HENSEL GEOSCIENCES

Specialists in all building stones including granite, marble, limestone and sandstone. Aggregate materials testing; geotechnical assessment, quarry and resource assessment. stone failure investigations, forensics, stone advice and stone procurement

ABN 30739710158
95 Austinville Road
Mudgeeraba Qld 4213 Australia
Phone: (07) 55302962
Email: hdhensel@bigpond.net.au
Web: henselgeosciences.com.au

Dr Hans on some unwelcome truths behind sealers and sealing

The issue of sealing is a serious source of argument and derision which has polarized the realists and the brain-washed. The philosophy of sealing has become **so entrenched** in the media, the advertising and the poorly educated people in the stone and general construction industry, that any comments questioning the practice are almost looked upon as heretical. It is virtually a "fait accompli" with anyone selling or installing stone.

People do not have the time these days to test the plethora of sealers that is out there – on the stones to which they want to apply these products, and in the situations where they are expected to perform. That includes an infinitely wide range of conditions. Collectively, this equation is impossibly large and no-one can ever come up with definitive answers. And don't the sealer manufacturers know that!! And they also know that their products are only good for a short time, (longer in suitable situations), and are not very likely to damage the stone – without the intervention of agents that are deleterious to the product. So it is very interesting that the huge majority of people believe the advertising and **NOT** the scientists and researchers who attend, and record, the string of failures that **DO** occur, and continue to occur, in inappropriate applications.

Anyone, such as builders, architects, interior designers and clients, who specifies this type of product for a particular stone finish should really stand back and **independently** review the many aspects related to sealing. Why is it being done? Does the stone require water and oil repellency? Does the stone have the porosity amenable to sealing? Is the application of the sealer likely to be detrimental to the stone – especially in certain environments? Is the composition of the stone suitable for the application of a particular type or style of sealer? Is there a long-term benefit for the application of the sealer given that it breaks down under certain conditions? What is the compatibility of the specified sealer (of which there are numerous) with the 13,000 or so stones on the world market given that sealer companies do not have the knowledge to differentiate between stones? There are many other questions that could or should be asked for specific locations.

What indeed is a sealer? A sealer is a fairly simple product where an elementary mass-produced base material (the polymer resin) is blended with a carrier fluid. In general, the carrier fluids are either low viscosity (usually between 0.76 and 0.79) or have a viscosity approximating water, i.e. near 1.0. Clearly, a fluid with a low viscosity is quite runny and will spread out and penetrate a porous material more so than a liquid of higher viscosity. In essence, most sealers of a particular type are quite similar. The amount of resin used is usually between about 4% and 8%, the rest is mostly carrier. The various manufacturers simply add small amounts of "more-mysterious" chemicals to the products that they produce, for marketing purposes or in order to make it a proprietary product for which they do not have to divulge accurate compositional information.

The word "sealer" is a term coined to improve/modernize the original description of "water repellent". It is basically an after-market product for stone that promises so much at the time of application by virtue of its **demonstrable repellency** of water. This is one of the great advertising tricks that appeals to the visual senses. By applying some sealer to a porous stone like sandstone, to brick, to Hebel, to wood or even newspaper, waiting for it to dry, then pouring water onto the coated surface, the advertisers amaze the audience with how effective a water-proofing/water repelling product this is. True, the beading of the water immediately after coating is impressive. But it is only a dirty trick. When the stone is left outside (accessing UV) or wiped 20-50 times with an alkaline cleaning product over a period of say 3 months the efficacy of that beading diminishes dramatically or disappears because much of the sealer has broken down

or been wiped off. The sealer salesmen will never demonstrate the efficiency of the sealer that has been "aged" because they know that they cannot repeat the beading demonstration.

