NATIONAL PLASTERERS COUNCIL

THE MOST COMMON REASONS FOR LOSS OF COLOR

Pigments have been used in swimming pool cementitious finish coatings for many years. The diversity of available colors, together with a variety of finish options, allows for almost limitless possibilities of aesthetic variation to be achieved. However, maintaining the intended "look" of the finish, in terms of color and intensity, can be difficult. Proper materials[1] and application ensure that a pool interior finish will achieve the anticipated service life, provided the proper start-up[14], proper ongoing care, and proper water chemistry is maintained within the "acceptable" range as per APSP.[2,3,12] The following conditions are the three most common causes of color loss issues whenever post-installation measures are not adequately performed or maintained.

1. Calcium Salt Migration Due To Cement Hydration (pigment masking)

Cement 'hydration' is basically the chemical reaction that converts dry cement powdered materials and water into a rigid structural material, or binder. While approximately 70% of cement hydration takes place in the first 7-days from the time of mixing, there is still a significant amount of hydration that will take place over the next 28 days (to approximately 85% of cement hydration).[16] The remaining unhydrated cement will continue to hydrate for years after placement.[13] However, the pigment that is dispersed throughout the cementitious material during the initial mixing of the material becomes locked into place once the cement reaches final set.

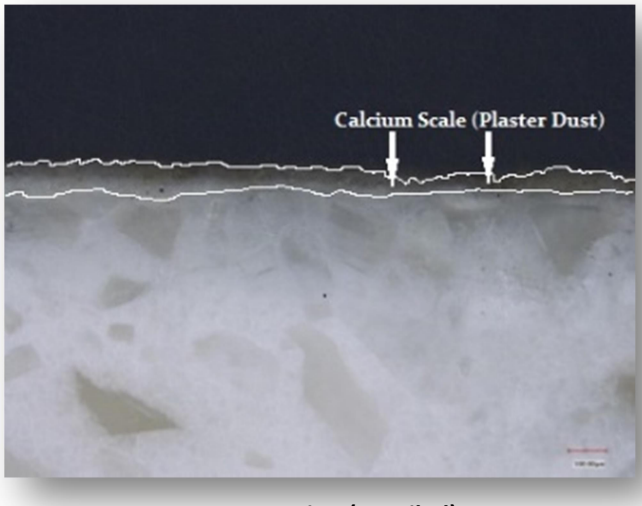
Though the pigment is no longer free to move or disperse after final set, cement hydration continues. A byproduct of the cement hydration reaction is a salt (calcium hydroxide), which ionizes in the presence of moisture and is free to migrate throughout the interior of the finish coating.[7,8,9] These calcium hydroxide ions can settle out, or precipitate to form a white crystalline deposit that can cover, or mask, the coloration of the finish.

For swimming pools, the greatest potential for pigment masking is on newly installed finishes within the first 3-days after the pool is filled with water. Adhering to a proper start-up procedure is important. Removal of any calcium hydroxide that migrates to the surface (plaster dust) is also important. Calcium hydroxide (plaster dust) should be removed and filtered out of the water within the first 3 – 5 days after the pool is full or it will carbonate and adhere to the surface. Calcium carbonate can be difficult and expensive to remove.

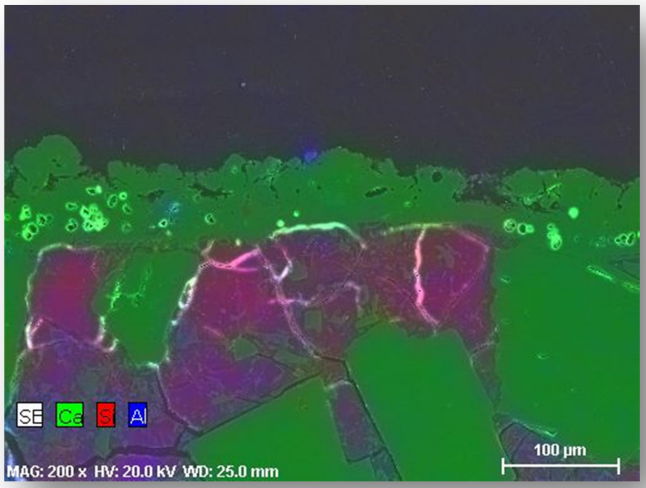
CALCIUM SALT MIGRATION DUE TO CEMENT HYDRATION (PIGMENT MASKING)



