

Cleaning Brickwork

Abstract: This *Technical Note* addresses cleaning of brickwork and brick pavements. Methods for removal of efflorescence and a variety of specific stains are discussed, which should result in the successful cleaning of brickwork.

Key Words: abrasive blasting, acid, bucket and brush cleaning, cleaning, efflorescence, poultice, pressurized water, stains.

SUMMARY OF RECOMMENDATIONS:

During Construction

- Store brick off the ground under protective covering
- Protect wall surfaces and unlaidd brick from rain-splashed mud and mortar splatter
- Use bricklaying techniques that reduce mortar smears during construction; brush excess mortar after tooling and remove large mortar tags using wooden paddles or nonmetallic tools
- Protect any unfinished walls with waterproof cover at the end of the workday, and extend covering at least 2 ft (0.6 m) down from the top of the wall on all sides

Prior to Cleaning

- Match the cleaning method and cleaning solution to the type of brick
- Verify that the cleaning method and cleaning solution used are approved by the brick manufacturer
- Protect adjacent materials that may be damaged by the brick cleaning process
- Perform trial cleaning on a 20 sq ft (2 m²) sample area and allow wall to dry before evaluating results
- For some projects, multiple cleaning trials may be required in order to achieve acceptable results
- Control and/or treat runoff in accordance with the requirements of the jurisdiction

For All Cleaning Methods

- Follow the brick manufacturer's recommended cleaning procedure
- When manufacturer recommendations are not provided, refer to [Table 1](#) for recommended cleaning methods for various brick categories
- Select the gentlest effective cleaning method
- Do not allow cleaning solution to dry on brickwork
- Do not use unbuffered muriatic (hydrochloric) or hydrofluoric acid
- Clean new masonry as soon as possible after mortar hardens, typically between 24 hours and seven days, depending on the cleaning method used
- Apply cleaning solution as recommended by the cleaning product manufacturer

Bucket and Brush Cleaning

- For pre-wetting, saturate the area to be cleaned and brickwork below with water prior to applying cleaning solution, and keep the entire area wet during the cleaning process

- Mix and apply cleaning solution according to cleaning product manufacturer's instructions
- Thoroughly rinse the area being cleaned and the area below with water

Pressurized Water Cleaning

- Use a stainless steel 25 to 50 deg. fan tip, held a minimum of 12 in. (305 mm) from the brick surface
- Do not use water pressures higher than 400 psi (2800 kPa) as measured at the nozzle tip unless permitted by brick manufacturer
- For pre-wetting, use very low pressure (less than 100 psi [700 kPa])
- Saturate the area to be cleaned and brickwork below prior to applying cleaning solution, and keep wet until final rinse
- Apply cleaning solution according to manufacturer's instructions by brush or a chemical pump/tank sprayer with a wide-angle fan-shaped sprayer nozzle tip, maximum 30 to 50 psi (200 to 350 kPa)
- For rinsing, use low pressure (100 to 400 psi [700 to 2800 kPa])

Other Cleaning Methods

- Poultice: Do not use as a general cleaning method; use only on persistent, localized stains
- Abrasive blasting: Except as noted in this document, do not use
- Microabrasives: Consult manufacturers of proprietary systems for suitability; these are gentler alternatives to abrasive blasting
- Lasers: Match laser type and light wavelength to stains to be removed; specialized contractors are required
- Refer to "Removing Specific Stains" for cleaning solution recommendations to clean various known stains

Efflorescence Control

- Allow one year of weathering to naturally remove new-building bloom
- Remove light efflorescence by dry-brushing or brushing with a stiff fiber brush and water
- Before attempting to clean recurring efflorescence, identify and correct the source of water penetration and allow the brickwork to dry
- Remove stubborn accumulations with a proprietary cleaning product according to the manufacturer's instructions

INTRODUCTION

The final appearance of brickwork depends primarily on the attention given to masonry surfaces during construction and the cleaning process. Even with good practices during construction, some cleaning may be required at the end of brickwork installation. Recommended cleaning methods and materials vary based on the type of brick, mortar, construction and reason for cleaning. For example, cleaning newly constructed brickwork of an entire building requires a different approach from removing stains from an isolated portion of an existing wall.

The selection of effective cleaning solutions, as well as the use of consistent and appropriate cleaning procedures throughout the job, is essential to successful cleaning and cannot be overemphasized. Improper cleaning practices can cause a host of problems that in severe cases cannot be repaired.

This *Technical Note* does not address specific safety issues related to various methods of cleaning brick masonry. Beware that cleaning agents and processes may be hazardous and may cause injury if used carelessly or inappropriately. Cleaning operations should be performed only by personnel trained to handle the safety risks associated with the work and following the label instructions.

