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TECHNICAL BULLETIN – TB161

ISSUES WITH RESIN BACKED TILES

JULY 2024

INTRODUCTION & SCOPE

We are familiar with natural stone tiles and their various colours, patterns, and textures. Traditionally these natural tiles have been cut from solid stone quarried wherever labour and technology have allowed, and the cost of extraction is recovered. After many years of extraction, some of the most popular colours/patterns in high-quality stone have become almost unavailable, and methods to supply more stone as demand increased generally consisted of cutting the stone thinner. Poorer quality stone is extracted from the same quarries and supplied from new sources in the thinner sections. In addition, many types of stone, such as limestone or travertine tiles, which are more suited for use in thick sections only, are supplied in the thinner sections normally associated with high-strength stone.

This bulletin discusses how poor-quality stone is reinforced using hard plastic resins, with or without a reinforcing mesh embedded in the resin. Installing stone tiles (normally supplied in sizes from 300 x 300mm up to 1200 x 1200mm) with these resin backings can be risky when using adhesives designed for ceramic tiles, especially when fixing to wall substrates.

Please note that this bulletin does not reference sheets of mosaic tiles, in which the small tiles (generally less than 100 x 100mm each in size) are bonded onto a mesh backing grid with (all too frequently) a thin, water-soluble glue.

We also note there are products known as agglomerates (e.g., agglomerate marbles or agglomerate granites) available in the marketplace in which variable (generally small) size natural stone pieces are mixed together in mass with a small amount (approx. 4 - 8% of the total material volume) of a resin binder and then placed in a vacuum chamber that extracts all the air from the mixture while the resin is still free flowing. This process draws the resin into any voids in the mix with the finer particles and creates a solid mass, then sliced (diamond saw cut) into panels of the required size and thickness. These agglomerate tiles may also contain materials other than natural stone, such as coloured glass chips. The final product differs from the resin backing applied to the stone tiles discussed here, even though the same resins may be used.

WHY A RESIN BACKING?

Poorer-quality stone may include veining, cleavage, or fracture planes (often associated with very crystalline stone) or stylolites (generally related to certain limestones), which makes the stone susceptible to breaking in any step of the extraction, cutting, transporting, or installation process. Even after installation, cracking may still occur and be aesthetically unappealing as a surface finishing material for floors and/or walls.

Mechanically weak stone tiles may be strengthened by applying a suitable reactive resin over the back. These thin resinous coatings fill and strengthen weak points such as very porous crumbly sections, irregular veins or cleavage planes, etc. These resins may even be mixed with finely ground stone to fill and patch voids in the stone surface.

Polyester resin, polyurethane resin, and epoxy resin-based systems are reaction resins generally used for backing natural stone. These two-component systems require a chemical reaction between the two components to set into compounds that remain set and inert in most climates.



They all have different degrees of flexibility or deformation, with the epoxy and polyester resins generally being more rigid (less deformable) than some polyurethane coatings. However, as these are applied to a rigid stone, flexibility is not desirable in the reinforcing material; hence, the more rigid epoxy and polyester resins are mostly used.

The resin coatings may include a reinforcing mesh with a grid spacing typically of 3 to 6mm. The resin may be applied first, and the mesh will be embedded into the wet layer before a second coat of resin is used. The degree of cover of the coating over the mesh may vary markedly. Some coating applications will barely cover the reinforcing mesh, leaving the mesh grid as a 'keyed' surface for the tile adhesive, although there may still be enough resin to contact the back of the stone fully. Other applications of the resin coating may completely fill the mesh grids and finish with an extremely smooth surface that provides no mechanical key for the tile adhesives. (Some suppliers broadcast sand over the wet resin to increase the bonding of the tile adhesives).

Polyester resins are more commonly used than epoxy resins because they are more economical. However, polyester resins do not adhere well to damp surfaces or cure fully in wet and/or humid conditions. Therefore, it is important to ensure the stone tile is sufficiently dry immediately before applying the resin coating to avoid the coating de-bonding after installation. Polyester resins are also subjected to alkaline hydrolysis and decomposed by alkaline materials in cement-based adhesives.

Polyester resins may also contain waxes that seal the resin surface from the atmosphere and allow the chemical reaction to proceed to completion. These waxes become a surface contaminant and prevent tile adhesives from bonding to the coating.

Epoxy resin coatings are applied in the same manner as polyester resins and do not have wax contaminants on the surface when cured. However, the epoxy may finish with a very smooth and inert surface, so the bonding of the tile adhesives remains difficult.

Polyurethane coatings are even more problematical as these resins are well known for the inability of tile adhesives to form bonds. As a guide, look at the problems associated with installing tiles over polyurethane waterproofing membranes using modern tile adhesives. Many adhesive manufacturers advise they have no adhesive to bond to the polyurethane coatings. One type of polyurethane bonded mesh is acceptable, and that is where the adhesive is between the tile back and the inner face of the tight mesh but not on the outer back face of the mesh itself.

WHAT DO WE REQUIRE OF ADHESIVES TO INSTALL THESE RESIN-BACKED STONE TILES?

Australian Standard ISO13007 requires the minimum tensile adhesive bond strength before de-bonding occurs to be 0.5MPa when the standard, internationally accepted prescribed test method is followed. While some bonding may occur when these resin-backed stones are fixed with tile adhesives, all too frequently, the bond strength required is not achieved. This means that should de-bonding occur; any damage or injury may not be covered by insurance or the tile adhesive manufacturers' product warranty. All too frequently, specific advice is never sought before installation, and the tile supplier/importer may refer all inquiries for fixing instructions to the adhesive manufacturers.

While there is no Australian or International standard for manufacturing these resin-backed stone tiles, adhesive manufacturers attempt to find suitable adhesives by testing where possible. This lengthy and time-consuming process only applies to the tile(s) being tested.



