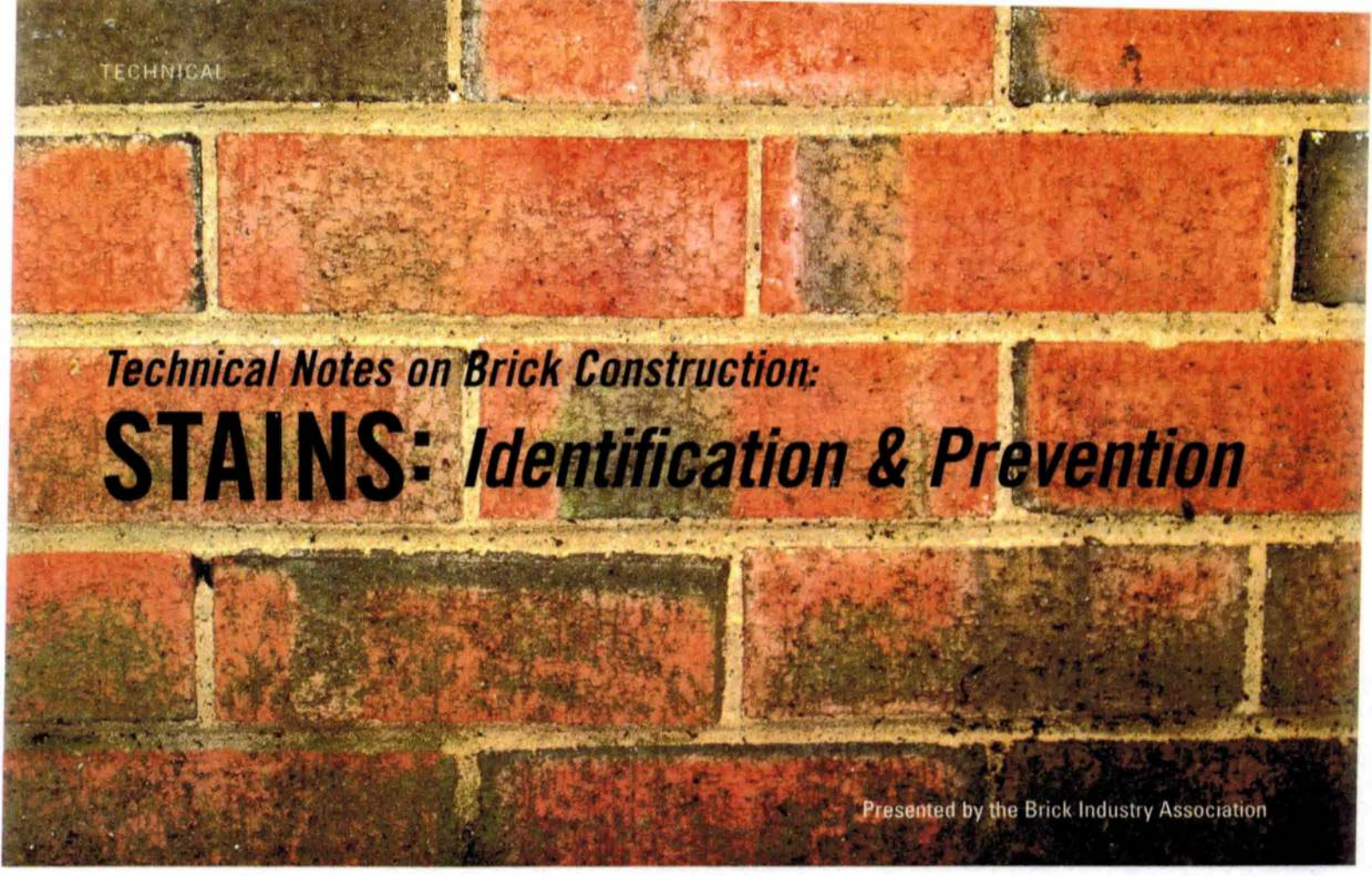

Technical Notes on Brick Construction:

STAINS: Identification & Prevention

Presented by the Brick Industry Association

SUMMARY OF RECOMMENDATIONS:

Identification:

- Use photos and descriptions for preliminary identification of efflorescence or stains
- When uncertain of correct identification of efflorescence or stain, have experienced brick personnel or professionals verify prior to cleaning

Prevention:

- Do not clean brickwork with unbuffered hydrochloric (muriatic) acid
- Use cleaning agent or procedure recommended by brick manufacturer to prevent cleaning-related stains
- Store brick off ground and cover with non-staining waterproof material
- Protect top of unfinished brickwork from weather

INTRODUCTION

Brick has been used to create beautiful buildings for centuries. Most of these structures have a substantial history of outstanding performance. In some instances the appearance is affected by the development of efflorescence or stains. These may originate from materials in the brick or mortar, from adjacent materials, and from outside sources such as cleaning agents. Each has a particular chemical composition and a unique means of removal.

