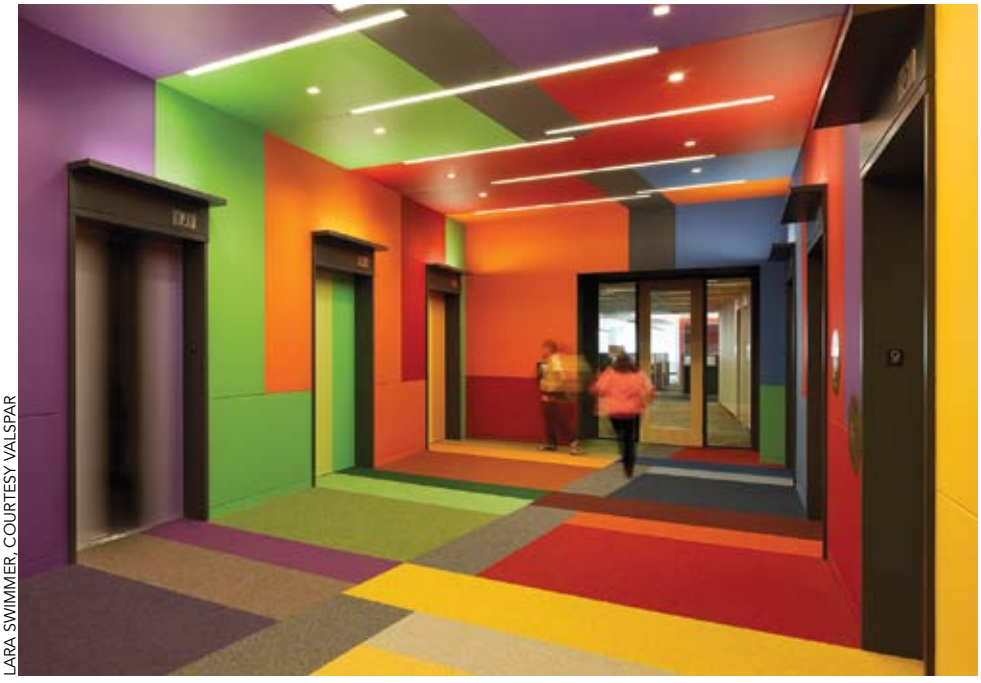
Paints & Coatings

THE LATEST TRENDS IN SUSTAINABILITY



LARA SWIMMER, COURTESY VALSPAR

High-performance interior coatings can be used to powerful effect, using water-based formulations with low VOC or zero VOC content, as at the headquarters of paint manufacturer Valspar Corporation in the Ameriprise Building, Minneapolis.

BY C.C. SULLIVAN AND BARBARA HORWITZ-BENNETT, CONTRIBUTING EDITORS

Thinking about building life cycle gives Building Teams a useful starting point for understanding the contribution of paints and coatings to sustainable design. When it comes to durability, a 50-year design ideally should include 50-year coatings. Many building products consume substantial amounts of energy, water, and petrochemicals during manufacture, but they can make up for it in the operations phase. Why not expect the same from architectural coatings?

The best paints and coatings protect building components long enough to produce a net-positive savings. In addition, buildings should have a beneficial effect on human health, so if coatings release harmful chemicals those exposures should be minimal as compared to the salutary effects on occupants and neighbors over years of facility use.

In recent years, however, most of the focus on sustainable coatings has been on reducing negative consequences rather than net-positive life cycle outcomes. “Being less bad is not being good,” says William McDonough, founder of Charlottesville, Va.-based William McDonough + Partners and co-creator of the Cradle-to-Cradle design methodology. What’s more valuable is to assess the sustainability value of architectural coatings relative to their performance value to end-users.

In this way, considerations of sustainability for architectural coatings and paints go beyond grams-per-liter (g/l) measures of volatile organic compounds (VOCs) to considerations about appropriate use, durability, maintenance, source control, resource conservation, disposal, and recycling. Health and welfare attributes—for example, impact on indoor environmental quality (IEQ)—are essential to proper selection and use.

With a life cycle mindset for coatings, the Building Team starts with project design options but then spends more time fine-tuning the formulation and functional features that enhance sustainability and usability. For example, the right paint specification can contribute cost-effectively

LEARNING OBJECTIVES

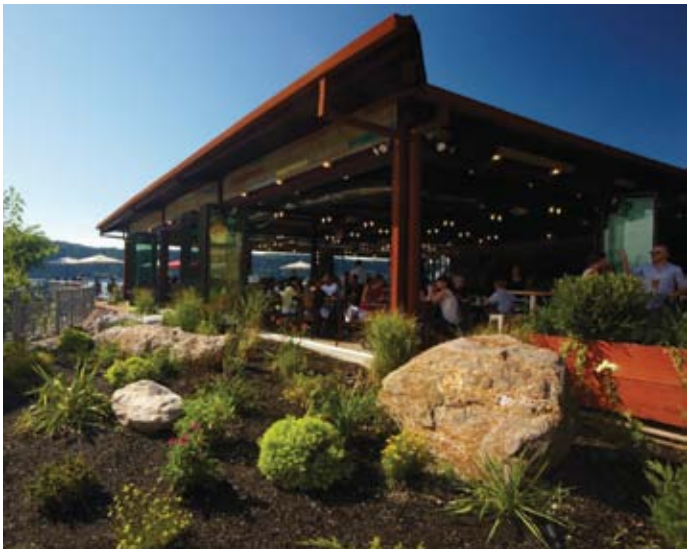
After reading this article, you should be able to:

+ LIST the sustainability and performance benefits of architectural coatings in general and for specific types of coating products.
+ DISCUSS green standards, labeling programs, and statutory VOC requirements for coatings used in the United States.
+ DESCRIBE the variables of paint and coating selection that impact sustainability and occupant health, safety, and welfare, including productivity and psychological benefits.
+ EXPLAIN the impact of sustainability improvements on paint and coating selection.

to noise reduction between occupied spaces. Paints can also add insulation to your walls, yielding a measurable increase in equivalent R-value, helping rooms feel more comfortable, and saving money by getting more from heating and cooling systems.

Other examples are specific to the expressed purpose of paints and coatings, such as *hiding ability,* a "characteristic of the dried film that depends on the nature and quantity of pigments, binders, and extenders," according to Albert C. Censullo, Professor of Chemistry at Cal Poly State University, San Luis Obispo, Calif. Also known as *hiding power or opacity,* the effectiveness of the coating for hiding the materials behind it can be quantified in square meters (of hiding) per liter, using tests such as standard ASTM D344 or ASTM D2805-11. Then the specifier can compare the product's hiding ability to how much VOC content is required to achieve the required hiding.

This measure—hiding power per unit of VOC—has real green building value: the better the hiding ability, the higher the performance and, potentially, the less the relative toxicity of the coating application. Censullo adds that this measure is not affected by dilution of the coating, which reduces hiding power and VOC contents in equal proportion. Censullo uses the term "hiding VOC" to describe this performance parameter, and calls it a "performance-based measure of VOC emissions associated with using a coating."



COURTESY ANDREW FRANZ ARCHITECT

For a new marina and restaurant complex on the Hudson River in Manhattan, the project team used lightly stained wood siding inspired by driftwood and weathering Corten steel for a lasting exterior inspired by working maritime buildings. Benjamin Moore MoorLife Low Lustre flat was specified for parts of the exterior.

GREEN PERFORMANCE VARIABLES

There are other critical performance measures for architectural coatings. A measure of post-application resilience is *scrubbability,* a description of abrasion resistance quantified in scrub cycles using standard tests such as ASTM D2486. One scrub cycle is a single mechanical back-and-forth motion, which erodes a certain amount of paint. How many scrubs does it take to break through a durable paint membrane? The minimum for interior latex flat wall paints, for example, as set by the Washington, D.C.-based certification group

HOW TO ADDRESS FAILURES in paints and coatings

As experienced designers, contractors, and owners know, most paint and coating problems are correctable, but some are especially stubborn to address. The following is a partial compendium of typical failure modes and methods for addressing the problem, as provided by paint and coatings manufacturer Benjamin Moore & Co. (www.benjaminmoore.com):

Surface imperfections. There are many types of imperfections that can be visible on painted or sealed surfaces. Alligatoring occurs when the paint film takes on the appearance of alligator hide. (A similar problem is known as wrinkling, which appears as a rough creased or crinkled pattern.) Alligatoring usually occurs when a topcoat is applied before an undercoat is dry, or if an alkyd enamel or other hard, rigid coating is applied over a latex primer or another more flexible finish layer. Some oil-based coats will lose elasticity as they age, causing this familiar cracking pattern.

Blistering (or bubbling) is caused by a localized loss of adhesion and lifting of the paint film from the underlying surface, sometimes when solvent gas expands on sunny façades. Blistering tends to occur in fresh coats of paint.

Both problems require removing as much paint as possible and repainting. However, blistering can immediately reappear if the problem is caused by moisture; to mitigate this problem, the contractor should repair loose caulk and retrofit drainage and drying details, if possible. Installing vents or exhaust fans can also reduce moisture by evaporation before it wets enclosure materials.

For alligatoring, most paint contractors will recommend completely removing the existing oil paint by using a heat gun, scraping, and sanding. After priming the reworked surface with a high-quality latex or oil-based primer, the area can then be recoated with exterior latex or similar paint.

Flaking and chalking. In some cases, a painted or coated surface will exhibit a loose powder or flaking surface. These problems are caused by decomposing paint and are different from efflorescence or mottling, which display white, crusty mineral salt deposits that have leached from mortar, concrete, or masonry surfaces behind the paint. A similar problem known as frosting is often seen on dark paints and coatings; in this case, a white discolored substance appears on the surface, similar to salt staining.

Chalking paint may be washed by rain and cause patterns, or it may wash across other surfaces, an effect called chalk rundown.

Miscoloring and staining. Other sources of miscoloration on exterior and interior surfaces include nailheads and other penetrations that leach a rust-colored stain onto a surface, which often trails down from the location of the hardware. Mildew appears as black, gray, or brown spots or areas on the paint film or caulk bead.

Another source of undesired color change is **surfactant leaching**, in which concentrated, water-soluble ingredients in latexes seep to the paint surface, often creating a brownish blotchy or shiny appearance. Tannin staining can also be a brownish or tan discoloration on the paint surface, caused by wood tannins that leach through the paint film.

When applied properly onto suitably prepared substrates, architectural coatings will rarely exhibit these kinds of failures. Even better, when integrated into a thoughtful sustainability program, paints and coatings can be a partner in effective building designs that promote improvements to project economics and social considerations as well as protecting the environment.

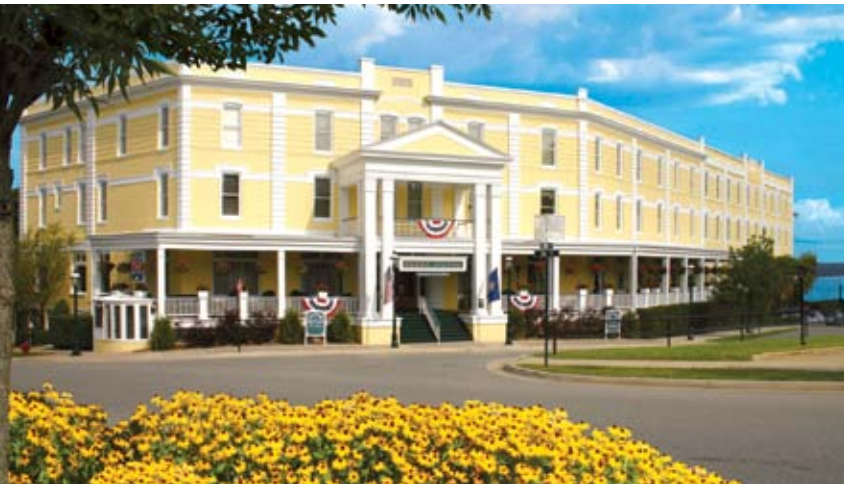
Green Seal (using the ASTM test method), is 400 scrubs.

In the life cycle of a paint, that means the applied product can be cleaned many times with less repainting required. It means the finish is engineered to last.

Other key sustainability measures include *color retention*, which is described as being high or low. High-quality paints are formulated to prevent premature or excessive lightening of paint color, which is commonly seen on south-facing walls and surfaces. ASTM G90 is one test of accelerated weathering outdoors, which can help compare the ability of coatings to resist color loss. In many cases, lower-quality paints fail due to chalking, which causes fading and poor color retention.

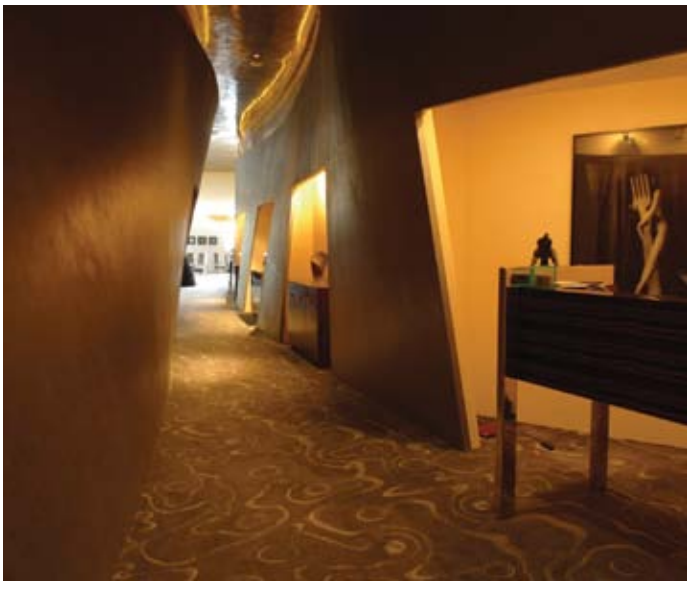
Another factor is *gloss level*, which is important for aesthetics and for setting interior reflectivity levels to enhance the propagation of daylight and electrical light. Gloss is defined by the Master Painters Institute (www.paintinfo.com), of Burnaby, B.C., based on seven categories of apparent reflectivity. Gloss level 3, for example, is a "traditional eggshell-like finish." MPI uses the standard gloss scale ranging from zero (no gloss) to a perfectly mirror-like 100, based on the intensity of received light from a reflected beam held at a 60-degree angle. By matching listed gloss levels, specifiers can avoid unwanted visible variances, which are most noticeable in low-gloss coatings—flat versus eggshell, for example.

Gloss level and the other performance variables are central to guiding Building Teams toward a more sustainable use of paints and coatings. They provide ways to quantify and manipulate the life cycle performance of sealants, paints, coatings, and adhesives. Life cycle assessment (LCA) is about determining the costs in materials and energy needs from the manufacturing process and application phase to the long-term performance (durability) and environmental and health costs, such as VOC exposure, against benefits such as improved productivity and protection of coated materials. LCA also considers the needs for removal, recoating, disposal, and recycling.



SAYEN PHOTOGRAPHY COURTESY STAFFORD'S HOSPITALITY

A recent hotel renovation and repaint of the Stafford's Perry Hotel in Petoskey, Mich., employed a smooth high-build coating (from Sherwin-Williams) and a conditioner to address problems of rotted wood, spalling bricks, and peeling paint on the 1899 brick façades.



COURTESY JOSHUA ZINDER ARCHITECTURE + DESIGN.

Waku Ghin, a new restaurant in the Marina Bay Sands casino, Singapore, features highly sculptural walls finished in a durable basecoat with a crack-resistant substrate and a decorative polished plaster with integral colors. Walls were finished in Armourcoat Perlata PLS N5474 silver. Mica panels and locally harvested woods were specified.

REDUCE, REUSE, RECYCLE

Regardless of a coating product's LCA, simply reducing the amount of coatings used is a useful strategy for green building. This includes using more uncoated surfaces as well as using more durable coatings that require fewer primers and coats. This relatively new focus for sustainably minded Building Teams naturally leads to the use of premium paints and coatings while also increasing the use of raw, unfinished materials.

Catalyzed finishes. The heightened awareness of sustainability among design and construction professionals has prompted greater interest in new catalyzed finishes—the thin but effective coatings favored by many cabinetmakers. These include various types of polyurethanes, polyesters, lacquers, conversion varnishes, and some vinyl sealers, and they can be more costly than other products on the market. "The finishes are harder and more resistant to water and chemicals because of their long molecular strands," says Andrew Franz, AIA, Principal of New York-based Andrew Franz Architect (www.andrewfranz.com). "Unlike shellacs or conventional lacquers, when a catalyzed finish dries it doesn't melt into the previous coat. To get proper adhesion, you have to sand between coats."

When properly applied these finishes can look completely invisible, allowing the wood or other substrate to be seen, which makes them desirable in casework and interior surfaces. "The reason we prefer catalyzed finishes for certain applications is that they can be used to present the grain of a wood finish or another material texture behind it," says Franz.

Low- and zero-VOC products. Building Teams should also be considering the use of paints and coatings that meet the most

stringent VOC requirements. Doing so can cut total VOC exposure to occupants and improve regional air quality, too. To determine the best specification, Building Teams should be monitoring new regulations and legislation nationally and at the local level, as well as such programs as LEED (www.usgbc.org/leed), Green Globes (www.greenglobes.com), and, more recently, the Living Building Challenge (living-future.org/lbc). Manufacturers are constantly reformulating their products to meet current guidelines for such organizations as MPI, Greenguard (www.greenguard.org), the Healthier Hospitals Initiative (healthierhospitals.org), and the Collaborative for High-Performance Schools (www.chps.net). Forward-looking manufacturers try to anticipate upcoming requirements, too.

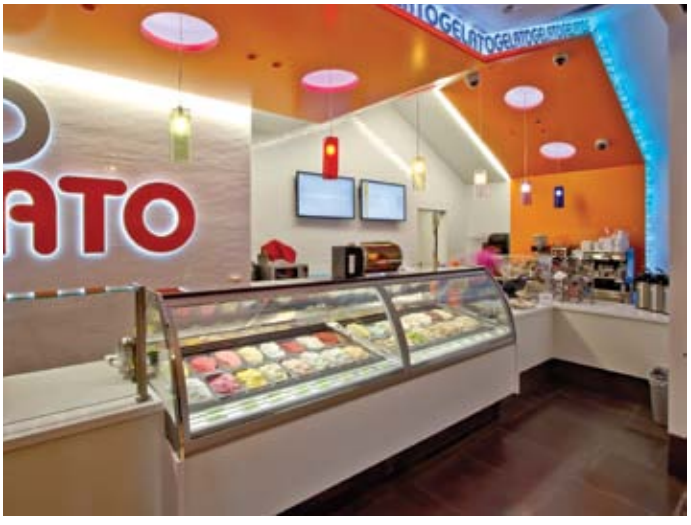
The term "VOC" refers to many organic solvents used in paint that "evaporate into the atmosphere and combine with nitrogen oxide and sunlight to create low-level smog and ozone," according to paint manufacturer Glidden (www.glidden.com). "This causes air pollution and contributes to global warming. Indoor application of products that release high levels of VOCs also causes the odor we all associate with paint and results in poor air quality for paint appliers and building occupants."

A number of regional VOC consortiums have adopted control measures that limit the VOC content of paints (see "VOC Opinion-Formers," opposite). Many waterborne architectural paint products meet the requirements for low-VOC or zero-VOC coatings.

The most stringent regulations come from the South Coast Air Quality Management District (www.aqmd.gov), the air pollution control agency for all of Orange County and the urban portions of Los Angeles, Riverside, and San Bernardino counties in California. Another aggressive regulator is the Ozone Transport Commission (www.otcair.org), a multi-state organization created under the Clean Air Act. The OTC encompasses the District of Columbia and 12 states ranging from Northern Virginia up to Maine. In addition, the Lake Michigan Air Directors Consortium (www.ladco.org), established in 1990, covers Illinois, Indiana, Michigan, Ohio, and Wisconsin.

Water-based formulas. Many Building Teams consider waterborne architectural paint products for project applications because these products often meet the requirements for low- or zero-VOC coatings. Water-based latex exterior paints date to the 1940s, starting with Super Kem-Tone, from Sherwin-Williams (www.sherwin-williams.com), in 1941. Prior to that, all house paints were oil-based alkyds, which offered performance advantages at the time. Over the years, better water-based paints emerged that matched the performance of many alkyds, with a smooth, hard finish that minimizes surface imperfections and stands up to high-traffic uses.

More recently, water-based acrylic alkyds have been introduced that offer a range of environmental benefits similar to water-based enamels with less than 50g/l of VOCs, as required by prevailing environmental regulations. "Earlier water-based acrylic alkyds had problems with poor package stability, and the products tended to dry



COURTESY JOSHUA ZINDER ARCHITECTURE + DESIGN

Bright, durable and easy-to-clean paints were essential for the Zio Gelato, a new shop at The Venetian in Las Vegas, to give it a "pop" against the neoclassical casino interiors. For life cycle performance and color matching purposes, a zero-VOC Benjamin Moore semi-gloss was specified.

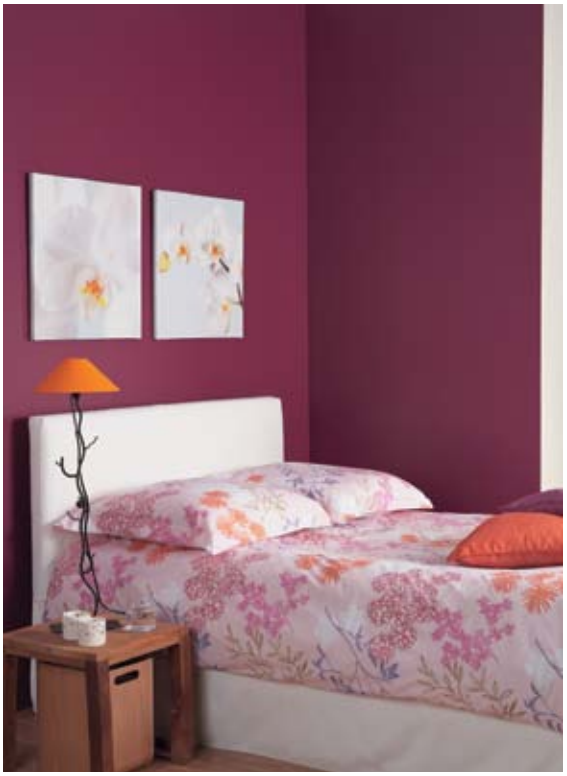
VOC OPINION-FORMERS, from Coast to Coast

Organic solvents used in paint include volatile organic compounds. These chemicals will evaporate into the atmosphere and combine with nitrogen oxide and sunlight to create low-level smog and ozone—a cause of air pollution and a contributor to global warming. Indoors, high levels of VOCs can cause unpleasant odors and in some cases deleterious health effects.

