

Efflorescence



Efflorescence is a harmless, white crystalline deposit, usually on the exterior surface of masonry, however, it can also be found in other forms and colors as described in this bulletin. Most efflorescence is preventable with proper construction technique and design. Efflorescence is more prevalent in late fall, winter and early spring, when evaporation is slowed down due to cold temperatures, and/or when humidity is high, such as after a rainfall.

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Identification of Efflorescence Types

- ▶ **NEW BUILDING BLOOM:** Occurring on masonry that is less than a year old and is uniform across the elevation. *The cause most likely can be attributed to construction techniques and moisture in the mortar.*
- ▶ **PROBLEMATIC EFFLORESCENCE:** Generally occurs after one year, several months after cleaning, or the natural removal of new building bloom, and is usually spotty (large or small area). *The cause most likely can be attributed to poor drainage, an air barrier breach, or a leak in the wall.*
- ▶ **LIME RUN:** White or gray in color, crusty formations originating from a 'spot' or hole and running down the wall. *Brought on by limestone/precast trim, mortar, and CMU or cement backing. Requires a large amount of water to flow through same 'spot' over an extended amount of time.*
- ▶ **WHITE SCUM:** White or gray discolorations. *By product of cleaning with muriatic acid, inadequate pre-wetting of the masonry, or rinsing the masonry during cleaning.*
- ▶ **VANADIUM:** Green or yellow discolorations (found in light colored brick). *Consequence of cleaning with muriatic acid, inadequate pre-wetting of the masonry, or rinsing the masonry during cleaning. NEVER CLEAN LIGHT COLORED BRICK WITH MURATIC ACID.*
- ▶ **MANGANESE:** Brown discolorations (found in dark colored brick). *A side-effect of masonry having manganese oxide as the color agent and cleaning with muriatic acid.*
- ▶ **RUST COLORED STAINING:** Dark brown or rust discolorations. *Result of corrosion found in, or adjacent to the masonry, such as a wall tie or steel angle.*
- ▶ **ALKALI STAINING:** Light to dark golden brown discolorations. *When alkali charged moisture vapor permeates limestone from the back face or bottom bed, it leaves alkali and organic matter at the surface.*

Lime Run



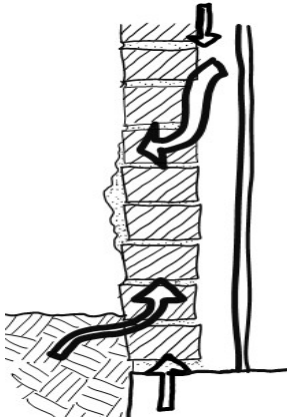
White Scum



Yellow Vanadium Stains

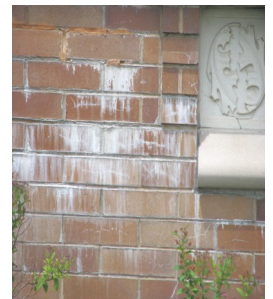


Causes of Efflorescence



- ▶ Occurs when water containing dissolved salts and other minerals enter the wall system either during or after construction through a leak and are brought to the surface. The water evaporations, leaving the salts or other minerals on the surface.
- ▶ The following must occur in order for efflorescence to exist:
 - ▶ Salts or other minerals must be present or in contact with the masonry, though mortar bridging or direct contact with the backup CMU or concrete.
 - ▶ Water in the path of salts or other minerals for a period of time sufficient to dissolve them.
 - ▶ The masonry must have a pore structure or a hole for the salt water to migrate to the surface, where evaporation can occur.
- ▶ *Rain water is the primary source of moisture with water from irrigation second, and condensation from within the wall third.*
- ▶ Condensation will accumulate enough when the air barrier is damaged, not correctly sealed at the joints and over laps or has a void. The inside moist air will rush past the back surface of the masonry and condense continuously.