In examining the role of a sealer it is necessary to ask "what is its purpose?" The answer usually given is "to prevent staining". Wrong !! Sealers do not prevent staining and/or etching – they merely provide you with time to clear up the spillage or soiling agent before it is absorbed by the stone or before it reacts with the surface to produce a stain. In domestic situations this is a quite reasonable scenario though also unrealistic in many instances. And how do sealers reduce the absorption of potentially offending substances? By substantially filling the pores of the stone. And is this not potentially detrimental to the natural "working" of the stone surface? The answer is yes. But then the manufacturer advises that the sealer allows for up to 95% of water vapour transmission. So what ! It is **liquid** moisture not vapour that dissolves chemical substances and remobilizes and concentrates these materials, usually from the bottom up – more so than from the top down.

There are essentially three varieties of sealers, namely impregnating (or penetrating), water-based, and acrylic. Each provides a different function and is designed for different purposes and situations. Fundamentally, the three varieties have different viscosities. By far the most popular is the impregnating type. This type of sealer has a low viscosity and it is meant to carry the dissolved resin into cracks, cleavages, pores and small cavities. The resin is meant to bond to the walls of these microstructures and the carrier gradually diffuses and disappears into the air. The water-based sealer is compositionally similar but because of a lower viscosity does not penetrate as deeply into stone. Its purpose is to provide a barrier just below and partly on the surface but, because it is water-based, treatment of stone takes longer. Evaporation and consolidation take longer than the penetrating sealer and because of the water-base it does not emit the undesirable volatile organic compounds of the solvent-based sealers. Acrylic sealers (which may be both water-based and solvent-based) provide a surficial coating which is intended to prevent surficial soiling. They are not universally applicable because this type of sealer creates a "plastic" appearance (also known as a wet look) to the surface, effectively concealing some of the characteristics of the stone. Additionally, being a surface application the coating will modify the slip resistance. It will also track (wear locally) and require considerably more maintenance by having to periodically strip and re-apply. It is also not suitable externally or where there is some UV because of their propensity to decay. This can lead to a very patchy appearance in terms of colouration and to the surface texture (peeling). And being a non-porous barrier it does not allow the stone to perform naturally. Acrylic-based sealers are commonly applied to concrete surfaces and recent formulations have incorporated colours.

Because of their popularity this discussion will focus on the low-viscosity (penetrating) type of sealer. Many aspects are also applicable to water-based sealers. Having discussed what a sealer is and what it is meant to do it is now necessary to look at the application of the product and then the ramifications of that application. Two words that mean a similar thing - penetrating and impregnating - are so often bandied around to convey to the prospective buyer that the sealer has some magical property so that it will go into whatever substance you put it on. **Great marketing and total rubbish**. It is the porosity of the stone or whatever product that determines whether the sealer will go in, or sits on top. Just because you put an impregnating sealer on glass or stainless steel does not mean that it will penetrate those products. The SAME goes for stone! If the porosity of the stone is low then no matter whether the sealer is promoted as penetrating or impregnating or whatever - it will only go in as far as it is allowed to by the property of the stone. Stone that has an absorption coefficient of less than 0.20% can be regarded as impervious or non-absorbent. There is no point in sealing this stone with the intent of sub-surface water repellency. It will not happen, yet the industry insists on applying such a product. Now, all sealing contractors know that it is imperative to remove from the surface of the stone all excess sealer straight after application to avoid blooming. But if the stone has not accepted the "penetrating" sealer because it is too dense to do so, it means that the contractor is wiping off what he has just put on. What a waste of money!! What is left on the surface is a very fine film of sealer that is not going to do the protective work that it is expected to do **BUT** it **will** bead immediately and temporarily after sealing - which usually satisfies the client. Easy money for the sealer salesmen.

