Triangle Tech Tips
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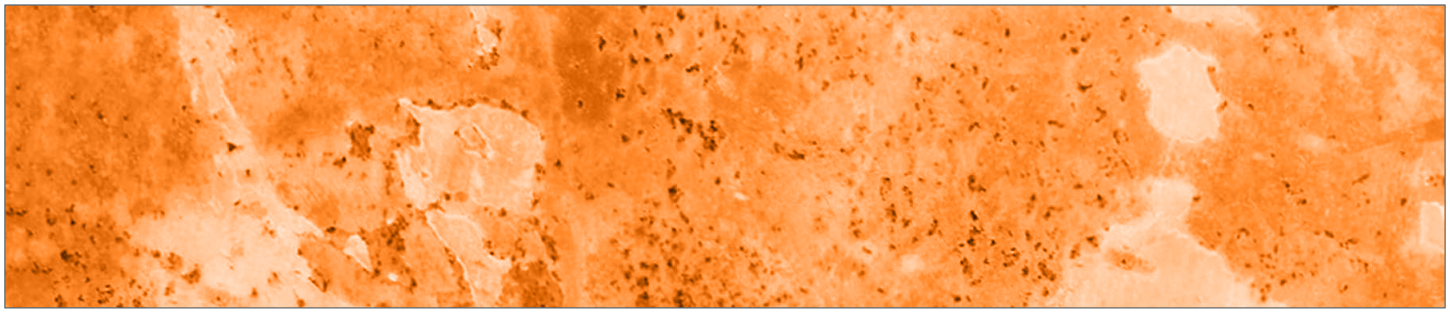
Surface Discoloration of Concrete



About concrete surface discoloration

Discoloration of concrete refers to changes or variations in the color of the concrete surface that differ from the intended or expected color. This phenomenon can occur for several reasons and can manifest as patches, streaks, or general unevenness in color. Addressing concrete discoloration typically involves identifying the root cause and taking corrective actions, such as adjusting the mix design, improving curing practices, or applying surface treatments.

What are the most common types of surface discoloration?

Efflorescence:
White, powdery deposits on the surface of the concrete. Occurs when soluble salts within the concrete migrate to the surface and react with carbon dioxide in the air.

Mottling or Blotching:
Irregular, patchy areas of varying shades of color. Can be caused by uneven curing, inconsistent water-cement ratios, or variations in the concrete mix.

Streaks or Stripes:
Linear discolorations that can result from the use of different batches of concrete, improper finishing techniques, or variations in the application of curing compounds.

Dark Spots or Stains:
Can be caused by contaminants like oil or rust; or result from uneven application of curing compounds or surface treatments.

Shadowing:
Variations in the depth of concrete over reinforcing steel, can lead to dark or light areas following the pattern of the reinforcement.

Color Fading:
Lightening or bleaching often caused by exposure to sunlight (UV rays) or the use of poor-quality pigments in colored concrete.

Yellowing:
Can result from using some curing compounds, admixtures, or sealers that react to environmental conditions or UV exposure.

Surface Dusting:
A white, dusty residue on the surface, often resulting from improper curing or finishing techniques.

Differential Curing:
This leads to areas of varying shades or colors, typically due to uneven moisture retention during the curing process.

What causes surface discoloration?

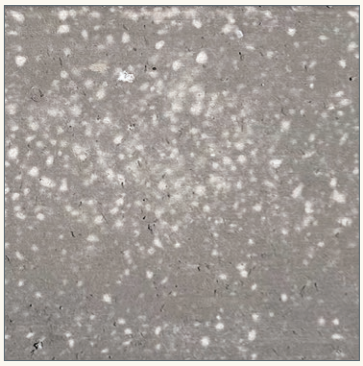
Discoloration from changes in cement or fine aggregate sources in different batches during a placement sequence can happen. However, this is usually rare and minor. Cement that has hydrated more will typically be lighter in color. Inconsistent use of admixtures, not enough mixing time, and incorrect timing of finishing operations can cause this effect. Concrete with ground slag as a cementitious material may show a yellowish to greenish hue, which will fade over time. However, concrete with ground slag generally has a lighter color. Discoloration in concrete that is cast in forms or slabs on grade is usually due to a change in either the concrete mix or construction practices. Most studies find that no single factor causes discoloration.

Preventing concrete surface discoloration

Concrete surface discoloration can be minimized or prevented by following best practices from the mixing stage, through the curing process. Preventing concrete surface discoloration involves careful attention to various aspects of concrete mixing, placing, finishing, and curing. Here are some strategies to help prevent discoloration:

1. **Use Low-Alkali Cement:** Using cement with a low alkali content reduces the factors that lead to some types of discoloration.
2. **Consistent Water-Cement Ratio:** Maintain a uniform water-cement ratio in all batches to ensure even hydration and color.
3. **Avoid Admixtures with Calcium Chloride or Chloride-Bearing Chemicals:** Calcium chloride is a major cause of concrete discoloration. Avoid calcium chloride accelerators, which can cause discoloration. Use high-quality admixtures and ensure they are uniformly mixed into the concrete.
4. **Use Uniform Materials:** Source cement, aggregates, and admixtures from consistent suppliers to avoid variations in color.
5. **Consistent Formwork:** The type and condition of the formwork can affect the surface color of the concrete. Forms with different absorption rates will create surfaces with different shades. Additionally, changing the type or brand of form release agent can also alter the color of the concrete.
6. **Thorough Mixing:** Ensure concrete is mixed thoroughly to evenly distribute materials and admixtures.
7. **Prevent Trowel Burning on Concrete Surfaces:** The most common issue is that metal fragments from the trowel get embedded in the concrete. Hard-troweled concrete can appear darker due to the densified surface, which lowers the water-cement ratio. This lower ratio affects how the cement hydrates, leading to a darker color. Also, troweling the surface too early increases the water-cement ratio, making the color lighter.
8. **Proper Curing:** Apply consistent curing methods to maintain uniform moisture and temperature. Use curing blankets, plastic sheeting, or curing compounds to protect the concrete surface. Inconsistent curing affects how well the cement hydrates, potentially leading to discoloration. If plastic sheeting is in direct contact with the concrete, it creates streaks. Using a uniform application of a high-quality spray or curing compound might be a better choice.
9. **Prevent Contamination:** Keep the concrete surface clean and free from contaminants like oil, grease, dirt, or chemicals during mixing, placing, and curing. Also, protect the concrete from adverse environmental conditions such as rain, snow, and direct sunlight, especially during the early curing stages.
10. **Proper Use of Ground Slag:** Be aware that concrete containing ground slag may initially exhibit a yellowish to greenish hue, which will fade over time. Ensure this is accounted for in planning and communication.

Figure 1: Five Common Types of Concrete Surface Discoloration



Efflorescence

Mottling / Blotching

Streaks from sheeting contact

Surface Dusting

Shadowing