



CERAMIC TILE INSTITUTE OF AMERICA, INC.

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SUBJECT: FURAN GROUTING SYSTEMS vs. EPOXY GROUTING SYSTEMS

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Furan and epoxy grout systems are the superior grouting systems for installations where chemical resistance is required. Furan was commercialized in 1941 and epoxies in 1949. Both of these materials have been used for chemical resistant installations in the food and beverage as well as the chemical industries over the years.

It is important to understand the differences between furan grouts and epoxy grouts so the correct product is specified and installed for a given installation. The specifier and installer both should know what the anticipated environment will be to insure a successful installation.

To understand the benefits of each of these two grouting systems you need to know the basic make up of each one. Furans are two component systems containing a furan resin and a filler powder with an acid catalyst. The furan resin is made up mainly of furfuryl alcohol reduced with monomeric furfuryl. The acid catalyst causes the furan resins to cure forming a thermosetting resin with excellent chemical, physical, and thermal resistance. Being a thermosetting resin means that it will not soften due to temperature. This is one of the characteristics of furan that helps set it apart from epoxies (Furan can withstand constant temperatures of up to 350F.) The filler powder materials that are mixed with the furan resins influence the chemical resistance and properties of furan grouts. Optimum chemical resistance is attained when 100% carbon fillers are used but other filler materials such as silica, barytes, and fiberglass or a combination of these may be used.

Furan grouting systems are commonly used in industrial plants which produce food products such as dairies, breweries, meat packing plants, bottling plants, ice cream plants, canneries, wineries, distilleries, institutional kitchens, and laboratories. Furan grouting systems are resistant to food products, processing materials, and residues as they exist, or the changed chemical state which they become such as alcohols, fermented sugars, and organic acids. Furans are also resistant to a wide range of cleaning agents, soaps, and other alkalis, as well as animal fats, oils, greases, and solvents used in the maintenance of processing equipment. Even though furan grouts are designed to withstand a wide range of industrial abuses in corrosive environments it needs to be noted that there are some chemicals such as nitric acid and chlorine compounds that furans are not resistant to.

The furan grout manufacturer should always be consulted if there are any questions about the chemical resistance of an installation to insure that the intended use is acceptable under the anticipated conditions.

Furan grouts are used to grout brick pavers and quarry tile. The tile surfaces may be smooth, non-skid, or abrasive depending on the intended use for the floor. The tile or brick surfaces must receive a wax coating to protect them from staining prior to the installation of furan. If the surface of the bricks or tiles are to have an abrasive finish then an additional coat of wax may need to be applied. The wax to be used is paraffin wax. The paraffin wax is applied hot and is typically done by the tile or brick manufacturer.

Water soluble soaps and waxes are not acceptable coatings because these types of coatings may break down prior to being installed due to premature exposure to water while they are being stored, transported, handled, or installed. The waxing can be done at the job site but rarely is today because it is far more labor intensive to do. If the wax is applied at the job site it should be done by qualified installers with previous experience. The wax coating should form a transparent even film on the surface of the brick or tile free of any voids. If the applied paraffin wax has a cloudy or milky appearance it is being applied either too cold or too thick or possibly both.

The furan grout should be mixed as per the manufacturers instructions. When mixing the furan grout, precautions should be made to avoid breathing the vapors. A respirator suitable for organic solvent vapors is typically recommended. Mixing ratios should be followed very closely although minor adjustments may be made to meet existing working conditions or to the installers preference. Caution should be used if the recommended mixing ratios are modified as this could adversely affect the properties of the cured furan grout.

Installation temperatures need to be between 60 F and 90 F. The working characteristics of furan are affected by temperature. The ideal installation temperature is between 70 F and 80 F. If temperatures exceed 85 F it is recommended that the furan resins and filler powder be cooled to extend working time. Furan grout should not be mixed in greater quantities than can be applied in 15 minutes. Once the grout has start to set, it cannot be tempered with liquid resin.

Furan grout is typically installed with 1/8" -1/4" joints depending on if the bricks or tiles are set with the brick layers method or the tile setters method.

The joints should be free of contaminants and debris prior to the installation of the furan grout. If the paraffin wax has been applied at the job site the installers need to remove any wax that may have gotten on the sides of the bricks or tiles to insure a proper bond.

