REAL WORLD epoxies
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EPOXY BASICS

Section	
Name	Epoxy Basics.
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Aim	Document basic epoxy concepts.
Scope	Basic concepts and glossary of common terms.
References	

Epoxy Basics

1 The Epoxy Basics

- Epoxy formulations are available in the full spectrum of forms and functions. They can be clear, low-viscosity sealers, brushable protective coatings, high-build mortars (applied by trowel/spatula) and flexible adhesives and sealants.

- Epoxies are predominantly solvent-based technology. This means that they are miscible and can be cleaned-up with organic solvents such as MEK, acetone and methylated spirits. There are water-based epoxy formulations, however these aren't as common or widespread as the two-pack, solvent-based technology.

- Two-pack epoxies consist of a Base/Part A (epoxy resin) and a Cure/Part B (primarily amine or amide compounds). The two components are mixed in a certain volume ratio specific to the product. A chemical reaction occurs between the two parts generating heat (exothermic reaction) and hardening the mixture into an inert, hard plastic (thermoset plastic). It is important that the correct mix ratio is used for the product to reach optimum performance. The higher the ratio (e.g. 4:1 compared to 1:1), the more critical it becomes to accurately measure volumes and mix thoroughly. Never add more cure to "speed the reaction up" as it will diminish coating properties. If a faster cure is required, the use of stir-in accelerators is recommended.

- It is essential when handling epoxies that the MSDS of the products be read and fully understood prior to starting. These documents will inform you of any hazards associated with the product and how best to deal with these hazards to ensure your safety and the safety of surrounding people. There are epoxies on the market that are corrosive, flammable and/or toxic (including carcinogens), so it is essential that the precautions and safe practices documented in MSDS be strictly observed.

- Surface preparation is the most crucial aspect of any coating job. It is the single biggest reason behind premature failure of systems. In short, surfaces need to be structurally sound, free of contaminants (as clean as possible) and have a rough surface profile to aid mechanical adhesion.

- Proper mixing of the two epoxy components (base and cure) is vital. If possible, use a mixing blade with an electric drill to improve dispersion. Often encountered in poorly mixed batches are the "no-mix" regions on the side and bottom of the container. This should never be used as it isn't mixed well enough to cure and will leave "soft" areas in the film. The coating can be transferred to another container to help avoid these regions before applying.

- A temperature change of 10°C will approximately double or half the pot life and complete cure time of the epoxy (hotter temperatures increase cure rate and therefore decrease cure time). Higher temperatures will tend to lower the viscosity of the epoxy, but also reduce the working time (pot life). Spreading the mixed epoxy over the substrate instead of keeping it in a container, if possible, will extend the pot life as it will prevent the build-up of heat.

- After the epoxy has begun to gel, it's generally too late to remedy any imperfections as the product becomes too thick to "touch up" effectively. Because of this, any attempts to fix spots after this point will invariably result in worsening of the problem.

- Clean-up of epoxies is most effective using organic solvents – methyl ethyl ketone (MEK), acetone, methylated spirits etc. If cleaning epoxy from skin, refrain from using organic solvents as they can be harmful. Instead, it is advisable to use hot, soapy water and vigorous scrubbing to remove.

- 100% solids epoxies generally become too thick if used in temperatures below 5°C. Adding small amounts of solvent (2-5%) or heating mixed product can be effective at lowering viscosity if required, however they do have side-effects that need to be understood. Moderate to room temperatures are the preferred range for working. After curing, the epoxies can withstand significant temperature ranges. Please consult NMP for service temperature ranges and low temperature applications.

- Epoxies, as stated, will harden in a relatively short time, however complete curing will generally take several days (3-7). Most epoxies will be sufficiently hard within a day, but may require more time before full properties are realised, i.e. chemical resistance, hardness etc.

- The best time to re-coat epoxies is within the "re-coat window". A second coat applied within this period will establish a chemical bond to the first coat in addition to a mechanical bond (chemical bonds are much stronger than mechanical bonds). Refer to the technical data sheets for information on the product's re-coat schedule. If re-coating after this period, the coating should be treated as a standard surface, which will need to be cleaned and abraded before applying onto.

- Standard epoxies will tend to yellow and "chalk" (lose their gloss) upon extended UV exposure. Measures such as using darker or yellow-based colours can help hide the effects. A UV-stabilised aliphatic urethane can be used as a topcoat on epoxies requiring UV resistance.

