TECHNICAL BULLETIN – TB161

ISSUES WITH RESIN BACKED TILES

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INTRODUCTION & SCOPE

We are all familiar with natural stone tiles and the great variety in colours, patterns and textures available. 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 being extracted from the same quarries as well as being supplied from new sources in the thinner sections**. In addition, many types of stone such as some limestone or travertine tiles, which are more suited for use in thick sections only, are being supplied in the thinner sections normally associated with high strength stone.

This bulletin discusses how the poorer 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 include references to the sheets of mosaic tiles where the small tiles (generally less than 100 x 100mm each in size) are bonded onto a mesh backing grid with (all to frequently) a thin, water soluble glue.

We also note there are also products known as agglomerates (e.g. agglomerate marbles or agglomerate granites) available in the market place 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 in the mix and creates a solid mass which is 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 is quite different from the resin backing applied to the stone tiles discussed here even though the same resins may be used.

WHY A RESIN BACKING?

The poorer quality stone may include veining, cleavage or fracture planes (often associated with very crystalline stone) or styolites (generally associated with 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 made stronger by the application of a suitable reactive resin over the back. These very thin resinous coatings fill and strengthen the weak points such as very porous crumbly sections, irregular veins or cleavage planes and the like. These resins may even be used when mixed with finely ground stone, to fill and patch voids in the stone surface.

The types of reaction resins generally used for the backing of natural stone include polyester resin, polyurethane resins and epoxy resin based systems. These are two component systems where the two components must chemically react with each other to set into compounds that remain set and inert in most climatic conditions.

They all have different degrees of flexibility or deformation with the epoxy and polyester resins generally being more rigid (less deformable) then 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 embedded into the wet layer before a second coat of resin is applied over the top. The degree of cover of the coating over the mesh may vary markedly. Some coating applications will barely cover the reinforcing mesh which leaves the mesh grid as a 'keyed' surface for the tile adhesive, although there still may be enough resin to fully contact the back of the stone. 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 in an attempt to increase the bonding of the tile adhesives).

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

Polyester resins may also contain waxes that seal the resin surface from the atmosphere and allows 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 the polyester resins and do not have the wax contaminants at 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, simply look at the problems associated with installing tiles over polyurethane waterproofing membranes using modern tile adhesives. Many adhesive manufacturers simply 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 insurances nor the tile adhesive manufacturers' product warranty. All too frequently, specific advice is never sought prior to installation, and the tile supplier/importer may simply refer all inquiries for fixing instructions to the adhesive manufacturers.

While there is no Australian, or International standard that refers to the manufacture of these resin backed stone tiles, adhesive manufacturers do attempt to find suitable adhesives by testing where possible. This is a lengthy and time consuming process and is only applicable 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 be achieving the same adhesive bond strength when installed.

Testing of 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 difficultly 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. Loss of bond has occurred even where 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 STONES TILES

- As a first choice, don't use tiles of this construction type where feasible.
- Carefully check the stone and see how much of the resin coating has been applied. If the reinforcing mesh is completely covered and the surface is smooth, find out 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 walls externally, seriously consider not installing. The added thermal stress may lead to system failure. In addition, should the stone become saturated, the resin backing may debond 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 in the same manner as for internal walls although the maximum weight limit does not usually apply to floor tiles.