Identification of the origin of the efflorescence, stain or foreign material is the first step in returning brickwork to its proper appearance. Some stains are often misidentified or are mistaken for efflorescence. Since correctly identifying efflorescence or a stain can be difficult, it is recommended that experienced brick personnel or professionals verify the efflorescence or type of stain. Misidentification may result in application of an inappropriate correction method. When correctly identified, efflorescence and stains can generally be removed. Inappropriate correction methods may result in further staining or damage of the brickwork.

Further information on the formation and prevention of efflorescence is discussed in Technical Note 23A. Once final identification of efflorescence or a stain is made, refer to Technical Note 20 for removal recommendations.

EFFLORESCENCE

Efflorescence is not considered a stain but will be discussed here for identification purposes. Refer to Technical Note 23A for causes and prevention. Efflorescence is normally a harmless deposit of water soluble, white salt crystals, as shown in Photo 1. In some instances, efflorescence may appear on mortar joints as shown in Photo 2. Efflorescence may appear in limited areas on the surface of brickwork as shown in Photo 3 or, in extreme cases, cover the entire brickwork surface.

Photo 1, Efflorescence

Efflorescence is usually white in color; however, all white stains on brick masonry are not necessarily efflorescence. Lime run and white scum, as discussed below, are occasionally mistaken for efflorescence.

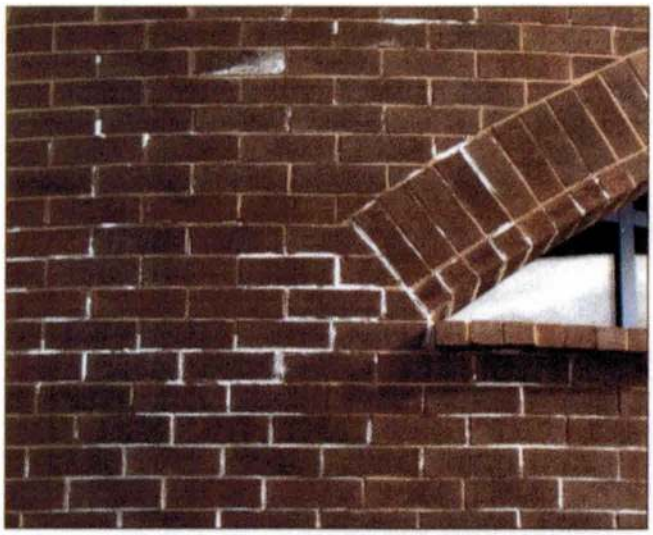

Photo 2, Efflorescence on mortar joints

Photo 3, Efflorescence in limited areas

LIME RUN (CARBONATE DEPOSITS)

Calcium carbonate deposits, sometimes referred to as "lime run," usually appear as white or gray, crusty formations originating from a spot and running down the face of the wall, as shown in Photo 4. However, the term "lime run" is misleading since the stain is not a direct result of the lime component in the mortar. In fact, hydrated lime actually helps to reduce the risk of lime run. Lime run nearly always occurs at a small hole or opening or hairline crack in the face of the brick masonry, as shown in Photo 5.

The source of the calcium compounds that contribute to lime run can be trim, mortar, backing, or other construction materials. Lime run requires large quantities of water that follow the same path over an extended period of time, similar to the formation of stalactites in limestone caves. The water takes any of several calcium compounds into solution and brings them to the surface of the masonry through an opening. At the surface, the solution reacts with carbon dioxide in the air, thus forming the crusty calcium carbonate deposit.

Materials containing cement are sources of calcium compounds and are an integral component of, or may be in contact with, the brickwork. To reduce the possibility of lime run, excess water must be eliminated or the path must be disrupted. Once lime run begins, it is likely to continue until the water source is stopped. ▸▸▸

Photo 4, Lime run

Photo 5, Lime run

WHITE SCUM (SILICATE DEPOSITS)

Silicate deposits, sometimes referred to as "white scum," usually appear as white or gray discolorations on the face of brick masonry, as shown in Photo 6. The discoloration may be present over the entire face of the brickwork or in smaller, irregularly shaped areas. White scum may also occur adjacent to trim elements, precast concrete and, occasionally, large expanses of glass.