As the resin coating is applied by various means and the thickness of the coating is variable, it is not acceptable to infer from one test result that all production from the same factory will achieve the same adhesive bond strength when installed.

Testing the adhesive bond strength with resin-backed stone tiles by Ardex Australia Pty Ltd has resulted in some unsatisfactory findings. All too frequently, the resin coating has de-bonded from the stone itself (which implies all manner of quality control and/or suitability problems), and/or the tile adhesive has de-bonded from the resin coating before the required minimum bond strength was achieved. This occurs because cement-based adhesives have difficulty forming the mechanical part of the bond they normally create, with the closed surface typical of resins, and the chemical bond has difficulty forming with the non-polar and 'inert' surface of the resin. Bond loss has occurred even when sand has been broadcast over the surface of the resin coating. Applying a specialised or protective primer to the rear face of the tile may or may not be effective.

RECOMMENDATIONS FOR INSTALLATION OF RESIN BACKED STONE TILES

- As a first choice, don't use tiles of this construction type where feasible.
- Carefully check the stone and see how much resin coating has been applied. If the reinforcing mesh is completely covered and the surface is smooth, determine what type of resin has been used. Then seek confirmation by testing, that the adhesive system will achieve the required bond strength.
- If the installation is to external walls, consider not installing it. The added thermal stress may lead to system failure. In addition, should the stone become saturated, the resin backing may de-bond very quickly.
- If the installation is to internal walls, particularly in wet areas, seek confirmation that the adhesive system will achieve the required bond strength when the tiles are wet. In addition, we refer to Ardex Technical Bulletins TB001 & TB148 should the tiles exceed the 32kg per square metre recommended maximum weight and/or the tiles are to be fixed more than 3m above ground.
- Resin-backed tiles for floor installations should be checked like internal walls, although the maximum weight limit does not usually apply to floor tiles.

The following photographs illustrate some of the issues discussed in this bulletin.



This example shows a double layer of reinforcing mesh, and the tile is still cracked.



This polyester resin-backed tile was installed in an external application with a cement-based adhesive. Over a two-year period, the adhesive's cement decomposed the resin, resulting in breakdown and de-bonding.



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When unpacked at the site, the upper picture shows the resin backing de-bonding from the stone.

The lower picture shows the smooth glossy resin surface to which the tile adhesive must adhere.



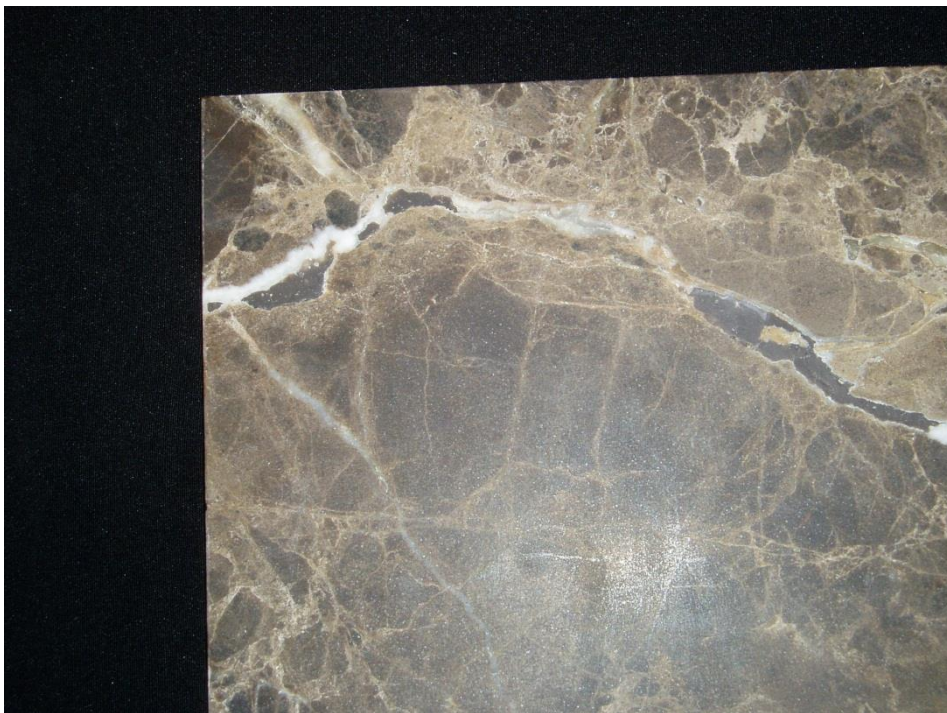


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The upper picture shows the sanded resin coating on the back of the tile and the white vein in the top right, which has holes throughout the front.

The lower picture shows the clear section of the veins that were filled with resin before the stone was polished. After polishing, some small holes appeared in the resin itself.





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The above examples show how greatly fractured and cracked stone (lower left and upper right show the polished faces) may be held together by the resin reinforcement backing. In addition, incomplete mesh coverage (upper left) is shown. However, the resin coating was to all edges of the tile, and the sand particles embedded in the resin (lower right) for better mechanical adhesion to the fixative.

IMPORTANT

This Technical Bulletin provides guideline information only and is not intended to be interpreted as a general specification for the application/installation of the products described. Since each project potentially differs in exposure/condition, specific recommendations may vary from the information contained herein. For recommendations for specific applications/installations, contact your nearest Ardex Australia Office.

DISCLAIMER

The information presented in this Technical Bulletin is to the best of our knowledge true and accurate. No warranty is implied or given as to its completeness or accuracy in describing the performance or suitability of a product for a particular application. Users are asked to check that the literature in their possession is the latest issue.

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