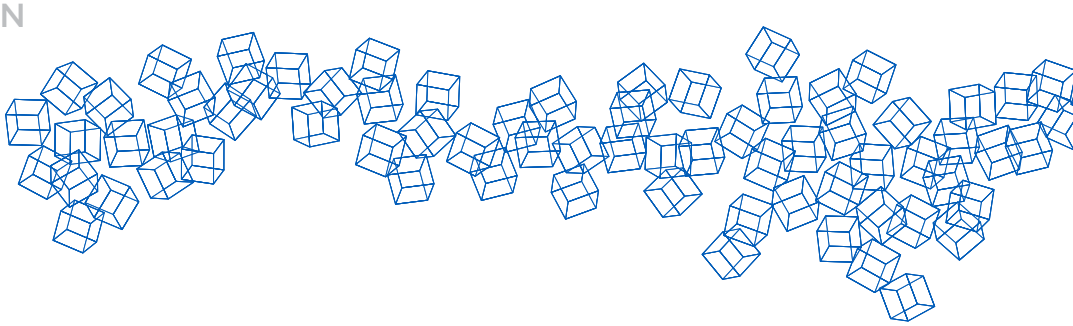
MAPEI®



Tile & Stone Installation Systems

Causes and cures of efflorescence

Efflorescence is a fine, white, powdery deposit of water-soluble mineral salts that forms on the surface of typical Portland-cement-based materials. When this occurs at the surface of grout, the deposits can cause discoloration. This is due to the exposure to air and evaporation, which convert the mineral salts into a crusty, crystalline material. Because efflorescence is composed of crystals, it can often be identified when light reflects on the tiny particles and causes them to sparkle. Such deposits tend to drastically reduce the aesthetic appeal of finished tile and stone installations, but they do not have a detrimental effect on the grout.

The mineral salts of efflorescence migrate through the pores and capillaries of any Portland-cement concrete matrix when three elements are present. First, there must be water-soluble salts present in the tile-setting system or substrate. Second, there must be sufficient moisture present to render the mineral salts into a soluble solution. Third, there must be a path for the soluble minerals to migrate through to the surface where the moisture can evaporate.

Potential causes of efflorescence

- Contaminated water (such as with high mineral, sodium chloride or chlorine content) was used during installation and cleanup. Water softeners may add such minerals by design.
- Grout was mixed at speeds too high, leading to extra porosity.
- Water entered the concrete slab substrate, either from above or below.
- A concrete slab was not fully cured when the tile and grout were installed.
- Too much water was used to mix the tile mortar and/or grout.
- Excessive water was used during cleanup.
- Water was used to re-temper and extend the mixed grout's pot life.
- Cleanup involved an improperly wrung-out sponge, or excessive wiping with a sponge.
- Water was left standing in empty grout joints before grouting.
- Tiles were grouted too soon after installation.
- Ambient and/or substrate temperature was too cold while the grout was curing.
- The tile installation was prematurely exposed to heavy amounts of water.
- The installation experienced water intrusion from above or below.

Prevention of efflorescence

Good work practices

Because it is easiest to prevent efflorescence before it occurs, the industry offers several best practices for doing so.

- If a jobsite's water has high mineral, chloride or chlorine content or is otherwise contaminated, use off-site or bottled water to mix and wash setting and grouting materials. Use only potable water.
- Minimize the porosity of grout. Grout should be dense and compact. Do not mix or clean with too much water or mix the grout at high speed.
- Prevent water from entering the finished installation. Properly installed vapor retarders, slab topical moisture-mitigation products and waterproofing membranes can help under the slab to reduce tiling system moisture that contributes to efflorescence.
- Before grouting, allow a minimum time for proper curing – 28 days for concrete slabs and 24 hours for tile-setting materials. Substrates that are young and "green" can still have a high level of moisture vapor emissions. Capping these substrates with tile and grout forces the vapor emissions laden with mineral salts to be concentrated to the comparatively narrow grout lines.
- Keep all water away from the finished installation for as long as is recommended by the grout manufacturer. Allow extra time for curing when the installation is exposed to low temperatures (below 60°F/16°C) and/or high humidity (greater than or equal to 70% relative humidity).

In addition to work practices, selecting installation materials that will not contribute to efflorescence is also an important strategy for prevention.

Design

When designing a tile installation, keep moisture away as much as possible. Some jobs are intended and designed to get wet, be saturated or be submerged. For those jobs, see the "Waterproofing" section below, using alternate materials.

