THE BRICK INDUSTRY ASSOCIATION

Brick Brief

August 2009

EFFLORESCENCE PREVENTION AND CONTROL

Introduction

Efflorescence is a white, crystalline deposit on the surface of concrete or clay masonry that is comprised of water-soluble salts. Efflorescence begins when soluble salts and other compounds are dissolved in water, which becomes a salt solution. This salt solution migrates to the surface of masonry through the masonry units or the mortar. The water evaporates and leaves the salts on the surface of the masonry as efflorescence.

Since efflorescence appears on the face of the brickwork, it is often erroneously assumed to originate from the brick itself. Fired clay brick is rarely the source of efflorescing salts. Instead, it is much more common for efflorescence to be caused by the transfer of soluble salt from cement-based mortar, grout or concrete masonry that is in direct contact with the clay brick used in the wall. This is known because clay brick, unlike other building materials, can be tested to determine its potential to contribute to efflorescence. This test, found in ASTM C67, rates a clay brick as "non-effloresced" when it does not exhibit efflorescence after partial immersion in distilled water for seven days. When similar testing is conducted on a material containing cement, the material typically fails. Non-efflorescing brick are readily available throughout the United States.

Photo 1: New Building Bloom. This type of efflorescence may begin before construction is completed.

Efflorescence that occurs on brickwork less than a year old is often attributed to "new building bloom," as shown in Photo 1. In most cases, new building bloom will dissipate over time if the brickwork is allowed to dry after completion and if environmental factors such as wind and rain are given sufficient time to naturally clean the brickwork. Efflorescence that occurs a year or more after construction is complete is generally attributed to excessive water penetration or poor drainage.

While more information on how to deal with efflorescence can be found in *Technical Note* 23A, "Efflorescence – Causes and Prevention," this *Brick Brief* furnishes suggestions on how proper material selection, design and detailing and construction practices can help minimize its occurrence.

Material Selection

Architects and specifiers can refer to ASTM C1400, "Standard Guide for Reduction of Efflorescence Potential in New Masonry Walls," which provides guidance to reduce the possibility of efflorescence in new buildings. More importantly, it should be kept in mind that all mortar, grout and concrete masonry units contain cement with varying degrees of water-soluble alkalis (water-soluble compounds) — usually the principal contributors to efflorescence.

Cements high in alkaline content are more prone to produce efflorescence than cements of lower alkaline content. Consequently, low-alkali cement should be specified when available to minimize the potential of efflorescence and new building bloom as well.

Careful selection of other products can also help reduce efflorescence potential. Specifying potable water and clean, washed sand for mortar or grout is recommended. It is also recommended to choose building trim, such as caps, coping and sills, that are not made of materials that contain soluble salts, which can increase efflorescence potential over prolonged exposure to water washing over its surface.

Design and Detailing

While rainwater can penetrate all masonry walls to some degree, proper design can limit available moisture, which in turn helps to suppress the development of efflorescence. Design measures that help improve the resistance of brickwork to efflorescence include the following:

Air space. For more than 40 years, BIA has recommended drainage walls that incorporate an air space because they separate the exterior brickwork from other elements in a wall assembly (see Figure 1). The air space allows the water to drain down the back of the brick wythe and prevents the migration of salts from backing materials by isolating the brick wythe from the materials containing soluble compounds. The air space must be kept clean during construction to allow drainage and to prevent water from bridging the air space and transferring soluble salts from other sources.

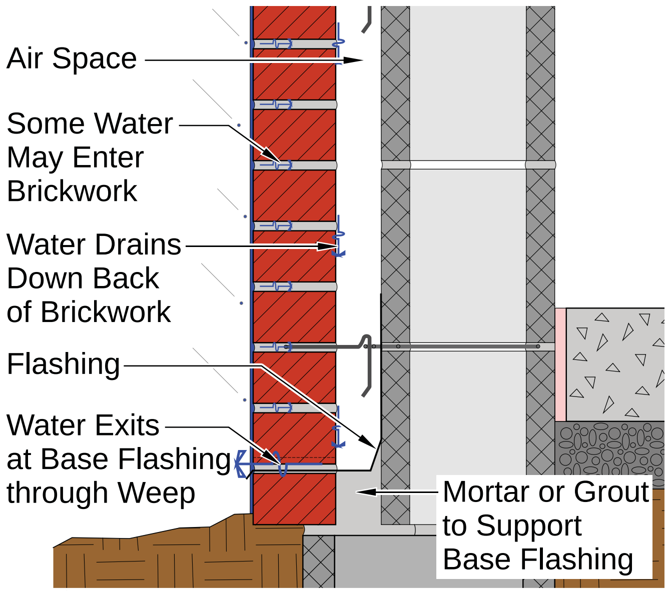

Figure 1: Drainage Wall Systems. BIA recommends the use of drainage wall systems, as shown above. BIA does *not* recommend the barrier strategy of filling a collar joint between masonry wythes because it places a source of salts in direct contact with the brickwork.

Flashing on trim. Trim materials are frequently used in locations most vulnerable to water penetration, such as caps, coping and sills under windows. These materials also may contain salts that contribute to efflorescence. To minimize efflorescence, buildings should include flashing or other materials to act as a capillary break, as well as a prevention of contact, between trim materials and the brickwork. Since moisture may still wash over trim material and collect water-soluble materials, the use of low-alkali materials can minimize efflorescence even more.

Waterproof below-grade masonry. Most groundwater contains a high concentration of soluble salts, which can accumulate in the masonry. To eliminate these salts as sources of efflorescence, BIA recommends waterproofing the masonry below grade and placing base flashing such that it drains water out of the wall a few courses above grade. Mortar or grout should be used to support the base flashing below the air space, as shown in Figure 1.

Construction Practices

Several steps can be taken to reduce the amount of water that accumulates in masonry materials during the construction process, including the following:

Storage of materials. All masonry units should be stored off the ground to avoid contact with rain or snow, groundwater or contamination by dirt and plant life. These materials should also be covered by a waterproof membrane to keep them dry.

Water. Clean, potable water free of salts and other materials should always be used.

Proper filling of mortar joints. Attention to both the complete filling of mortar joints intended to receive mortar, as well as keeping all cavities and air spaces clean and free of mortar droppings, is absolutely critical.

Covering unfinished brickwork. Unfinished brickwork should be covered with water-resistant membranes or tarps held in place by weights or ropes at the end of each workday. Otherwise, partially completed masonry walls exposed to rain and other elements can become saturated with water that can take weeks — if not months — to dry after the completion of the building.

Sealant joints. Joints between masonry and door and window frames, expansion joints and other locations where sealants are required should be treated with care since they are the most frequent sources of rain penetration into masonry.

Moving Forward

While the above-mentioned measures are helpful today, it should be noted the National Brick Research Center (NBRC), headquartered at Clemson University, has been developing a test method that consistently evaluates materials that potentially contribute to efflorescence by measuring soluble salts with ion chromatography. Ultimately, a set of guidelines can be used to select masonry materials, which will be very significant in helping to curtail the potential for efflorescence.