Developments in Corrosion Protective Coatings


In “Development of Low VOC Maintenance Coatings” (pp. 39-42), Gail Pollano describes new approaches to formulating high performance coatings to meet environmental regulations. Pollano first discusses how coatings prevent corrosion: by limiting the penetration of water and by adding corrosion-resistant pigments. After discussing problems inherent to formulating water-borne coatings, the author reviews successful water-bornees, including acrylics, urethane-acrylic copolymers, hydroxy-functional emulsions, urethanes, and fluoro-emulsions.

Coatings based on polysiloxane provide improved resistance to heat, chemicals, and weathering compared to other coatings used for corrosion protection in the chemical processing and pipeline industries, says R.E. Foscante in “Developments in High-Performance Protective Coatings: Polysiloxanes” (pp. 43-52). The article reviews the performance requirements for protective coatings in these industries. The author also discusses the state-of-the-art in protective coatings for atmospheric corrosion control, comparing the performance of these formulations with polysiloxane coatings.

He focuses on 4 coating formulations, including heat-resistant polysiloxanes, chemical-resistant polysiloxanes, polysiloxane topcoats, and polysiloxane acrylic topcoats. The author notes that these formulations are compatible with inorganic zinc silicate primers. The article concludes with a discussion on an oxysilane-cured epoxy, which displays improved acid resistance and increased cross link density when compared with a typical epoxy polyamide.

Spherical zinc phosphate pigments provide performance superior to lead and chromate pigments, says Gil Ericson in “Formulation with Spherical Zinc Phosphate Corrosion-Inhibiting Pigments” (pp. 53-63). The author first describes the shape and typical size of the pigments. He then discusses a formula for determining how much test pigment to substitute in an existing coating formulation.

The selection of spherical zinc phosphate, molybdate-modified spherical zinc phosphate, and multiphase pigments of hydrated spherical zinc and iron phosphates is described next. The article concludes with suggested formulations using these pigments.

Using Flow Modifiers in Coatings

The role of flow modifiers is explored by Marilyn A. Grolitzer and Dennis E. Erickson in “Flow Modifiers: A Key to Developing High Quality Surface Coatings” (Journal of Coatings Technology, June 1995, pp. 89-93). According to the authors, flow modifiers reduce or eliminate surface defects; aid in pigment dispersion, air release, and substrate wetting; and promote flow and leveling. The article discusses the formation of surface defects and how they can be controlled. The authors then explain how flow modifiers work. The article concludes with a discussion on evaluating and selecting flow modifiers.

On Improving Low VOC Uretanhes

In “Crosslinking of Waterborne Polyurethane Dispersions,” an article in the September 1995 Journal of Coatings Technology, Valentino J. Tramontano and Werner J. Blank (pp. 89-99) explain how hydroxyl/carboxyl functional water-borne polyurethane dispersions of low molecular weight can be used to produce films of more uniform structure and crosslink density than commercially available, high molecular weight polyurethane dispersions. The study reviewed in the article compares film properties and network formation of the low molecular weight dispersion and a high molecular weight polyurethane dispersion. The authors describe the experimental procedures and tests, including stress-strain measurements, Fourier transform infrared spectroscopy attenuated total reflectance, and strain testing. According to the authors, the water-borne dispersion displays better flexibility, impact resistance, and pencil hardness than the commercially available polyurethane dispersion.

continued
Shotblasting Equipment Compared

Shotblasting machines offer a method of preparing concrete that minimizes dust and eliminates cleanup, says Rosalie Johnston in “A Contractor’s Guide to Shotblasters” (Concrete Repair Digest, June 1995, pp. 194-199). Johnston categorizes the machines as either walk-behind or ride-on. The author discusses abrasive selection and the factors affecting equipment productivity. She also describes how shotblasters work. Recommendations are given to achieve different concrete finishes. The article concludes with tips for safe operation.

Guide Specifications for Lead Removal

The National Institute of Building Sciences (Washington, DC) has published Guide Specifications for Reducing Lead-Based Paint Hazards to assist building owners and their representatives in identifying, evaluating, and reducing lead-based paint hazards.

In addition to general information on lead-based paint hazards, the book offers 34 guide specifications for lead-based paint hazard reduction projects. A guide specification for mechanical removal of lead-based paint is included.

ASTM Publishes Testing Manual

Cyclic Cabinet Corrosion Testing (ASTM: Philadelphia, PA), edited by Gardner S. Haynes, provides information on corrosion mechanisms in accelerated tests and service environments, and guidance on determining acceleration factors with the appropriate corrosion mechanisms.

The book contains 10 papers on the use of cyclic cabinet corrosion tests for comparing the corrosion resistance of various materials. The papers were presented at the Cyclic Cabinet Corrosion Testing Symposium held at the Dallas/Ft. Worth Airport in Texas, on November 14-19, 1993. The symposium was sponsored by ASTM Committee G-1 on Corrosion of Metals.