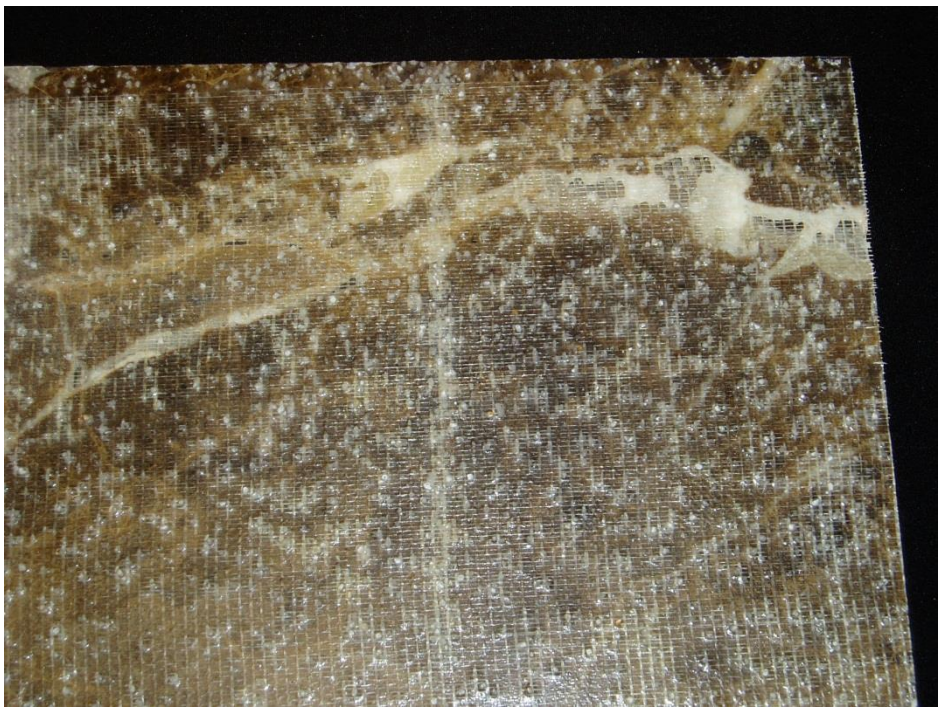
The following photographs illustrate some of the issues discussed in this bulletin.

This example shows double layer of reinforcing mesh and tile still cracked.

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

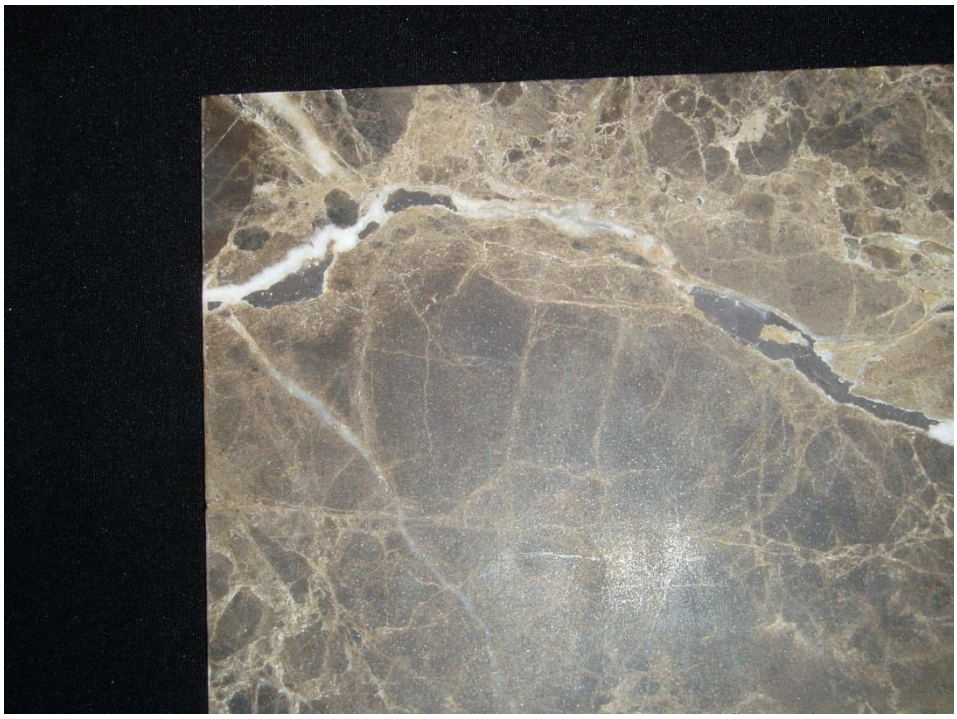
The upper picture here shows the resin backing de-bonding from the stone when unpacked at site.

