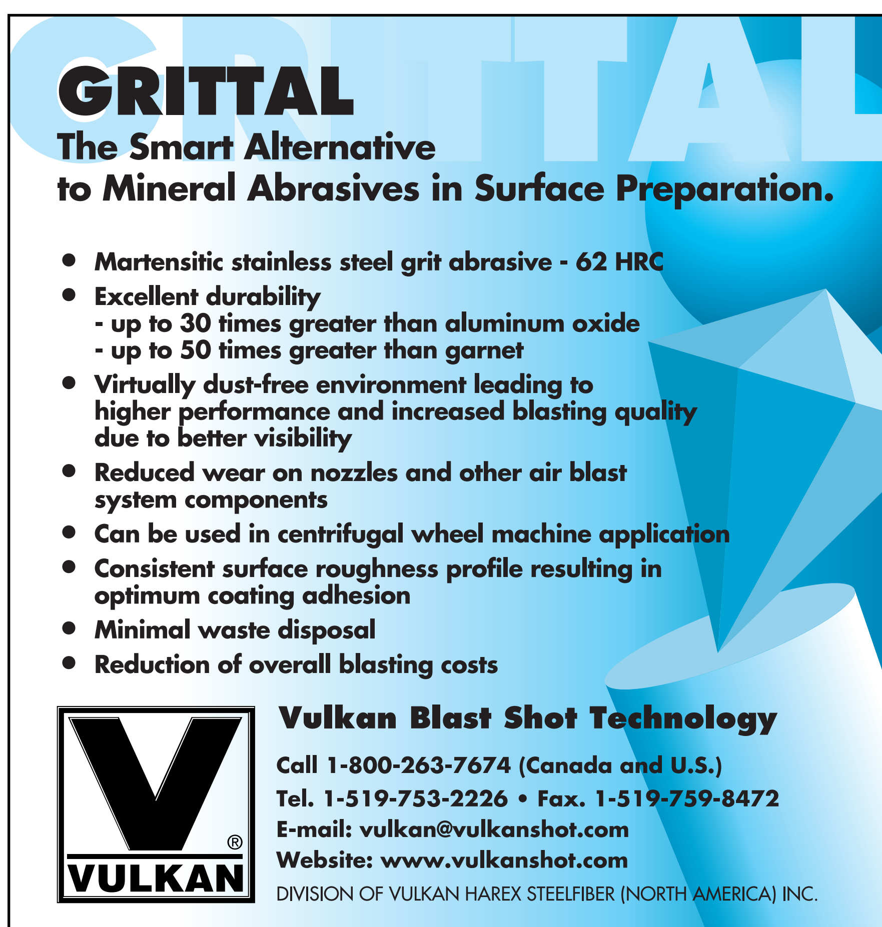

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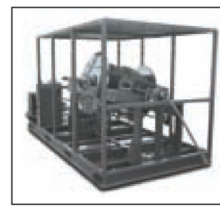
The product has an insulated handle and a side handle for two-hand operation. It has a 1.3 hp air motor and a safety-lock throttle lever to prevent accidental start up. The company says that the sander can be used for material removal on non-ferrous surfaces such as carbon fiber, fiberglass, and painted aluminum. The vacuum sander can be connected to external or central vacuum systems.

Aluminum Coating for Cold Spray

International Paint LLC (Houston, TX), an AkzoNobel company, has introduced its new two-component, cold-spray, aluminum coating system—Intertherm® 898 CSA. It is designed to protect piping from corrosion under insulation (CUI) and can be applied using standard equipment. The new product can also offer protection in temperatures ranging from -265 to 1050 F, according to the company.

More information on the product can be found at www.internationalpaint.com.

Automated Units Ease UHP Worker Strain



From NLB Corp. (Wixom, MI) come two new Roto-Reel® units that automatically feed high-pressure water jet hose to relieve operators from the strain of manual hose feeding.

The two available models, 200 and 500, both feed hose up to 40 feet per minute, can be ordered with air or hydraulic power, and come skid-mounted or trailer-mounted with a protective cage. The 200 model has a hose capacity of 200 feet and is intended for applications requiring water pressure of up to 20,000 psi. The 500 is used for applications of up to 10,000 psi and has a hose capacity of 500 feet.

