Everyone's Guide to Instant Epoxy Expertise

Need a quick, practical education on epoxies and epoxy coatings? The following list of epoxy information points will get you up to speed fast.

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<u>Disclaimer:</u> Much of the information below is general in nature, non-specific to any particular brand, and randomly presented. There are always exceptions to everything and no doubt someone could debate nearly every point made below. However, in general, and to the best of my knowledge, the information below holds true and will make you immediately knowledgeable about epoxies.

1. Epoxy coatings are used because of their outstanding chemical resistance, durability, low porosity and strong bond strength. Better protective coatings are available but not as common, field applied, brush-on, roll-on, or trowel-on coatings.

2. Epoxies consist of a 'base' and a 'curing' agent. The two components are mixed in a certain ratio. A chemical reaction occurs between the two parts generating heat (exotherm) and hardening the mixture into an inert, hard 'plastic'.

3. Epoxies yellow, chalk (or more commonly least lose their gloss), in direct sunlight (UV). The yellowing can be a real problem. For pigmented epoxies select colors that are dark or contain a lot of yellow (such as green). Even clear epoxies will yellow and cloud up. Often epoxies are topcoated with latex or urethanes that will retain their color and attractive gloss. This is particularly true if color coding or matching company colors is important.

4. After the two epoxy parts are combined there is a working time (pot life) during which the epoxy can be applied or used. Generally the pot life will be anywhere from minutes to one hour or longer. At the end of the potlife the mixture becomes very warm (or even dangerously hot) and quickly begins to harden.

5. Epoxies will harden in minutes or hours, but complete cure (hardening) will generally take several days. Most epoxies will be suitably hard within a day or so, but may require more time to harden before the coating can be sanded.

6. In theory, a temperature change of 18 degrees F. will double or half the potlife and cure time of an epoxy. Higher temperatures will lower the viscosity (thin) the epoxy, but also reduce the working time a person has to apply the epoxy. Spreading out the mixed epoxy instead of keeping it concentrated in a bucket or container will extend the potlife.

7. Generally epoxies become too thick and cure too slowly to be applied at temperatures below 50 or 60 degrees F. Temperatures in the 60s, 70s, or low 80s, are best. After the epoxy has cured, it can handle temperatures well below zero degrees F.

8. Epoxies will begin to soften at about 140 degrees F, but will reharden when the temperature is reduced. For common epoxies this temperature is approximate upper end of working temperature range of epoxies. Special high

temperature epoxies do exist, however.

9. By their nature, epoxies are hard and brittle. Additives can be added to epoxies that make them less brittle, but generally at the loss or reduction of other positive epoxy properties such as chemical resistance.

10. There are special epoxy formulations that have increased chemical resistance, increased temperature resistance, the ability to be applied underwater, and enhance resistance to yellowing and UV damage.

11. Epoxies are expensive, but there are ways to 'water down' the epoxies with less expensive solvents an/or non-solvent thinners. These cheaper, diluted epoxies do not perform as well as the more expensive, unaltered epoxies. Diluted down epoxies are especially common with 'floor epoxies' where pricing pressures are especially strong. To a large degree you do 'get what you pay for'. A common non-solvent thinner is a chemical known as nonyl phenol. This chemical is sometimes used in small amounts to make epoxy mixing ratios easy whole numbers. However, cheap epoxies may contain large amounts of this inexpensive chemical. Check your epoxy's MSDS for references to nonyl phenol.

12. Another clue of a cheap epoxy is if it requires haz-mat shipping. Generally the better resin systems can be shipped non-haz-mat. The exceptions are special high temperature and/or more UV resistant epoxies, which often require haz-mat shipping.

13. Other clues of cheap epoxies include 'induction time' (after mixing the two components the mixture must sit for several minutes to 'self cook' before being applied), and crystalization of either part A or part B if left sitting for several months (like crystalized honey, simple heating will dissolve the crystals).

14. As they cure most epoxies 'blush'. Blush is a waxy film that forms in the surface of the curing epoxy due to moisture in the air. Because nothing sticks to the waxy film (including paint or additional layers of epoxy) it must be washed off. Most epoxies blush to some degree but some of the very best epoxies do not, in fact, some can actually be applied underwater.

15. The best time to recoat epoxy is within about 48 hours after the initial coat. Because epoxies take days to reach full cure, a second coat applied shortly after the first coat will partially fuse to the first coat rather than forming a simple mechanical bond.

16. Always mix the epoxies in one container then pour it into a second container and apply it from the second container. The reason is that mixing is never very good at the corners, edges and sides of the mixing container. If you apply the epoxy from the primary mixing pail you will certainly get some of the unmixed epoxy from the bottom of the container and that epoxy will not harden. Transferring the epoxy to a second container leaves the unmixed epoxy behind, or blends it into the well mixed epoxy.

