

Product/Service Information

CHEMISTRY AND STONE

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As stone is a natural product that has been created over millions of years by Mother Nature and is a part of so many cultures, it has become the desired prestige symbol of building industries across the globe. It will always be desired as a building material for its timeless beauty and its opulent appearance with no one piece being exactly the same. Especially calcium based stones comprising of once living matter combined with various minerals and compressed over time giving a quality unique appearance. A slice or slab of evolution that man made products cannot match.

There are a wide range of natural stones that are composed of a various minerals which intern affect the performance of these stones.

It is important to understand the 'Make up' of these stones to get the best result from using these unique materials.

Composition of stones

Limestone

Limestone is composed calcite (CaCO_3) it is calcareous sedimentary rocks formed at the bottom of lakes and seas from calcium deposits of shells, bones, fossils etc. Over thousands and millions of years, layers build up adding weight. Heat and pressure causes a chemical reaction at the base of the layers turning the sediments into limestone.

Many limestone's contain visible fossil and shell remnants.

Some limestone can have more than 95% calcium. Other minerals also found in limestone in small amounts are alumina, ferric and alkaline oxides. Magnesium limestone or dolomite limestone is formed when a part of the calcium minerals are replaced by magnesium.

Limestone has a high absorption.

Marble

Marble is metamorphosed limestone or dolomites.

Marble is formed from limestone with heat and pressure over years in the earth's crust. These pressures or forces cause the limestone to change in texture and makeup. Fossilized materials in the limestone, along with its original carbonate minerals, recrystallise and form large, coarse grains of calcite (CaCO_3).

Impurities present in the limestone during the recrystallization period affect the mineral composition of the marble which is formed. The minerals that result from impurities give marble wide variety of colours.

The purest calcite marble is white.

Marble containing hematite (ferric oxide) has a pink or reddish colour.

Marble that has limonite (ferric hydrate) is yellow, beige or brown.

Marble that has graphite and pyrite has grey to black colour.

Marble with serpentine is green.

Marble has a low absorption.

Travertine

Travertine is a form of limestone composed of calcium carbonate (CaCO_3) which is deposited by mineral springs (especially hot springs) or rivers.

Travertine is usually hard and semicrystalline. It often has a fibrous or concentric appearance with coloured and banded patterns existing of white, tan and cream colours.

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Travertine

It is formed by a process of rapid precipitation of calcium carbonate, often at the mouth of a hot spring or in a limestone cave. In the latter it can form stalactites, stalagmites, and other speleothems.

One characteristic of all travertine is the presence of small voids that were caused by air bubbles in the hot water. At times when and if the spring went cold, onyx was formed. It is not uncommon to find bands of onyx among travertine beds. Travertine has a high absorption.

Onyx Marble

Onyx Marble is often separated from marble as it is created by calcite or aragonite precipitation especially in caves. Onyx marbles are compact- usually colour bands/patches and/or sometimes translucent. Unlike travertine it has low absorption.

Basalt

Basalt is a common igneous (Mafic Extrusive volcanic) rock. (Most common rock in the earth's crust). Almost all oceanic crust is made of basalt. Basalt's common minerals are calcium rich plagioclase (feldspars, pyroxenes and olivine). Colours; black, grey or greenish black.

Sandstone

Sandstone is a sedimentary rock group which is mostly made up of tiny grains of quartz. Most sandstone is formed in oceans, lakes and rivers where tiny bits of rock and dirt settle to the bottom. After many years these layers of sand get buried under tons of more sand and dirt until it compacts into solid rock. Sandstone can be found in many colours.

Sandstone is principally composed of silica. Sandstone is comparatively porous.

Quartzite

The parent rock for quartzite is quartz-rich sandstone. As sandstone becomes deeply buried, rising temperature will fuse the quartz grains together forming the extremely hard and weather-resistant rock quartzite. Pure quartzite is light in colour.

Granite

Granite is from igneous (Felsic volcanic) rock, it is a very hard, crystalline, and primarily composed of feldspar, quartz accompanied by one or more dark minerals. It is visibly homogeneous with a granular texture.

Granite has a highly dense grain, is impervious to stains, low porosity. Granite is very hard and cold to touch.

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Working with calcium based stone.

As you can see most of the highly sort after stones are calcium based. Being calcium we need to understand the 'pH, affect on these stones.

What is pH and why is it so important?

pH is a measurement of the **acidity** or **alkalinity** base of a solution.

The **pH scale** ranges from **0 – 14** and is divided into three sections.

Acid range being 0 - 6.9 with 0 being the most acidic

Neutral range being 7, neither acid nor alkaline.

Alkaline range being 7.5 – 14 with 14 being the most alkaline.

The strength of a solution is determined by where on the pH scale the reading falls. As a general rule on the acid side, the lower the number the stronger the acid and on the alkaline side, the higher the number the stronger the solution. The pH reading measures “**strength**” not quality.

When the alkalinity of the solution is increased to **pH 8** from **pH 7**, the strength is now **10 times stronger** than that of **pH 7**. Increase the **pH** to **9**, the solution is now **100 times stronger** than it was at **pH 7**. For each whole step up or down the **pH scale** the strength increases or decreases by **10 times**. That means that **pH 14** which is **10 million times** as strong as **ph 7**. It is the same for the acid side of the scale.