The papers cover:
- mechanisms of corrosion in cyclic cabinet tests;
- fundamental testing principles related to corrosion mechanisms;
- tests for automotive steel sheet products;
- the performance of coated and uncoated aluminum alloys for heat exchanger applications; and
- tests for simulating atmospheric environments.

continued
ASTM says that the book clearly documents the failure of the salt spray test to predict actual service performance in a number of environments. The publication also presents alternative test procedures and correlates the results with service performance.

**On Using Cadmium Pigments**

Cadmium pigments offer environmental advantages for the formulation of high performance coating systems, says Leonard J. Ulicny in “Cadmium Pigments: Their Role in Today’s Coating Systems” (American Paint & Coatings Journal, June 5, 1995, pp. 49-52). The author argues that the cadmium in pigments is a byproduct of zinc purification, that would otherwise have to be disposed of. In addition, he says, cadmium pigments are less soluble than cadmium.

Another advantage to cadmium is its ease of dispersion, which could allow formulators to reduce solvent levels in coatings. The hiding characteristics of cadmium pigments may also allow the use of thinner films, says Ulicny.

The author points out that the industry does not yet know the environmental impact of alternatives to cadmium pigments.

**Water-Borne Epoxies Resist Corrosion**

A high molecular weight, water-borne epoxy coating system resists corrosion and chemicals, contains low levels of volatile organic compounds, and offers long pot life and ease of application, says Jason L. Chou in “Novel Corrosion Resistant Waterborne Epoxy Coatings” (Paintindia, May 1995, pp. 37-44). The author first describes the development of water-borne epoxy coating technology. He then reviews the
components of the new water-borne epoxy system. Chou follows by discussing the formulation parameters and properties of the coating. He describes properties such as flexibility, cure rate, barrier properties, and resistance to chemicals, corrosion, and chalking.

**Handbook Published on Special Tests**

*Special Nondestructive Testing Methods*, the ninth volume of the Nondestructive Testing Handbook series, has been published by the American Society for Nondestructive Testing, Inc. (Columbus, OH) to explain methods that provide information about a material’s mechanical behavior. Such methods are used to evaluate how a material bends, becomes warm, and exhibits stress and strain. In the case of metal identification, special nondestructive methods are used to determine how chemistries differ.

Methods discussed include acoustic holography, alloy identification, Barkhausen noise, holographic interferometry, infrared thermography, laser ultrasonics and photoacoustics, magnetic resonance imaging, moiré imaging, neutron diffraction testing, optical profilometry, photoelastic analysis, resistance strain gaging, shearography, speckle interferometry, tapping, and vibration analysis.

**European Coatings Industry Described**

Four articles appearing in the May 1995 and June 1995 issues of *Pitture e Vernici* are of interest to members of the coatings industry. One article in the May 1995 issue predicts growth in the European coatings industry (“European Growth Indicators for Coatings in Europe,” pp. 7-9). The article presents information on the consumption and production of indicators such as metal products, hand tools, agricultural machinery, and motor vehicles. Another chart projects market growth for industrial coatings to the year 2005 in the United Kingdom. The article also cites growth in the production of water-borne architectural and heavy-duty coatings in Australia between 1989 and 1994.

In the staff article, “Chambers for Continuous and Cyclic Accelerated Corrosion Tests,” 2 test chambers, one for continuous corrosion tests and one for cyclic corrosion tests, are described (May 1995, pp. 11-12). The features of each test chamber are reviewed. The article also lists continuous and cyclic test standards.

In “Water-Borne, 2 Component, Acrylic-Isocyanate Paints for Metal and Wood Finishes,” Andrew Trapani, Kurt Wood, Tim Wood, and Gabriele Munari say that the new coatings offer cost and performance that are competitive with solvent-borne, two-component urethanes with less volatile organic compound content (May 1995, pp. 14-23). The authors first discuss isocyanate chemistry and then describe the formulation of the water-borne, acrylic-isocyanate coatings for metal and wood.

Robert F. Brady says that fluorinated polyurethane coatings offer ease of maintenance; long service life; and resistance to corrosion, heat, actinic radiation, and chemicals (“Fluorinated Polyurethane Coatings for Unique Defense Applications,” June 1995, pp. 13-18). The article first describes the formulation of fluorinated polyurethane coatings containing powdered polytetrafluoroethylene. The author continues by describing tests of the coatings in U.S. Naval vessels and shore facilities. According to Brady, applications of the...
coating include tank linings; ship hulls; collection, holding, and transfer tanks; and ship bilges.

Assessing Compliance on Lead Paint Jobs

The September-October 1995 issue of Painting & Wallcovering Contractor features 2 articles on assessing compliance on lead paint abatement projects.

