ProblemSolvingForum

MEASURING SEALERS FOR METALLISED COATINGS

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Sealers for thermal spray coatings (TSC) are low-viscosity, clear or pigmented paints (including lacquers and vinyls) formulated to flow over and be absorbed into the natural pores of the TSC. The pigment particle size for coloured sealers must be small enough to flow easily into the pores of the TSC, nominally a 5-fineness grind per ASTM D1210, Standard Test Method for Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage.

Sealers improve the appearance of the TSC and reduce the retention of dirt and contamination on the surface. Sealed TSCs have a longer service life, are easier to clean and maintain, and do not degrade cathodic protection. When applied, the seal coat should be thin enough to flow over and penetrate the TSC and seal the pores. Because the sealer penetrates the pores, its thickness is not really measurable. Typically, the seal coat is applied at a spreading rate that results in a theoretical 1.5-mil (38-micron) dry film thickness (DFT).

To get an approximation of the wet film thickness (WFT) or DFT, apply the sealer to a smooth companion coupon as well as to the TSC. Measure the WFT on the coupon before the sealer dries. After the seal coat has dried to the touch on the coupon, measure the DFT.

TSCs should be either sealed or sealed and topcoated under any of the following conditions:
• The environment is very acidic or very alkaline. (Normal pH range for pure zinc is 6 to 12 and for pure aluminium is 4 to 11.)
• The metallic coating is subject to direct attack by specific chemicals.
• A particular decorative finish is required.
• Additional abrasion resistance is required.
• The environment includes frequent salt or fresh water (excluding potable water) spray, splash, or immersion service.

The seal coat should be applied on a dust-free and uncontaminated surface as soon after thermal spraying as feasible, preferably within eight hours. Sometimes, however, the sealer cannot be applied within eight hours. If this is the case, prior to applying the sealer, verify by visual inspection that the sprayed metal coating has not been contaminated. Also verify that the TSC is dust-free by using the pressure-sensitive tape method (ISO 8502-3, Preparation of Steel Substrates Before Application of Paints and Related Products—Tests for the Assessment of Surface Cleanliness—Part 3: Assessment of Dust on Steel Surfaces Prepared for Painting [Pressure-Sensitive Tape Method]).

A topcoat is essentially a full coat of paint and may be applied over a seal coat. Topcoats should normally be applied as soon as the sealer is dry and preferably within 24 hours. Do not apply a conventional topcoat over an unsealed TSC.

A description and guide to application of sealers and topcoat paints may be found in the following publications:
• SSPC-CS 23.00(I), Interim Specification for the Application of Thermal Spray Coatings (Metallizing) of Aluminium, Zinc, and Their Alloys and Composites for the Corrosion Protection of Steel, 1 March 2000; and

Suitably thinned epoxy polyamide and heat-resistant silicone-aluminium paints are specified and successfully used by the U.S. Navy as ambient-temperature and high-temperature sealers, respectively, for aluminium TSCs on steel substrates (MIL-STD-2138A[SH]).

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The coating applied on top of a metallised surface is a sealer that is supposed to penetrate the more or less porous layer of arc- or flame-sprayed metal. A film-forming coat on top of the metal is not necessary unless certain requirements regarding colour, gloss, or finish are specified.

Because the sealer penetrates the metal, it is impossible to measure dry film thickness with conventional thickness gauges. That is, the total thickness of the metallic film would be the same before and after application of the sealer. Consequently, it is also impossible to measure the wet film

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thickness by ordinary methods. Specifications, however, would normally identify thicknesses for the metallised coating as well as for the sealer. The specified sealer thickness should be regarded as the recommended amount of sealer (rather than a stringent requirement) for the specified metal coat thickness.

To get an idea about the amount of sealer applied compared to the specified thickness, a small plate of smooth metal or glass could be attached to the metallised surface. When the sealer is applied, this plate is coated with a wet film, which can be measured by conventional methods. However, this should be regarded as a theoretical approach to the correct amount of sealer, since it is significantly influenced by the actual thickness of the metal coat. The porosity will also influence the required amount of sealer. Higher porosity requires more sealer.

How can you determine that the correct amount of sealer has been applied on top of a metallised coating? One should examine the behaviour of the sealer after application on top of the metallised coating. The sealer will penetrate the substrate relatively rapidly, and when the substrate is saturated (i.e., before a discernible film is formed on top of the metallised coating), the recommended amount of sealer has been applied. Such an application requires skill and good workmanship. At the same time, it compensates for variations in metal coat thickness as well as variations in porosity.

