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EPOXY & FIBERGLASS FLOORING, SEAMLESS FIBERGLASS WALL SYSTEMS, SEALERS, HIGH PERFORMANCE COATING SYSTEMS, AND INDUSTRIAL CLEANERS

INDUSTRIAL FLOORING TECHNOLOGY SERIES- #10 POLYMERS USED FOR POLYMER FLOORS

I'm often asked "is a urethane better than an epoxy?" This is rather like being asked if Toyota is better than a Buick. Well, it depends on which one and what it's used for. There are a LOT of choices. So maybe it would be useful to narrow down the characteristics and some of the choices.

For high performance industrial floor (and occasionally wall) use there are 7 common resin choices: Epoxy, urethane, polyester, vinyl ester, poly aspartic, poly urea and silicone resins. I'm going to try to make this simple and I'm sure a chemist here and there will say I missed something.. ahhh well…yea I did. I think I have formulated a few thousand of these items and I could go on and on and on …. But to be helpful I will try to be brief and to the point.

EPOXY MATERIALS

There are in general 4 common epoxy materials used : liquid epoxy, solid epoxy, higher molecular weight epoxy and novolac epoxy- which can be either a liquid or a solid. These are blended with an amine of some sort – aliphatic, aromatic, cycloaliphatic, polyamide, amido amine, etc to give the final product characteristics. To make it more fun sometimes these are blended as well.

In general the liquid epoxies are formulated with the aliphatic or the cycloaliphtic resins and are typically used as high solids coatings or in trowel applied blends. (The aromatic also but these are highly suspected carconigenic materials, have to be used with precautions but generally do give very good chemical resistances especially if post cured – baked on tank car walls for example) For the most part the aliphatic and cycloaliphatic wear about the same but the later generally has better UV resistances and chemical resistances.

The solid resins need to be dissolved in a solvent and are more often used as thinner wall and floor coatings. Most popular of this type is the polyamde epoxy which has been in general wall and once floor use for 40 years or so. Originally it was considered a "great" item but now it's been replaced by many other and better materials – our #1300 for example. Still it's pretty good for general purpose wall paint – better certainly than an enamel. As a floor coating it's at best ho hum. Today many epoxy paints use a higher order of cross linker (amine) and give very good performance.

The novolacs are muli functional epoxy material. The basic epoxy has 2 reactive groups while novolacs can have several more. More reactive sites= higher cross link density = better chemical resistance with the right amine cross linker. These are targeted for wall and tank liners usually and are useful against specific strong chemical attack.

SOME GENERAL CONSIDERATIONS

1. Epoxies usually have good adhesion making them a good choice for primers.
2. Epoxies usually do not have good UV light resistance - they yellow- and some are really quite poor.
3. Epoxies have generally low heat deflection temperatures. This means that heat will soften them and they will not reharden as strong as they were before. So if the use is at temperatures above ambient you want to do some checking.
4. Epoxies are frequently used for building thickness by themselves or with an aggregate filler. Useful for floors and wall systems.
5. Epoxies can give virtually odorless installations.

6. Epoxies take a while to develop full characteristics often 7 days for full chemical resistances
7. Epoxies are normally formulated for ambient cure conditions : 45F-90F. Often an epoxy simply stops reacting at cooler temperatures and waits for warmer times to start up again. Above or below these temperatures you need an item specifically formulated for these cure conditions.
8. Epoxies are relatively inexpensive and user friendly in installations.
9. Sometimes tough to color match since the amine gives color to the material as well as the pigment
10. Skin sensitization is possible

URETHANE MATERIALS

Once again I may over simplify too much in the aim of being useful. You might consider that ther are two types of urethanes the aromatic and the aliphatic.

