Selecting The Proper Fluid-Applied Polymer Resin Flooring System For Concrete Floors

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Over the last 40 years, the protection of concrete floors has evolved from essentially nothing to a fairly sophisticated process involving some type of protective polymer resin coating or surfacing. The main purpose of installing or applying these types of materials, of course, is to provide protection to the slab from deterioration or contamination, or to provide some added benefit such as aesthetics, wear resistance, non-slip functionality, chemical resistance, ease of maintenance, physical performance, and a myriad of other properties.

Without question, no other surface in a building takes more abuse than floors, regardless of the type of building—industrial, institutional, or commercial. Floors are subjected to just about every kind of abuse—impact, abrasion, chemical attack, and thermal shock. Concrete floors, without some sort of treatment or coating, are not designed to withstand this continual abuse.

Concrete floors are inherently porous and tend to generate dust from wear and abuse. They are also subject to abrasion and chemical attack. It is for this reason that virtually all concrete requires some sort of protection, regardless of where it's located. The problem, in the overall picture, is to determine what type of protective material to choose to respond to the given conditions.

This article will focus on fluid-applied polymer resinous floor systems and coatings that are bonded directly to the concrete surface, offer long-term protection, and may or may not add aesthetic value.

Decisions, decisions.
The problem facing most design, building, and facility decision makers—whether they are architects, designers, or facility managers—is to choose the most effective material and application that will result in the best performance and lowest lifecycle cost. It is increasingly clear that these individuals must rely on knowledgeable professionals to assist in the proper selection, application, and maintenance of the floor system. The polymer resin flooring specialist can guide the owner in proper material selection, application, and long-term performance, thereby reducing the long-term cost of floor maintenance.

Total floor protection should be part of any study or evaluation for new or old concrete floor protection. The thorough process for selecting a resin flooring system, the writing of a detailed specification, and the preparation of detailed application procedures and final acceptance criteria will give the owner a basis for choosing the right system.

A comprehensive selection process should be followed to narrow the search for the right product and application for floor coatings. Remember, the task is not just selection of the material, but a total system in terms of application, total thickness, and aesthetics.

The material-selection process

1. Evaluate the Surface
The polymer flooring specialist must be able to provide a complete program from conception to long-term maintenance. The process should include the following:

- ***Evaluate the existing concrete surface to determine what you are working with***. The surface must be structurally sound, clean, and must not be contaminated with any foreign material that could interfere with the bond of a new resin flooring system.

- ***Is the concrete surface distressed in any way?*** Are cracks, spalls, or unevenness present? Does the resin flooring system require a level floor or one that slopes to a drain?

  Patching, repairing, and leveling are as important as the polymer flooring system and would require a whole separate discussion to address thoroughly. It is important to state, however, that any material used

to level, patch, or slope must be compatible with the total flooring system. A cheap, low-performance patching and leveling material can ruin an otherwise excellent polymer floor.

It is also good practice to allow the same contractor that is doing the polymer-floor installation to make any needed repairs to the concrete substrate.

- ***What type of surface preparation is needed for the area in question?*** Surface preparation is the most important step in the installation process and is critical to long-term performance of the total system.

  Unfortunately, no single "best way" to prepare the surface exists. The resin flooring selection (thin-film coating or thick, aggregate-filled surfacing) will have a bearing on the type of preparation. Or, to put it another way, the required surface prep can dictate the type of system from a thickness standpoint. A thin-film coating requires preparation that will not leave a heavy profile or texture. A heavy profile may require a leveling or fill coat before the thin-film material installation. This could double the estimated material cost.

It is also important to remember that new concrete requires proper preparation, as does an old concrete surface. Curing compounds must be removed, a proper profile or texture achieved, and any surface laitance removed.

2. **Consideration of performance conditions**

Four major types of abuse will dictate the performance requirements of a polymer resinous flooring system.

- ***Chemical exposure***. Severity of exposure and types of chemicals are both important. Resin materials differ widely in chemical-resistance capabilities, making identification of the exposure highly important. Common splash and spills also are far less problematic than constant immersion.

- ***Abrasion***. The amount of wear or traffic a surface will be subjected to is an important criterion. The presence of steel-wheeled traffic as opposed to rubber-wheeled traffic must be taken into account. Any surface exposed to steel-wheeled traffic requires special treatment for long-term wear resistance.

- ***Impact***. Heavy loads and direct impact require a thicker, aggregate-reinforced resin floor system.

- ***Thermal shock***. Temperature fluctuation, or thermal shock, can have a significant impact. Thermal shock caused by steam cleaning of the floor surface may result in a loss of bond due to differential thermal expansion if the polymer floor system is not chosen properly. The coefficient of expansion of most polymer floor systems is much higher than for concrete and must be carefully considered when selecting a material.

Once the degree of severity of the major sources of abuse to the polymer floor is identified, they must be ranked in order of importance for the particular project. This will provide a major focus for what is needed in terms of type of material and applied thickness.

Other selection considerations

Other considerations are often overlooked when selecting or specifying a polymer floor system. These lesser considerations don't necessarily contribute to the function of the system, but are important in successful installation of a particular system and assurance of owner satisfaction.

- ***Aesthetics***. The final appearance of the floor surface is more important than many people perceive it to be. An owner's thinking on how the floor was going to look versus the final appearance is sometimes quite divergent. In the current marketplace, identical performance characteristics can be obtained with a variety of decorative appearances and surface textures.