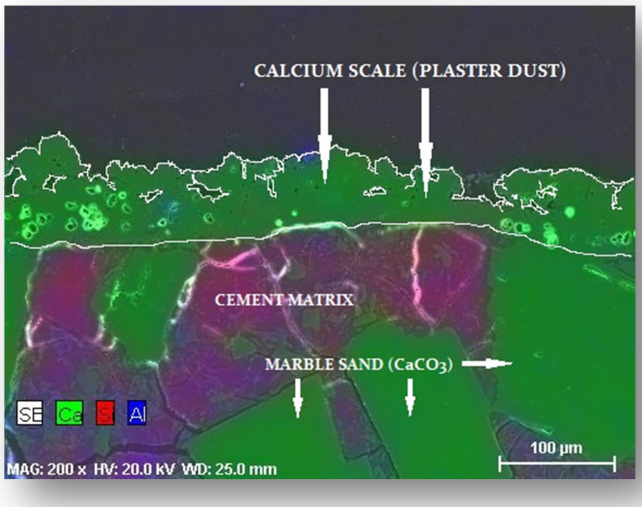
Top View



Cross Section (Detailed)



EDS Hyper Map



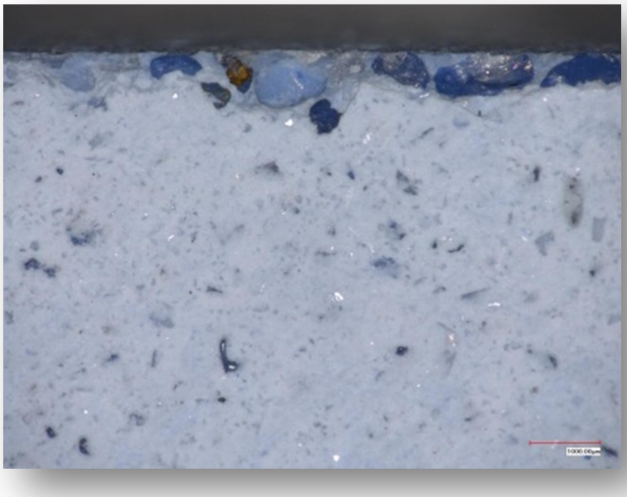
EDS Hyper Map (Detailed)

Ca = Calcium Si = Silicon Al = Aluminum

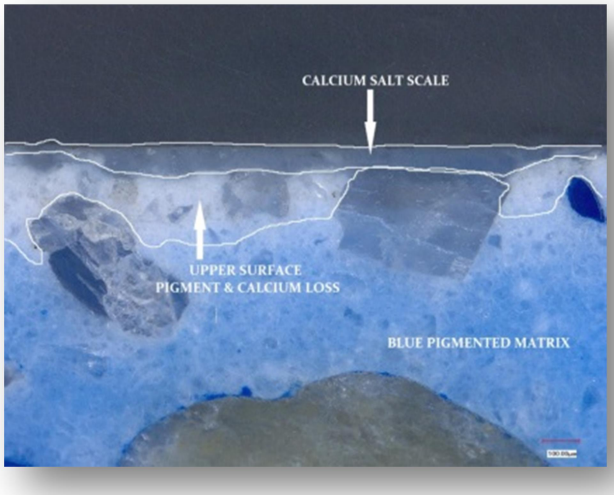
2. Precipitation of Minerals or Metals (surface scaling)

All materials that are in a water-contact environment are subject to mineral scale or metal stain precipitation. Concrete, cementitious coatings, brick, metal, tile, and even glass surfaces are subject to salt scale or staining from minerals or metals precipitating from the water. Surface scaling often exhibits itself as a white or light-colored film or layer, which can mute or completely mask the intended finish color. Metal precipitation can often alter the coloration of the surface by staining the finish. For example, copper and manganese can cause a blue, green, or black coloration and iron can cause a red, orange, or black coloration. Having the water periodically tested for metals and hardness, and taking the necessary precautions to avoid the accumulation of significant concentrations of metals and mineral salts can avoid this from occurring. Alternatively, sequestering or chelating chemicals may be used. However; once started, their continued usage becomes necessary as long as significant amounts of mineral or metal remain in the water, or precipitation of that mineral or metal is likely.