AROMATIC URETHANES

1. are not uv stable and do yellow a lot
2. in general have only modest chemical resistance
3. usually have good wear resistance
4. are quite inexpensive compared to the aliphatic urethane
5. often are not cross linked with another resin but can be.- these are usually the single pail system.
6. are most usually dissolved in very flammable solvents
7. do not have good adhesion and ought to be used over an epoxy prime.
8. Were the original urethanes developed in the 1950's
9. The monomer is consider carconegenic and is released when sprayed but not when rolled

ALIPHATIC URETHANES

1. More commonly used
2. More often cross linked then used as a one component, air cured system.
3. Are excellent against UV light
4. Can have amazingly good and wide spread chemical resistance when cross slinked with the right material
5. Usually applied over an epoxy primer for best results.
6. The cross linked material- acrylic or polyester- is relatively easy to pigment and color match.
7. Sometimes the material is not easy to recoat and recoat window intervals need to be observed.
8. Usually dissolved in flammable solvents.
9. Can have excellent to amazing abrasion and wear resistance.
10. More expensive then the aromatic urethanes and most epoxies.
11. Not used for build but makes a good top coat over a built up epoxy surface
12. Sometimes can be made to cure at relatively low temperatures
13. Often used outdoors on tanks, bridges etc.
14. No carcenovic materials when sprayed
15. Skin sensitization is possible

WATER BASED URETHANE

1 these are a concession to the usually strong odors the aliphatic urethanes have during installations while retaining excellent UV light resistance.

2. sometimes they give amazingly good wear resistance – our #2300 ACROTHANE

3. often do not have as good chemical resistance as the solvent borne materials

4. The installation odor is minimal.

5. installation, shipping and storage temperatures are a big factor.

6. best to use over an epoxy primer.

7. Some types may be used in conjunction with cement materials to give a near odorless floor surface suitable for use in many food plants.

POLYESTERS AND VINYL ESTERS

The novolac epoxies have more reactive sites then the usual epoxies and so are more chemical resistant. Take this a bit further and you have the polyester and vinyl ester materials with up to a dozen or more reactive

sites (ok hydroxyl sites but scheesh!). These are one component materials dissolved in a solvent – styrene usually- which also enters into the reaction with the resin, forming the cross linked final polymer. Like epoxies and urethanes there is a lot of variety in these materials.

TYPICAL CHARACTRITICS ARE

1. Amazing to extraordinary chemical resistances depending on the resin – yep there are novolac polyesters too- and about the best chemical resistances you can get from ambient temperature cure systems.
2. A LOT of odor during installation. Some studies suggest only 1-2% of the styrene actually evaporates but it seems more. These ABSOLUTELY require ventilation consideration for flammability, toxicity and odor absorption, especially by food stuffs.
3. Often catalyzed by quite dangerous materials- MEKP.
4. Very good heat deflection temperatures vs epoxies – often 240 F and above
5. Very low viscosities making it good for self leveling and trowled aggregate systems
6. May be thickened for wall systems- CHEMSHIELD SYSTEM- or laminated in with fiberglass for additional strength- FABRILON SYSTEM
7. Questionable adhesion in some resin systems necessitating a primer and over catalyzing can make the material shrink and delaminate.
8. Usually a short working time with most resins, so experienced applicators are needed. NOT a do it yourself or rookie material.
9. Some have very good UV light resistance – eg fiberglass resins used for boats and cars.
10. Usually bought in 55 gal drum quantities and not often sold in smaller quantities. They are not small job materials unless you have some left over.
11. Will stay a bit sticky and needs a wax surfacing agent. Once this is in the top coat, recoating is VERY difficult.
12. Usually are durable and have good wear characteristics, but can be inflexible so the need for an aggregate filler or fiberglass strengthening is essential.
13. Usually for ambient temperature installations.
14. Pigment dispersions are available for nearly any color you want.
15. Usually these make a stronger and more chemical resistant built up surface than epoxies, and are preferable if the installation odor can be controlled
16. Installation time for a build up surface is less than for epoxies which minimizes down time for a customer.

