Is It Efflorescence or Silicate Deposits?

By Ed McGettigan

A tenant notices a white residue sticking to the windows of his apartment. The innocuous looking residue is distorting his outside views. He calls the property owner who investigates and concludes that the substance is efflorescence. The owner thinks he knows the solution: Clean the windows and apply a sealer to the concrete to stop the efflorescence from reappearing.

Although that fix used to work in the past, building design changes in the past 20 years have exacerbated the problem. Buildings that are geographically located in areas known to harbor alkali-silica reactive aggregates and are made of precast concrete with flush-mounted windows provide the perfect conditions for "silicate deposit" staining.

Typical efflorescence (water-soluble salts) or even the more tenacious efflorescence (calcium oxide that has leached and formed carbonate deposits) are relatively easy to remove from windows; however, removing silicate deposits can be an expensive process once the residue takes hold. Removal requires polishing the glass with cerium oxide or an expensive proprietary cleaner. And there is also the danger of damaging the glass or surrounding frames during this cleaning process. A better solution would be to remove the root cause of silicate deposits.

Root Cause of Silicate Deposits

The tenacious crystalline white residue on the glass is composed of silicate particles that are dissolved from the concrete surface. When it rains, water washes over the concrete and dissolves microscopic amounts of solids via a process called solvation. Concrete being siliceous consists of various inorganic molecules, including silicate anions.

Silicate anions have the ability to change chemical structure simply by the way they hydrate and dehydrate. During wet-dry cycles, the orientation of the anions is altered, and bonding to silicate surfaces – such as glass– can occur. Silicate anions have a negative net electrical charge that wants to be balanced in order to make an electrically neutral compound. Glass provides a favorable environment for the anions to react.

These silicate deposits when coupled with atmospheric pollutants form a conglomeration that becomes a window-cleaning nightmare. Other contaminants associated with concrete or atmosphere pollution, such as metals, also make these silicate deposits insoluble.

Can Silicate Deposits Be Prevented?

There are three possible strategies to mitigate silicate deposits:

1. Redirect water runoff by installing drip edges around windows
2. Clean windows frequently and treat with a glass protector
3. Paint or seal the concrete

Drip edges have limited effectiveness, especially during a wind-driven rain. As for frequent cleaning of the windows to remove the deposits – it is costly and repeated aggressive cleaning techniques can make the glass progressively harder to clean. Painting the concrete would be effective, but it becomes a long-term maintenance issue in addition to altering the appearance of

Silcate staining on windows

Removing silicate deposits can be an expensive process once the residue takes hold

Selecting a sealer is a tricky proposition

Concrete wet-out

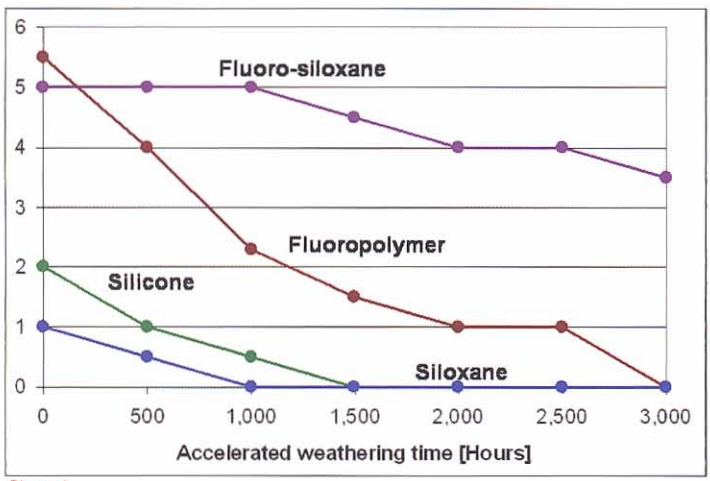

Chart 1

the building. Sealing the concrete with a silicone or penetrating-type product is normally effective for only one to two years.

Traditional Clear Water Repellents Are Ineffective

Silane and siloxane – traditional water repellents – penetrate into the substrate to prevent traditional efflorescence, but have limited effectiveness against silicate deposits. Even so, they dramatically reduce water absorption into the concrete, preventing leaching of contaminants. The water repellent on the concrete's surface will breakdown via UV radiation within a few years, allowing the concrete to "wet out" during a rainstorm. Moisture then makes contact with and dissolves the silicates.

A new class of water repellents, based on zero volatile organic compounds (VOC) silicon nanotechnology, has been proven effective in mitigating silicate rundown. This new technology, which is based on fluoro-siloxane chemistry, provides excellent surface repellency and has the advantage of being inherently UV resistant. Additionally, the repellents do not alter the water vapor transmission nor do they change the natural appearance of the concrete.