Photo 6, White Scum

A number of mechanisms may precipitate white scum on brickwork. White scum is typically related to the cleaning of brickwork with unbuffered hydrochloric (muriatic) acid solutions or inadequate prewetting or rinsing of the brickwork during cleaning.

Silicate deposits on brick masonry should not be confused with scumming that sometimes occurs on brick during the manufacturing process. This type of scumming will be evident on bricks before they are placed in the wall.

VANADIUM (GREEN OR YELLOW) STAIN

Some bricks develop yellow or green salt deposits as shown in Photos 7 (yellow) and 8 (green) when they come in contact with water or unbuffered hydrochloric (muriatic) acid. These stains are usually vanadium salts. They may be found on red, buff or white brick; however, they are more conspicuous on lighter-colored brick. The vanadium salts responsible for these stains originate in the raw materials used for the manufacture of the brick. The yellow and green stains are usually vanadyl salts, consisting of sulfates and chlorides, or hydrates of these salts.

Vanadium stains occur in a manner similar to efflorescence, except that vanadium oxide and sulfates are dissolved and result in a solution that may be quite acidic. As water evaporates from this solution at the surface of the brickwork, vanadyl salts are deposited. The chloride salts of vanadium, such as vanadyl chloride, may form as a result of washing with unbuffered hydrochloric (muriatic) acid or excessive moisture exposure. *[Ref. 2]*

Preventing vanadium stains is important since they can be difficult to remove and improper cleaning efforts may result in a brown, insoluble deposit. To minimize the potential for vanadium stains, the following steps are recommended:

- Store brick off the ground and under nonstaining protective covers.
- Never use or permit the use of highly-concentrated, unbuffered hydrochloric (muriatic) acid solutions to clean light-colored brick.
- Seek and follow the cleaning recommendations of the brick manufacturer.

MANGANESE (BROWN) STAIN

Under certain conditions, tan, brown, or occasionally gray staining may occur on the mortar joints of brickwork as shown in Photo 9. Occasionally, a brown stain will streak down onto the faces of the brick, as shown in Photo 10. This type of stain is the result of having a manganese oxide as a coloring agent in tan, brown, black or gray brick and its reaction to an acid.

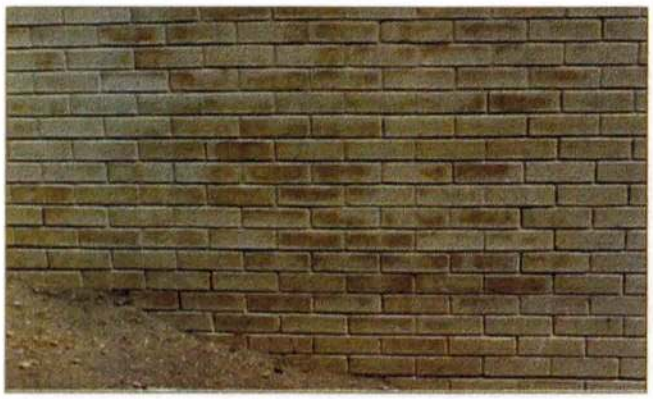

Photo 7, Yellow vanadium stain

Photo 8, Green vanadium stain

Photo 9, Manganese stain

Photo 10, Manganese stain

During the brick firing process, the manganese coloring agents undergo several chemical changes, resulting in manganese compounds that are insoluble in water. They have varying degrees of solubility in weak acids. Once dissolved, these compounds may migrate in solution toward the surface of brickwork. As previously discussed, acid solutions can occur in brickwork under certain conditions. Brick may also absorb unbuffered hydrochloric (muriatic) acid during cleaning. It is also possible that some geographical areas may be subject to acid rain. *[Ref. 4]*

Manganese staining is closely related to efflorescence since it is the sulfate and chloride salts of manganese that travel to the surface of the brickwork. When the solution reaches the mortar joints, the salts are neutralized by the cement or lime in the mortar, producing insoluble manganese hydroxide. The manganese hydroxide precipitate is deposited on the mortar joint and, when dry, converts to brown manganese tetroxide resulting in the stain. *[Ref. 2]*

Unbuffered hydrochloric (muriatic) acid should not be used to clean tan, brown, black or gray brick. Proprietary cleaning compounds are available for cleaning brick containing manganese. Test for effectiveness and follow the advice of the brick manufacturer.

