Architectural Coatings for Structural Concrete

By Michael Winge

For decades, paints were used on above grade concrete surfaces mainly for decorative purposes, with little regard given to their value in protecting the concrete structure. Often, these exterior paints were not vapor permeable and would peel off substrates when a high moisture level was present. After the introduction of latex acrylic paints and coatings in the 1950s, users began to expect more from exterior paints and took interest in the overall performance of the coating. Over time, it became clear that architectural coatings needed to be multi functional and possess a variety of attributes to truly protect a concrete substrate. Today, architectural coatings must be waterproof, possess a high resistance to wind driven rain, protect against chloride penetration, be carbonation resistant, allow water vapor diffusion (breathable), have a high UV resistance and have aesthetic value. Additionally, a coating may also need to be elastomeric, possessing the ability to bridge small moving cracks and withstand movement resulting from freeze/thaw cycles. Here is a summary of the primary properties that should be considered when choosing a coating for concrete:

Waterproofing

The primary function of a protective coating is to keep water out of the building or structure, and create a protective envelope for the concrete surface. This resistance to water absorption is a basic, yet critical function of any architectural coating. Any paint or coating that absorbs considerable amounts of water will not protect the concrete and will often peel from the surface. Since chloride ions only enter concrete while dissolved in water, waterproof coatings will generally keep chloride ions out of the concrete, further protecting the steel reinforcing. Once chlorides have entered the concrete, they migrate to the steel, attack the steel surface and instigate corrosion.

Carbonation Resistance

Carbonation is the natural phenomenon that occurs in concrete when a loss of pH takes place. This occurs when atmospheric carbon dioxide reacts with the moisture inside the concrete pores and converts high-pH calcium hydroxide to calcium carbonate, which has a more neutral pH. At a lower pH level, concrete's corrosion protection ability is reduced (carbonation moves from the outer surface of the concrete inward, advancing toward the reinforcing steel).

Like other exterior coatings, an anti-carbonation coating can still be water vapor permeable. An anti-carbonation coating forms a cured polymer network, or "fishnet", that catches the larger carbon dioxide molecules but allows the smaller water vapor molecules to pass through.

Water Vapor Transmission

Architectural coatings need to let the concrete "breathe" or allow water vapor to pass from the structure and through the concrete without building up vapor pressure. This helps protect moisture from building up behind the coating, which can lead to condensation in the building or structure and possibly affect the adhesion of the coating to the concrete.

UV Resistance

Sunlight will degrade most polymer materials over a period of time. In the case of protective coatings and paints, it may significantly reduce the protective performance that was expected.

While it is expected that a good quality architectural coating perform for at least 10 years, the life of these coatings is not unlimited and, after time, their technical benefits will start to decrease. Ultra Violet light can also cause fading in the organic pigments used to color many coatings, especially in dark colors.

Elasticity

Most concrete structures move thermally and some even dynamically. This may require a protective coating to have additional elasticity (the ability to elongate and recover) and crack-bridging properties, particularly at low temperatures when coatings become more rigid and cracks become wider. Many coatings are flexible as a free film, but few are elastomeric, and fewer still are sufficiently elastomeric enough to bridge recurring fine cracks at low temperatures.

Fine cracks, which are often insignificant structurally, are very significant to the long term durability of reinforcing steel. These fine cracks can allow water, chlorides, and carbon dioxide intrusion, which lead to corrosion of the rebar and subsequently damage the concrete structure.

Aesthetics

One of the most important and fundamental advantages of architectural coatings is that they beautify the concrete building or structure to which they are applied. Coatings can be tinted, either by the manufacturer or the local distributor or paint store, to an almost unlimited amount of color choices. Most manufactures offer standard colors that the specifier or end user can pick from, but many manufacturers and suppliers also have the ability to match custom colors and tint small amounts of material to that color. This makes paints and coatings a very unique product in concrete protection, because the look of the product is often even more important to the customer than the technical benefits the product provides.

Architectural coatings are also available in many types of textures, ranging from smooth to course, which also add to the aesthetics of the building while helping to hide any imperfections in the concrete substrate. Elastomeric coatings also provide the added benefit of bridging and hiding small cracks in the concrete, as well as providing a uniform look to the building by coating over elastomeric sealants.

VOC Levels

In the past several years, many states have enacted regulations aimed at lowering the levels of VOC (volatile organic compound) in coatings, thereby protecting air quality. Most manufacturers have had to reformulate many products to water based formulations in order to meet these VOC regulations and still maintain the products performance. These lower VOC products can also contribute to LEED credits in building construction.

Conclusion

Today, architectural concrete coatings are much more than just paint. They need to be able to fulfill a variety of functions to not only protect the steel rebar in concrete from corrosion, but also add an aesthetic value to the concrete structure. There are many different types of products and chemistries on the market that can be used for this application. Understanding the benefits and limitations of each type of product for each specific application is critical to ensure a successful application to both protect and beautify concrete.▪

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