

## A Grain of Salt, A Drop of Water, A Pinhole Path = Efflorescence Risk

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Brick walls and buildings are esteemed the world over not only for their timeless beauty and uncompromising sophistication, but also for low maintenance, eco-friendly attributes and water and fire resistance. They often stand stronger in storms against flying debris that might more readily damage wood, glass or siding. Brick evokes a rustic elegance embraced by all architectural styles. Yet, like sterling silver, wood, copper and many materials, brick can lose some of its aesthetic appeal for a variety of reasons, among them efflorescence.

The most common definition of efflorescence is the “action or process of developing and unfolding as if coming into a flower, like blossoming.” In that context, it can refer to flowers, culture or intellect. As a medical term, it points to a powder or crust forming as in a rash. Chemically, it indicates a process that results in a powder residue where water evaporates after water with salt content penetrates from a wet space through a porous dry space.

A white or gray powdery film on a beautiful brick wall is both unsightly and challenging to eradicate. It can appear green or brown depending on the iron content in the clay. There are some remedies and cleaning procedures, but embracing one of Benjamin Franklin’s wise adages might make more sense and cause much less angst: “An ounce of prevention is worth a pound of cure”.

There are three conditions that must exist for brick efflorescence to develop, and eliminating any one of them dramatically reduces, and potentially eliminates, the possibility of the evaporation and crystallization processes that deposit efflorescence on brick. On a brick wall:

- [Grain of Salt] ~ Water-soluble salts must be present;
- [Drop of Water] ~ Sufficient moisture must exist to convert salts into a soluble solution;
- [Pinhole Path] ~ A porous pathway is necessary for the soluble salts to travel to the surface. Here, the moisture will evaporate, leaving salts to crystallize and result in efflorescence.

The grain, the drop and the pinhole might not quite be enough to cause the white powdery residue that wrecks the attractive appeal of a brick wall, but where there is one – grain, drop, pinhole – mostly likely there are many more. Likewise, you do not often find just one flea on a dog.

### **Prevention**

It's tricky, but not impossible, to avoid having any water soluble salt in masonry because it occurs as a natural element in clay used to make bricks and in the Portland cement in mortar and grout. The chances of efflorescence occurring can be lowered by using a low alkali Portland cement, one that has 0.6% alkali or less, by weight. Many fired clay brick manufacturers add chemicals like barium carbonate to immobilize sulfates so they cannot be dissolved even if moisture is present. Know your brick for salt potential.

Soluble salts are found in sand and water, too. Read packages of dry products for processes like washing and drying sand before blending to eliminate efflorescence potential. Mortar and grout manufacturers have developed proprietary blends in admixture products with chemicals, which claim to maintain product flow and bonding qualities while decreasing water content. They are all different, so knowing precisely what is in the compound and following each product's specific directions are imperative for good results.

Eliminating the soluble salts in every material is but one way to assure no efflorescence on a brick wall. The second condition is moisture, and there is no reliable way to build a quality brick wall without mortar or grout, which are wet by their very nature. Water needs to be tested before combining it with dry material to assure it is salt free, potable and clean. Additionally, concave and V-type compact mortar joints can hamper water seepage. Mechanical vibration consolidates grout and improves the bond, and dense tooled mortar joints can produce a more compact, less permeable result.

Mortars more resistant to water have been developed for applications where mortar will be exposed to above average contact with water. "Water repellents are used in mortar to slow the movement of water through the mortar joint," states Nick Blohowiak, National Sales Manager – Masonry, SPEC MIX, a Quikrete Company. "It is generally used in combination with water repellent masonry units and in situations where there is concern that the mortar will have an elevated exposure to water. If the masonry units are water repellent, and the mortar used in combination with the water repellent block does not have water repellent in it, the mortar can effectively act like a sponge while the block will act like a pane of glass. When then washing this masonry system, the block will shed the cleaning solution while the mortar will pull it in leading to accelerated deterioration of the mortar joint due to the cleaning chemicals. If the mortar has water repellent in it, it too will shed the cleaning solution in a way that is similar to the masonry unit and the masonry system will remain as intended by the designer after the cleaning process."



“Efflorescence can be prevented by proper installation of vents and by eliminating the flow or collection of moisture behind a masonry surface,” says Ron Baer, President of Kem-O-Kleen. “Moisture has the physical property of attempting to flow toward the molecules that are dry. Therefore, if wetting is taking place on one surface while drying is taking place on another, the fluid will flow in the direction of the drying, carrying salts with it.”

“Equilibrium of drying from back and front to center to avoid flow is the ideal,” Baer continues. “If the back of a brick is damp, as might occur if flashing or gutters are not installed properly and water drains behind the brick, then the drying process will draw moisture, and possibly efflorescence to the front. Efflorescence will also occur if brick is used for a ground retaining wall without proper protection on the surface in contact with the ground. The ground prevents the backside of the brick from drying while the atmosphere dries the front, drawing the salts to the front.”