STAINS FROM EXTERNAL SOURCES

Other stains affecting brickwork are generally caused by external sources such as pollution, organic growth, runoff or others. Usually, the source or composition of these stains is obvious. Organic stains, as shown in Photo 11, can include algae, mold or other organisms. Certain materials above or adjacent to brickwork such as copper (Photo 12), bronze, aluminum, synthetic stucco or paint (Photo 13) can stain brickwork surfaces. In addition, externally caused stains such as hard water from sprinkler systems can effect brickwork (Photo 14). The color and appearance should be considered during identification. Laboratory or field tests can determine the stain composition and assist in proper identification. Once the correct identification is made, the appropriate method to clean the brickwork can be implemented.

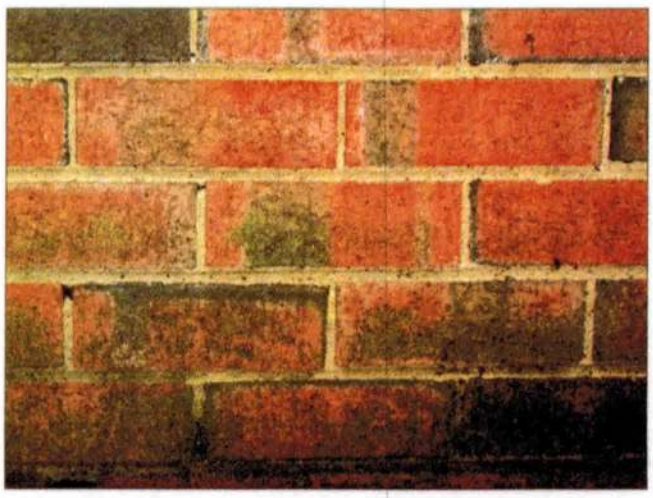

Photo 11, Organic stain

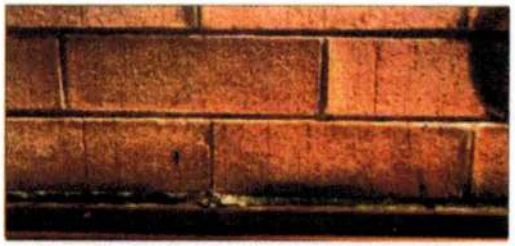

Photo 12, Stain from copper

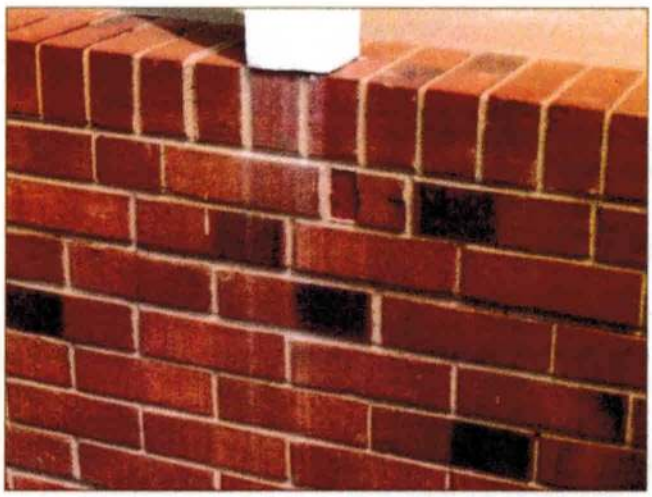

Photo 13, Runoff stain from paint

Photo 14, Hard water stain

Photo 15, Rust stain

Rust-colored stains may actually be corrosion, as shown in Photo 15. Such stains can be the result of corrosion of wall ties or joint reinforcement in or adjacent to the brickwork. The use of improper mortar additives or ingredients, placement of wall ties or joint reinforcement with inadequate cover, welding splatter on the brick or the corrosion of a material placed on the brick cube or pile prior to being laid in the brickwork can all attribute to these stains. ▸▸▸

SUMMARY

The proper identification of efflorescence and stains on brickwork is essential to stain removal. Photographs and laboratory or field testing can assist in this effort. When uncertain of the composition or origin of efflorescence or stains, verification by trained, experienced brick personnel or professionals is recommended. The use of an incorrect cleaning agent or method on a stain could result in further staining that is more difficult to remove than the original stain. Understanding the mechanisms involved with the formation of efflorescence and stains on brickwork is useful in design and construction to minimize their occurrence. ■

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