What then for a highly porous stone like a sandstone or limestone? Is not such a stone amenable to sealing? Here again you need to ask a specific question about the role of a sealer. Is a sealer used to protect the surface of the stone from staining and soiling? The expected answer is "yes". However, when a low-

viscosity sealer is applied to the porous stone what exactly happens to that liquid? It is absorbed, right, and the sealer salesmen will proudly tell you how many millimeters it will penetrate. But wait, if it penetrates to say 1mm (rarely more) then there is no sealer on the surface (except for a thin film) so how can the sealer be protecting the surface of a porous stone? It can't because it is not being absorbed by the quartz crystals or the feldspar or the lithic fragments but by the intergranular pore space. So although not having a surface repellancy it will have a good repellency below the surface. And occupying the sub-surface pores also means that it will be shielded from damaging UV – allowing the advertising to claim that the sealer has resistance to UV.

The penetration of sealer into a porous stone (followed by its consolidation) leads to a common and serious problem. Most importantly, it changes the physical characteristics of the stone surface. The sealer binds together and forms a layer which is different to that of the underlying stone. If the stone is then subject to wetting and drying plus warming and cooling, such as what happens in a deck or pool surround, this bound surface layer behaves differently to the rest of the stone because it is no longer "stone" but a mixture of resin and stone. That means that it has a coefficient of expansion much higher than natural stone (in keeping with much higher values of polyester-based stone products) and this will lead to a fretting and/or a peeling of that upper layer after only 3-12 months of exposure depending on a medley of factors. It also leads to fretting/microspalling and delamination around arrises in the pavers. The presence of salt is an additional exacerbating factor because of the blocking effect (due to the sealed layer) of water moving from underneath the tile through to the surface.

In interior situations where the stone remains dry at all times sealers have their rightful place. But if the stone is in an area that periodically gets wet then there is a potential for problems. And where do the sealer salesmen tell you that it is needed most? – wet areas such as bathrooms! They tell you this will stop the staining on the surface and the penetration of water through the tiles. Unless the stone is extremely porous water will not penetrate though stone from the top. The problems always arise from the bottom up. But how can this be?? – the sealer is supposed to prevent this, isn't it. What the sealer cannot prevent is the fracturing of the grout. The grout between the tiles is generally cementitious and usually more porous than the stone. It also has physical characteristics that are different from that of the stone. So thermal fluctuations in the shower will gradually cause micro-fracturing of the grout or even an unbonding of the grout against the stone and opens the joints up to the entry of water into the sub-tile area. And what is the sub-tile area?? Generally a screed bed, i.e. a miniature aquifer, capable of holding **and retaining** a substantial amount of water. Once under a tile a 20mm cementitious screed bed will take about 3 months to dry out under favourable conditions. And that is, if there is no more water applied at all. So now, what is the sub-tile water (known as residence water) doing?? It is gradually dissolving small amounts of calcium (because calcium-based substances dominate the adhesive, screed and concrete base) along with very small amounts of iron, manganese, other elements, possible tannins, and a cocktail of compounds used in showers. As the shower tries to dry out, the residence water with its dissolved substances tries to move up by capillary action (a natural consequence of higher temperature above the stone). But then it hits a barrier just below the surface – correct, the sealer layer, and the liquid and dissolved substances can go no further. So many of these compounds start to concentrate and when attaining a sufficiently high concentration they will start to precipitate out. This leads to a gradual discolouration at first. A continuous build-up of these substances will gradually force their way through this layer by breaking it up, firstly on a granular scale and then following natural structural features (weaknesses) within the rock and dislocating small fragments. Once this failure has commenced then there is no way of arresting it.

In exterior situations the sequence of events is similar, if not faster because of the presence of the principal driving mechanism – the sun (additional heat/more evaporation) or just greater movement of air. External pavers undergo the same processes as described above. Discolouration is the main manifestation of stone failure but surface disintegration of granite surfaces due to the restriction of natural processes in the stone will occur after a few years. Pool surrounds and ledgers in cemeteries are good examples of such failures. It just takes longer because external structures tend to use thicker stone.

To counter the argument of water forcing its way into stone, in both interior and exterior situations, the stone salesmen will propose that you seal the stone on all (6) sides. Sells more sealer that way. Clever !! Again, they presume total repellency for long periods and under all conditions with all varieties of stone.