Without moisture, efflorescence will not occur. Efflorescence will tend to develop where wet areas are not pitched, flashed or waterproofed properly. This is especially true with exterior areas. Exterior installations in North America can face extreme weather conditions during and after completion. The least amount of moisture exposure possible, especially during the installation process, is recommended.

Waterproofing

Waterproofing membranes such as *Mapelastic® AquaDefense* are typically used to keep topical moisture from penetrating to the substrate, but will also help to keep moisture from reaching grout joints that could otherwise contain perfect conditions for efflorescence formation.

Vaporproofing

Vapor emitting from a concrete slab can also contain soluble salts. Moisture barriers such as *Planiseal® VS* and *Planiseal VS Fast* are proven ways to reduce moisture vapor emissions from a concrete slab.

Sealers

Grout sealers are not a cure-all for efflorescence; however, a properly applied and maintained sealer such as *UltraCare™* Penetrating Stone, Tile & Grout Sealer will deflect some of the water from entering the tile-setting material and substrate.

Mortars

The best advice for overcoming efflorescence is to use setting materials that do not contribute to efflorescence. Because the soluble salts creating efflorescence are always associated with Portland cement, eliminating Portland cement will eliminate efflorescence. Normal tile-setting mortars contain Portland cement. However, mortars that are rapid-setting (that is, within three hours) do not contain Portland cement and will not contribute to efflorescence. Such mortars are still cement-based, but the cement itself is a calcium aluminate rather than the efflorescence-contributing Portland cement. *Ultraflex™ LFT™ Rapid*, *Ultraflex RS* and *Granirapid®* are examples of rapid-setting mortars.

Grouts

Modern research and technology have created alternatives to Portland-cement grout. In addition to Portland-cement grout, MAPEI offers a fast-setting cement (calcium aluminate) grout named *Ultracolor® Plus FA*. MAPEI's single-component, ready-to-use acrylic grout is *MAPEI Flexcolor™ CQ*. *Kerapoxy® CQ* and *Kerapoxy IEG CQ* are 100%-solids, reaction-resin (epoxy) grouts. All of these grouts cannot and will not contribute to efflorescence.

Correcting and cleaning efflorescence

Correction

Once efflorescence has occurred, all is not lost. Before trying to correct unsightly patches of mineral salts, reconsider the three elements necessary for efflorescence to occur in the first place. Unfortunately, after efflorescence occurs, we already know that mineral salts have been contributed by a Portland-cement concrete, mortar or grout. And a pathway exists to the surface, because all concrete products have pores and capillaries to a certain degree. That leaves the final element of water.

Examine and eliminate (when possible) the entrance of unwanted water into the tile system. For exterior installations, ensure that flashing and coping are in place, properly installed and not damaged. Drainage systems, downspouts and grading should be properly installed, not clogged and directing water away from the building.

Cleaning

Keep in mind that efflorescence can generally be cleaned off of the grout. Cleaning should always start with the easiest, least destructive approach before more aggressive techniques are attempted. Sometimes scrubbing with a stiff bristle brush, either dry or with clean water, is all that is needed to remove efflorescence.

Stubborn deposits may require the use of an acid-based, heavy-duty tile and grout cleaner such as *UltraCare* Sulfamic Acid Crystals or *UltraCare* Acidic Tile & Grout Cleaner. When using any acid-based product, be mindful to follow all instructions, protect adjacent surfaces, soak the area with water before application and rinse thoroughly after use. Always test in an inconspicuous area to confirm desired results before proceeding. In severe cases, several applications may be necessary. Acids should never be used for everyday cleaning because they work by eroding a small top layer of the grout and can damage sensitive tiles and stones.

Once efflorescence has been removed and the grout is clean, the application of a penetrating sealer from MAPEI's *UltraCare* line can help to keep some moisture away. If the cleaning resulted in a slight amount of shading, periodic cleaning with a neutral cleaner such as *UltraCare* Concentrated Tile & Grout Cleaner will reduce this condition over time. Otherwise, consider using *UltraCare Grout Refresh™* to re-color the grout.

When care is taken with design, material selection and suitable corrective actions, any efflorescence does not need to permanently ruin an otherwise acceptable tile installation.

Jobsite conditions vary and may present installation issues not covered in this technical bulletin. For the most current product information, visit www.mapei.com or contact MAPEI's Technical Services Product Support Team.

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