When alkaline and acid come in contact with each other you get an aggressive pH chemical reaction; For example; If you add a few drops of vinegar (**acidic pH 2**) to some baking soda (**alkaline pH 9**) you will see the reaction. Or to neutralize a glass of cola (**pH 2.5**) it will take 32 glasses of alkaline water (**pH 10**)

We can now begin to understand why stones composed of **calcium** which has a **pH of 12** are damaged by solutions which are **acidic 0 – 6.9**

When installing Limestone, Travertine, Onyx, Basalt and Marble you should always use “Neutral” silicon not acidic silicon.

When cleaning Limestone, Travertine, Onyx, Basalt and Marble you should always use a Neutral or ideally an alkaline cleaner not an acidic cleaner.

Rain Water has a **pH of 5.6** this can vary by the time it comes out of the tap.

(Acid rain can be even lower). So water can etch calcium based stone.

Note; “Pure” water is **pH 7**.

In wet areas like bathrooms and showers The **pH rating** of items like shampoo, conditioners, soaps Etc. need to be considered as they can effect stone especially shower floors and vanity bench tops.

Some examples of solution that will affect Calcareous stone.

These are just some of the solution to be aware of with calcium based stone. The more acidic the solution, the greater the reaction (etching) and give you less time to prevent the reaction.

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10,000,000	pH = 0	battery acid, strong hydroflouric acid
1,000,000	pH = 1	hydrochloric acid secreted by stomach lining
100,000	pH = 2	lemon juice, gastric acid, vinegar
10,000	pH = 3	grapefruit, orange juice, soda
1,000	pH = 4	tomato juice, acid rain
100	pH = 5	tap water, black coffee
10	pH = 6	urine, saliva
1	pH = 7	"pure" drinking water
1/10	pH = 8	sea water
1/100	pH = 9	baking soda
1/1,000	pH = 10	Great Salt Lake, milk of magnesia
1/10,000	pH = 11	ammonia solution
1/100,000	pH = 12	soapy water , CALCIUM
1/1,000,000	pH = 13	bleaches, oven cleaner
1/10,000,000	pH = 14	liquid drain cleaner

White wine pH 3 – 3.3, red wine pH 3.3 – 3.5, Beer pH 2.5, Cola pH 2.5, Black Coffee pH 5, Lemon Juice pH 2, Vinegar pH 2, Tomato juice pH 4. Extremely acidic – Artificial sweeteners, Beef, brown and white sugar, Carbonated soft drinks, Fish, Seafood, Tea (black), Fruit juices with sugar, Jams, Jellies, Lamb, Pork, Poultry, Chocolate, Fats, Oils, Hard Liquor, Spirits, Cigarettes and tobacco. Etc.

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Other chemical Issues that can affect Stone.

There have been many articles written about stone and the problem associated with stone.

One such article is;

'The Ten Most Common Stone Problems' by Fredrick M. Hueston.

1. Loss of shine
2. Etching
3. Staining
4. Efflorescence
5. Spalling, Flaking and Pitting
6. Yellowing
7. Uneven Tile-Lippage
8. Cracks
9. White Stun Marks
10. Water Rings/Spots

Having already shown that CLEARSTONE™ offers a barrier to Etching and also Staining, [as the coating is chemically resistant] we can show that CLEARSTONE™ can address one way or another, all these other problems.-(addressing the chemical related problems first)

Water Rings /Spots

Strong alkalis also cause deterioration and attack the coloured minerals, fading them.

The over use of a strong alkaline detergent can cause severe salt efflorescence and bleaching.

Water rings and spots are common on marble tops where 'hard water' is left on the surface and allowed to dry on the surface. This is water that is rich in minerals such as calcium and magnesium and when the water evaporates it leaves behind these minerals forming rings or spots.

Coating with CLEARSTONE™ will prevent water rings and spots along with removing the need to strong alkaline cleaners.

Efflorescence

Efflorescence appears as a white powdery residue on the surface of the stone. It is a common condition on new stone installation or when the stone is exposed to a large quantity of water, such as flooding. [Shower floors] This powder is a mineral salt from the setting bed. The stone will continue to effloresce until it is completely dry. The drying process can take some time to dry naturally.

After removing the efflorescence from the surface and drying the affected area. The surface can be coated and sealed with CLEARSTONE™ to prevent efflorescence from happening again from flooding on the surface. Any moisture that may continue to come from beneath the stone 'osmosis' would need to be addressed.

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Spalling, Flaking and Pitting

Like efflorescence mineral salts are the cause for spalling, flaking and pitting. Instead of the salts depositing on the surface [efflorescence] they deposit below the surface of the stone, causing pressure within the stone and therefore the stone spalls, flakes or pits.

CLEARSTONE™ will bind the surface together and prevent moisture from penetrating the surface from the direction in which it is coated. IE; if you coat all sides of the stone and it has been completely dried or as much as possible prior to coating, it will be totally sealed from any moisture getting in or out of it.