The universal band-aid to poor stone selection!! Experience has shown that this fix is again only temporary and water will eventually penetrate the stone. What they neglect to inform you is that the "enemy" of sealers is alkalinity. High-pH conditions such as those produced by cementitious products will cause the sealer to break down and loose its repellency. Another problem experienced with 6-sided sealing is very poor adhesion by the sealed tile or paver to the substrate (unless you use certain lock-in proprietary products) and adhesion between the tile and the grout. A long hairline fracture is a common development within the tile joint, thereby opening the tile and sub-tile area to water ingress.

A recent perusal of a stone association magazine naively espoused the virtues of sealers and the sealing of calcareous stones to "protect" that valuable investment. Clearly they are caught up in the hype of the advertising (money, money, money) that goes into the publication. Learned comments on sealers and their limitations are barred from publication lest some of the advertising be withdrawn. It says volumes for the magazine. In short, sealers do **NOT**, can **NOT** prevent the reaction between acidic products and calcareous stones from occurring – especially if the stone is somewhat porous. Remember, the sealer has penetrated into the stone and left the surface totally vulnerable. The better the quality of the stone (i.e. the lower the porosity) the more limited is the reaction. So for high quality marbles that have low porosities (such as some Carrara marble (0.10-0.30%) you should never even think about sealing it with a sealer. Because it is not possible to prevent etching by acidic solutions (most food products) it is best to have a honed finish even though it opens the surface porosity. However, tests have shown that it is not easy to stain quality marble (where is the staining substance likely to go?). Compared to marble, which has been produced in response to elevated thermal conditions, limestone tends to retain some of the characteristics of sedimentary rocks, notably some structures, fossils, and generally a higher porosity. An intermediate class is recognized, termed compact or high-density limestone. Both groups are very commonly used, principally in internal situations where the surface is generally polished to (a) display the characteristics of the stone, (b) to provide a natural repellency to water, and (c) to assist with its maintenance. Huge expanses of limestone are used universally on hotel foyers, airports, structural cladding, and general construction (e.g. the Great Pyramids, Colosseum). It is worth pointing out (facetiously) that not many of these structures have been sealed, although Aquamix wanted to seal the Pyramids as an advertising stunt and did indeed apply some sealer to an old Scottish castle.

Other sealing "failures" include reactions when applied to non-porous stone such as black granites, reactions to other sealers, reactions to oily limestone, and the application of excess sealer. It has already been pointed out that it is a pointless exercise to apply sealer to a non-porous stone such as many of the quality black granites. Nevertheless it is done. Because of their density and high natural resistance to soiling sealers do not penetrate into these stone types. So it remains on top. This can also happen in the event of excess being applied. Some sealers react to certain food substances, some to particular chemical, and some to hot fluids. But the most interesting one was a reaction to halogen downlights over a kitchen bench which resulted in large whitish circles. It is well-known that certain paints or coatings are not compatible and react. Some sealers behave in a similar manner and their compatibility should be established prior to use. Less well-known is that many limestones contain quite abundant organic material, particularly the eastern Mediterranean, Middle-East and some Spanish varieties. Some of this organic material is crude oil. The darker (black) limestone also contain abundant carbonaceous material. Because of the exhalation/exudation of organic material from these limestones testing needs to be done to check the compatibility of the sealer and the stone. Another detrimental aspect of sealers in general is when they are over-applied to a stone. A particular mall in Australia using a high quality, low-porosity stone was sealed several times in order to provide a "wet-look" and to facilitate easy cleaning. Because the product was applied to deeply exfoliated stone that would not absorb the sealers there was clearly an excess of sealer on the stone. Being a soft plastic substance in an environment that necessarily produces fine particulates the result was an embedding of the black sooty particulates into the excess sealer - resulting in an appearance that is dirty and which cannot be cleaned. Similar problems occur with a beige-coloured Australian granite in Sydney and Brisbane.