Another contributor to contaminated materials can be storage. While OSHA has extensive regulations regarding safety in terms of height, pallet handling and load requirements, bricks and block must always be wrapped and stored on pallets off the ground. Obviously, the ground has salts which can adhere to or penetrate the brick, and dirt and other outside debris can splash on to bricks or be carried to them by rain and wind which can negatively hamper the mortar bond.

Nitterhouse Masonry Products, LLC, a 5th-generation family business in eastern Pennsylvania, suggests on its website: “Applying an impregnating hydrophobic sealant to a building material surface can prevent the absorption of water. The sealant also will stop water from traveling within a building material. And, installing capillary breaks such as polyethylene sheeting between a building material and soil can minimize the risk of salt entering the material.” [www.nitterhousemasonry.com]

Quality masonry construction, however, can control water presence before and after construction with excellence in architectural design and a keen eye toward potential water penetration. Backing materials, for example, might contain soluble salts and negate all the cautionary steps taken with the bricks and mortar. Wide eaves and flashings that protect the top of the brick wall from rain and snow can help. Landscape architects need to be exceptionally vigilant on the placement and range of sprinkler systems and adjust landscape plans accordingly.



## Cleaning

Even with all the best of intentions and control measures in place, efflorescence may still find its way to an exterior brick wall. To be sure you are dealing with efflorescence, Baer suggests wetting a finger, rubbing it on the white surface and then tasting the material for salt flavor. “However, the most important remedial step is to remove the source of moisture causing the loss of drying equilibrium,” he states. “Often the cause is not the fault of the mason but other trades. My understanding of the consequence of efflorescence is that it is strictly cosmetic. However, the consequence of the cause of efflorescence, moisture where moisture does not belong, is not a good long-term situation.” It can come from condensation inside a wall, as well as newly sprung leaks in pipes, rain water penetrating a compromised roof or wall or other water incident. Cleaning the brick and investigating the source can go hand in hand.

The mantra for cleaning brick is always to use the most-gentle methods and cleaning agents available to get the job done. Sand blasting is falling out of favor for efflorescence because it is harsh enough to change the texture of the brick and damage mortar joints. Since efflorescence is water-soluble, then the correct combination of water pressure and appropriate cleansers applied on a dry, warm day should clean it effectively.

More than 40 years ago, stone mason Charlie Hewitt determined there had to be a better way than what was then available to clean brick, so he designed and patented the Kem-O-Kleen®. This easy to haul, easy to use, cleaning system all neatly mounted on its own trailer chassis is basically a three-step process of wet, wash, rinse. The patented design and technology are evaluated and updated annually for constant improvement; however, the machines can last decades, so it's not necessary to buy new equipment often. Any part, which wears out can be replaced without dismantling the entire machine. It is also strategically crafted so the engine is mounted away from the fuel tank, and the combustion tank is separated from the fuel tank by the water tank. The acid tank filler neck is not near the electrical cords, burner or switches. It's a little marvel that will comfortably pass through a door five feet wide and can be disconnected from a trailer hitch.



Since efflorescence is water soluble, it's possible to remove it with water pressure, rinsing the building in warm, dry, preferably sunny, conditions. In some cases, it can be brushed off with a stiff dry brush, and if the wall is not gigantic, a mix of 50-50 warm water-white vinegar solution may work. Clear water repellents, silicone and acrylic coatings also may help remove efflorescence. The coating will absorb water across a masonry surface and prevent efflorescence from recurring. To apply a coating correctly, Nitterhouse recommends this three-step process:

- 1) Rinse the Building Surface: Rinse the building surface with water. If the surface is outdoors, you can use a hose to spray down the surface. Or, if the surface is indoors, you can use a spray bottle filled with water to rinse the surface thoroughly.
- 2) Apply the Cleaning Solution: Spray the cleaning solution onto the building surface and allow it to sit for several minutes. If necessary, you may need to apply multiple coats of the cleaning solution to the surface for optimal results.
- 3) Rinse the Building Surface Again: Rinse the building surface with water one last time. Then, use a fresh, dry cloth to clean the surface. Ensure the surface is dry to minimize the risk of ongoing efflorescence. [[www.nitterhouse.com](http://www.nitterhouse.com)]

Once the efflorescence is completely removed, a team of architectural and construction experts should evaluate the source of the soluble alkali sulfates, the moisture and the travel path before sealing the wall. If salts and moisture are trapped beneath or behind a masonry wall, they may still crystallize when the water evaporates, which is crytoflorescence. Salt crystals can expand and surpass the tensile strength of the brick, causing it to bulge, disintegrate or otherwise break.

Ben had it right with the ounce of prevention being worth a pound of cure, though perhaps he did not have brick efflorescence in mind. Excellence in design and materials can prevent brick efflorescence in many circumstances. But even the best laid plans of mice and men do not always come together perfectly. Because of the vast assortment of materials, cleansers, procedures, equipment and supplies, there are many reputable, professionals in the brick and masonry cleaning business. Not only do they understand water pressure, masonry composition, personal safety, cleaning agents and residue collection, but also they know about permits, environmental rules and process regulations. Should you do it yourself with Kem-O-Kleen® or another machine or procedure, check with the local municipality for specifics. Permits are usually much less expensive than fines, and it enhances your reputation for competence to do it right.