Changes in VOC Regulations' Impact Technology

From the time the VOC regulations were implemented in the United States in 1999 (Canada in 2010), manufacturers have introduced a plethora of new products that, although they are within the regulations, are not innovative. The new products' active ingredients tend to be the same as those from products developed 30 years ago. The only changes worthy of noting regarding the new products are these: they have a longer shelf life and better reactivity for treating masonry and natural stone.

The most noted impediment of the VOC regulations is the need to use water as a solvent. Numerous studies have shown a reduction in penetration of water-based products into the substrate versus that of solvent systems. This problem is most evident on denser substrates, such as precast concrete.

In order to mitigate silicate rundown, it is necessary to use a material that will keep the concrete from wetting out even during a wind-driven rain. Repelling a light or steady rain is easy for most clear sealers.

The deterioration of clear water repellents on building facades is mainly due to the effects of weathering, including UV deterioration, loss of bond and the dissolution of the active ingredient – all three of which will lessen the repellency of any treatment. What's needed is a substance that is inherently UV stable, has a strong chemical bond to concrete and is insoluble in water.

Selecting a sealer based on its ability to bead water is an insufficient criterion when trying to stop silicate deposits. A more stringent test uses an alcohol- and water-based mixture. The alcohol lowers the water's surface tension, allowing it to spread and soak more easily over the treated substrate. Running this test after accelerated weathering provides a good indication of the long-term ability to keep silicate deposits from dissolving into rainwater.

Confirm if a previous sealer has been applied

Perform an extensive evaluation before beginning a cleaning regimen

Chart 1 shows the results after 3,000 hours of accelerated weathering. The alcohol and water mixture almost completely wets out the traditional silicone and siloxane sealers, while fluoropolymer-based sealers resist wetting of the substrate. After accelerated weathering (ASTM G 154), the silicone and siloxane become completely ineffective. Weathering also causes a dramatic decrease in the fluoropolymer's performance. The fluoro-siloxane, on the other hand, retains most of its repellency even after 3,500 hours.

Surface preparation of the concrete is recommended prior to application of the fluoro-siloxane sealer. Pressure washing – and, if needed, cleaning agents – is normally sufficient. Keep in mind that the cleaning process may rinse additional silicates onto the windows. The windows must be rinsed to remove any loose silicates lest they dry and bond to the glass.

Confirm whether a previous sealer had been applied. If one had been, consult the manufacturer to find out whether additional surface preparation is needed.

Cleaning Silicate Deposits Off Glass

Before starting any cleaning procedures, it's best to check with the window manufacturer. This is especially true for any windows that are still under warranty. The next step is to hire an experienced window cleaner: there are many hidden problems that can surface during the cleaning process.

Generally, the recommended procedure for removing silicate deposits is to polish the glass with an optical-grade cerium oxide. There are also proprietary cleaners available for removing stubborn stains. Whichever product is used, be careful to not scratch the glass. Also, don't polish the glass in direct sunlight, make sure the windows are clean to remove loose particles before polishing and remember there are about another 100 caveats.

It is imperative to perform an extensive evaluation prior to beginning a cleaning regimen.

Owner's Expectations

It may be impossible to remove all the silicate deposits without damaging the glass. And the process of removing the silicate deposits is a costly one. But when the job is complete, the change in the window's appearance will be dramatic. Nearby dirty windows will reveal just how well the process worked.

Taking a "before" and "after" picture is a good idea so that the improvement is visibly noted. Obtaining a representative "before" photo can be difficult, however, for a couple of reasons: First, it is hard for a photograph of the glass to capture the full magnitude of the deposits. Second, since the silicate builds up gradually over the course of several years, initially the owners tend not to notice until there is a critical mass of deposits. Conversely, once cleaned, owners are most sensitive to any new deposits, which raises the question: are the deposits new or are they leftover from the initial cleaning?

It is important to set up a mutually agreed upon standard for acceptability of window cleanliness. The first step is taken before the job even begins: the building must be tested. The owner should pay to have a band of windows cleaned and the concrete directly above sealed, leaving a section of the concrete unsealed for comparison. The performance can be evaluated over time, and information on cleaning the glass can be used to give a more accurate project cost.

It is rare in the restoration business to have the perfect solution to a problem that has a direct cost-benefit relationship. It is not uncommon for owners of a midsize building to pay more than $75,000 to remove silicate deposits from windows. There is, however, a known solution to this problem. All that is needed is to balance expectations, develop a proper glass restoration procedure and solve the root cause by applying the proper sealer to the concrete.

About the Author

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