Visit www.nlbcorp.com for more information.

Binks Introduces Spray Gun

Binks (Glendale Heights, IL) has released a new product, the 2100 Conventional Spray Gun.

Some of the product's features include waterborne compatible stainless steel fluid passages, stainless steel threads, a maximum delivery air nozzle, a curved handle with less trigger pull, and air adjustment with a cheater valve.

More information can be found at www.binks.com.

New Epoxy Mastic Protects Concrete

Krylon Products Group (Cleveland, OH) has introduced Krylon® Industrial Surface Tolerant HB Epoxy Mastic, a high-build, fast-drying, polyamide epoxy.

ARP Soluble Salt Meter

SSM Model # RPCT-07-001

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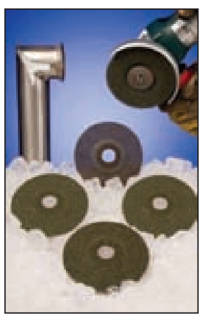
The product is designed for maintenance painting and fabrication shop applications. The company says that typical applications include concrete surfaces, water treatment plants, and general concrete flooring in industrial environments. The epoxy is available in three package colors and can be custom-tinted.

For more information on the product, visit http://go.kpgind.info/pr.

Quiet, Cool Abrasive Wheel Released

Rex-Cut Products, Inc. (Fall River, MA) has released its Rex-Cut Sigma Screen™ depressed center Type 27 wheel. It is a mesh abrasive wheel that runs cool and provides chatter-free performance. According to the company, the product is ideal for cleaning up weld splatter, light grinding, and paint and rust removal.



The wheel is made of a blend of zirconia-ceramic abrasive grains bonded to a flexible mesh, and comes in coarse, medium, fine, and very fine grits. Multiple wheels can be stacked onto a grinder, the company says.

More information about this product can be found at www.rexcut.com.

Novel Technology Assesses Corrosion

Avantium (Amsterdam, the Netherlands) has introduced a novel technology to measure the corrosive properties of fluids on metal. The equipment combines the use of a short residence time of the liquid at elevated temperatures with a closed loop system. A patent describing the methods was published in September 2008.

For details, go to www.avantium.com.

Nano Additives Resist Scratches

BYK-Chemie GmbH (Wesel, Germany) has announced two new nano silica additives for coatings. Part of the Nanobyk® 3650 line, the newly developed 3651 and 3652 contain nano silica particles that are distributed within the coating and work by absorbing impact energy and slowly releasing it to avoid damage, according to the company. The product keeps the coating from being damaged when conditions would normally result in scratches.

The new products are recommended for industrial, wood, furniture, and automotive coatings.

For details, go to www.byk.com.

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M&J Painting Wins Hart Bridge Painting Project

By Brian Churray, PaintSquare

The Florida Department of Transportation awarded a contract of $26,244,610 to M&J Painting Company (Campbell, OH) to perform structural steel repairs and coatings application on the Hart Bridge, a 3,844-foot-long by 65-foot-wide steel through truss bridge over the St. Johns River. All existing structural steel surfaces will be pressure-washed, abrasive blast-cleaned to a Near-White finish (SSPC-SP 10), and coated with an organic zinc-rich epoxy primer, an epoxy intermediate, and a polyurethane finish. The cables, anchorages, and cable transition areas will be abrasive blast-cleaned and recoated with an elastomeric acrylic system. Class 1A containment according to SSPC-Guide 6 is required to control the emission of the existing lead-based coatings. The contract also required SSPC-PCCP certification.

