



## Prevent Stains in Natural Stone with Six-Sided Sealing

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Natural stone is more popular than ever among customers who value its beauty, durability and uniqueness. However, those inherent qualities can pose challenges in nearly all applications when installing stone. With the increasing use of natural stone tile on both commercial and residential projects, knowing how to prevent problems is especially relevant.



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TILE INSTALLATION SYSTEMS



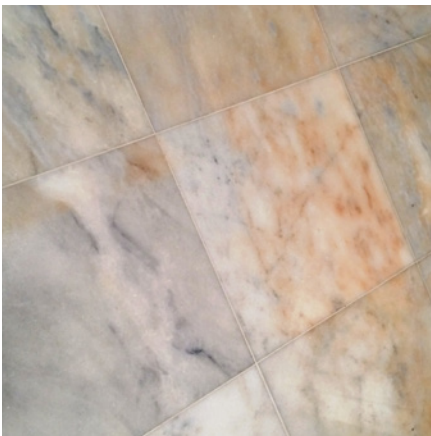
**Photo 1: Picture Framing on Granite**

Many natural stone installations suffer from aesthetic problems such as picture framing, soluble mineral blooms and staining (from minerals such as soluble pyrite), water marking and even some efflorescence. (Photos 1 & 2) In other cases, the base of stone veneer and seat walls may be stained from moisture wicking upwards, carrying impurities that permanently discolor the installation. (Photo 3) Although not all natural stones are prone to these issues, they can affect many commonly used marbles, limestones and granites. Some materials are known to carry possible risks, such as iron staining of white carrara marble.

Due to these issues, some believe there is no alternative but to not use, sell or specify certain stones that may pose a challenge. The good news is that there is another approach that can be implemented to aid in water management and allow successful installation of these beautiful natural materials. This method is called six-sided sealing and it will be explored in detail.

### **The Problem of Moisture**

The greater the quantity of water and the higher the pH (more alkaline), the greater the risk and degree of staining becomes. It is not uncommon to see this in certain types of limestone, but it is not limited to them. (Photo 4) This means the stone is most at risk during the installation phase when there are both significant quantities of water available from the mortar beds, concrete substrate and bonding mortar plus high alkalinity from these Portland cement-based materials. Environmental exposure to weather conditions, interior wet areas, accidental spills and joint fillers are other causes of irreversible staining. Managing the amount of water that can be absorbed by the stone during the installation phase, as well as managing water exposure post-installation, is the best way to reduce the risk of stains occurring.



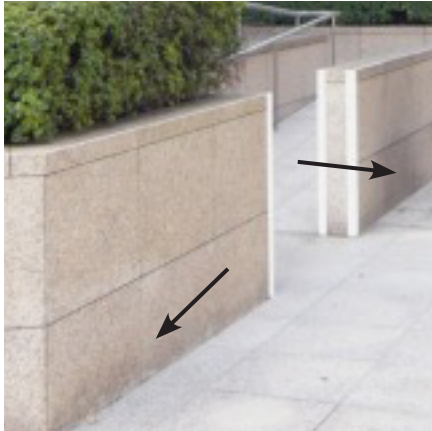
**Photo 2: Iron Staining on Marble**

### **Water Management System**

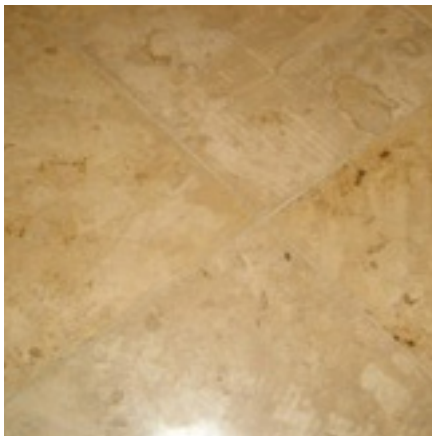
A comprehensive water management system should be implemented across the entire tile assembly to fully protect the stone from staining and contamination. This system will also deliver additional benefits by helping to reduce the risk of other water-related problems including freeze/thaw damage and dimensional deformation (warping), which is a well-documented problem with water-sensitive stone.

There are a number of elements to a water management system that should be applied when designing, specifying, selling or installing natural stone. Here are the components of the system leading up to six-sided sealing.

1. Correct water evacuation. Make sure that residual water can exit the tile assembly via properly installed drains. This is imperative to the success of any installation exposed to water. Water that is allowed to pool or stand will increase the risk of water-related staining as well as issues such as freeze/thaw damage, efflorescence and warping of moisture sensitive stone.