PRECIPITATION OF MINERALS OR METALS (SURFACE SCALING)



Top View



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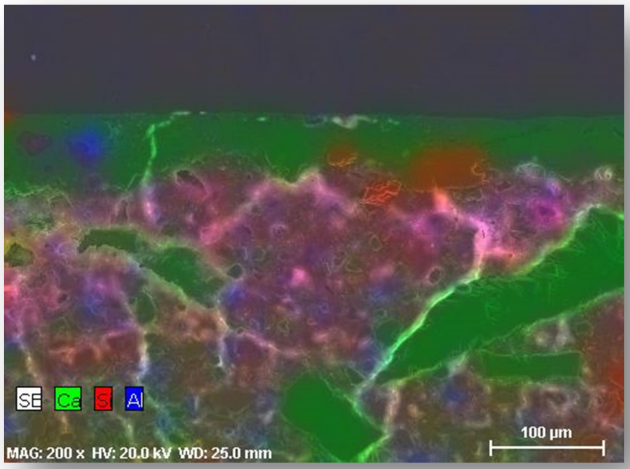
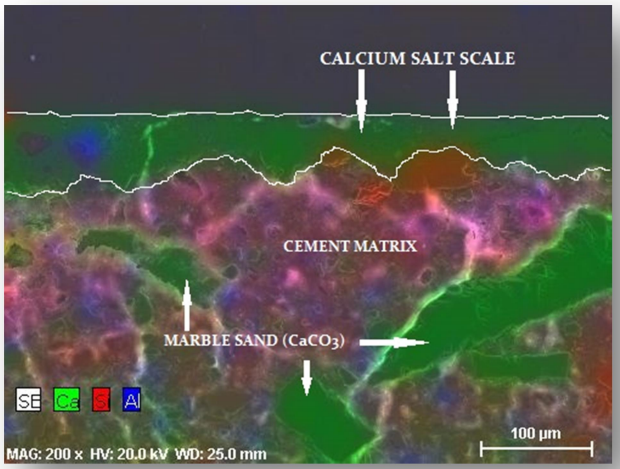


EDS Hyper Map



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3. Dissolution of Cement Compounds (pigment loss)

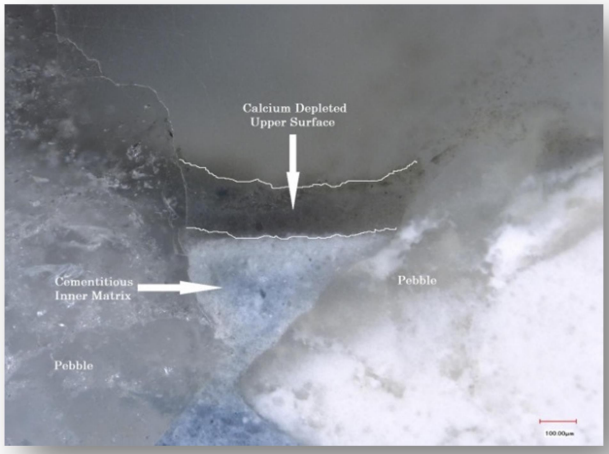
Water chemistry plays an important role in the life expectancy of a cementitious coating. Reactions with the soluble cementitious materials can take place whenever water, or moisture, is allowed to permeate through a cementitious surface coating. Water chemistry parameters that are not maintained within the "ideal ranges", as defined by ANSI/APSP to be "balanced"[2,3] can become aggressive to the cementitious surface coating. Allowing such conditions, can result in the dissolving of components of the cement/aggregate matrix and the leaching of cement compounds.[5,6,10,11] The leaching of the pigment, which is held in place by these cement compounds, occurs as well.[15] Organic pigments have a much smaller particle sizing than inorganic pigments, making them more likely to be released from the cement binder and lost, as the binder becomes more porous from ongoing deterioration or weathering. Generally, this appears as 'faded', lighter-colored, or white areas across the surface.

If water is allowed to remain in an aggressive condition for an extended period of time, pigment can be partly or completely leached up to $^1/_8$" in depth leaving the surface color faded or white if the pigment is completely removed. The resulting color loss is irreversible. The term "aggressive water" is considered to be water that is chemically outside of established balanced ranges.[2,3,12] Aggressive water is capable of removing, dissolving, or otherwise reacting with components of the surface materials causing deterioration.[9,10,11] This would include water that has low calcium hardness, low pH, low carbonate alkalinity, and/or a combination of these.[4]

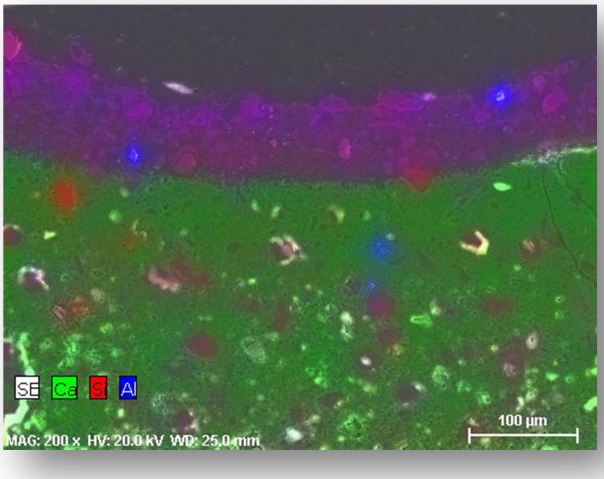
DISSOLUTION OF CEMENT COMPOUNDS (PIGMENT LOSS)