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This question is not as easily answered as one would think from first glance. If one answered the question simply, the answers would be that measurement should be conducted with a magnetic dry film thickness (DFT) gauge and a wet film thickness (WFT) gauge, respectively. However, I believe the question goes beyond the simple answers.

Most sealers used for metallising are applied to specifications of roughly 1-2 mils (25-50 microns) DFT. The prevailing intent of sealing is to fill the pores of the metallised coating before oxidation takes place and extend its service life or provide a tie coat to a traditional topcoat. In practice, the wetting properties of the sealer cause it to be absorbed into the metallised surface/profile with no measurable thickness on the surface. This may result in the measured DFT not meeting the manufacturer’s recommended applied DFT.

The difficulty in making a DFT measurement is compounded by having to measure this thickness through several substrates of non-uniform thickness. The measurement is made on a 1- to 2-mil (25- to 50-micron) coating applied on the profile of the metallised surface, through the metallised coating (typically 10–15 mils [250–375 microns]), to the steel substrate, which is profiled (typically +2.5 mils [+67 microns]) as well. The variations in assessing these thicknesses along with the level of accuracy of a dry film thickness instrument (typically within 3% of the reading) would make measurement of a coating of 1–2 mils (25–50 microns) highly suspect. Measurements of WFT would be equally suspect.

Since the intent of sealing is to fill the pores of the metallised coating before oxidation occurs, verification could be done practically rather than quantitatively. An inspector could visually check for the sealer by on-site verification during application. Alternatively, at a later date, the inspector could check the metallised surface for the presence of the sealer by looking for its colour, since tinting of the sealer is usually required for visual inspection.

A second alternative would be to estimate the surface area to be coated and apply the manufacturer’s recom-
mended volume of sealer accordingly. This is currently being done in activities such as the coating of concrete floors and seal coating in overcoating projects using similar products.

Third, an inspection test panel (coated in conjunction with the sealing of the steel member) could be used to verify the thickness of the sealer without dealing with the profile and substrate issues.

Got an Answer? Here Are Some Upcoming Questions

- When steel is adjacent to concrete, is there any painting system (surface prep and paint) that can be applied to both surfaces simultaneously? If not, what systems can be used, and in what order should the work be carried out?

- What is the best accelerated test for predicting field performance of an inorganic zinc-rich primer? The ASTM D5894 cyclic test has the best proven correlation with performance of most coatings; but this test is too severe for untopcoated zinc primers. Zinc primers may fail the ASTM B117 salt fog test and still perform well in service. How do we test zinc primers without rejecting good formulations?

- What coating specification, including surface preparation, is required to resist ozone used as an additive in big steel filter vessels?

- What coating specification, including surface preparation of the prestressed concrete and generic coating materials, is suitable to withstand the concentration of hydrogen sulphide gas in a sewer environment?

- A building has been used as a car garage for years, and the concrete floor has been well contaminated with oil, grease, antifreeze, etc. The building is being converted to a store, and the owner wants to paint the floor. Except for the contamination, the concrete is in excellent condition. How should the floor be prepared, and what coating should be used?

- If my company employs an inspection agency to verify compliance with specifications for a painting project and the coating subsequently fails prematurely, should the inspection agency bear some responsibility for the failure?

- What is the influence of admixtures (hardeners, dust suppressants, etc.) to concrete on the subsequent adhesion of protective coating systems? If there are negative effects, what can be done to eliminate them?

- As a cost-cutting measure, some facility owners have recently begun to provide bidding contractors with the amount of steel to be cleaned and painted rather than provide facility design and detail drawings. Is this a reasonable practice (to solicit realistic bids)? Why or why not?

- How do you detect microbiologically influenced corrosion?

- Are any of the laboratory electrochemical techniques used in coating research viable for the prediction of coating performance in practice?

Responses should be 1–2 typed, double-spaced pages. Responses and questions should be sent along with your name, address, and telephone and fax numbers to: Brian Goldie, Publisher, PCE—tel: +44 20 8288 0077; fax: +44 20 8288 0078; e-mail: brianpce@aol.com; or Karen Kapsanis, Editor, JPCL—tel: +1 800 837 8303 (USA and Canada only) or +1 412 431 8300; fax: +1 412 431 5428; e-mail: kkapsanis@protectivecoatings.com.