**Photo 3: Moisture Wicking of Impurities**



**Photo 4: Alkalinity Staining on Limestone**

2. Waterproof membranes and moisture vapor control. Keeping the substrate underneath the stone as dry as possible is an important part of a successful, problem-free installation. Moisture intrusion can come from both external and internal sources. Internal water can come from ground water (on-grade installations) and external water from precipitation that can filter through the installation to be stored in the substrate. Applying products to address possible ground water, or waterproof membranes to ensure the substrate cannot store water supplied from above, will greatly reduce contamination issues as well as reduce freeze/thaw damage and dimensional deformation.
3. Use of appropriate adhesives. Using specialized and appropriate adhesives such as an improved, polymer-modified mortar meeting ANSI A118.15 rather than standard mortars will help to reduce water in the system. In the case of water-sensitive stone, using an adhesive that contains no water at all, such as a 100% solids epoxy mortar, may be required. Also, note that when a sealer is applied to the back of a stone or tile, it reduces the surface water absorption close to zero. The sealed surface effectively acts more like a very dense material. Therefore, adhesives that are recommended for dense materials, such as granite or porcelain tile, should be used along with their specific installation methods even if the stone is a naturally less dense material such as limestone, sandstone or similar. In some cases, using a rapid-set mortar may also be beneficial to reduce the time the stone is exposed to the additional moisture.

CUSTOM's MegaLite® Ultimate Crack Prevention Large Format Tile Mortar and ProLite® Premium Large Format Tile Mortar mortars are advanced formulas with the polymer content to achieve a superior bond to the back surface of the sealed tile and are ideal for many of these applications. Both mortars are also well suited for either floor or wall installation of heavy stone or large format tile with one or more sides longer than 15". Where use of an epoxy mortar is indicated, we recommend EBM-Lite™ Premium Epoxy Bonding Mortar.

4. Proper placement of soft movement joints. Movement joints filled with a flexible silicone sealant are important because they manage the natural expansion and contraction of the tile assembly. If not controlled, this movement can lead to loss of adhesive bond. One of the consequences is that voids are created under the stone that can collect water and lead to staining and contamination problems. If joint placement is not addressed, it can ultimately lead to the complete failure of the installation. Follow Tile Council of North America Handbook Detail EJ171 for soft joint placement and treatment.
5. Six-sided sealing. The final component of a water management system to protect natural stone is pre-application of Aqua Mix® Penetrating Sealer to all six sides of the tile.





**Moisture-sensitive limestone was sealed on six sides at this business park.**

### What is Six-Sided Sealing?

By sealing all six sides of the stone, water is prevented from entering and moving through the stone to the surface and possibly triggering one or more of the potential problems outlined. With the right sealer, potential damage from moisture exposure and capillary migration will be reduced and possibly eliminated. It is critical to understand that six-sided sealing is an important component in creating a successful water management system for stone installations. It is a powerful preventative tool, but not the sole solution.

Managing the amount of water that can be absorbed by the stone during and after installation is the best way to reduce the risk of these types of problems occurring. However, for a sealer to work successfully in this environment, it must have two important characteristics. The first is that it does not interfere with the bond of the adhesive. The second is that it can perform in the high alkaline environment of the curing cement adhesive or mortar. For years, many in the industry have seen sealers as either bond breakers or products that significantly reduce the effectiveness of an adhesive. This is why they have not recommended or advocated their use for sealing the back and sides of stone tile, although most have acknowledged the potential ability of sealers to reduce the risk of staining during installation.

### A New Approach

While not commonly used in North America, six-sided sealing has been recognized and used successfully in Europe, Asia and the Middle East for decades. Custom Building Products' Aqua Mix® brand has been a pioneer solution provider for many large and complex projects. This includes the Burj Khalifa- the tallest building in the world - and nearly 4 million square feet of iron sulfide-containing granite pavers at the Dubai International Airport.

Experience on high-profile projects like these, the use of the highest quality raw materials and the latest advancements in chemistry have made Aqua Mix the industry leader. Advanced technology has created a new sealer that performs effectively in a high alkaline environment. This makes it suitable for application to all six sides of a stone - without breaking the adhesive bond.

Specifically, Aqua Mix's Penetrating Sealer is recommended for these six-sided applications when and where required. Its chemistry not only allows it to perform in a high alkaline, wet environment, but due to it residing within the stone and not on the surface, this ensures the sealer's ability not to interfere with the bond of an adhesive, cement mortar or grout. Two questions are often asked: 1) does it still allow the adhesive to cure, and 2) can the stone still breathe? The answer is for both is yes.