Not only will sealers result in stone failures under certain conditions – leading to disputes, but some stone suppliers have a policy voiding all warranties related to stone if someone applies the product or specifies that it should be sealed. The argument, which is valid, is that the physical and chemical properties of the stone have been modified by the application of a product that has penetrated into the stone (however little)

and that the stone is no longer what has been supplied. This policy justifiably casts more responsibility on the architects and interior designers who unanimously appear to be over-influenced by the marketing and salesmen extolling the virtues of their products.

The marketing and advertising of sealers is an artform of untruths, exaggerations and blind indoctrinations in their advertising material and presentations. Several of the larger companies try to outdo each other in the amount of advertising with some producing small books describing their medley of products. But under scrutiny the wording from one product to the next is almost identical and some of the written material is plagiarized from other companies. Irrespective of the company under close examination there is little factual information that is universally applicable because of their naïve insistence that stone is just stone that just all behaves the same. With about 13,000 stones on the world market and an infinite possible combination of applications and situations their task would seem difficult. However, clever marketing aimed at an audience not capable or willing to undertake their own tests or believing their own instincts and training has lead to the development of the "miracle in a bottle". All stone must be sealed is the catch-cry – irrespective of the stone, the conditions and the situation, and we have the product for you. Should a problem arise with a sealing experience the sealer salesmen are at the ready to sell you a stripper and then a "better" and more expensive product. Does anyone ever ask just who it is that sells sealers? Unlikely! The answer is that salesmen sell sealers! What does a salesman know about the stone that the client is intending to coat, if most stone suppliers don't even know? This miracle in a bottle does everything – from preserving statues, castles, plastic (engineered) stone, to preventing salt penetration, weathering, efflorescence, cohesion, etc. for any rock in any situation. Recently, there has been a promotion for a sealer to protect cobblestones from tyre damage. It is the most successful scam in the world's stone industry having only developed in the last 15-20 years. It has been so successful not just through its marketing but also because it is almost as good as an alibi. It takes time for problems to develop and after 1-5 years all is forgotten. Hence giving 10-15 year warranties, with fine-printed conditions that can never be challenged, is a safe thing for the sealer salesmen. Moreover, because the bulk of the sealer is really a carrier, its application onto stone, even inappropriately, will not harm the stone in the immediate future. In a way it can be compared to applying methylated spirits to stone. Nothing usually happens and the solvent evaporates and leaves no trace. For this reason it also facilitates fraud by some applicators, in applying product that has been considerably diluted but charged at full rates.

In conclusion, one the most important aspects to put forward is that there is **NO** expert out there on sealers, myself included. My expertise comes mostly from testing dozens of sealers on all sorts of stone over the years as well as the assessment of numerous failures on stone that are directly attributable to the application of this product – usually in situations where it should never have been applied. **There has been no long-term systematic practical research** carried out on sealers and their compatibility with stones in a wide range of applications over a reasonable period of time. The sealer manufacturer has done no such extensive geoscientific research, the sealer distributor has done no such research, the builder or fabricator has done no research, no laboratory has done the research, and certainly no salesmen selling the product has done any worthwhile research. However, there is a plethora of people out there espousing the virtues of this "magical" product because of the potential for making significant profits from the ignorant populace. Moreover, this is massively supported by an army of totally unqualified, uninformed, forum tragics and commentators for "Do-it-yourself" and "Home-beautiful" magazines who simply regurgitate what the sealer salespeople have told them or plagiarize what has already been written somewhere else. Beware of these self-styled experts out there who simply and confidently provide the unknowing client with information that is on the bottle, as provided by the distributor of the product. **Do not be fooled by these "EXPERTS" just because they are armed with a little more (marketing) information than the intended recipient!** If necessary ask them about their extensive practical testing programme that they have **NEVER** undertaken.

Sealer salesmen don't particularly like me.

Dr. H. D. Hensel