If the bricks or tiles have been set with a portland cement-sand bond coat then the joints need to be tooled, (to remove any excess mortar) acid washed, and rinsed with water and allowed to dry prior to grouting with furan. The acid washing is done to neutralize the alkalinity of the portland cement. This is necessary because if the joints were not acid washed the alkalinity of the portland cement would neutralize the acid catalyst of the furan and as a result the furan may not cure.

During the grouting process several passes should be made over the joints to insure full joints. It is also important to remove as much of the excess furan grout off the surface of the bricks or tiles leaving as little residue as possible. This will aid in the cleaning process. Any voids or air pockets in the furan grout should be filled while the grout is still soft. Once the floor has been grouted it should remain free from all traffic, liquids, and dirt until the grout is completely hard. This should take about 24 hours at 80 F.

After the furan grout has set for the 24 hour period it can be steam cleaned to remove the epoxy residue and wax leaving a clean finished floor. The furan manufacture should be consulted as to how soon the floor can be exposed to chemicals and cleaning agents.

There are two types of epoxy grouts. The first type is the 100% solid epoxy grouts which should meet ANSI 118.3. The second type is the modified epoxy grouts which should meet ANSI 118.8. The 100% solid epoxy grouts are two or three part components systems made up of epoxy resins, hardeners, and fillers. The hardener can be included in the filler as a 2 part system or alone by itself in a 3 part system. Modified epoxy grouts are 3 part systems made up of epoxy resins, hardeners, and pre-blended portland and silica sand.

Epoxy resins utilize alkaline hardening systems to make them cure which makes them compatible with concrete unlike the furan resins which cure by acid hardening systems. The 3 main types of hardeners used in 100% solid epoxy grout systems are aliphatic polyamines, modified aliphatic polyamines, and aromatic amines

As well as making the epoxies cure, the hardener also dictates the chemical and thermal resistance, the physical properties, and the ability to withstand moisture during installation.

While epoxies are considered thermosetting resins like that of the furan resins, they also have thermoplastic qualities meaning that they soften at elevated temperatures unlike the furans. Therefore, the epoxy grouts typically should not be used in areas where constant temperatures will exceed 150 F - 160 F. It also should be mentioned that some manufacturers claim that their 100% solid epoxy grouts can withstand higher intermittent temperatures than this, so each epoxy grout manufacturer should be consulted.

The 100% solid epoxies have outstanding physical properties, and are considered chemical resistant, however, the furan grouts have a broader range of chemical resistance than that of the 100% solid epoxy grouts. One benefit of the epoxy grouting systems is that they can be

installed on unglazed tile surfaces without having wax coatings whereas furans grouting systems cannot.

The 100% solid epoxy grouts are significantly different than the modified epoxy grouts. The different characteristics of each should be understood before selecting an epoxy grout. The 100% solid epoxy grout system is considered a superior grouting system over the modified epoxy grout. When selecting an epoxy grout for chemical resistance applications the 100% solid epoxy grout systems would be the proper selection.

The 100% solid epoxy grouts offer chemical resistance, stain resistance, and have an extremely low absorption rate. The 100% solid epoxy grouts can be used in a wide variety of industrial, commercial, and institutional applications where heavy traffic and acid/chemical conditions are anticipated. Such applications would include restaurants, commercial kitchens, pet hospitals and animal clinics, pharmaceutical labs, commercial laundries, and hospitals just to name a few.

While the 100% solid epoxy grouts are resistant to many chemicals and acids they are not resistant to them all. The 100% solid epoxy grouts should not be used in areas where constant exposure to animal fats, edible oils, and citric acid is anticipated. In conditions such as dairies and meat processing plants the animal fats and the edible oils act as plasticizers which over a period of time will make the epoxy virtually useless. In applications such as food processing plants where high concentrations of citric acid are present, the citric acid (commonly found in fruits such as oranges, lemons, grapefruits, pineapples and limes) will attack the epoxy over a period of time. In some cases this attacking can be somewhat reduced by constant routing cleaning but the proper choice for these types of installations would be the furan grouting systems.