**Six-side sealed granite pavers at Dubai International Airport.**



**Photo 5: Insuring Tiles are Staged for Proper Sealing and Cure**

### Application Steps

Prior to applying a sealer, any dust or residue should be brushed off all sides of the stone. As fabricating stone tiles or pavers is a wet process, it is not unusual to see elevated moisture readings when immediately removed from the crates, boxes or packing containers. For best results, allow this moisture to cure out prior to sealing.

There are several ways to apply the sealer to all six sides, such as brushes or paint rollers, but the most effective and efficient method is to submerge the tile in the sealer and allow for full absorption into the tile. The tile should be submerged on average for 10 to 15 seconds to achieve maximum penetration, but may vary by stone. After being removed from the sealer bath, the tile must be wiped dry of any excess sealer on the surface. In some cases, a squeegee can be used. Again, testing is always recommended as the type and texture of the stone, jobsite conditions and experience of those applying the sealer will vary.

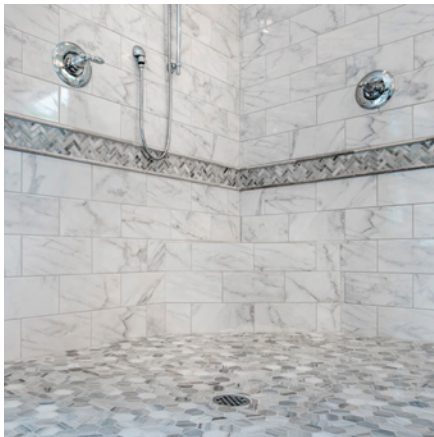
The sealed tiles should be set up on narrow supports so that air can get to all sides, and allowed to dry thoroughly. (Photo 5) It is important that the sealer is completely dry before installation with a cement-based mortar. After sealing, test tile samples to ensure that water beads on all six sides. For best results, allow the sealer to cure for 48 hours prior to installation.

### Additional Benefits of Sealing

Once the face of the tile has been pre-sealed, grouting becomes a faster and easier process. The sealer will help prevent the grout from potentially staining the face of an otherwise porous tile. Sealing also makes it easier to remove the grout from the face of the tile during cleaning, similar to using a grout release product. Since all sides of the tile have been sealed, water will not migrate into the stone and darken it. Six-sided sealing will prevent pigments in grout and silicone sealants from entering the tile and creating "picture framing" around the perimeter. (Photo 1)

Because the tiles are pre-sealed, they are also protected from accidental spills during the first few days after installation. Normally, the installer or owner must wait several days for the grout to cure before sealing the entire installation. During this period, the stone is typically unprotected, but pre-sealing eliminates this concern.

Over time, the repellent qualities of the sealer will be affected by the hardness and texture of the material, surface wear, weather conditions and cleaning regimens. All installations should be periodically tested (at least annually) to ensure that the sealer is still doing its job. If the stone absorbs water droplets instead of retaining beading, reseal by applying Aqua Mix Sealer's Choice® Gold for maximum stain protection to both the stone and grout.



**Six-sided sealing in wet areas can help prevent iron staining.**



**Photo 6: Mock-up Test Showing Sealed Stones vs. an Untreated Piece**

### Summary

Keeping the stone as dry as possible, both during installation and after, is the key to minimizing water-related problems. There are a number of significant benefits in using a suitable sealer, such as Aqua Mix Penetrating Sealer, to protect all six sides of a stone from moisture-related problems. The use of six-sided sealing is most beneficial when used during the installation and cure phase of the adhesive/mortar (approximately 28 days) where the risk of water-related issues is highest. The six-sided sealing process must be seen as one component in a complete water management system. Implementing the complete system is required to properly manage all risks of these types of stains that can occur during installation and to a lesser extent throughout the life of the stone tile installation.

Note: Previous experience with a particular stone is valuable and the stone quarrier, importer or supplier may caution about potential issues prior to installation. If this is not provided, ask for information and any testing results available. Given the amount and variability of natural stone we see today, and with new types being discovered frequently, there is no substitute for a mock-up to assess and insure that all variables and risks have been addressed up-front prior to the installation. (Photo 6)

While many procedures and details have been discussed in this paper, it is not intended to be a complete instruction document. Contact Custom Building Products Technical Services at (877) 278-2311 for more complete and comprehensive instructions and recommendations prior to implementing six-sided sealing.



### About the Author

Rod Sigman is the Business Development Manager for Technical Installation and Care Products for Custom Building Products. He has worked for the company for 28 years supporting Aqua Mix® in various roles including training and education for national accounts, job inspections, product specifications and product research and development. Mr. Sigman is also a frequent speaker at many national trade shows including Coverings, Surfaces and Total Solutions Plus.

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