POLYUREA AND POLYASPARTICS

Take a urethane and mix it with an amine and you get a poly urea. Lets see there are maybe 1000 different urethane materials available and several thousand different amines and these are blended in all sorts of combinations to give the final product, for simplicity I will class them as slow, medium and fast. As in the urethanes there are aromatic and aliphatic the later being much more UV resistant but more expensive. This area of technology is probably the fastest developing chemistry and new things are coming out nearly daily. I'm more apt to wait and see how these actually perform then to rush into using something new for the sake of novelty.

SLOW- pot life when mixed from 5 minutes to 30 minutes

1. Usually used as a coating for terrific abrasion resistance and/or UV good light resistance: #1410 for example
2. Can be very clear and water white
3. Can be 100% solids so very little to no odor during installation.
4. Usually quite expensive per gal but not so per equivalent thickness and typical of good urethanes.
5. Characteristics can range from wet noodle spaghetti flexible to hard enough to hammer with.
6. Often used as a mold filling material for various castings
7. Fairly easy to pigment and color match especially with dispersions.
8. Can be a high build material suitable for decorative flooring.
9. Usually not great chemical resistances.

MEDIUM – POT LIFE FROM 0.1 SEC TO 5 MIN

1. Often used in a two component pump and static mixer system.
2. Often used as crack and joint fillers. – example: PFAC- with short time to use of 30 min or less
3. Sometimes used with two component spray guns as truck bed and tank truck liners.
4. Wide variety of flexibilities and hardiness's.
5. Not really great chemical resistances though some specific resistances can be quite good- PFAC with 3 years immersion in 1N NaOH with no effect for example
6. Some special formulations have excellent long term heat resistance: PFAC for example to 400F

FAST - INSTANT REACTING TO 0.1 SEC

1. These need two component high pressure – often heated- spay equipment and are NOT a rookie adventure.
2. Often have superb to nearly unbelievable abrasion resistance – marine propellers, coal chutes, pump parts etc.
3. Some have quite good heat resistance – PFAC to 400F for instance
4. So far the spray equipment does not have the fine differentiation of the usual airless sprayers but I bet this will improve.
5. Nearly instantaneous cure and zero time to use after application.
6. No solvents so installation odor is minimal.
7. Very good weathering and UV resistance is possible so these are gaining popularity as bridge and other outside metal coatings.
8. Might be bit tough to remove and possibly a challenge for recoating. Doing it right the first time is essential.
9. MVT is a big consideration over concrete and these can bubble or delaminate in some conditions.
10. Can build and build and build one layer over another quite quickly, though this can become expensive.
11. These are cutting edge technology and it is suggested you investigate where a specific product and applicator have had success in the past in similar situations as yours. Avoid being an experiment. Some of these are where the shot blast and put 100% solids epoxy down over anything was about 10 years ago. That seemed a good idea but it did not always work out so well. Also see #8 above.

SILICONE TYPE MATERIALS

Normally these are used as penetrating sealers providing hardening and dust proofing of the concrete. Often these give a pretty good shine and are routinely polished for VERY high shine. For a review of the various properties see INDUSTRIAL FLOORING TECHNOLOGY SERIES- #6 SILICONE MATERIALS.

IN GENERAL

1. These penetrate the surface and do not give a "build" and do not "fill" the surface without several coats.
2. Cannot be over coated with an epoxy or urethane
3. Usually do not give more than modest short term chemical resistance
4. Are VERY easy to apply- often no more than a bug sprayer is needed
5. Are not available in colors (yet)
6. May be considered "green" products
7. Usually do not burn and are a good choice in a welding environment- better than coatings
8. Breathe moisture very well, or can be designed to a barrier moisture vapor (Sinak materials for example)
9. Often can be applied very shortly after the concrete is poured
10. Are usually rather low in cost to install, though polishing can raise this cost quickly
11. Some combinations give quite excellent stain barrier properties and superb salt and water barrier properties
12. Might be technology worth watching in the upcoming years.

Tom Hennessy ChE
I hope this helps