Restoration Technology for Polymer Concrete

Consideration for the Selection of Materials for Corrosion Protection & Versatility

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Polymer concrete is one of the most durable, longest-lasting and corrosion-resistant materials available for industrial infrastructure. This class of products consists of a matrix composed of heavy-duty aggregate and either chemical-resistant resin or cement binder. These castable materials may offer up to five times the physical strength compared to standard portland-based concrete.

Tank pad & pump base poured with polymer concrete

Polymer concretes are designed to give superior mechanical properties similar to masonry. Because of chemical resistance throughout the entire thickness, polymer concretes may preclude the necessity of barrier coatings and linings. They offer a one-step approach to solving corrosion and provide superior compressive, flexural, and tensile strength. In addition, select fillers enable physical properties such as absorption and freeze-thaw durability to far exceed most inorganic counterparts.

Application of polymer concrete offers advantages since the product develops strength rapidly. Most castables in this category set through a catalyzed chemical reaction. This thermo-setting process occurs within 24-48 hours, primarily. Compared to the 28-day hydration/curing downtime of standard concrete, construction may proceed much more rapidly.

When properly specified and installed, polymer concrete provides a solution for some of the most difficult corrosion problems. Understanding the capabilities and limitations of the different fillers and resin systems within the polymer concrete family is important. As technologies evolve, the chemistry of various formulations proliferates as well. Engineers, architects, maintenance personnel, and contractors can create a value-added solution to their corrosion problems when knowing what to recommend. The wide variety of polymer concrete formulations can make selecting the correct materials a challenge. Ultimately, selecting the right chemistry can translate into substantial cost savings as determined by increased longevity or decreased construction downtime.

A few of the more common formulations of polymer concretes include silicates, epoxies, calcium-aluminates and vinyl esters. Sauereisen, Inc. of Pittsburgh, PA specializes in corrosion resistant materials and produces a broad selection of polymer concretes to supplement other product lines including refractories, mortars and monolithic barriers of various thickness.

For environments subject to the highest temperatures and acid concentrations, Potassium Silicate polymer concretes provide optimum protection. The silicates can withstand temperature ranges in excess of 1,400^{0}F (760^{0}C). This chemistry will also withstand most solvents, oils, acids, and acid salts (except hydrofluoric) over a pH range of 0.0 to 7.0.

For years, Silicate-based refractories have provided thermal insulation and chemical protection for flue gas structures subject to hot, acidic gasses commonly found in coal burning power generation facilities. Recently, polymer concretes have been specified for horizontal applications, such as chimney floors, where greater compressive strength is beneficial compared to the gunite-applied refractory. In either case, these acidproof concretes possess resistance to full concentrations of sulfuric acid and up to Oleum. Typical applications are construction of sumps, containment pads, dikes, trenches, and support columns or bases. One novel installation in South America involved the formation of a potassium silicate polymer concrete "jacket" around the exterior surface of a sulfuric acid drying tower.

Concrete pad rehabilitation with polymer concrete around a sulfuric acid tank

Epoxy polymer concretes, as a group, offer low permeability and broad chemical resistance. Epoxies exhibit greater bond strength, lower porosity, and more broad chemical resistance than inorganic varieties. Typically, compressive strength of epoxies is greater than 10,000 psi. This classification of polymer concretes shows tolerance to a wide spectrum of acids and alkalis over a pH range of 0.0 to 14.0. These products are often categorized as either general purpose epoxy polymer concrete or as a novolac epoxy. The novolac epoxy resin possesses a greater degree of cross-linking than the standard Bisphenol-A epoxy. Consequently, the novolac resin system offers an upgrade in properties. Among epoxies, novolac systems will tolerate greater chemical concentrations while exhibiting compressive strength of 16,000 psi.

Further up the line of organic polymer concretes is the vinylester family. Novolac Vinyl-esters are specified where certain chemicals such as bleaches or oxidizing solutions are present. Like epoxy-resin based polymer concrete, vinylester polymer concretes can be of a general purpose grade as well as a novolac vinylester formulation.

Often the temperature environment is a determining factor in selecting one of the organic polymer concretes. Sauereisen's epoxy, novolac epoxy, vinylester, and novolac vinylester polymer concretes resist maximum service temperatures of 200^0F, 250^0F, 220^0F, and 350^0F, respectively.

The materials industry continues to develop new varieties of polymer concrete. Sauereisen reports recent advances in working with calcium aluminate formulations for substrates where thermal shock is a concern and with polyurethane where a higher level of flexibility is desired. In either case, material formulators working in conjunction with installation contractors are able to deliver a material that is easy to apply and durable enough to last a generation.

New off-loading pad at a sulfuric acid processing area