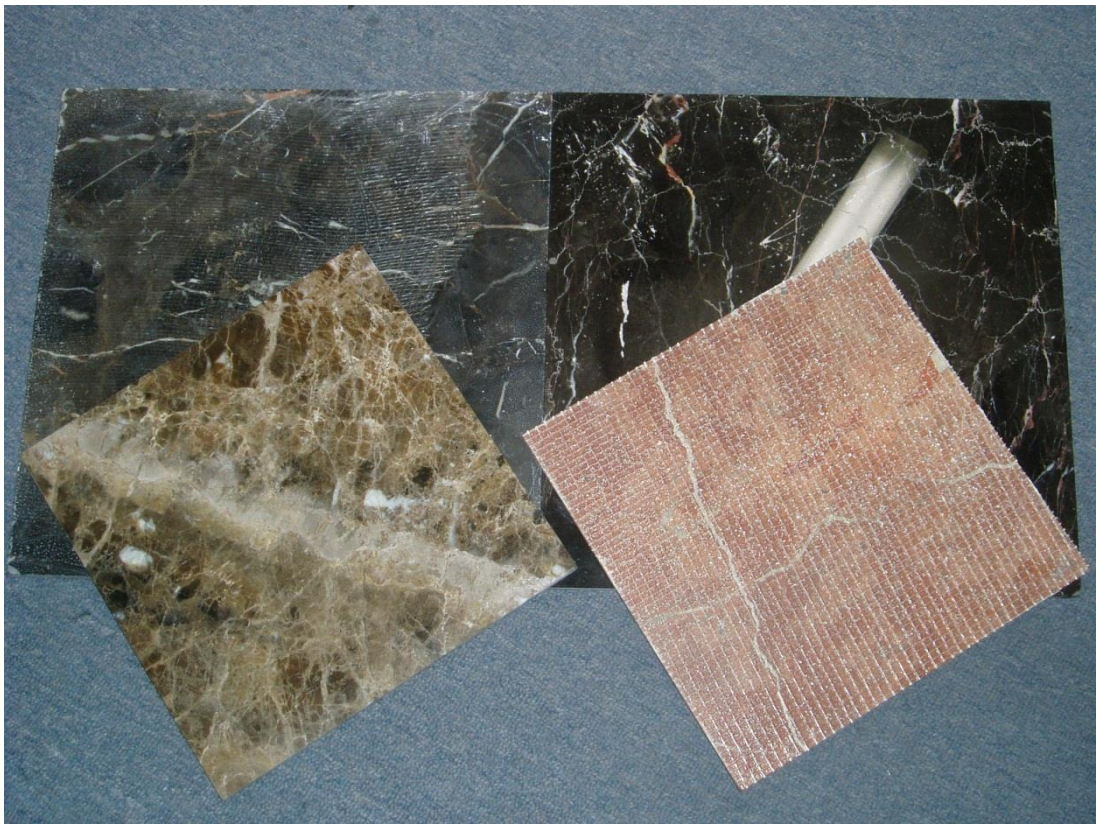
The lower picture shows the very smooth glossy resin surface to which the tile adhesive would have to adhere.



The upper picture shows the sanded resin coating on the back of the tile and also the white vein in the top right with holes all the way through to the front.

The lower picture shows the clear section of the veins that have been filled with some resin prior to the stone being polished. After polishing, some small holes have appeared in the resin itself.





The above examples show how greatly fractured and cracked stone (lower left and upper right shows the polished faces) may be held together by the resin reinforcement backing. In addition, incomplete mesh coverage (upper left) is shown although 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 about specific applications/installations contact your nearest Ardex Australia Office.

REASON FOR ISSUE
Periodic review. Some minor text ammendments. Change of AS4992 to ISO13007.

REVIEW PERIOD
5 years from issue.

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