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Standard Guide for Reduction of Efflorescence Potential in New Unit Pavement Systems[1]

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1. ~~Scope~~ Scope*

1.1 This guide covers methods for reducing efflorescence potential in new unit pavement systems.

1.2 The values stated in inch-pound units are to be regarded as the standard. The SI units given in parentheses are for information only.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*
C67 Test Methods for Sampling and Testing Brick and Structural Clay Tile
C270 Specification for Mortar for Unit Masonry
C1180 Terminology of Mortar and Grout for Unit Masonry
C1232 Terminology of Masonry

3. Terminology

3.1 *Definitions:*

3.1.1 Terminology defined in Terminologies C1180 and C1232 shall apply in this guide.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *cryptoflorescence, n*—a crystalline deposit of water-soluble compounds in the pores of unit pavement system materials.

3.2.2 *efflorescence, n*—a crystalline deposit, usually white, of water-soluble compounds on the surface of a unit pavement system.

[1] This test method is under the jurisdiction of ASTM Committee C15 on Manufactured Masonry Units and is the direct responsibility of Subcommittee C15.05 on Masonry Assemblies.

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3.2.2.1 *Discussion*—

While not considered to be efflorescence, stains produced by acid-soluble vanadium compounds in clay masonry are usually yellow or green; and stains produced by acid-soluble manganese compounds are usually brown or gray.

3.2.3 *jointing material, n*—mortar, aggregate, sealant, or ~~sealant~~ other materials used between paver units.

3.2.4 *unit pavement system, n*—a system consisting of edge restraint, wearing course of discrete clay or concrete pavers, setting bed, jointing material, base or sub-base, or combination thereof, and appropriate drainage elements.

3.2.4.1 *Discussion*—

Flexible pavement is a unit pavement system whose wearing course consists of discrete clay or concrete pavers on an aggregate base, an aggregate base stabilized with asphalt or cement, or asphalt pavement.

***A Summary of Changes section appears at the end of this standard**

3.2.4.2 *Discussion—*

Rigid pavement is a unit pavement system whose surface wearing course consists of discrete clay or concrete units on a rigid base such as concrete.

4. Significance and Use

4.1 This guide provides information that, if implemented, will reduce efflorescence potential in new unit pavement systems. However, its implementation will not always completely prevent efflorescence.

4.2 This guide may be augmented by related information contained in the appendixes of Specification C270, the additional material listed in Appendix X1 in this standard, and other publications.

5. Principles of Efflorescence

5.1 Efflorescence is directly related to the quantity of water-soluble compounds within, or exposed to, a unit pavement system; and to the quantity of water exposed to these compounds. Water-soluble compounds or water causing efflorescence may be from adjacent surfaces or beneath the pavement system: for example, fertilizer in runoff from adjacent flower beds or lawns; ground water evaporating through the wearing ~~course.~~ course; and water from sprinkler systems and roofs. Since neither water nor water-soluble compounds can be completely eliminated from unit pavement systems, the potential for efflorescence is reduced by reducing water-soluble compounds and water retained within the unit pavement system.

5.2 Water can penetrate through joints in the surface of unit pavement systems. It can penetrate voids in the mortar joints or the interface between the paver unit and jointing material.

5.3 If a significant amount of water penetrates a unit pavement system, the water will dissolve water-soluble compounds that may exist in the paver units, mortar components, grout, setting bed, concrete slab, admixtures or other secondary sources, and may deposit them on the exterior surface of the unit pavement system when it migrates to the surface and through evaporation. The presence of a concrete slab below sand setting beds in unit pavement system allows water to remain on top of the slab where it can more readily dissolve water-soluble compounds in the concrete.

5.4 The most common efflorescence deposits contain two or more of the following: potassium, sodium, calcium, sulfates, carbonates, bicarbonates, chlorides, and hydroxides.

5.5 Some water-soluble compounds deposited on the surface of unit pavement systems can chemically react to form compounds that are not water-soluble. Calcium carbonate ($CaCO_3$) deposits on unit pavement system are a fairly common example. They are a result of reaction between the efflorescence compound calcium hydroxide and carbon dioxide after the calcium hydroxide is deposited on the surface of the pavement and is exposed to the air.

5.6 Under some circumstances, particularly when exterior coatings are present, efflorescence compounds can be deposited below the surface of the paver units. This condition is called cryptoflorescence. When cryptoflorescence occurs, the forces resulting from its confinement can cause disintegration of pavement surfaces.

6. Reduction of Efflorescence Potential in New Pavements

6.1 Efflorescence on new unit pavement systems is reduced when water penetration of the pavement is minimized; when water that penetrates pavement is quickly drained from the pavement; when contact between dissimilar paver units is minimized; when potential efflorescence compounds in the pavement system materials are minimized; and when exposure of the pavement to potential efflorescence causing compounds is minimized.

6.2 The amount of water from precipitation and other sources that is able to penetrate a unit pavement system is minimized by:

6.2.1 A minimum surface slope to drain of ¼ in./ft (20 mm/m).

6.2.2 Good bond and full contact between paver units and mortar in masonry pavements. This condition is achieved by using mortar that is compatible with the paver units; completely filled mortar joints; compacted concave, V, or grapevine mortar joints; cold weather construction practices that prevent masonry materials from freezing.

6.2.3 Construction practices that protect uncompleted unit pavement systems from rain or snow during construction.

6.2.4 Properly sized and located movement joints in the ~~pavement.~~ pavement and in rigid bases such as concrete.

6.2.5 ~~Overhangs~~ Gutters, overhangs, and canopies to protect the pavement from rain.

6.2.6 Utilization of compatible applied water repellent on the surface of unit pavement systems or integral efflorescence controlling admixtures in paver units when specified.

6.2.7 Utilization of compatible integral water repellent admixtures and mortar modifiers.

6.3 Water that penetrates a unit pavement system is quickly drained out of the system by:

6.3.1 The use of a drainage system that conveys water to low points and allows water to be conveyed out of the pavement system.

6.4 Contact between dissimilar paver units is minimized by: