



CONCRETE:

Creating Opportunities for Coatings

By Cynthia Challenger,
CoatingsTech Contributing Writer

Concrete continues to be widely used in the construction industry, as this cost-effective, versatile, and sustainable material attracts growing interest for both commercial and residential applications. Stamping, staining, and other techniques provide methods for making concrete floors, walls, patios, walkways—and even countertops—attractive. All of these surfaces, whether new or previously installed, must be protected and maintained. Coatings, from block fillers to penetrating and reactive sealers to specialty elastomerics to more conventional resin systems, provide the necessary protection. Thus, demand for these materials, along with other surface preparation and maintenance products, is increasing as well. Those raw material and coating suppliers that can provide easy-to-use, environmentally friendly solutions that achieve the desired performance at a reasonable price will be able to capitalize on the opportunities currently presented by the marketplace.

Concrete is classified as a masonry substrate, along with brick, stucco, block, stone, and other similar materials. The total North American masonry coatings market is valued by coating consultants The ChemQuest Group to be \$1.4 billion, with cement/concrete flooring and decking accounting for 36% (\$500 million) of those sales. While demand declined about 11% from 2008 to early 2010 due to the recession, sales in 2010 were flat and are expected to increase about 3–4% annually from 2011–2015.

Because there are so many different types of coatings that can be applied to concrete, estimates of market size vary. Market

research firm Kusumgar, Nerlfi & Growney (KNG) values the concrete coatings market in North America at \$700 million in 2010, an estimate that includes acrylics, epoxies, urethanes, etc. for flooring, industrial maintenance, secondary containment, pulp and paper, water and wastewater treatment, and vertical architectural applications, which account for 50% of total sales. Other segments broken out by the consulting firm include penetrating sealers at 18%, cure and seal coatings for hardening wet concrete at 6%, parking deck and membrane waterproofing systems at 13%, and acrylic or silicone-based elastomerics, also at 13%.

Exterior applications account for approximately 69% of sales, and 80% of concrete coatings are applied by professional contractors, according to George Pilcher, vice president with ChemQuest. These numbers may be changing in the future, though, as consumer interest in "greener" concrete solutions and the preference for completing DIY projects become more prevalent. Garages and basements are becoming extensions of the general living space, and are increasingly being coated for both aesthetic and protective purposes. "As the economy begins to recover," adds Mark Wilgen, brand manager of high performance coatings for Rust Oleum, "professional contractor activity remains slow, while consumer activity has stabilized and is showing some growth."

In flooring applications, solventborne systems still predominate, but a shift to VOC compliant, high-solids coatings has taken place, and investment in waterborne technology has increased, according to ChemQuest. Bayer MaterialScience LLC is one company that now offers polyurethane dispersions (PUDs) and 2K waterborne polyurethanes with 15 g/L or less of VOC and very low odor for coating concrete floors. According to Scott Grace, technical director for waterborne coatings at Bayer, these are designed to perform just as well as, if not better than, their solvent-based counterparts.

Outside of flooring applications, waterborne and 100% solids coating systems are more commonly employed. "Compliance with regulations is obviously a big driver for development of waterborne systems, but growing consumer preferences for greener coatings and the ability to gain Green Seal and other certifications and for U.S. Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED) points for new construction are also leading to increased demand for such technologies," adds Michael Growney, a partner with KNG.

The nature of concrete and its many uses provide significant challenges for those looking to

apply a coatings system to protect and/or beautify a concrete surface. "It is important for coating formulators to educate both professional installers and do-it-yourself applicators about managing their expectations for the final look and functionality of the coating," asserts Tina Snider, marketing manager, resins for coatings at BASF in North America. One key to success in this area is to ensure that proper preparation techniques are used and that coatings are properly maintained once applied. "This area poses both challenges and opportunities," she observes. "It is a challenge to train end users, but there is also opportunity to develop new products that make the cleaning and maintenance phases of the coating process easier."

Proper preparation is absolutely critical. New or wet concrete contains extensive moisture and possesses a very alkaline pH. Whenever possible, it is recommended that new concrete be allowed to cure for anywhere from 28 to 90 days. Even after drying, entrapped air can be released as air bubbles, and salts can form and move to the surface. This efflorescence can lead to the salts appearing beneath or on top of the coating. Water also remains, so a breathable coating that lets water vapor escape but does not lead to efflorescence is desired. The highly porous nature of concrete poses its own set of challenges. "Concrete is in essence a rigid sponge," observes Jeff Spillane, senior marketing manager for COROTECH® High Performance Coatings with Complementary Coatings Corporation. "Therefore, the coating system used needs to seal the concrete and incorporate a finish coat that will address the end users' needs for aesthetics, durability, and chemical resistance."

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Often pretreatments—block fillers, penetrating or reactive sealers, and waterproofing coatings—are employed following proper cleaning of the surface. Common cleaning methods include pebble blasting, power washing, acid etching, or cleaning with a commercial concrete cleaning agent. Block fillers are designed to fill the pores, voids, and pinholes in the concrete, providing a more solid surface for better adhesion of the coating. Penetrating sealers work into the pores and react

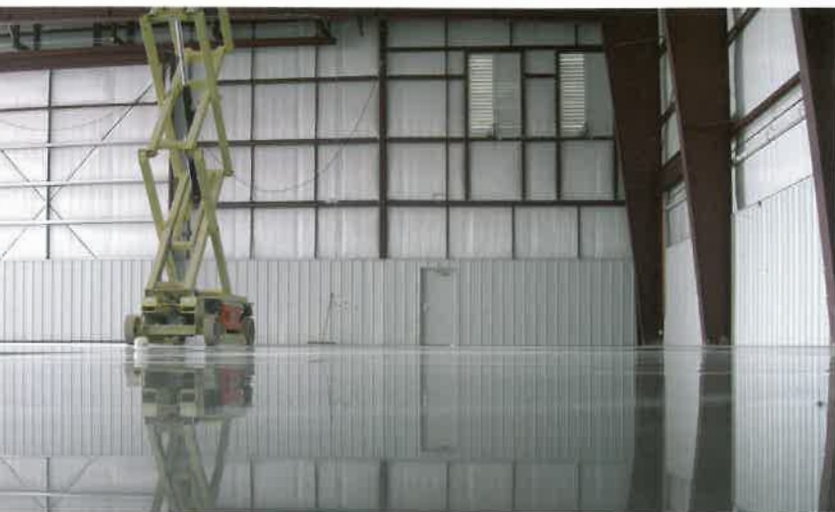


Photo courtesy of PROSOCO, Inc.

with the concrete but do not create a film, while clear water-repellant, film-forming systems create a barrier at the surface. Sealers and water repellants are generally formulated with silane-siloxane and acrylic systems. Hydrophobic silicone-based resins are also sometimes used in combination with oleophobic fluoropolymers to provide both water and oil repellency properties.

Another option is to use a reactive densifier such as Consolidator® LS™ lithium silicate. "These systems have received increasing attention over the last several years because they help improve the hardness of the concrete surface," says Tom Stalnaker, laboratory manager with PROSOCO, Inc. The densifiers actually react with the calcium hydroxide in the concrete, producing a harder surface and providing a better bond to the topcoat. PROSOCO has also developed a cleaner/densifier combined product that helps improve the properties of any areas of the concrete surface where the coating might be worn.

Some specialty additives are also used with concrete coatings. "Texturing additives, for example, are used to impart different decorative looks and surface profiles. Non-slip additives enhance the look and safety of floor coatings, particularly those where a higher-gloss finish is desired. Decorative flake is used to accent and provide color variation for large floor spaces," comments Beth Kirol, technical manager for exterior and machine applied coatings with PPG Industries' architectural coatings business. Hydrophobic additives (silicon-based) prevent water penetration and staining from water-based stains, while oleophobic additives (fluorine-modified) prevent penetration and stains from oil materials, such as dirty motor oil, according to Wilgen. Additionally, many of the same additives used in multi-substrate coatings are used in concrete coatings to control

application properties related to flow and leveling, sag resistance, hiding and coverage, open time, temperature range for application, and microbial protection.

Before any concrete topcoat is applied, a primer should be used first to improve the adhesion, coverage (cost), and aesthetics of the following coat, according to Matt Engel, market manager for epoxy additives with Air Products. He believes that waterborne epoxy primers are the best choice from a cost and performance standpoint.

Selection of the appropriate pretreatment and primer/topcoat system depends on the specific surface to be coated (exterior wall, patio, garage floor, etc.), the expected level of wear and exposure to sunlight and weather (residential or commercial floor, pool deck, parking garage), and the desired appearance (functional to highly decorative). "The preferred top-coating systems for concrete depend on the application," states Engel. "The main job of a concrete coating is to protect the concrete from mechanical or chemical attack and/or improve appearance and ability to be cleaned. So, depending on the performance and aesthetic properties desired, there are different preferred coating systems for concrete." Specific performance demands of a project include adhesion, abrasion and impact resistance, chemical resistance, durability, moisture resistance, alkali and efflorescence resistance, flexibility, cleanability, appearance (gloss and texture), and cost considerations, according to Kirol.

For residential and light industrial applications, water-based acrylics have the best balance of price and performance, according to Snider. "For more demanding applications, where higher levels of abrasion resistance, chemical resistance, and exterior durability are required, a 2K urethane is preferred." She further explains that acrylic resins provide aesthetic and functional value including chemical, weathering, alkali, abrasion, and dirt pick-up resistance with good gloss for residential and light industrial applications. Urethanes,



whether 100% solids or waterborne, have good overall properties with the hardness of epoxies, but remain more flexible for higher-end residential and medium- to heavy-duty industrial applications.

Epoxies are also effective top-coating systems for concrete. As more environmentally friendly coating technologies have advanced, two-component waterborne epoxies have become the best choice for institutional and garage floor applications, while 100% solids epoxy coatings are the best choice for heavy-duty flooring or concrete tank lining, according to Engel. In certain heavy-duty industrial applications, such as food and beverage production facilities, there is a need for thermal shock resistance as well as chemical and abrasion resistance. "In these cases," says Engel, "cementitious urethane and cementitious waterborne epoxy flooring have been employed due to their high strength, chemical resistance, and excellent adhesion, even with thermal shock cycles."

For vertical architectural applications, acrylic latexes are the dominant technology, as they provide effective protection and attractive color choices, as long as the surface is prepared properly, according to Michael Edison, president of Edison Coatings. He adds that a block filler or penetrating sealer might be applied first to address potential adhesion problems due to the porosity of the concrete. Self-priming coatings are also being developed for concrete applications. PROSOCO has introduced a self-crosslinking acrylic that applies like a conventional acrylic coating, thus maintaining ease of application, but provides increased durability.

Two key trends in construction are impacting the use of acrylic coatings for concrete walls, according to Spillane. First, there has been a dramatic increase in the use of tilt-up construction for commercial structures because buildings made this way can be completed in one third the time it takes when using concrete block. Tilt-up surfaces often have deficiencies, so coatings are required not only for protection but often are also texturized to hide these imperfections. The second trend is the growing popularity of Exterior Insulation and Finish Systems (EIFS) in residential construction. EIFS consist of a Styrofoam layer covered with multiple, very thin layers of cement mixed with acrylic polymer, which is applied by trowel. While they do not require a coating initially, they do wear and eventually must be painted, which is typically done with conventional latex paint.

Elastomeric coatings containing silicone-based or acrylic resins, which are applied very thickly, are used where weather extremes lead to expansion and contraction of the concrete. The breathable elastomeric coatings are designed to move with



the surface and thus not crack. They sometimes are even used to coat cracked surfaces, in effect providing a bridge over the crack and preventing further damage, according to Stalnaker. Their widest use is in coastal locations that experience severe weather, including wind-driven rain.

Concrete floors also generally require a higher level of protection, and thus epoxy and urethane coatings are most commonly used in these applications. Again, there is a wide range of choices, including high solids solventborne, waterbased (1K and 2K versions), and even UV-curable coatings. Epoxies and novolacs account for 55% of concrete floor coating consumption, polyurethanes 24%, acrylics and poly(methyl) methacrylates 10%, and various others including polyurea and polyaspartic systems make up the remainder, according to ChemQuest.

Garage floors must be resistant to hot tire pick-up, but do not face exposure to UV radiation or weathering. An epoxy primer with a polyurethane topcoat is the typical system used in these cases. For exterior horizontal surfaces such as patios and walkways, typically an aliphatic polyurethane, which is UV-resistant, is applied over the epoxy primer. Polyurea and polyaspartic coatings are finding growing use on parking and plaza decks, where weathering and excessive wear are concerns.



In the flooring area, consumer (DIY) demand for concrete coatings is expected to grow in the coming years. "Garages, like basements, are becoming an extension of the normal living space in the home. People spend more time in these areas, and they are thus looking to make them more comfortable and attractive. Companies that help organize and improve the space in garages—including installation of racks and hooks for storage and the coating of the floor—are helping to spur this demand," notes Spillane.

In general, there is more interest in coating concrete and other masonry surfaces than there used to be, according to Pilcher. "A lot of surfaces that in the past have been left uncoated are now being protected to reduce maintenance and increase durability, and in some cases, like for driveways and sidewalks, to even improve reflectivity to provide cooler surfaces." Consumers are attracted to the various options for making concrete surfaces more decorative—acid or acrylic staining, stamping, and polishing—and thus demand for these materials and those required to protect the decorated surface is growing significantly. There is also a trend toward green construction, which is leading to the reuse of existing concrete floors and therefore is serving as another demand driver for coatings, according to Engel. "PPG also sees many customers choosing to restore buildings with structural integrity instead of buying or building new ones, increasing the number of projects requiring restorative sealers and elastomeric coatings. Textured coatings help these owners to hide their buildings' imperfections and make them look new again," says Kirol.

Polished concrete floors are also becoming very popular as retailers replace vinyl tiles with more durable, lower maintenance concrete floors. "Polishing often includes a concrete densifier to improve wear and stain resistance, while increasing gloss. With this technique, it is possible to make 20-year-old concrete floors look like marble," Wilgen remarks.

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Companies are, in addition, now viewing the concrete walls of their buildings as key advertising space and are painting colorful company logos and other corporate messages on them, according to Pilcher. BASF has observed an increase in the use of specialty pigments for concrete coatings. "Architects and designers are seeking opportunities to make concrete coating colors more decorative, and to add specialty finishes," says Brian Marsicano, business director for pigments with BASF in North America. Demand for the company's Mearlin®, Firemist®, and Lumina® effect pigments, which add metallic and pearlescent appearances to concrete surfaces, has been growing, as has the use of its more conventional pigments for matching the colors of concrete surfaces to major brand colors, particularly in commercial construction. PPG also sees a growing trend toward using bright and deep colors on building exteriors. "All colors are not equally durable, however," states Kirol. "The owner of a monumental building does not want to have to repaint the exterior every three years, so it is important to help meet customers' expectations by assisting them in selecting a color palette that will make their building aesthetically pleasing and ensure protection and durability."

BASF's Snider also notes that use of 1K clear coatings directly on concrete and as a topcoat on stained or coated concrete is another trend in this sector. "Developing a single product that can be used for many types of applications and by different levels of users is one of the challenges facing coating formulators today," she adds. "For example, a clearcoat that can be used on pavers, stamped concrete, driveways/sidewalks/patios, garage floors, porch, and floor applications would be extremely attractive in the marketplace."

