WHEN GOOD STONE TURNS BAD – TO SEAL OR NOT TO SEAL?

The availability of large format natural stone pavers at affordable prices has resulted in a dramatic increase in the use of stone as paving in commercial and residential settings. This increase in popularity includes the use of stone as paving as pool surrounds. Sandstone especially is a popular choice as poolside paving. It is generally slip resistant, cool under foot and provides a 'casual feel' sympathetic with the surroundings.

However, Stone Initiatives has received calls for help from around Australia when good quality paving has begun to deteriorate prematurely. Both suppliers and end-users have been left scratching their heads as to why their good stone has turned bad.

In most cases the stone supplier has assisted the end user in their selection by providing them with information that has allowed them to evaluate the stone's suitability for the intended location. Usually the information provided includes a recommended maintenance regime including methods for cleaning the stone and protecting it from stains by application of a sealer.

In general, sealers (both topical and impregnating) have been found to be of great benefit in maintaining, and in some cases enhancing, the appearance of stone. From Stone Initiatives' investigations, it is evident that in some cases when used in environments such as pool surrounds, these sealers are implicated in the accelerated decay instead of providing protection to the stone – but why?

Firstly, it is hoped that a topical sealer has not been used to seal the stone in an external situation. These sealers develop an impermeable barrier on the surface of the stone, and although they prevent any substance from entering the stone (either in a liquid or vapour form), they also prevent anything from leaving the stone. This situation becomes a problem when there is moisture below the surface of the paving.

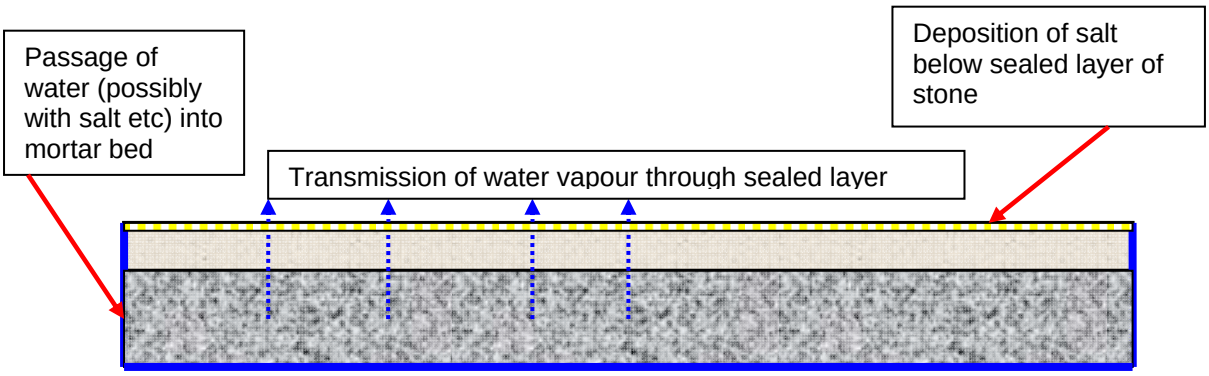
Although pavers themselves may be relatively impermeable, the joints may allow water (e.g. from the pool or rainfall) to permeate through to the substrate via the joints. Lateral movement of moisture from garden beds or stormwater can also enter the substrate. Pavers are usually laid with a mortar screed over a concrete slab; this situation often does not allow for drainage of this water out of the bedding material. If the moisture cannot drain out of the bedding, the only exit route is through the paving.

You may have seen pavers showing significant decay around the perimeter. This decay could be described as 'picture framing'. This form of decay is a sign that the moisture has travelled preferentially along the joint line between abutting pavers, depositing any dissolved salts at the surface upon evaporation. The moisture may also exit as water vapour through the paving itself. If a surface sealer has been applied, the transmission of this vapour will be interrupted, leading to a build up of vapour pressure behind the sealed layer. This layer can, and does often break down, especially where daily surface temperature variations are significant.

The mode of failure in this situation will depend upon the nature of the bond between the paver and sealer. In cases where the sealer is purely superficial, the failure may exhibit itself as peeling, but if the sealer has penetrated the stone to some depth (typically a few mm), then the surface of the stone may begin to decay and spall. Plate 1 shows the appearance of a commercial granite paving installation where a surface sealer has been applied and the bedding has become damp following heavy rain with subsequent peeling of the surface sealer.

The use of an impregnating sealer has also been associated with accelerated stone decay. Impregnating sealers are usually applied by brush or roller and soak into the surface a few millimetres depending on the method of application and porosity of the stone. Once 'sealed', this layer has a hydrophobic (water repellent) nature, forming a protective skin on the sealed surface. This layer prevents the transmission of liquid water into or out of the stone.