Regional consortiums around the United States have adopted VOC control measures that limit their use in paints. Listed in order from the most stringent regulations to the most flexible, according to paint manufacturer Glidden, those organizations include:

- South Coast Air Quality Management District (SCAQMD) – With the strictest VOC limits in the nation, this air pollution control agency covers Orange County, Calif., and urban areas of Los Angeles, Riverside, and San Bernardino Counties. www.aqmd.gov
- Ozone Transport Commission (OTC) – Created under the Clean Air Act, this multi-state organization covers Connecticut, Delaware, the District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and Northern Virginia. www.otcair.org
- Lake Michigan Air Directors Consortium (LADCO) – Founded in 1990, this forum on air-quality issues and a provider of technical assessments and assistance on problems of air quality serves Illinois, Indiana, Michigan, Ohio, and Wisconsin. Several LADCO states use the VOC standards set by OTC. www.ladco.org
- California Air Resources Board (CARB) – With a focus on consumer products, CARB was established in 1967 to help maintain healthy air quality in 24 air districts in the state that also measure and regulate VOC emissions. www.carb.ca.gov
- EPA National VOC Rule for AIM Coatings (AIM) – The VOC content of architectural and industrial maintenance (AIM) coatings is addressed in the national standard, although it is "the least stringent VOC rule of all legislative bodies," according to paint manufacturer Glidden. www.epa.gov/stateply/index.html

SOURCE: GLIDDEN



COURTESY PPG

Environmental color (here, from paint manufacturer PPG) can elicit specific emotional and psychological responses. Primary hues are said to be energizing, while men and women may respond differently to beige, orange, and purple.

too quickly and yellow," says Steve Revnew, Vice President of Product Development at Sherwin-Williams. He says that the new technologies offer longer "open time, flow and leveling, and resistance to yellowing."

Light-reflective products and colors. Interior paints and coatings make indirect contributions to building energy performance and IEQ through daylighting and reduced need for electric lighting. By specifying paints with high light-reflectance values (LRVs), coatings help "support sustainable lighting plans by propagating daylight into a space and reducing the standard number of lighting fixtures required to optimize employee performance and safety," according to PPG (www.ppg.com/coatings), a manufacturer of architectural coatings. Moreover, the use of LRV is common in ensuring proper contrast between interior surfaces to assist the visually impaired in schools, hospitals, and other institutional and commercial settings, which is recommended in the Americans with Disabilities Act Accessibility Guidelines.

"Color consultants, architects, and designers use LRV data in several stages of color planning and specifying," according to PPG, which is why the manufacturer includes this information on its paint samples and color chips. LRV is quantified as a percentage from zero reflectivity—i.e., perfect black—to 100%, a perfectly reflective white. Multifamily buildings typically are designed for an LRV of about 50%, while office interiors are usually more reflective.

"LRV can be misleading when it comes to yellow," cautions color consultant Lori Sawaya, Propietor of the Land of Color (http://thelandofcolor.com). "Yellow is one of the most reflective hues in the spectrum. As the coverage area expands, yellow grows exponentially more intense."

Sawaya recommends considering both LRV and visual brightness or intensity; in some cases, intensity would be the more important factor.

Sustainable graffiti-removal systems. Among the many other considerations for building life cycle is graffiti removal. In recent years, a number of paint producers have introduced low-VOC, water-based paint removers in addition to their matching, environmentally beneficial coatings formulations. These graffiti systems lift urethanes, lacquers, latexes, alkyds, elastomerics, and varnishes from a variety of architectural surfaces, including wood, brick and masonry, steel, aluminum, and some plastics. Unlike other systems, these products contain no toxics or air pollutants and can be cleaned from the work site with denatured alcohol or simply with soap and water.

SPECIFYING FOR SUSTAINABILITY

According to PPG Architectural Coatings, the U.S. Greenguard Environmental Institute "aims to protect human health and improve quality of life by enhancing indoor air quality and reducing people's exposure to chemicals and other pollutants. Simply put, U.S. Greenguard certification ensures that a product is low-emitting."

Products carrying the Greenguard mark

have been independently tested numerous times to prove they meet rigorous third-party chemical emissions standards established by the organization, according to PPG. The standards are based on established emissions criteria such as the SCAQMD rules in California, which are the most stringent of any state, as well as norms set and monitored by various public health agencies and the U.S. Environmental Protection Agency.

Greenguard has also used as a model Germany's Blue Angel certification (www.blauer-engel.de/en/), an eco-label program introduced in 1978 and considered the oldest in the world, covering more than 10,000 products. However, while Blue Angel only recognizes products "of considerable benefit to the environment and, at the same time, meeting high standards of serviceability, health, and occupational protection," Greenguard certification is broadly recognized and accepted by sustainable building programs and building codes worldwide.

For LEED, the standards are fairly consistent and easy to meet. As of 2012, the LEED for New Construction (LEED NC), Core & Shell (LEED CS), and Commercial Interiors (LEED CI) 2009 programs require the following levels of VOCs in paints in the Environmental Quality (EQ) Credit 4.2-1, Low-Emitting Materials – Paints and Coatings (in grams/liter):

- Primers: <200 g/l
- Flat: <50 g/l
- Non-flat: <150 g/l
- Anti-corrosive: <250 g/l

Levels are also given for clear-finish coatings, such as wood sealers, on the high end of the VOC spectrum. These levels are based on SCAQMD Rule 1113 and include shellacs (730 g/l), lacquers (550 g/l), and varnishes (350 g/l), as well as stains, floor coatings, and waterproofing sealers. These maximum levels for paints are equivalent to those in Green Seal's standard GS-11, which dates back almost two decades.

STEPHEN A. WOLFE

At the Natural History Museum in London, a large curving surface was produced with a resilient polished plaster of hydrated lime, marble and concrete, applied over an EIFS basecoat. The Darwin Centre Phase Two houses labs and specimen storage.

The question might be raised: Why are these levels based on SCAQMD Rule 1113? According to Hernando Miranda, who heads sustainable design consulting firm Soltierra LLC (www.soltierra.com), "The rule was chosen because it is updated regularly, has the strictest VOC requirements in the U.S., and is vetted through a public comment process." With tighter VOC requirements having been established in 2012 and even more stringent requirements going into effect on Janurary 1, 2014, "the SCAQMD rule is still ahead of everyone else, as far as I can tell," says Miranda, former Vice-Chair of the USGBC's IEQ Technical Advisory Group.