Top View



Cross Section (Detailed)



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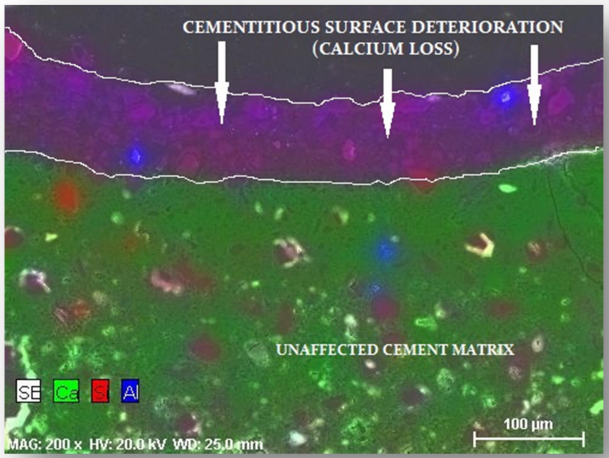

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5. National Plasterers Council, "Technical Manual", 8th Edition, 2016, Section 7.6.1.6 – *Leaching Deterioration*, pp. 25 – 26, 1000 N Rand Road, Suite 214, Wauconda, IL 60084, info@npconline.org.
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14. National Plasterers Council, "Swimming Pool Start-up Procedures", 1000 N Rand Road, Suite 214, Wauconda, IL 60084, info@npconline.org.
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16. J. Thomas, H. Jennings, The Science of Concrete, Section 5.1, Overview of the Hydration Process, Fig. 5-3, "Typical Development of the Degree of Hydration and Compressive Strength of a Type I Portland Cement Over Time", Northwestern University, Evanston, IL.

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Pool Interior Finish Disclosure

Pool Interior Finishes are composed of materials which may have inherent shading and/or color variation which is normal and should not be construed as a defect. Environmental factors such as humidity, temperature, substrate conditions, etc., during the installation process can cause normal color variations (normal mottling) across the surface of a coating. This is generally a uniform shading or cloudy appearance. These variations may be more pronounced on a cloudy day or at night with the light on. These conditions are beyond the contractor's control. Discoloration or mottled-shade variation is not considered a failure or defect, but is characteristic of most cementitious products, not needing remedy. It is a normal occurrence of most exposed aggregate finishes to have variation in the surface aggregate density, or variations in the concentration of aggregates across the finished surface. Proper evaluation of an interior finish is done when the pool is full of water and under natural light conditions only. The pool interior finish is NOT guaranteed for evenness of color and may not be the exact shade anticipated. The shade and color of pigmented surfaces will vary and "fade" over time. Crazing (check cracks and hairline cracks), may be noticeable and may be quite pronounced with colored finishes and are normal and are not considered defects.

It is highly recommended to perform a start-up procedure on freshly plastered pools, such as the NPC Start-up Procedure. A proper start-up will promote a longer lasting interior finish.

The longevity of the surface will be dependent on the water chemistry after start-up being properly maintained in accordance with the Association of Pool & Spa Professionals (APSP) published standards recommended practice of maintaining the Langlier Saturation Index at 0 to +/- 0.5. Overall common water chemistry parameters to be monitored are: chlorine, total and carbonate alkalinity, pH, calcium hardness, cyanuric acid and total dissolved solids.

Note: The contractor may choose to add a line for the signature, or initials of the recipient of these disclosures.

This document is endorsed by the National Plasterers Council, Inc

Note: We urge you to contact your NPC professional applicator for more information specific to your pool or spa. Chemical treatment alone will not produce sanitary pool water. A filtration system in proper operation along with a regiment of care including pool brushing will produce the optimal results for a clean and safe pool.

Additional consumer awareness information is available from the following sources:

The Association of Pool & Spa Professionals (APSP)
2111 Eisenhower Avenue
Alexandria, VA 22314
703.838.0083
www.apsp.org

National Swimming Pool Foundation (NSPF)
4775 Granby Circle
Colorado Springs, CO 80919
719.540.9119
www.nspf.org

National Plasterers Council (NPC)
1000 North Rand Road, Suite 214
Wauconda, IL 60084
847.416.7271
www.npconline.org

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