2 Glossary

Acid Etch: Acid etching refers to the use of acids to clean and profile a concrete surface prior to application. Acid etching was traditionally the preferred method for preparing concrete for thin film coatings, however increased environmental awareness has seen alternative methods used.

Aggregate: Hard, inert particulate matter (usually minerals such as quartz, aluminium oxide etc.). Most commonly used to describe the particles that are spread onto or mixed into coatings to provide the non-slip texture on floors.

Amine Blush: Some amines used to cure epoxies can develop a surface oiliness/waxiness or whitish appearance. This phenomenon is cause by the sorption of moisture and carbon dioxide from the atmosphere, which can interfere with numerous coating properties, including surface

tackiness/greasiness, poor adhesion, difficulty in re-coating/over-coating, poor gloss retention and even reduced shelf life of the products.

Backroll: Backrolling is an application technique used to improve the smoothness/evenness of application, especially in glossy topcoats. After the coating has been roughly rolled into place, it is then rolled again to achieve a more even finish.

Bleeding: Discolouration caused by migration of components from the underlying film.

Blistering: Blistering is the formation of small bubbles in the coating film. The bubbles are formed as a result of water migration through the film, which accumulates at the substrate/coating interface. If the water ingress is sufficient to create significant pressure within the blister, then large sections of the coating can be removed when the bubble ruptures.

Broadcasting: Broadcasting is the act of applying aggregate onto a floor coating to achieve a non-slip floor. A common method of broadcasting is done in a manner similar to spreading grass seed or feeding chickens.

Chalking: Chalking is the formation of a loose powder on the surface of the coating film. The powder is actually a part of the coating (usually pigment or extender) that has been released by the coating as the film weathers. The cause of chalking is weathering (UV exposure etc.).

Crawling: Crawling is the industry term for the movement of a coating film that causes widespread "dewetting" of the substrate. The result of crawling is areas without any film coverage. Contamination left on the surface after surface preparation is the main cause of these defects.

Corrosive: A material that causes damage to skin, eyes or other parts on the body upon contact. The technical definition is the destruction, or irreversible damage to living tissue on the area of contact. The MSDS of products need to be checked so that the user is aware of the hazards they contain.

Coverage: The coverage of a coating is usually expressed as square metres per litre of product (m^2/L). The wet film thickness can be used to compute the expected coverage of a coating. For example, a coating applied at 1mm thickness (1000 microns), will cover 1 square metre per litre used. Another example is a product applied at 400 microns will cover 2.5 square metres per litre used.

Dry Film Thickness (D.F.T.): As some coatings have solvents and other volatile compounds in them, the thickness at which the product is applied will not remain constant as it dries. The solvents will evaporate and cause the thickness to shrink. The dry film thickness is the thickness of the film once all the solvents have escaped the film.

Epoxy Mortar: Epoxy mortars are generally a combination of specially formulated epoxy and aggregate, used to form a high-viscosity product often applied by trowel or spatula. Epoxy mortars are used to level rough, badly worn or uneven substrates or in areas of extremely heavy traffic or impact.

Filler: Generic term for the powders that get mixed into coatings and perform a certain function.

Flammable: The flammability relates to the ability of a substance to be ignited. All forms of matter – solids, liquids, and gases – can be flammable. For paint-related material, the major concern is with volatile solvents used to thin paints. The MSDS of products need to be checked so that the user is aware of the hazards they contain.

Floating/Flooding: Floating and flooding are discolorations on the surface of a coating. Floating is usually the appearance of streaks that create a mottling effect, whereas with flooding a complete, albeit subtle, colour change is experienced.

Gel Time: The gel time is the time taken to reach a solid state once the base and cure is mixed. At this point, the mixture loses all of its fluid properties, i.e. ability to flow, and will be solid to the touch (although perhaps still tacky).

Gloss: The appearance of a surface to be "shiny". Gloss results from the even reflection of light from particularly smooth surfaces.

Grinding: The use of abrasive stones on a rotating grinder to prepare the surface. Floor grinders are classified by their weight and the number of stones on the grinding wheel. A typical term would be a two-head grinder, usually having three to four grinding stones.

Holidays: A term used for areas of insufficient paint thickness. In the worse cases, large areas of the underlying surface can be seen through the faint layer of coating on top.

Jiffler Mixer: "Jiffler" is a brand name but is now synonymous with a type of coating mixer, which fits into an electric drill. It is distinctive in that it has two impellers, each with three blades and each blade with numerous holes to increase agitation and flow.