A recent trend noticed by Edison is the demand for more durable, long-lasting coating solutions in both commercial and high-end architectural projects. That has led to growing interest in potassium silicate based coatings that react with the concrete surface to both harden it and provide a protective film. "There definitely is a growing demand for higher performing coatings with much longer lifetimes. The costs up front might be a little

higher, but if a coating lasts 20–30 years rather than 5–10, then the cost of recoating that surface is dramatically reduced. And when you are talking about painting a high-rise building or a bridge, those costs can be significant."

Grace adds that the coating itself accounts for only 25–30% of the total cost of a painting project, so it makes sense to invest a little more into a higher performing coating that needs to be applied less frequently. Convincing some customers, particularly those strapped by tight budgets today, can often be a challenge.

"Other unmet needs in the marketplace include improved graffiti resistance, sound-deadening properties, application and drying characteristics in high humidity conditions, moisture resistance, and dirt pick-up performance," Pilcher observes. "We also see a trend toward the desire to apply concrete coatings under more extreme conditions and in more extreme environments," adds Engel. "A good example is coatings applied for infrastructure rehabilitation such as sewer repair, where the need for high chemical resistance and the ability to cure under a wide range of temperature, moisture, and humidity levels is driving the use of new technology."

While no step-change technology has been introduced in recent years, investment in R&D in response to the trends being observed in the marketplace has led to improvements in sustainability and ease of use. "Meeting ever-decreasing VOC limits has been a challenge for the industry," says Edison. "Resin and additive suppliers and coating formulators alike have struggled to develop new formulations that provide the same level of protection without costing more, but the rewards for the industry's efforts are beginning to be realized." More recently, according to Engel, the issue of emission over time from concrete coatings has been raised, and thus there is increased interest in some application areas for the elimination of the use of plasticizers that have a tendency to emit over the life of the coating.

Other companies are working to devise coating systems designed specifically for ease of use by DIY applicators. "We have seen a noticeable increase in the number of products formulated as 'easy to use' for the do it yourself market," says Snider. Bayer, for example, is developing a 1K polyurethane acrylic hybrid dispersion for use by consumers. On the flip side, the company has introduced polyaspartic coatings, derivatives of polyureas that are 100 g/L VOC and highly reactive, producing very high-performance coatings for parking decks and similar applications while also enabling very rapid return to service. These coatings must be applied by trained contractors, though, who have the experience to safely work with these coating systems, according to Grace. In addition to developing 100% solids and waterborne alternatives, researchers at Bayer are creating resin systems based on renewable raw materials that provide 100% solids formulated coatings with 35–40% renewable content.

Bayer also offers UV-curable polyurethane coatings for the concrete flooring market. These coatings are applied to the floor and then cured by a portable, walk-behind UV lamp. "In just the last three to four years, lamp manufacturers have made great strides in the design of portable curing equipment and have introduced safe and effective machines. The availability of these devices has really opened the door for UV curing of horizontal concrete surfaces," explains Ramesh Subramanian, head of business development for UV Coatings with Bayer MaterialScience.

What is driving the interest in this technology, which finds use in industrial, commercial, and residential applications, is the very rapid return to service provided by UV curing combined with the very low-VOC content and high-performance properties of the polyurethane coatings. Another advantage is that these coatings are one component and are available both in 100% solids and waterborne systems. The 100% solids coatings can be cured immediately after they are applied, while the water must evaporate first from the applied waterborne systems before they can be cured. This can take 40–60 minutes. "Both enable very large floor spaces—warehouses, restaurants, manufacturing plants, etc.—to be coated and ready to use in just one to two hours, providing minimal disruption of activity and a low odor, greener coating solution," Subramanian comments. "And as equipment manufacturers come out with bigger, wider machines, the return to service time will be minimized even further." One important note is that these coatings can only be applied by contractors trained in the handling of the coatings and the safe operation of the curing equipment.