Photo courtesy of Florida DOT

Continued

Tri-Brothers Contracting Secures Tank Coating Contract

Tri-Brothers Contracting, Inc. (Southgate, MI) won a contract of $275,000 from Texas A&M University (College Station, TX) to recoat two 500,000-gallon-capacity water storage tanks at a wellfield. The project includes cleaning and recoating the interior and exterior surfaces of one tank, as well as cleaning and overcoating the exterior surfaces of the second tank. The interior tank surfaces will be abrasive blast-cleaned to a Commercial finish (SSPC-SP 6), tested for soluble salts with as-needed remediation, abrasive blast-cleaned to a Near-White finish (SSPC-SP 10), and lined with a zinc primer, an epoxy intermediate, and an epoxy finish. The contract requires the use of dehumidification equipment to facilitate proper curing. The exterior surfaces of the first tank will be abrasive blast-cleaned to a Commercial finish (SSPC-SP 6) using copper slag abrasive media and coated with a zinc primer, an epoxy intermediate, and a urethane finish. The exterior surfaces of the second tank will be pressure-washed, spot-cleaned, and overcoated with an epoxy spot-primer and a urethane finish.

Photo courtesy of Durham Engineering

F.D. Thomas Secures Polyurea Lining Contract

F.D. Thomas, Inc. (Medford, OR) was awarded a contract by the City of Bellingham, WA, to repair and line approximately 8,000 square feet of wall and floor surfaces in a 64-foot-diameter by 22-foot-high concrete reservoir. The concrete will be coated with a 100%-solids pure polyurea system. The contract, which required provision of a third-party NACE Level III certified coatings inspector, is valued at $113,616.

Lepi Enterprises to Recoat Filter Piping

Lepi Enterprises (Zanesville, OH) secured a contract from the City of Springfield, OH, to clean and recoat approximately 6,000 square feet of filter piping, valves, and mechanisms at a water treatment plant. The piping and appurtenances will be recoated with an aluminum epoxy-mastic primer, an epoxy intermediate, and a urethane finish. The contract, which includes containment of the existing lead-based coatings, is valued at $86,587.

Contra Costa County Awards Cooling Tower Coating Contract

Contra Costa County, CA, awarded a contract of $8,800 to Metro Structural Painting (Concord, CA) to repair, clean, and recoat structural steel supports, stairs, and ribs associated with an existing cooling tower. The steel will be pressure-washed with degreaser at 5,000 psi (minimum), spot hand-tool and power-tool cleaned (SSPC-SP 2 and SP 3), and coated with waterborne elastomeric acrylic prime coats and a urethane enamel finish.

Eagle Painting and Maintenance to Recoat Quincy Bayview Bridge

Photo courtesy of Missouri DOT

Eagle Painting and Maintenance Company (Lansing, IL) won a contract of $3,232,400 from the Illinois Department of Transportation to recoat structural steel surfaces on the Quincy Bayview Bridge, a 4,507-foot-long by 27-foot-wide cable-stayed bridge that spans the Mississippi River between West Quincy, MO, and Quincy, IL. The steel will be abrasive blast-cleaned to a Near-White finish (SSPC-SP 10) and recoated with an organic zinc-rich

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primer, an epoxy intermediate, and a urethane finish. The contract, which required SSPC-QP 1 and QP 2 certification, includes containment of the existing lead-bearing coatings.

Slater Waterproofing Secures Reservoir Rehabilitation

Slater Waterproofing (Montclair, CA) was awarded a contract by the City of Torrance, CA, to rehabilitate a 10 MG concrete reservoir and an 18.7 MG concrete reservoir. The rehabilitation includes crack repair work and application of a crystalline waterproofing system. The contract is valued at $413,882.

