EFFLORESCENCE ON PORTLAND CEMENT PLASTER (STUCCO)

By Walter F. Pruter

Every so often an otherwise attractive, integrally colored stucco installation is marred by the development of unsightly white stains or blotches. This "new building bloom" or efflorescence is often crystalline or crusty, at other times it is powdery or fluffy. In its worst forms, efflorescence can appear as a scum or unattractive green or brown stain. These stains generally do no real damage to the plaster but are always unsightly, often a nuisance to remove and sometimes a source of irritation between building owners and plastering contractors.

It isn't always possible to predict the development of efflorescence but understanding how it occurs can help in the design and construction of plastered surfaces and reduce the potential for such problems. The major source of efflorescence is calcium hydroxide from hydrated portland cement. When magnesium and/or calcium hydroxide leaches to the plaster surface, it combines with carbon dioxide in the air (carbonation) to form a salt-calcium carbonate.

Hydraulic cements can also contain other soluble salts that can produce efflorescence when water penetrating the plaster picks up the salts and carries them to the surface through cracks and capillaries in the plaster. These are usually sodium and potassium sulfates and may have their origin in masonry or concrete in contact with the plaster, as well as in the plaster constituents. These highly soluble alkaline compounds come to the surface and are usually washed away by rain or hosing.

Prior to building codes requiring the installation of a foundation weep screed at the bottom terminus of exterior plaster, it was a practice to plaster down over foundations and in contact with the soil. Dry plaster would absorb moisture from the soil and this moisture frequently contained a variety of soluble sulfates. It isn't unusual to see stuccoed buildings erected prior to 1982 to have extensive efflorescence on the plaster all around the base of the building. Some of these salts can be so deleterious that they have obliterated paint, color coat and even the basecoat plaster.

Three conditions must exist simultaneously for efflorescence to develop:

1. Soluble salts must be present
2. Water must contact the salts to form a solution.
3. The salt solution must have a path to migrate to a surface where the water can evaporate.
In conventional plaster construction that is exposed to weather, eliminating all three of these conditions may be impossible. Plaster cement and sand can contain some soluble salts. Water can be introduced as rain that penetrates or is absorbed by the plaster or as water vapor that condenses in the wall; not to mention all the water used in plaster construction.

By taking steps to minimize each of these contributing factors one can reduce the likelihood of efflorescence.

Cements high in alkali are most likely to contribute to the problem. Sand should be well washed in fresh water. Type S hydrated lime that meets the requirements of ASTM C206 or C207 should add little efflorescence potential. Sand washed in seawater has been known to introduce soluble salts to the mix. Obviously the water used for mixing plaster should be clean, potable and free of any substances that could adversely affect the plaster performance.

Irrigation systems that impinge on stucco surfaces should be redirected to avoid contact with the plaster. Rainwater exposure cannot be completely eliminated but with proper design and workmanship, it can be reduced. Good flashing details and drainage-type construction that provides paths for water to escape quickly can go a long way toward limiting its damaging effects.

The following simple precautions can reduce the amount of water that gets into a wall and provide paths for water to escape without contributing to efflorescence:

- At parapet wall tops provide waterproof coping or other cladding to prevent water intrusion.
- Flashing at window heads, etc. and in horizontal stress reveals should extend beyond the face of the finish and turn down to form a drip. All joints in flashing must be lapped and sealed.
- Avoid construction of deep-set plastered windowsills and similar weather-exposed horizontal surfaces where water can accumulate.
- Where plaster abuts concrete, brick masonry and concrete masonry units, separate dissimilar materials with a casing bead to protect the plaster from another source of soluble salts.
- Proportion plaster to produce higher density and less absorption.
- Use low water-cement ratio and provide adequate curing to reduce the amount of water passing through the pores in the plaster.
- Use effective water stops and joint sealant systems to reduce the water flow at joints.

**WATER REPELLENTS**

Clear water-repellent coatings are recommended by some to reduce or prevent efflorescence, but their use can cause more problems than they solve. If applied to a wall that still contains moisture and soluble salts, a water repellent can prevent the salts from migrating to the surface while not allowing water vapor to escape.
REMOVING EFFLORESCENCE

What do you do when you have followed all the precautions and still efflorescence appears? It might happen soon after the newly finished building is rained on. This "new building bloom" is usually temporary. If the owner can be persuaded to let it be, it will often disappear over time with rain and normal weathering.

Failing that, most true efflorescence can be removed by dry brushing, then flushing with clean water.

Determining the type of salt causing the efflorescence can help in the selection of a cleaning agent that would effectively dissolve the efflorescence but have minimal impact on the stucco. Many proprietary cleaners have been developed to remove specific types of efflorescence. If the wrong cleaning solution is used it can cause the soluble salts to become insoluble, creating an even greater problem.

When brushing will have an adverse effect on the texture, white vinegar can be used to neutralize the calcium carbonate. Apply a solution at a ratio of 6:1-9:1 to the stucco, then rinse thoroughly with fresh water.

Very stubborn calcium carbonate is sometimes removed with a mild muriatic acid solution (1 part muriatic acid to 12 parts water). Always test the acid solution in an inconspicuous part of the wall to make sure it won't harm the appearance.

To minimize the effects of cleaning on a wall always start with the gentlest method possible and progress toward harsher measures as needed. The gentlest method is usually dry brushing. If that isn't effective, try using a brush dipped in water or use a gentle water spray. Proprietary cleaners, acids and other chemicals should be used only when gentler techniques prove unsuccessful.

A word of caution before using any acid solution: Wet the entire wall surface with clean water before applying acid solution. Doing so allows the cleaning solution to remain on the surface of the plaster by reducing absorption.