The modified epoxy grouts are basically considered polymer modifiers for cementitious grouts. The main benefits gained by using a modified epoxy grout over standard portland cement grout is a lower absorption rate, improved shrinkage qualities, improved stain resistance, improved strength, improved resistance to impact, improved resistance to salt intrusion, and a very limited resistance to diluted chemicals and cleaners. Modified epoxy grouts should not be installed in areas where continuous chemical exposure is anticipated.

The modified epoxy grouts can be used in residential and commercial installations in areas such as public toilet rooms, entry ways, kitchens, and countertops to name a few.

The epoxy grout systems are offered in many different colors and can be used with many types of tiles including ceramic mosaics, porcelain tiles, quarry tiles, ceramic wall tiles, pre-cast terrazzo, slate, and other stone tiles. Epoxy grouts can be installed in joints varying in size from 1/8" - 1/2". The 100% solid epoxy grout has a tendency to run when used in vertical joints exceeding 3/8". Some epoxy manufacturers do not recommend that their epoxy grouts be used for exterior applications. If an epoxy grout is being considered for an exterior application the epoxy grout manufacturer should be consulted to see if it is recommended.

When installing epoxy grouts it is extremely important to follow the instructions of the manufacturer precisely. Epoxies are sensitive to the hardener-resin ratios. If the proper amount of hardener is not used for a given amount of epoxy resin then the epoxy grout will not cure properly and could adversely affect the physical properties of the epoxy. It is recommended that the installers should mix the entire amount of each epoxy unit. The installers should not try to mix the epoxy materials into smaller quantities than the unit size which the epoxy comes to save material. This

could result in a failure where the repairs could end of costing far more than the remaining saved material.

Installation temperatures have the same effect on epoxies as they do on the furans. The higher the temperature the faster the epoxy grout will set and conversely, the lower the temperature the slower the epoxy will set.

Epoxy grouts should be installed at temperatures between 65 F - 90 F although, some manufacturers so make cold weather formulas. The ideal installation temperature for optimum workability is between 70 F - 80 F. After the epoxy is mixed it should be removed from the bucket to prolong the working time of the material.

The installers should only mix as many units of epoxy grout as they can spread and clean in a 20-30 minute time frame. The exact amount of time will depend on the working conditions. All of the excess epoxy grout should be removed from the surface of the tiles before it hardens. If excess epoxy is allowed to dry on the surface of the tile it can be difficult to remove but in most cases can be done so with a solvent stripper such as MEK. It is important not to allow the stripper to get in contact with the grout joints to avoid damage to the grout.

When installing epoxy grout with porous and unglazed tiles it is strongly recommended to preseal the tile before installing the epoxy grout. If the epoxy grout gets into the body of the tile it most likely will become permanently stained. The tiled surface must be clean before it is sealed. It is also important to make sure that the tile is bonded well before grouting. The tile installers should try to get complete coverage with the bonding mortar to prevent leaving voids under the tiles. If substantial voids are left under the tiles the epoxy grout has a tendency to settle into these voids during the grouting process resulting in a less than full joint. If this happens additional grouting will probably be necessary with additional expenses incurred.

In summary both the furan and epoxy resins are the premier materials for chemical resistance. Furan grouts have superior chemical and thermal resistance while epoxies offer moderate chemical resistance and thermal resistance with superior bond strengths. Both are important products for the tile industry and between them they can be used in most corrosive environments. These types of installations should be done by experienced mechanics familiar with these products and installation methods to avoid failures and costly mistakes.

Individually these products meet and serve specific needs. No one material does it all and sometimes one physical property must be sacrificed to gain another. For this reason it is vitally important to understand the performance

abilities and limitations of each product. The specifier should know and understand that there will be higher costs associated with these types of installations than that of portland cement grout installations. Hopefully, by understanding and anticipating the higher installation costs up front the proper installations will not be compromised during the course of a project. It is the responsibility of the specifier and ultimately the installer to insure that the proper product is installed for a given installation. If these products are installed correctly and installed in the proper conditions they will be successful installations giving the end user many years of trouble free service.

Ultimately, with successful installations owners and architects will be satisfied and as a result these types of installations, as well as other types of tile installations, will continue to be considered and specified in future projects benefiting our entire industry.

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