17. The difference between polyester (fiberglass) resins (commonly used in fiberglass boats) and epoxy resins: Polyester resins are much less expensive, have very strong fumes, are more porous than epoxy resins, and only sticks really well to itself. For anti-blister marine barrier coats, and bonding to wood, steel, etc. use epoxy resin not polyester resin. Generally epoxies (which are often solvent-free) can be applied to foam products whereas the polyester resins will dissolve these products.

18. End users can thicken epoxy with many things, Tiny glass spheres, known as micro-spheres or micro-balloons are commonly used. Besides thickening, their crushable nature makes sanding the hardened epoxy easier. On the downside, they work like tiny ball bearings, resulting is sagging and slumping. Another thickener is fumed silica (a common brand name is Cabosil (tm)) which looks like fake snow. About 2 parts fumed silica with one part epoxy will produce a mixture similar in texture and thickness to petroleum jelly. Micro-spheres and fumed silica can be combined together.

19. While epoxy floors are very common, for serious and demanding applications the epoxy is either mixed with, or applied under and above, quartz (sand) or aluminum oxide grains. Either way, the result is really a quartz or aluminum oxide floor, held in place with the epoxy. The quartz, and even better the aluminum oxide, is much more durable and wear resistant than the epoxy alone.

20. How thick should your epoxy coating be? Thicker is not necessarily better. The paint on your office walls is probably 2-4 mils thick (1000 mils = 1inch). Ten mils is considered a fairly thick industrial coating. A gallon of epoxy applied at 10 mils will cover 160 square feet. That same coating, applied 1/4 inch thick, will only cover 6.5 square feet. To be price competitive with the 10 mil coating on a cost per square foot basis, the quarter inch thick coating would have to be very inexpensive. A primary way to reduce cost is to use low quality resins and lots of cheap fillers. As a result, the thicker coating may be inferior to the thinner, higher quality coating.

21. Adhesion of underwater applied epoxies: Underwater epoxies generally have good to excellent adhesion to most submerged surfaces, however, steel surfaces in saltwater environments can be a problem. Such surfaces are often protected by a cathodic protection system. These systems use electrical current to suppress corrosion. Dissimilar metals in saltwater also form tiny electrical cells. Because epoxy bonding is due to molecular attraction of charged particles, existing electrical charges, known or unknown, can interfere or disrupt epoxy bonding. It is best to test underwater coatings for possible cathodic adhesion problems if used in marine settings on steel surfaces.

22. Epoxies and other paints/coatings should not be applied directly to galvanized surfaces. Galvanization is itself a protective coating, one that works by forming its own protective layer. Epoxies applied to galvanized surfaces will soon peal off. If galvanized surfaces must be coated, be sure to use an approved primer. For reasons not known to the author, aluminum is also another metallic surface that epoxies sometimes have a difficult time getting a good bond to.

23. Fisheyes are areas on a painted surface where the coating literally pulls away for the substrate leaving a coatingless void or fisheye. Often fisheyes are caused by surface contaminants such as a bit of silicon, wax, or oil. I have also seen them on clean plywood where epoxies paints have been used as sealers and the problem might be due to uneven saturation (soaking-in) of the epoxy into the wood. Surface tension plays a big part in fisheyeing. There are some additives that can be mixed into the epoxy that will reduce surface tension. Likewise, on wood, applying several coats of solvent thinned epoxy, instead of one coat of unthinned epoxy, seems to work well. Applying a thick coat of epoxy over a contaminated fisheye surface will bury the fisheye but expect the coating to peel away in the future. As a rule of thumb, always suspect some sort of surface contamination as the primary cause of fisheyeing.

24. Adding a bit of solvent to a solvent based or solvent-free epoxy is something that most manufacturers would not officially approve of and something that might not work with all epoxies. However, it can be done (unofficially) with the epoxies I deal with. Adding solvent to these epoxies will: 1) thin them out; 2) increase potlife; 3) allows them to flow off the brush/roller a bit more smoothly; and 4) perhaps allows them to 'soak-in', penetrate, or may be soften, the substrate just a little bit. Not change is visible in the epoxy unless 12% or greater solvent is added. With that amount of solvent, the epoxies no longer cure with a glossy finish.

25. It is best to use epoxies with a mix ratio close to 1 to 1 as opposed to something 4-1, 5-1, etc. because errors in the mix ratios can be more pronounced with the latter. That said, no matter what the mix ratio is, some epoxies are more forgiving of mix ratio errors than others. One 'trick' of epoxy vendors with odd or very sensitive mix ratios is to sell calibrated pumps that disperse the epoxy components in exact amounts.

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