Kit: The total volume of coating when the base and cure are combined in a two-pack epoxy coating, e.g. 4 litres of base and 4 litres of cure will make an 8 litre kit.

Laitance: An accumulation of loose, fine powder on fresh cement caused by the upward movement of water throughout the drying process. Needs to be removed prior to coating as it can affect adhesion.

Micron: A unit of length used to characterise coating thicknesses – 1,000 microns = 1mm.

Material Safety Data Sheet (MSDS): A document containing information on the hazards associated with a product. This includes notes on health hazards and effects (including first aid), precautions for use (protection, equipment etc.), safe handling information (storage, transport, spills, disposal), physical and chemical properties, product composition and other important information.

Orange Peel: Brush marks (brushed films) and orange peel (sprayed films) occur when the product being applied has a highly viscous or thixotropic nature. These viscous forces within the coating are strong and as a result any displacement of paint through brushing or spraying will more than likely still remain after the process has finished.

Nap: The length of the fibres on a paint roller.

Opacity: The extent that a coating "hides" the surface. A coating with low opacity will allow the surface to be seen through the film. Generally speaking, higher filler/pigment levels and even application of films will improve opacity in coatings.

Pinholes: Minute holes in a dry film that form during application and curing of coatings. A damaging defect in terms of creating catastrophic coating failure, as it can allow moisture penetration and therefore corrosion to continue/proceed etc.

Pigment Pot: Pigment pots consist of epoxy with pigment dispersed into it to form a coloured epoxy paste that can be mixed into a tintable formulation to give it colour. The pigment pot is mixed with the tintable base first then mixed with the cure. See tintable for more information.

Pot Life: The pot life can be viewed as the time it takes for the epoxy to cure to a point where it becomes "unworkable" in the container. This point corresponds to an approximate doubling of the original viscosity of the mixture and makes the product difficult to apply.

Primer: A product applied to the surface as an undercoat to aid in the adhesion of a topcoat. The topcoat in such systems is usually a protective coating that doesn't have sufficient adhesion to the substrate on its own.

Sealer: A low-viscosity product that is used to seal substrates to prevent materials from penetrating.

Self-levelling: A property that sees the coating able to form a completely smooth surface upon application without additional smoothing techniques, e.g. backrolling.

Settling: The separation of paint ingredients in the container. This is due to dense ingredients falling through the resin and accumulating at the bottom of the tin over a period of time. Products that display significant settling will need to be re-dispersed before use, i.e. re-mixed. If settling is suspected, it is best to pre-mix in the container first before decanting just in case.

Solvent-based: Solvent-based coatings are coatings that are miscible with organic solvents, but do not necessarily contain any solvents. This means that they can be thinned and cleaned-up with solvents such as MEK, Acetone, Methylated Spirits and other thinners.

Solvent-borne: Solvent-borne coatings consist of a resin system that is dispersed in an organic solvent. Solvent-borne coatings need certain quantities of solvents (as much as 70% by volume) to reduce the viscosity so that they can be applied easily. Once the coatings are applied, the solvent evaporates and leaves the actual resin on the surface. In water-borne and latex coatings the same principle applies, however the main solvent is water.

Substrate: The surface onto which the coating will be applied.

Thinner: A volatile liquid, single or blended, added to a coating to facilitate application by lowering viscosity or for extending pot life.

Thixotropy: The property of a coating whereby the viscosity is reduced on brushing or stirring but increases again on standing. It can be achieved through the addition of certain modifiers, and is used to impart flow control in the fluid, eg anti-sag properties.

Tintable: Tintable formulations are colourless two-pack epoxy coatings that use a Pigment Pot (see Pigment Pot) for pigmentation. Such systems are effectively three-pack epoxy coatings. Tintable formulations are used for greater variety and flexibility in colour when supplying epoxy coatings.

v:v: Notation accompanying mixing ratios meaning "by volume", e.g. 2:1 v:v, meaning the product should be mixed with twice as much base as it does cure by volume.

Viscosity: The viscosity of a liquid can be described as its resistance to flow. A high-viscosity liquid will have a very "thick" feel and will tend to resist flowing.

Wet Film Thickness (W.F.T.): The wet film thickness is the initial application thickness of the product. If the product contains solvents, they will evaporate from the film and reduce the thickness to the dry film thickness.