



Selecting the Polymer To Make Concrete Patches **LAST**

By Floyd Dimmick, Sr.



Despite the wealth of literature published during the last two decades on the topic, patch material selection—almost always a polymer—is still the subject of much confusion. Perhaps some light here can be shed on the distinctions between the capabilities of the available polymers, their workability during placement, and the expected life of the patch.

But first, what is a polymer?

Polymerization is a process of combining simple molecules to form more complex ones with different physical properties. A polymer is the result: a giant molecule.

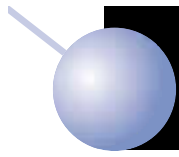
When mixed with an aggregate, a polymer, often called the binder, serves as an adhesive and helps create a composite material. The various polymers are the main controlling factors in the overall durability of most concrete patch systems. Thus knowing the physical behaviors of different polymers under different environmental conditions is necessary to successful concrete patching.

One thing is certain: despite the numerous patch systems offered in the industry *there are no cure-all formulas.*

Epoxy Polymer Concrete (EPC)

Epoxy systems used for polymer concrete patches are two-component. The liquid epoxy resin component is available in a wide range of molecular structures consisting of bisphenol A or F, novolac and other monomers, or combination mixtures of these raw materials. Additives are often blended in to improve such properties as wetability, flexibility, adhesion, and color.

The curing agent component, or hardener, is available in a wide selection of properties and chemical structures. Most ambient-temperature-cured systems contain aliphatic amines, cycloaliphatic amines, amidoamines, polyamides, tertiary amines, or a blend of these materials. And because of the hundreds of formula combinations of epoxy resins and curing agents, it is easy to understand the diversity of properties available in cured EPCs.



SOLUTIONS FOR CONCRETE REPAIRS

The properties of a system when cured are determined by the selection of epoxy resin and the curing agent to achieve the cross-linking and overall density of the thermoset polymer. This selection is made by the epoxy manufacturer and offered as a completed patch system to concrete contractors or coatings professionals.

Careful selection of the EPC is required for high performance patching projects. Typical properties to consider:

- Placement on smooth or rough surfaces
- Lift height and down time between lift placements
- Coldest substrate application temperature
- Hottest substrate application temperature
- Non-flammable formula
- Maximum batch size
- Odor during placement
- Working time (pot life)
- Cure time until useable by the customer
- Adhesion to dry, moist (damp) or wet substrates
- Adhesion property to PCC
- Ease of placement
- Compliance with ADA or OSHA slip requirements
- Shrinkage or swelling during cure
- Compatible on interior or exterior applications
- Abrasion resistance
- Chemical resistance
- Heat resistance temperature
- Physical strengths
- Product and placement cost

Since the early 1950s, industrial floors have been repaired with EPCs. Because of their versatility and performance, coupled with a long history of use, there is more documentation on epoxies from research and completed applications than any other polymer. EPCs are considered the overall safest polymer to use under the widest variety of placement and curing conditions.

Methacrylate Polymer Concrete (MMAPC)

Methyl methacrylate (MMA) and high molecular weight methacrylate (HMWM) are the primary monomers used in methacrylate polymer concrete. It is supplied as a multi-component polymer system and mixed just prior to use. MMA monomer is low viscosity, highly volatile liquid with a sharp, pungent odor.

A promoter and peroxide initiator must be added to the monomer to begin polymerization. The mixed polymer is blended with the select gradations of aggregate as a composite overlay system. Training is recommended for new applicators, but an experienced placement crew can easily apply the system.

MMAPCs have been used for many years as industrial floors with satisfactory performance. They provide good working life during placement and relatively rapid cure time of one to five hours at 21°C (70°F). One of the tricks, however, is they must be covered during cure to prevent monomer loss due to evaporation, and they are intolerant of moisture during placement or cure. High shrinkage of the polymer is typically controlled with the aggregate selection. MMAPCs exhibit good chemical resistance to weak acids, caustics and solvents.

Some MMAPC system disadvantages have been overcome using an acrylic resin base as a substitute for methacrylate. These acrylic resins are 100% reactive and solvent free and this makes them safer for interior applications. The resin system also has better chemical resistance to aromatic solvents than MMA and cures quickly.

Polyester Polymer Concrete (PEPC)

Polyester resins are always supplied as two-component systems. The resin component is a low viscosity material mainly produced by a reaction of unsaturated dibasic acids with dihydroxy alcohols and commonly dissolved in a vinyl group monomer such as styrene. The initiator component is usually organic peroxide. The initiator is very sensitive to elevated temperatures above 90°F (32°C) and gradually loses its reactivity.

Polyester molecules in their uncured state are very sensitive to humidity and water, and must be applied to dried surfaces. Many formulas are also sensitive to alkaline conditions, which can cause loss of bond. Polyesters should never be used on substrate temperatures lower than 50°F (10°C) because the cross-linking state will not develop. The uncured PEPC is flammable with flash points below 100°F (38°C) during installation. If it sounds like tricky stuff, the answer is yes, it can be!

The overall properties of the cured system are most dependent on the polyester component. The system is typically mixed in a different sequence than EPC or MMAPCs. The resin is premixed with aggregate, then an initiator is added with the promoter and the composite is blended, causing a cross-linking reaction between the styrene and polyester.

Most PEPC formulas are typically used on lower tensile strength concrete that require reduced chemical and durability performance. They must be applied to dry concrete. Caution must be observed in polymer selection because PEPCs can debond and develop delaminations just below the bond line when subject to rapid thermal changes. Epoxy or methacrylate primers can improve the bond to PCC. PEPCs will tolerate moderate exposure to organic acids. When high performance is required or thermal changes will occur, systems other than PPCs are a better bet.

No Easy Solutions

Obviously, there is a wealth of concrete patching alternatives and there is no easy solution. If the right polymer concrete is applied to a job in the right way, the longevity of the patch should be high. But it does take some understanding and a little willingness to do the homework on the part of the professional. CP

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