TECHNICAL BULLETIN – TB228

EFFECTS OF ALKALINE CONTAINING MATERIALS ON GLASS MESH BACK TILES

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INTRODUCTION & SCOPE

The recent trend towards using either very thin porcelain, or stone, and also structurally unstable stone, has led to the introduction of tiles which have glass mesh or woven matting bonded to the tile rear face.

In some cases the mesh is fully embedded in the resin that holds the mesh in place, but with others, the resin adhesive is only between the mesh and the tile back face. In this case the glass mesh is then exposed to the ceramic tile adhesive when the tiles are bonded.

This bulletin looks at the potential for decomposition of the glass due to alkaline attack from lime in the adhesive and subsequent problems with the tile bond due to changes and decomposition of the backing, and resistance to damage because of loss of mechanical reinforcement.

WHAT HAPPENS?

Standard glass is not resistant to alkaline material such as the lime present in cement based adhesives. Over time the reaction of the lime with the glass in the presence of moisture causes the glass to break down. The general reaction can be characterised by this unbalanced equation derived from Molchanov & Prikhidko (1957) where in this discussion Calcium Hydroxide has been substituted for Sodium Hydroxide as the alkaline agent used in the original paper (lime = Calcium Hydroxide whilst Sodium Hydroxide is also called Caustic Soda).

$$SiO_2 + nCa(OH)_2 \rightarrow xSiO_3^{2-} + Ca^{2+} + H_20$$

Basically the alkaline material attacks the glass by de-polymerisation and leaches out the silicates into solution. The end result for the glass is weakening and fracture of the strands.

This breaking down of the glass mesh, increases the potential for loss of integrity of the reinforcement and a higher risk of mechanical damage (movement or impact from walking). The other potential issue is the development of reaction materials at the interface which are weaker than the original tile adhesive, with the risk of de-bonding under tile stress (e.g. thermal movements, building movement, wind loading).

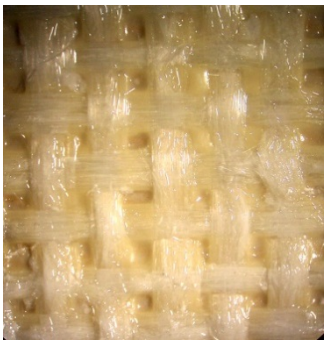
A trial was performed with a sample of mesh backed tile immersed in lime water (~pH12.4) and the results can be seen on the next page.

SOLUTIONS

The suppliers of the tiles need to use a glass for the mesh that has high resistance to alkaline attack, but also tile users can maximise the long term performance by using:

- non-cement based R class adhesives such as epoxy,
- specialised rapid cure F rated C class adhesives with reduced alkalinity effect (e.g. Ardex S28 Neu),
- a primer / seal coat applied to the back face of the mesh to protect it, and improve adhesion of C class adhesives (Ardex WPM300, WPM368 barriers or P9 primer),

but also effective control of moisture behind the tiles to stop alkali movement and activation.

		
Figure 1. Fig 1. Shows the rear face of a glass mesh backed porcelain tile. Control material untested & magnified 6.4x.	**Figure 2.** Fig 2. Shows the rear face of a glass mesh backed porcelain tile. Material immersed in tap water for 9 months magnified 6.4x.	**Figure 3.** Fig 3. Shows the rear face of a glass mesh backed porcelain tile. Material exposed to lime water for 9 months magnified 6.4x.

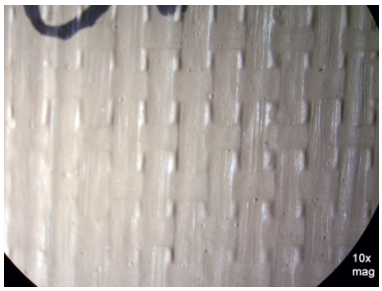
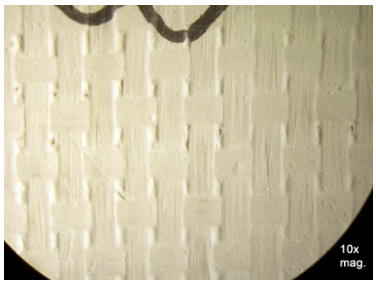
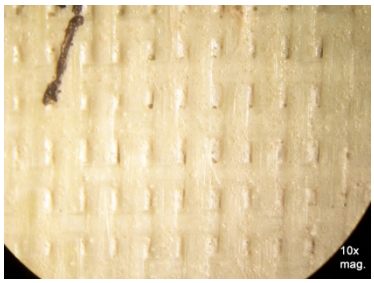
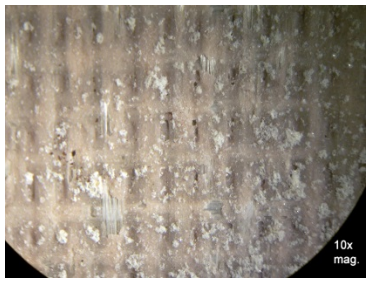

		

Figure 4. Back face of mesh sealed with WPM368 after 4 months immersion in lime water.	**Figure 5.** Back face of mesh sealed with WPM300 after 4 months immersion in lime water.	**Figure 6.** Back face of mesh sealed with P9 after 4 months immersion in lime water.
		
Figure 7. Back face of mesh sealed with WPM368 and then bonded with a C class non-F rated adhesive, after 4 months immersion.	**Figure 8.** Back face of mesh sealed with WPM300 and then bonded with a C class non-F rated adhesive, after 4 months immersion.	**Figure 9.** Back face of mesh sealed with P9 and then bonded with a C class non-F rated adhesive, after 4 months immersion.

As can be seen in the above images, the mesh is not affected by tap water, however lime water produced breakdown of the glass mesh, which could be scraped away.

Where the mesh has been protected with a prime/seal coat the mesh is unaffected by standard cement based adhesives.

Note

Where the tiles are large format, and at the time of writing this commonly means the large thin sheet porcelain tiles (where dimensions exceed 1m on each side), another constraint is the drying performance of the adhesives. Cement based C class adhesives, unless F rated, will display prolonged drying times with these tiles, especially when the substrate is waterproofed or relatively non-porous. Whilst the adhesive will cure, it remains physically damp so does not develop full strength in the normal time spans expected. This can have ramifications for flooring applications. It also means moisture is present for far longer, and assists in the development of alkaline attack conditions to which unprotected glass is exposed to.

References

Molchanov V.S. & Prikhidko N.E. (1957) Corrosion of silicate glasses by alkaline solutions. *Bulletin of the Academy of Sciences of the USSR, Division of Chemical* science, Volume 6, Issue 10, p.p. 1179-1184

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