- ▶ Salts and other minerals can be absorbed from the ground or concrete foundation though capillary action, sometimes, several feet up into the wall.
- ▶ Mortar and materials commonly used as masonry backup, such as CMU and concrete can also be a significant contributor to efflorescence due to the Portland Cement content.
- ▶ Limestone and precast trim, such as caps, coping, sills, lintels, etc., are often used in conjunction with masonry and have a high salt and mineral content.
- ▶ Due to the Portland Cement content of mortar and grout, the barrier wall or composite wall strategy of filling the collar joints between wythes to provide a continuous barrier of water penetration is not recommended in order to reduce the chance of efflorescence.
- ▶ **Studies have shown that approximately 90% of all efflorescence is from water entering masonry during construction.**



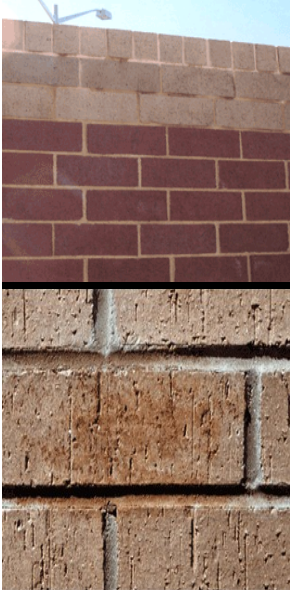
Green Vanadium Stains



Causes of Efflorescence (cont.):

- ▶ Workmanship is key to a good quality product, as always. So, partially filling the joints, deep furrowing mortar beds, incorrectly locating or installing the flashing, and improper sealant installation will be subject to increased rain penetration, the most common cause of efflorescence.
- ▶ Moisture from the ground during storage and rain infiltration during construction are the main water components for new building bloom and possible irreversible masonry staining.
- ▶ Improper use of hydrochloric acid (muriatic) as a cleaning solution causes issues with appearance and serviceability:
 - ▶ Using the wrong kind of cleaning process.
 - ▶ Over cleaning which will dissolve the cement past in the mortar and leave exposed sand.
 - ▶ Not following the manufacturer's directions.
 - ▶ Too much cleaning due to poor workmanship.

Manganese Stains



Prevention of Efflorescence:

- ▶ Isolate the exterior wythe of masonry with an air space.
- ▶ **Attention to keeping the cavity clean the entire way up the wall is critical in order not to produce mortar bridges at the masonry ties or projected courses.**
- ▶ Install a damp proofing on the CMU backup for air infiltration reasons as well as making sure that a mortar bridge does not come in contact with the CMU.
- ▶ Do not apply a parging of the backup wythe, as this will crack and allow air through and subject the first wythe to more Portland Cement through mortar bridging.
- ▶ **Store masonry off the ground on skids and keep stored masonry covered at all times.**
- ▶ Use clean sand for mortar if you are mixing it by hand (ASTM C-144).
- ▶ Waterproof below grade masonry, backfill the void with mortar, and install the flashing above grade (a 1 to 2 courses above is best).
- ▶ Applying a coating such as silicone water repellent might stop the water from escaping, thereby eliminating the efflorescence from getting to the exterior, *however*, it will not stop efflorescence from forming on the interior if there is a leak or breach in the air barrier. Efflorescence will create tremendous pressures which will result in spalling. This will cause major damage to the masonry from the inside out and it will be too late to realize that there is a leak or breach in the air barrier.



Rust Stains



- ▶ **Always completely fill the head joints. I CAN NOT STRESS THIS ENOUGH...**
- ▶ Correctly locate flashing, end dams, weeps.
- ▶ **Tool the joint properly, by compacting the mortar. This will create a weather tight bond and minimize water intrusion.**
- ▶ Ensure proper curing of mortar and adequate hydration in order to maximize the Portland Cement in the mortar.
- ▶ Do not wash efflorescence except in dry warm weather, dry brushing it off is preferable.
- ▶ Carefully review and locate irrigation sprinklers and water patterns.

Alkali Staining



- ▶ Protect mortar from freezing and premature drying. Mortar needs to cure like concrete, slow and complete in order for it to reach its full structural strength and maximum wall protection.
- ▶ **Always cover the top of the masonry wall in progress at the end of every day with plastic. Make sure that the plastic is secure and will not blow off.**
- ▶ Reducing the moisture content in masonry does not mean reducing the water content in mortar, or allowing walls to prematurely dry out. Both of these measure will contribute to the increased permeability of the wall and as a result increase the potential for recurrent efflorescence.
- ▶ ***No single precautionary measure can expect to take care of all potential conditions. The goal is to minimize all the contributing factors.***