Discolouration -Yellowing

There are many reasons for discolouration of stone. Surface and embedded grime. Surface cleaners, wax , sealers and other coating can contribute over time. Some stones have inherent minerals in them that cause them to discolour with age. This is caused by oxidation of iron within the stone and especially problematic with white marbles. There are ways of removing most stains by chemically treating the surface or grinding the surface.

**Once the surface is cleaned CLEARSTONE™ puts a barrier on the surface that stops the surface of the stone coming in contact with the chemicals/grime that cause most of the problems.
The CLEARSTONE™ surface is much easier to maintain.**

Example of efflorescence



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Other Non-Chemical issues that can affect stone.

Loss of Shine

Loss of shine, scuffing and scratches can be attributed to general wear. This is especially true with marble, travertine and limestone.

The light refracts off the worn stone surface and distorted due to light hitting all the scratches giving a dull appearance especially when view in bright areas or from a particular direction. Any undulations, cracks or blemishes in the stone's surface will also show up for this reason.

The normal way to fix this is to professionally hone and polish the stone onsite, which can be quite messy and time consuming.

In the case of CLEARSTONE™, it's the resin surface not the stone that scuffs or scratches. The CLEARSTONE™ surface much easier to maintain and repolish if required by either the end user our licensed applicators.

With the CLEARSTONE™, if the surface is flat and smooth, the light will refract evenly of the surface and not show up any of the undulations, cracks or blemishes in the stone as it is below the surface of the coating.

White Stun Marks

Stun marks appear as white marks on the surface of the stone and are common in many types of marble.

These stuns are the result of tiny explosions inside the crystal of the stone. Sharp impact or pin point pressure on the marble surface cause these marks. Women's high heels or blunt pointed instruments are common reasons for stun marks. Bar tops often have stun marks from bottle being dropped unevenly onto them. Most stun marks will grind out but some travel through the entire thickness of the stone.

As the CLEARSTONE™ is thick and reasonably impact resistant it will absorb the impact pressure. CLEARSTONE™ actually spreads the impact across a wider surface area and act as a barrier to stop the crystals in the stone crushing and causing them to 'explode'. Bar tops that were covered in stun marks prior to coating have shown no sign of further problems after coating.

Example of etching, water rings/spots



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Cracks

Cracks can be caused by a variety of causes with most common being building movement, or poor installation practices. Cracks can appear from weaknesses in the stone created by mineral deposits. With stones that are very brittle the back of the stone is often supported by a fibre mesh and resin but the face of the stone has no protection, especially the stone is not evenly supported.

While larger cracks can sometimes be repaired by filling with a colour matched polyester or epoxy, very small hair line cracks may not be able to be filled, which normally would require replacing.

Firstly, the CLEARSTONE™ coating can be coloured and used as filler.

CLEARSTONE™ can be used as clear filler highlighting the cracks as features or as part of the natural look of the stone. It can also be used to highlight other features in stone like unfilled travertine where you actually can look into or through the holes during its creation.

CLEARSTONE™ is a cross linking process that bonds to the surface of the stone together bridging the cracks making a very solid stable continuous surface.

Lippage – Steps, chips, grinding marks Etc.

Lippage is a term given to tiles that are set unevenly. In other words the edge of the tile is higher than the next. This usually results in the surface having to be ground or the stone needing to be replaced.

Other similar problems that require the same treatment are; steps in stone bench tops, chips in the surface, grinding marks Etc.

With CLEARSTONE™, provided that the lip, chip or mark is ground so that there is not sharp edge to it, [that is the edge of the lip, chip or mark is ‘rounded off’ or blended in] the coating will cover up the problem.

Although there is a ‘dip’ in the stone’s surface when coated you can not see any of the distortion in the stone’s surface or the joint. Once again, this has to do with the light refracting of the surface of both the CLEARSTONE™ coating and the stone under the coating. It gives an optical appearance that the stone’s surface is not distorted but has a three dimensional appearance to it due to the thickness of the CLEARSTONE™ resin. The actual top [resin] surface reflects as a flat surface.

Even though there is still a step in the stone’s surface, the actual surface feels flat and is easy to walk on or work on.

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Conclusion

Etching is inevitable on unprotected stone.

Stone sealers will NOT STOP ETCHING.

The only way to totally protect the stone is to apply a clear coating over the top of the stone.

CLEARSTONE™ resin coating is not affected by pH nor does it have a pH rating.

CLEARSTONE™ does not detract from the natural appearance of the stone.

CLEARSTONE™ is thick enough to become a real barrier, which in-tern becomes the actual work surface that is easy to maintain and total-ly impervious.

Amazingly, the man made alternatives are to take the stone, crush it and mix it with resin and grind the surface exposing the stone. Some products are formed by crushing quartz into small granules then mixing them with resin to form a 'granite' appearance. And some others break 'calcium based stone' into larger pieces and when exposed still have the same inherent problems.

Why don't we simply coat the 'real thing' with CLEARSTONE™?

Whilst most of the information in this article is common knowledge, we are happy for anyone to use this article provided you accredit Innovative Composites CLEARSTONE™.

Trevor. E. Holloway, Director.

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