LEED programs for some time referenced the California Department of Health Services rule, Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers. The lengthy and vague standard was a source of confusion and was later replaced with simple tabular requirements, as have been used in LEED NC 2.2 for many of the compliance options. In general, Building Teams can use the referenced standards, maximum VOC levels listings, and other Performance/Intent Equivalent Alternative Compliance Paths, or PIEACPs.

MATCHING MARKET NEEDS

In general, LEED for Schools and LEED for Homes require the same VOC levels as other LEED programs. Although LEED for Schools came under fire by *USA Today* last December for uneven performance in terms of energy efficiency, its toxicity standards are familiar in this market. Most schools have been implementing similarly low-toxicity and low-VOC materials and finishes for 10 years or more.

At least 16 states adhere to LEED or similar programs (notably, CHPS) to guide their school construction programs, covering about half of all U.S. public schools. Nine more states are considering similar requirements, and many individual school districts must meet green standards in order to receive state construction funds.

Hotels, restaurants, and casinos have also been focusing on VOC content of furniture, fixtures, and equipment (FF&E) after a decade-long, industrywide effort to reduce conditions that set the stage for mold and mildew. More upscale hotels also have been making greater use of operable windows and higher levels of fresh, outdoor air for ventilating rooms.

While many hospitality owners set in-house criteria for coatings, sealants, and paints, others are adopting relevant green standards, says Joshua Zinder, AIA, Founding Partner, Joshua Zinder Architecture + Design (JZA+D) in Princeton, N.J., who spoke on IAQ at the Green Tourism & Hospitality Conference earlier this year. "A large and growing number of environmentally aware hotel operators voluntarily follow industry standards or new state green-building codes that limit VOCs and other toxic materials, including known carcinogens like formaldehyde," says Zinder. Among the brands with active programs are Wyndham, Marriott, and Hilton.

Some hospitality companies integrate their VOC reduction efforts with new building concepts intended to serve the needs of health-savvy consumers and business travelers, says Zinder. For example, Starwood's Element hotel line promotes sustainable practices, organic foods, and healthy lifestyles. "Others have programs for meeting green standards in the United States and globally with all of

their properties," he adds. The Sands Corporation operates LEED-certified buildings like the Palazzo in Las Vegas; in overseas markets like Singapore, the company builds and refurbishes properties to the international BCA Green Mark standard (http://www.bca.gov.sg/greenmark/green_mark_buildings.html).

According to Zinder, overseas projects are often subject to local standards for IEQ. In Singapore, a regional program called the Singapore Green Labeling Scheme (www.greenlabel.sg), identifies low-VOC paints, SGLS-approved adhesives, and similar products, as well as mechanical, electrical, and plumbing system features such as ultraviolet light emitters for air-handling units and titanium dioxide sprays used for toilets. The SGLS mark can also be found on locally distributed carpets, laminates, waterproofing systems, exterior paint, and drywall.

Projects in Asia meeting Green Mark and SGLS criteria in 2012 span the continuum from three stars to five stars, including Sofitel So Singapore, InterContinental Singapore, and Holiday Inn Express Singapore Orchard Road.

In the United States, healthcare is another sector focused on building material toxicity. This has been a natural extension of the decade-long drive to phase out mercury-based thermometers and incinerators that emit dioxin. "Hospitals are also working to avoid toxic VOCs that are given off by many common paints and adhesives used in new construction," says Dan Dunlop, President of Jennings (http://jenningsco.com), a healthcare marketing specialist firm. "Low-VOC products improve conditions for employees and patients by giving them cleaner air to breathe."

GIVING LIFE CYCLE COATINGS LONGER LIFE

There is a push across these same markets for increased durability and resilience of architectural coatings. In today's market it is not enough to offer low- or zero-VOC formulations; there is an expectation that these same improvements for air quality also make the coatings better. Is this a fair request?

When it comes to life cycle performance, a number of exterior coatings, such as protective metal finishes, have been designed primarily for durability and long life with minimal maintenance needs. An important example of this is the class of fluoropolymer coatings, which are used for exterior metals, including curtain walls, panels, louvers and grills, column covers, windows, doors, and skylights. The coatings are known for a relatively long life cycle and for good durability, which reduces waste and provides additional protection to the building.

Today's fluoropolymers are available without cadmium-based or lead pigments. There is also broad interest in lighter-color formulas and emissivity-controlling products to comply with Cool Roof designs or to increase the reflectivity of exterior surfaces. Programs such as EPA's Energy Star consider emissivity values for coating products; this quantifies a material's emittance, or its ability to release absorbed heat. Expressed as a number between 0 and 1 or as a percentage, emissivity levels that are low can help keep buildings warm in winter, if desired, while high emissivity is good for surfaces in warmer climates.

Recent product formulations also have lower VOC levels and

JIM SCHAFER, COURTESY PPG

For the Children's Hospital of Pittsburgh at the University of Pittsburgh Medical Center, the Building Team employed tinted glass and shop-painted fluoropolymer metal coatings in white and blue. Field-applied finishes include fluoropolymers and high-performance paints.

less HAP content—for "hazardous air-polluting" substances. Some manufacturers will also reference MACT, the federal Maximum Achievable Control Technologies standard introduced in early 2007. Some specialty surface coaters of miscellaneous architectural metals must adhere to the rules, as their operations are considered "major sources" of HAPs, defined as a facility that emits more than 10 tons per year of a single HAP or more than 25 tons per year of total HAPs. This rule affects some 3,500 facilities in the United States.

While product formulas vary to some degree, fluoropolymers are known collectively for good UV protection and chalk resistance, meaning that they will not fade in the sun or fragment into a powdery chalk on exposed surfaces due to environmental conditions. They also exhibit high mar resistance and film integrity, which describes adhesion and hardness of the single-coat or two-coat application.

Standards that test for the performance of fluoropolymers are well established and rigorous. Examples include ASTM D 4214 for chalking resistance, ASTM D 968 for abrasion resistance, and the American Architectural Manufacturers Association's AAMA 2605-11,Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels. According to the coatings manufacturer Valspar, today's novel fluoropolymer coatings have better environmental attributes yet also "have the same long-life characteristics as the original formulations, and will meet or exceed AAMA 2605 specification requirements."

