

# CAUSES AND SOLUTIONS FOR KEEPING CONCRETE RESIDUE OFF GLASS

BY PETER DeNICOLA

**W**hite deposits on glass can be a problem with concrete buildings—especially if there are flush mounted windows (refer to Fig. 1). The problem normally occurs after several years and is characterized by “white water spots” or white powder on the windows. The residue is very difficult to remove, requiring proprietary cleaners and excessive “elbow grease.” The glass can be damaged either by the deposits or even by the cleaning process. The amount of deposits on the windows is sometimes exasperated after concrete restoration, commonly leaving the contractor unfairly blamed for damaged glass.

Deposit residue is normally mistaken for efflorescence. Efflorescence is defined in ACI CT-13 as “a generally white deposit formed when water-soluble compounds emerge in solution from concrete, masonry, or plaster substrates and precipitate by reaction such as carbonation or crystallize by evaporation.”<sup>1</sup> The logic is that water is absorbed into the concrete, dissolves salts or alkalis, and carries them to the surface. The salts recrystallize as the water evaporates and the alkalis react with carbon dioxide to form carbonates. The resulting deposits appear similar, but carbonate deposits are more difficult to remove because they are water insoluble.

As a building owner investigates the reason for the white deposits, attention is directed toward the



Fig. 1

concrete and efflorescence. Because water is a contributing factor, the first reaction is “Let’s seal the concrete.” At this point, a clear water repellent is applied, generally a silicone, acrylic, siloxane, or silane. The owner also uses this opportunity to clean all the windows. This procedure is normally effective for 1 to 2 years. Then the owner assumes that the water repellent is not working or the contractor misapplied the product. The actual answer is the problem was misdiagnosed.

In actuality, the white residue on the glass is silicate anions from the surface of the concrete. The distinction between silicates and the aforementioned discussion on efflorescence is important. Classic efflorescence does not chemically bond to the glass. Efflorescence is relatively easy to remove with the proper cleaning chemicals, with carbonates being more difficult due to the need of acidic cleaners. On the other hand, silicate anions will chemically bond to the glass, making them extremely difficult to remove. It is not uncommon to have to manually polish the glass with cerium oxide to remove silicate deposits.

Silicate anions are made up of silica, alkali, and water. The specific composition and reactivity of the silicate species depends primarily on the ratio of silica, alkali, and water. The reactivity of silicate anions can change simply by the way they hydrate and dehydrate. During wet-dry cycles, the orientation of the anions is altered and bonding to other silicates surfaces (remember, glass is a silicate!) can occur. Compounding the situation is that contaminants associated with the concrete or atmosphere, such as aluminum and calcium, will also make the silicate deposits insoluble.<sup>2</sup>

## DEPOSIT REMOVAL AND MITIGATION

Removal of silicate deposits is difficult. This is especially true if the cleaning proceeds on the assumption that the residue is “just” efflorescence. Cleaning recommendations are difficult due to the fact that the entire window unit’s (glass, frame, and seal) compatibility with the cleaning method needs to be addressed. Cleaning recommendations and procedures are not within the scope of this article.

It is suggested that you contact the window and glass manufacturer for cleaning recommendations.

Once the glass is clean or as a preemptive measure on new construction, mitigation of silicate deposits is not easy. It is difficult to completely stop silicate staining on windows. Three methods that can be successful are:

1. Redirect water runoff away from glass surfaces, primarily by installing drip edges on windows;
2. Clean windows frequently and use a glass protector treatment; and
3. Paint or seal the concrete.

Drip edges on windows have mixed effectiveness, especially during wind-driven rain. Other architectural details such as reveals or splays help but have limitations. Increasing the intensity and frequency of window cleaning is the standard “solution.” This adds significantly to maintenance costs. In addition, repeated aggressive cleaning techniques may damage the glass. Painting the concrete will be effective as long as the coating remains intact. Besides being a maintenance issue, coatings change the aesthetics of the building. Also, most owners select concrete because it’s normally a low-maintenance material. As discussed previously, most clear water repellents are effective for only a few years.