In the situation where the stone has been laid over a concrete slab (or similar impermeable substance), the only way for the water to escape is back through the surface of the stone. This poses a problem where only the top face of the stone has been sealed, as the passage of moisture out of the stone is restricted to water vapour. In this situation, if the water contains any type of soluble compounds, these will be deposited immediately below the treated layer as the water evaporates. Over time this accumulation of compounds (such as salt and/or soluble lime) can cause delamination (flaking) of the stone immediately below the 'sealed' layer. This action is shown schematically in the figure below.



The water repellency endowed upon this thin layer can also change its behaviour compared to the body of the stone. As the main body of the stone becomes wet, some minor dimensional change (expansion) will occur. Where a water repellent layer is present, the dimensional change of this thin layer will be less than the main body of the stone leading to the development of shear stresses and the possibility of detachment in the form of flaking (see Plate 2).

The discussion so far has illustrated that the haphazard use of sealers can do more harm than good; so what needs to be considered when deciding whether to seal?

Selection - Careful stone selection (not just based on appearance) is vital to ensure adequate performance. Choose a durable, dimensionally stable stone; evaluating results from a resistance to salt attack test is a good indicator.

Choosing a stone with a good inherent stain resistance will also minimise the dependence on sealers. Stone that has a low water absorption capacity and is chemically inert will usually have a good resistance to staining. Also consider the stone's apparent stain resistance. A stone that is highly figured or variegated will tend to hide stains better than one that is plain or uniformly coloured.

Matching the sealer to the stone also needs to be considered. Firstly, do you want to enhance the look of the stone or keep the 'natural look'? From an aesthetic point of view, the effectiveness of natural finish or 'wet look' sealers will depend on the stone type and surface finish.

Some stone types, such as dense black granites, have very low porosity so their ability to soak up sealer is very limited. Over application of sealer on these stones can lead to blotchiness and streaking, which can be very difficult to remedy.

Installation – Thoughtful design of the whole paving system may also help protect your pavers. Incorporating sub-surface drainage or falls will facilitate the flow of moisture away from the pavers and minimise the effect of soluble salts or decay from repetitive wetting and drying of the stone.

Another option is to consider sealing the paving units prior to installation. Dip-sealing or six-sided sealing of paving stones can reduce the uptake of moisture from the bedding as well as from the top face. This method has been found to be particularly useful where the stone is used in aggressive environments such as pool copings. A word of caution here: not all sealers are suitable for six-sided sealing as some may interfere with the bond between the paver and the bedding or adhesive.

'Two Bob Each-way' – depending on the installation the judicious use of an impregnating sealer may be restricted to high risk areas, such as around the barbecue or main entertaining area. These areas are often sheltered and usually located away from the main wet areas such as the immediate pool surrounds, therefore the risk of excessive moisture and/or salt build up is much less. In this scenario, the stone at highest risk of staining is protected while the stone in wet areas is allowed to freely exchange moisture and salts can be freely flushed away.

Expectations – sealers are not 'magic silver bullets' that will protect your paving from all harm. It is important to be realistic about the performance of sealers.

Sealers can…

- Make cleaning easier.
- Increase resistance to staining.
- Reduce uptake of dissolved salts.
- Enhance the appearance of the stone.
- Reduce the establishment of biological growths (algae, moss etc.).

Sealers will not…

- Last forever – reapplication is required to maintain efficacy.
- Prevent water under hydrostatic pressure from entering the stone.
- Stop all stains – they are only designed to reduce the rate of absorption. Spills should still be cleaned up as soon as possible.

So, back to the question – to seal or not to seal? Sadly there is no definitive answer. Sealers are an important treatment that can maintain the appearance and serviceability of stone when used in the right location and applied in the appropriate manner. It is important to remember that although sealers can assist in maintaining the unique properties and appearance of stone, they should not be considered as a substitute for the use of the right stone for the job. Fitness for purpose is the key.

CAPTIONS
(hi-res images sent separately)

Plate 1: Peeling of a surface sealer after application on stone with a wet bedding.

Plate 2: Flakes of sandstone that have spalled from sandstone paving which had been treated with an impregnating sealer. The flakes retained their water repellency while the underlying stone was unaffected.

Plate 3: Delamination decay of sealed stone used as a pool edging. Although this stone had been tested and found to have a very high resistance to salt attack, the use of a sealer has affected the dimensional stability of the stone's surface in wetting / drying situations.

Plate 4: Time spent in careful selection of the right stone for the job can have rewarding and stunning results.