Many fluoropolymers are engineered as two-coat systems that utilize a full-strength 70% PVDF (polyvinylidene difluoride) fluoropolymer resin system for protection against chalking. Colors are formulated using mixed metal oxide (ceramic) pigments and select inorganic pigments; careful attention is paid to preventing color fading due to weather and solar UV. Hardness is important for building elements that must be finished after coatings are applied, as well as for those transported and installed with pre-coated metal surfaces. Darker colors tend to show marring most easily, according to Valspar.

RESOURCE CONSERVATION PROGRAMS

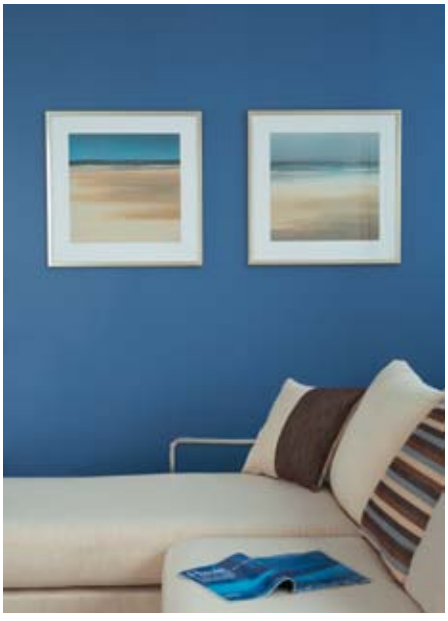
Not all coatings are intended for the durability and life span of fluoropolymers, however, and most architectural coatings have predictable cycles of maintenance and recoating needs. Where it is

necessary to maintain coated surfaces or renovate buildings, there are a number of considerations related to sustainable management and construction practices. The basic categories of resource conservation include recycled content, regional materials, and reduced construction waste.

Containers for transport and application have been an area of attention among manufacturers and environmentalists. Some coatings companies use recycled containers for at leasts some of their products; Sherwin-Williams, for example, offers 100% recycled buckets from post-consumer resin with soy-printed labels containing 75% recovered fiber and 25% postconsumer waste. Downstream, the contractor can collect and recycle the containers. PPG initiated a recovery program in 2008 for its five-gallon plastic pails used for water-based products. Dry pails returned to company-owned stores were collected, shredded, and recycled through cooperating distribution centers.

Paint recycling is another opportunity for the Building Team. Companies like Acrylatex Coatings & Recycling (www.acrylatex.com) operate or partner with reclamation plants that receive thousands of gallons of new, surplus, incorrectly tinted, and unwanted leftover paint from multiple sources. "These collected paints are then carefully processed through several manufacturing procedures to be transformed into a variety of renewable and affordable products," according to Acrylatex. In some cases, the materials are used as an energy source, too. The resulting coatings are suitable for interior or exterior applications for commercial and institutional buildings.

Due to concerns about possible toxic materials and lead content in paints and coatings, construction debris from paint removal and renovation projects is treated carefully. Structures built before 1978 can contain lead paint, and common renovation activities like sanding, cutting, and demolition can create hazardous lead dust and chips, a serious health hazard. The EPA and most states provide guidance for minimizing health risks during renovations. The onus is on building owners and remediation contractors to determine if lead-based paint waste qualifies as a hazardous waste; large quantities and concentrated lead-based paint debris from lead abatement and rehabilitation projects are excluded from disposal at many landfills.



COURTESY PPG

Blue (here, in a covering from manufacturer PPG) is said to have a soothing effect on viewers. There is a growing appreciation among design professionals of the psychological benefits of color in various interior settings.

For guidance, the EPA's Pre-Renovation Lead Information Rule TSCA 406b (http://www.epa.gov/lead/pubs/toolkits.htm) covers renovation, repair, and painting. Many commercial renovation projects use air-pressure and water-pressure equipment for abrasive blasting to remove paints. Some abrasives used in the blasting process can be recycled for additional uses, according to Andrew Seelinger, a specialist with Naval Sea Systems Command, Washington, D.C. "Steel grit creates a rough surface profile on the substrate that aids coating adhesion," thereby helping the paint to stick to the surface, he explains. "It is durable and can be reused if prevented from rusting, and it generates the least amount of waste per unit of surface area stripped." Less aggressive materials include aluminum oxides as well as garnet and glass beads, which are used in "single-pass operations," meaning the abrasive is not recycled but rather disposed with the removed paint, says Seelinger.

ASSSESSING THE IMPACT OF COLOR ON OCCUPANT WELL-BEING

Building Teams are focusing on durability and end-user training to reduce the total amount of coatings used. In addition, other less tangible qualities of architectural coatings factor more prominently in the calculus of sustainable design today.

For example, there is growing consensus that environmental color inside buildings and even exterior hues can be used for specific psychological effects—"to energize, subdue, inspire, aggravate, or stimulate," according to a recent article in the Sherwin-Williams magazine ***Stir.*** In restaurants, for example, studies show that orange can stimulate diners' appetites, while blue has a suppressant effect. And while primary hues are often used in K-12 schools, the science shows they are more likely to increase activity (and perhaps hyperactivity) among adolescents, the magazine reported. Worse yet, reds are proven to raise blood pressure.

Yellow is also a stimulating color, according to the expert colorist Carlton Wagner, while pink has been tested to reduce aggression in prisoners; however, recent studies show that this ameliorating effect is temporary, Wagner reports.

Nor are these effects universal. One University of Texas study showed that, among women, episodes of depression are more likely in white, gray, and beige workplace interiors. This is not the case for men, however, who are more likely to experience depression in spaces painted orange or purple. For both sexes, the likelihood of color-blindness increases with age, which affects color choice for senior environments. While assisted-living and long-term care facilities often are designed with neutrals and pastels, the effect may be lost on their target audience, ***Stir*** reported.