- ***Installation parameters***. In many cases, a flooring project is up against a very tight installation schedule. This places limits on some systems, depending on how long it takes to install a given material. In occupied areas, the odor of some solvent-based systems or the inherent odor of the material itself will limit its use.

Temperature of the surface at the time of installation is critical in selecting a material. Some systems, such as epoxies, are quite temperature sensitive; lower temperatures also can affect cure time greatly.

- ***Life expectancy***. Owners want a flooring system that will last forever, and will be guaranteed. In actuality, a given system will require periodic maintenance. Maintenance procedures must be clearly outlined and understood in order to provide a significant life expectancy.

- ***Economics***. The system's economics must be considered a major factor, perhaps the single most important factor. At times, low-cost systems will prevail at the expense of more durable systems. Generally, all other considerations aside, the old axiom that "you get what you pay for" holds a great deal of validity. Another generally accepted maxim is that the thicker the applied system, the better the performance.

Material properties and application procedures
The primary reason to go through a material selection process is to make the right call on the proper resin material for the application being planned. It is critically important to review technical data, performance characteristics, and installation procedures for the materials that have survived the elimination process thus far.

The technical data and performance review can be difficult for most architects, engineers, specifiers, and owners because no standard form of data presentation exists. The following discussion, however, identifies differences in technical data and performance based on applied thickness. Various ASTM test methods, Federal Standard test procedures, Corps of Engineers test methods, and other guidelines are used by resin formulators to represent the capabilities of their products. In many cases, the reviewer must compare test method to test method to determine the differences in the reported values. Professional assistance is suggested to completely understand the data. To ensure optimal performance, it is necessary to keep in mind the key service conditions the materials will be subject to.

Resin type and thickness
At this point in the selection process, it's time to settle on the type of resin material, application, and applied thickness.

Polymer resin flooring for concrete can be classified by:

- ***Thickness***

Thin-film	1-10 mils
High-build	10-30 mils
Slurry/broadcast	40-125 mils
Topping/overlay	125 mils-1/2 inch plus

- ***Polymer type:*** Epoxy, polyurethane, polyester, vinyl ester, acrylic, methyl methacrylate (MMA), or other.

- ***Appearance.*** Functional, decorative, or both.

- ***Finish***. Is a smooth or textured finish preferred?

The selection process can narrow the thickness and the appearance requirements. Consideration of polymer type, however, can prove more difficult and may require professional assistance in reviewing data and comparing performance.

Thousands of formulations exist for polymer resin flooring systems for concrete, and each is different from the next. While epoxies and polyurethanes are the most commonly used polymers, performance and data vary significantly. In a general comparison, however, it can be stated that urethanes are used for thin-film to high-build coatings, and are characterized by excellent abrasion and wear resistance, excellent gloss retention, and good to excellent stain and chemical resistance. Some urethanes also exhibit excellent elastomeric properties and, due to low permeability, are used extensively where waterproofing capabilities are important.

Urethane resins are also used as binders in urethane cement systems. These materials offer unique performance properties that include excellent resistance to thermal shock, chemical resistance, tolerance to moisture-vapor transmission, and rapid cure. Historically, most urethanes were solvent-based coatings. Regulatory and

environmental mandates, however, have made it necessary for manufacturers to reduce VOC (volatile organic compound) content. Many formulators now offer ultra-high-solids and water-based urethane resins that are VOC compliant in all states.

Epoxy formulations used in resin floor systems typically are 100% nonvolatile (no solvent), and are characterized by excellent adhesion, good to excellent chemical and abrasion resistance, and excellent mechanical properties. Applications include bonding adhesives, crack repair, concrete coatings, aggregate-filled toppings, and overlays.

Specialized epoxy formulations are used as flexible crack isolation membranes and moisture-vapor control primers, among other applications.

MMA—methyl methacrylate—is a unique type of acrylic resin that is 100% reactive (no VOC). MMA resin is characterized by very rapid cure (typically one hour for full cure), and offer cold-temperature cure (down to minus 20 F), UV resistance, and good chemical resistance. These resin floor systems are used in food plants, sports stadiums, freezers, or projects where very limited time is allowed for the installation and curing. In spite of the 100% reactive nature of MMA, however, it generates a strong odor that requires good ventilation.

Vinyl ester resin systems offer excellent chemical resistance, and are typically used for secondary containment dikes where chemicals are stored and in other severe chemical processing areas such as metal plating where a variety of strong acids may be continuously spilled. Vinyl ester generates a strong odor that requires good ventilation during application.

More detailed comparisons of polymer resin types would require discussion of individual thickness classifications, which goes beyond the scope of this article.

Installation and inspection

Once the polymer floor system has been chosen, the material must be applied and the job inspected and approved. The choice of an appropriate specialty flooring contractor to install the system is just as important as the material used. A contractor trained to install a particular polymer resin floor system (e.g., thin-film coating versus thick overlay) is critical. Once the system and the contractor have been selected, coordination among parties must be maintained to ensure the best performance and user satisfaction.

The job does not end with the application of material. A long-term review, maintenance, and repair program should be established for continued performance and satisfaction. Floor surfaces are punished by continuing wear, abrasion, and impact. Even the most durable surface will show areas of distress that require attention. Still, attention to selection and application details prior to installation will prolong the life of a flooring system. As years go by, the success of the project will depend on the coordination between the flooring specialist and the facilities manager. The payback will be a trouble-free floor at lower cost.