Photo courtesy of Air Products and Chemicals, Inc.

Edison Coatings has elected to focus on offering premier coatings products for high end and specialty applications. Recent technology from the company includes potassium silicate coatings; clear aliphatic polyurethanes with metallic pigments that can be used to create multicolored faux finishes; and a self-priming latex coating designed for high-density, concrete surfaces.

Complementary Coatings Corporation has been offering coatings for concrete through its Coronado and Insl-X brands. The company is in the process of combining the industrial coatings products of the two firms into one portfolio, which it will offer under the COROTECH brand. The official launch of the new line will take place in early 2011, according to Spillane. "After the transition is completed, new products will be introduced to ensure that COROTECH has a robust portfolio of high-solids, solvent-based, and waterborne technologies."

Rust-Oleum also offers a variety of products for use on concrete, including OKON Water Repellent Sealers, EPOXY SHIELD high-performance concrete and asphalt coatings, Rust-Oleum Semi-Transparent Concrete Stains and Sealers, and Watertite Waterproofing Paints and Sundries.

PPG's architectural coatings business offers Perma-Crete[®] masonry coatings based on acrylic, epoxy-ester, and silane/siloxane technologies that include block fillers, primers, patching compounds, topcoats, vertical and horizontal concrete stains, water repellents and sealers, elastomeric coatings, and textured coatings. Its protective and marine coatings business also offers self-leveling systems,

thin-film and high-build systems, primers and finishes, sealers, resurfacers, patching and repair systems, containment coatings, and non-skid and decorative high-performance coatings that work well on concrete, according to Kirol. Recently introduced products include Perma-Crete[®] Pitt-Flex[®] elastomeric coating with elongation and crack-bridging properties; Perma-Crete quick-dry, acrylic vertical concrete stain; Amercoat[®] PSX[®] high solids VOC compliant siloxane coating for weather, corrosion, and chemical resistance; MegaSeal[®] MT fast-curing aspartic ester floor coating; and MegaSeal[®] WRU abrasion resistant floor coating.

For concrete coatings, Air Products supplies low- or zero-VOC epoxy curing agents, resins, and a variety of additives. Its Anquawhite[®] 100 waterborne epoxy curing agent cures to a completely clear film even for films as thick as 20 mils, while Anquamine[®] 287 is designed for use in fast-drying concrete primers, even on green concrete, and flooring applications with cement containing aggregate. Ancarez[®] AR555 is a zero-VOC waterborne dispersion of solid epoxy resin that provides excellent coalescence and fast dry properties, according to Engel. Additives from Air Products that are effective for waterborne concrete coatings and sealers include Surfynol[®], Dynol[™], and EnviroGem[®] surfactants for improved surface wetting; Surfynol defoamers for foam control with a wide range of binder systems; ZetaSpense[®] dispersants for improved color development and pigment dispersion; and Carbowet[®] APEO-free surfactants, according to Shauna McAuliffe, marketing specialist for specialty additives with Air Products.

All of these companies—whether suppliers or formulators—are looking to develop products that will meet the needs of both contractors and consumers that want to protect and beautify concrete surfaces. "Concrete is often viewed as lasting forever, but it is not impervious to water and weather," states Wilgen. "While it has great compressive strength, concrete is not very flexible and actually shrinks as it ages. It also is a wearable surface and erodes over time with exposure to water, weather, and foot/automobile traffic. Coatings—and more specifically the right coating for a given application—are therefore very important for maintaining and extending the life of concrete structures. Contractors and consumers have many options for coating concrete. Therefore, coating formulators that can improve the efficiency of the coating process for professionals and gain their trust and loyalty while also offering consumers brands that balance cost, performance, and sustainability have the opportunity to experience real growth," he concludes. ■