Examples of the impact of color on building occupant productivity go beyond the psychology of color-induced stimulation or suppression. The benefits of color choice and light reflectivity for workplace interiors are amply documented. Some considerations are specific to the task at hand: for example, in hospital operating rooms, the complementary

colors of the scrubs have been used for years to counteract vision-impairing afterimages experienced by medical staff during surgery procedures, says Shashi Caan, Founder of New York design firm The Collective (http://www.sccollective.com) and Chair of the interior design program at Parsons School of Design. Similarly, this kind of visual respite can be used in high-stress workplaces and education venues.

Building Teams are increasingly using light green and yellow hues—the predominant colors of natural environments—in healthcare facility design. These choices follow on recent research from experts in evidence-based design and biophilia, such as studies by Roger Ulrich at the University of Texas showing that colorful views of the outdoors, trees, and natural landscapes may have a measurable effect on improving patient outcomes.

MAINTENANCE AND OPERATIONS FOR PAINTS AND COATINGS

Most facility managers, interior designers, and architects leave color choice largely to intuition, while factoring in the basics of air quality, durability, and visual appeal. John Ward, Manager of Plant Operations for the Christus St. Michael Health System in Texarkana, Texas, says, "A facility like ours requires an incredibly wide range of durable, high-performance coatings, from wall paint to floor coatings to wall coverings. We rely on outside technical expertise, not only to help us specify the right coatings but also to help us train our staff in the proper application of each."

With that in mind, Christus St. Michael will use low-odor and VOC-compliant products in patient rooms, corridors, waiting rooms, and many of the facility's general areas. In operating rooms, a water-based catalyzed epoxy is used for durability, as opposed to the pre-catalyzed water-based epoxies used in procedure rooms. (Both are zero-VOC products.) Acoustical wall coverings and floor coatings are also used, and floors in operating rooms, food prep areas, and kitchens use a decorative, seamless epoxy flooring system with vinyl chips broadcasted into it. Boiler room floors are finished with a high-gloss epoxy with a clear acrylic glaze.

In outdoor spaces, the healthcare provider keeps a stock of solid color stains (for concrete walkways in their courtyard and some sitting areas) as well as traffic paints to touch up parking lots, fire lanes, and the hospital helipad.

Besides maintaining inventories of all the coatings, hospitals and other institutional facilities usually stock related equipment and application products, such as brushes, rollers, spray equipment, ladders, scaffolds, caulk, tape, and even protective wall enclosure units for working in sensitive patient areas.

Whether on the building exterior or interior, the use of paints and coatings requires careful specification and meticulous application to avoid premature failures. Poor craftsmanship can lead to lapping marks, which show areas where wet and dry paint layers overlapped during application. If incompatible paints are used, the result can be poor adhesion between the coats, leading to visual imperfections. Even if applied correctly, inferior coatings may exhibit dirt pickup, fading, and poor gloss retention, requiring remedial measures to restore the surfaces to proper condition.

> EDITOR'S NOTE

This completes the reading for this course.
*To earn **1.0 AIA/CES HSW learning units**, study the article carefully and take the exam posted at*:
www.BDCnetwork.com/PaintsCoatings

green paints and coatings AIA/CES MODULE

*Pass this exam and earn **1.0 AIA/CES HSW learning units**.*
*You must go to **www.BDCnetwork.com/PaintsCoatings** to take the exam.*

1. True or false: The hiding power of a coating per unit of VOC (volatile organic compound) content is not affected by dilution.
   A. True B. False
2. One measure of post-application resilience for a coating is scrubbability, a description of abrasion resistance quantified in scrub cycles using standard tests, such as
   A. ASTM G90
   B. ASTM D344 or ASTM D2805-11
   C. ASTM D2486
   D. None of the above
3. The gloss level of a coating is important to proper interior light reflectivity levels. It is defined by the Master Painters Institute in seven categories of apparent reflectivity based on standard gloss scale ranging from:
   A. 60-degree to 90-degree angles
   B. Zero to 100
   C. 5 to 500 footcandles of luminous intensity
   D. None of the above
4. These thin, resilient coatings favored by many cabinetmakers include various types of polyurethanes, polyesters, lacquers, conversion varnishes, and some vinyl sealers. The finishes have long molecular strands and must be sanded to get proper adhesion between coats. What are they?
   A. Decorative plasters
   B. Fluoropolymers
   C. Zero-VOC paints
   D. Catalyzed finishes
5. The most stringent air-quality regulations affecting the selection of VOC content for coatings are promulgated by:
   A. The East Coast's Ozone Transport Commission (OTC)
   B. California's South Coast Air Quality Management District (SCAQMD)
   C. The Lake Michigan Air Directors Consortium (LADCO)
   D. None of the above
6. Water-based latex exterior paints were introduced commercially in the 1940s. Prior to that, however, all exterior building paints were:
   A. Enamel polymer alkyds
   B. Acrylic alkyds
   C. Oil-based alkyds
   D. None of the above
7. For flat paints, LEED for New Construction (LEED NC) requires what level of VOC content to qualify for credits in the Environmental Quality (EQ) Credit 4.2-1, Low-Emitting Materials – Paints and Coatings?
   A. Less than 50 g/l
   B. Less than 150 g/l
   C. Less than 200 g/l
   D. Less than 250 g/l
8. Emissivity values for coating products, expressed as a number between 0 and 1 or as a percentage, quantifies a material's or coating's:
   A. Relative VOC content or toxicity
   B. Ability to release absorbed heat
   C. Light reflectivity value
   D. None of the above
9. Which of the following materials used as an abrasive in paint removal blasting processes is a durable product that can be reused in many cases, and also generates the least amount of waste per unit of surface area stripped?
   A. Steel grit
   B. Aluminum oxides
   C. Garnet or glass beads
   D. Turpentine
10. Which of the following is an example of undesired color change in a painted or coated architectural surface?
    A. Blistering.
    B. Chalking.
    C. Alligatoring.
    D. Surfactant leaching.