Using engineering studies to evaluate the performance of containment ventilation can help protect workers from overexposure to lead, comply with regulations, and avoid fines from the Occupational Safety and Health Administration (OSHA), says John Cignatta in “Computer-Based Engineering Study Key to $5 Million OSHA Bridge Painting Case” (pp. 86-89). The author uses a recent case against a painting contractor to illustrate the necessity for engineering studies. He then reviews an engineering study commissioned by OSHA to estimate lead levels in containment and assess the effectiveness of control measures within the containment. The formulation of a model for the study is described, and the analysis is discussed. He devotes considerable attention to studies that use computer programs to estimate dust concentrations in enclosed structures.

Robert Lowes weighs the advantages and disadvantages of treatment and stabilization methods for lead-based waste in “Lead Alchemy: Contractors Take Their Chances When They Try To Make Lead Waste Non-Hazardous” (pp. 94-97). The author notes that the Environmental Protection Agency (EPA) has approved some stabilization methods as Best Demonstrated Available Technologies. These include mixing paint waste with lime and fly ash, cement, concrete, and proprietary mixtures. Lowes, other methods of reducing leachable lead concentrations, such as adding quantities of sand to spent blast waste and mixing iron filings with disposable abrasives, do not have EPA approval. The article concludes with a discussion of a proprietary abrasive additive and the option of recovering lead from paint waste through smelting.

The article notes that the EPA considers contractors doing lead abatement to be co-generators of lead waste.

On Measuring Solvents in Water-Bornes

Walter Caseri and Roland Hany examine the suitability of nuclear magnetic resonance spectroscopy for quantifying the organic constituents of water-borne coatings in “Solvents in Water-Borne Paints: H-NMR Spectroscopy” (European Coatings Journal, June 1995, pp. 445-447). The authors describe the process by which water-borne coatings are first diluted with a calibrating substance, filtered, and analyzed for organic constituents. The authors argue that the method offers an economical means of coatings analysis.

On Protecting Pipelines

Derek N. Mortimore describes protective coatings for pipelines and pipeline rehabilitation in “New World Developments in Pipeline Protection” (Corrosion & Coatings SA, July 1995, pp. 4-9). Protective systems for pipeline exteriors include asphalt and coal tar enamel, cathodic protection, fabric-reinforced tapes, and fusion-bonded epoxy (FBE). Cement mortar linings, epoxies, solvent-free epoxy, and FBE have been used as interior protective coatings, the author says.

Mortimore discusses the points that must be considered during coatings specification, such as the design life of the pipeline, service and environmental conditions, and the coating's compatibility with the cathodic protection.

Protective systems now used, says Mortimore, are extruded polyethylene systems, three-ply fusion-bonded epoxy systems, and a temperature-resistant system composed of FBE/neoprene and urethane elastomer or urethane/polypropylene syntactic foam. Mortimore notes that, for effective, seamless pipeline protection, the specifier must consider the components of the pipeline, including line pipe, bends, field joints, and repairs. The author concludes by outlining the pipeline rehabilitation process.

Using the Internet

In “Getting onto the Internet,” Susan Dahlberg describes the services provided by the Internet, access to it,
Better Water-Bornes for Maintenance

A surfactant-free carboxylated styrene/acrylate polymer dispersion can be used to formulate heavy-duty, corrosion-resistant water-borne coatings comparable in performance to solvent-borne coatings, say Allan Fream and S. Magnet in the August 1995 Surface Coatings Australia ("Surfactant-Free Polymer Dispersion for High Performance Water-Borne Industrial Coatings," pp. 26-30). The authors first review the problems commonly associated with water-borne coatings, including adhesion, permeability, resistance to flash rust, mechanical stability, and microbial attack.

The properties of the dispersion are then discussed. The authors emphasize the importance of raw materials selection in formulating coatings with the dispersion. Each raw material, they say, should have little effect on the water resistance and stability of the coating. Appropriate corrosion inhibitors, pigments, fillers, plasticizers, and coalescents are then reviewed. The authors conclude by listing 2 sample formulations: an air-drying primer for airless application and an air-drying primer for brush application.

Impedance Data Questioned

S. Feliu, M. Morcillo, and S. Feliu, Jr., find that data generated from impedance measurements do not yield accurate estimates for paint resistance, even when numerous replicate specimens are evaluated (“The Reliability of Parameters Derived from Impedance Measurements in the Metal/Paint System,” Surface Coatings International, August 1995, pp. 338-341). The authors describe the measurement of the electrical resistance and capacitance of a chlorinated rubber coating applied over 14 steel coupons. They argue that increasing the number of coated specimens to 100 would still yield a high degree of error.

The “Latest Literature” column presents summaries of books and of articles that appeared in other journals. The column is intended to help JPCL readers locate additional information on protective coatings and linings. The summaries are not evaluative.