## COATING AND SEALER SELECTION

To drastically reduce silicates from getting onto the glass, the concrete surface must be kept as dry as possible. The coating or sealer must keep water from “wetting” the surface of the concrete (refer to Fig. 2). Properties that are needed are:

1. A highly hydrophobic surface on the concrete;
2. The coating or sealer must either chemically bond or have excellent adhesion to the concrete; and
3. Long-term weather resistance.

The mistake that is commonly made when specifying a sealer is to misinterpret a product’s claims. Test methods used to indicate performance of sealers focus on water absorption, chloride ion reduction, and penetration into the substrate. Surface characteristics of the treated concrete are not tested in regard to silicate absorption. In addition, ultraviolet (UV) or weathering resistance is normally overstated.

The best water repellents for concrete are silanes. They are effective against traditional efflorescence for 10-plus years. Unfortunately, they have limited effectiveness against silicate deposits. Silanes are designed to penetrate the concrete. Because there is a limited amount of silane on the concrete’s surface, this material will rapidly break down due to UV radiation. Then, moisture can wet the concrete surface and allow the silicates to absorb into the rainwater.

Higher-weight sealers that do not penetrate as well, such as siloxanes and silicones, may have a

few years of effectiveness. However, a combination of initially poor water repellency<sup>3</sup> and degradation from weathering limit their effectiveness.<sup>4</sup> A high-build coating is an option if the owner is willing to accept the expense and the physical change to the building.

There is a family of low-surface-energy sealers based on silicon nanotechnology that shows promise in mitigating silicate rundown. This technology is based on a silane backbone and a fluorinated functional group, thus forming a fluoro-siloxane. The advantage is chemical bonding to the concrete (silane component) and a highly hydrophobic surface (fluorinated component). The product is clear and allows water vapor to escape the concrete. The main advantage is the fluoro-siloxane molecule is inherently weather-resistant. The energy from UV radiation is not strong enough to break the bonds. Increased UV stability leads to longer performance when compared to traditional silane water repellants.

The need to reapply a protective treatment to prevent silicate deposits is extended from 1 to 2 years to 5+ years with the fluoro-siloxane molecule. A portion of the building in Fig. 3 was treated with the fluoro-siloxane material. After several years of weathering, the treated concrete surface remains dry after a rain event, thus eliminating silicates from dissolving upon wetting of the concrete surface and being redeposited on windows.

## CONCLUSIONS

Before beginning a restoration project and implementing a strategy for cleaning and long-term

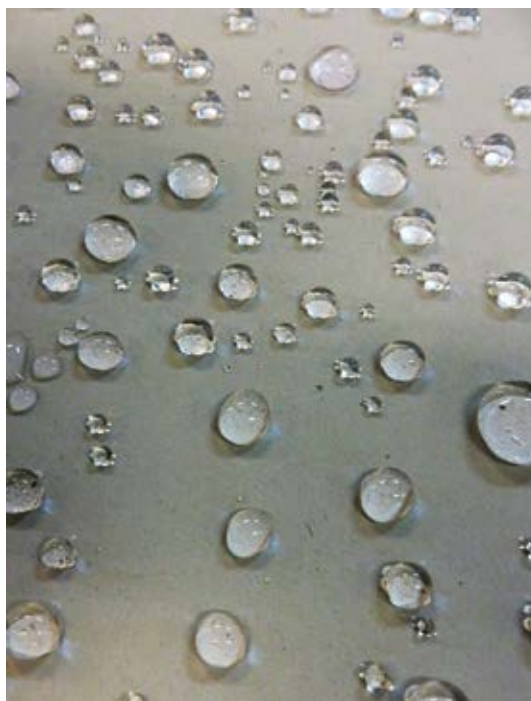


Fig. 2



Fig. 3

protection of the building envelope, the following points need to be considered:

- White deposits on glass are not necessarily efflorescence;
- Inspect the windows for staining. Take photos and point out to the owner that the staining is preexisting;
- If cleaning the concrete, make sure the windows are also rinsed with water or protected. Pressure washing can cause concrete particles to run onto the glass, increasing the silicates contacting the glass; and

- Before starting a glass-cleaning procedure or choosing a sealer, apply a test section to verify that results are acceptable to the owner.

## REFERENCES

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