Certified Coatings Wins Paint Remediation Bid

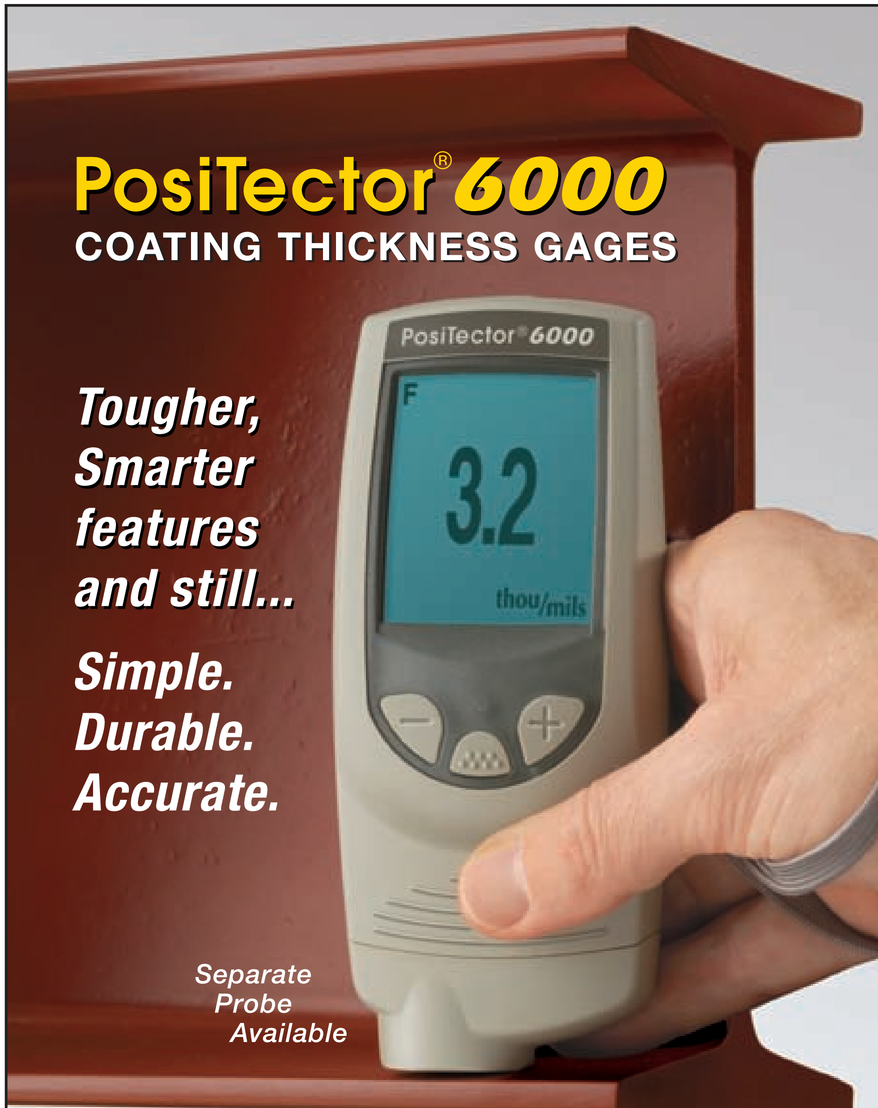
The United States Department of Transportation, Maritime Administration, awarded a contract of $3,411,975 to Certified Coatings (Concord, CA) to perform environmental remediation services on obsolete vessels located at the Suisan Bay Reserve Fleet in Benicia, CA. The one-year term contract that includes four one-year extension options involves removing or encapsulating exfoliating coatings on vessel hulls, superstructures, and decks.

Seacor Painting to Recoat Power Transformers

Seacor Painting Corporation (Campbell, OH) secured a contract of $42,410 by the Key West Utility Board to recoat five existing power transformers. The transformers will be recoated with a vinyl alkyd primer and a silicone alkyd finish, or a contractor-proposed system suitable to the high-heat, humidity, and salt air of the local environment.

Era Valdivia Awarded Reservoir Repair Project

The Village of Schaumburg, IL, awarded a contract of $240,425 to Era Valdivia Contractors, Inc. (Chicago, IL) to repair a 195-foot-long by 98-foot-wide concrete reservoir and the associated 46-foot-long by 24-foot-wide booster station. The reservoir repair work includes abrasive blast-cleaning and recoating one interior wall and one foot of adjacent floor surfaces. The concrete will be repaired with epoxy mortar and coated with a moisture-cured urethane primer and a 100%-pure polyurea finish. The booster station repair work includes coating stairs, walls, floors, and piping with various epoxy systems, as well as sealing parapet wall surfaces with an acrylic latex-modified cement waterproofing system. The contract includes removing lead-bearing coatings from piping surfaces. ■



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