GENERAL

Prior to beginning masonry cleaning, there are a number of considerations common to all projects that should be addressed during the planning process.

Project Considerations

Clean Water. Water used for cleaning should be potable (suitable for drinking). Iron content should be less than 2 parts per million by weight. Determine whether the local water includes additives, water softeners or other agents that may cause issues if used for cleaning.

Cold Weather. Air temperature, temperature of masonry and wind conditions affect the drying time and reaction rate of cleaning solutions. Chemical cleaning solutions are generally more effective when the outdoor temperature is 50 °F (10 °C) or above. To avoid harming the masonry or increasing the risk of efflorescence, do not clean during freezing weather or when freezing weather is expected. It is preferred to use cleaning methods that involve water only when the ambient temperature will be 40 °F or above and will remain so until the wall is dry. Ideally, temperatures should be above freezing for seven days after cleaning is completed.

Hot Weather. Do not allow cleaning solutions to dry on brickwork. Be aware that an increased risk of rapid drying exists in high temperatures. In hot weather, the cleaning crew can reduce this risk by working on small or shaded areas and being diligent about keeping the wall saturated during cleaning solution application and rinsing.

Work Area. The size of the work area should be determined after trial cleaning or as part of the first area cleaned. The size of the work area can be modified as appropriate while the work progresses.

Work Sequencing. Cleaning should be performed systematically, proceeding consistently per the “General Cleaning Procedure” section of this document within a given work area or scaffolding tier and from one end of the elevation to the other. Perform cleaning to achieve uniform coverage of surfaces, including corners, moldings and interstices, and to produce consistent results without streaking or damaging the wall surface. Avoid overlapping work areas.

Safety. Some chemicals used to clean brickwork may be harmful, including their fumes. Protecting people and property is an essential component of any cleaning project. Use protective clothing and accessories, ensure proper ventilation, and exercise safe handling procedures in accordance with OSHA requirements. Comply with federal, state or local laws regulating the use and disposal of chemicals and cleaning runoff or wastewater. Some jurisdictions may require containment and treatment of the runoff water before it can leave the site. Dilution of runoff and its release into the stormwater management system should not be expected or allowed unless expressly permitted by the applicable jurisdiction. Strictly observe the cleaner manufacturer’s safety data sheets and recommended handling requirements. The contractor should consider preparing a formal cleaning plan describing the cleaning process, materials and procedures to ensure that these handling and protection issues are addressed.

Brick Texture. Brick texture may also influence the effectiveness of cleaning operations. Mortar stains and smears are generally easier to remove from brick with smooth textures because less surface area is exposed. Smoother brick textures include die skin extruded brick, glazed brick, water-struck molded brick and dry-pressed brick. Brick

with smoother surfaces are easier to clean because residue, acid staining, and mortar smears are more visible on their unbroken surfaces. Mortar and dirt tend to penetrate deeper into textured surfaces. Brick that are wire-cut or coated, or textured extruded brick and sand-struck molded brick, provide additional surface area for water and acid absorption. Use of pressurized water may assist in achieving complete rinsing of rough-textured brick.

Characteristics Requiring Extra Care. Both new and existing brickwork may incorporate characteristics that must be considered in the development of a cleaning plan to avoid damage during the cleaning process. These can include but are not limited to decorative coatings or finishes, water repellents, mortar type, mortar color or historic significance.

Trial Cleaning

Before cleaning, it is beneficial to test potential cleaning procedures and solutions on a sample area of about 20 sq ft (2 m²), or large enough to evaluate the selected cleaning procedure. Although not common for small residential projects, trial cleaning on larger, more complex projects not only serves as a means to determine whether mortar or stains can be removed but also helps to identify the most effective procedures that cause the least damage to the masonry. Optimal concentrations of cleaning products and solutions to unexpected problems can also be determined through trial cleaning. Once approved, the test area can serve as a standard for the appearance of the brickwork after cleaning.

Reactions between cleaning solutions and certain minerals found in some brick or their surface coatings may cause stains or worsen existing stains. It is always best to test a small area before subjecting the entire project to the cleaning procedure. Ideally, a portion of the sample panel can be tested, leaving the building and the rest of the sample panel undamaged in case the brickwork is adversely affected. Trial cleaning should be performed on an inconspicuous location on the building and conducted at temperature and humidity conditions that will closely approximate the conditions that will be experienced during cleaning of the remainder of the building.

Judge the effectiveness of a cleaning agent or procedure by inspecting both brick and mortar in the trial area after it has dried sufficiently, usually in about one week. Approval of the cleaned brickwork in cleaning area should precede application of the cleaning agent to the remainder of the building.

CLEANING NEW BRICKWORK

With new construction, keeping the masonry clean as it is erected can be very cost-effective, as it can eliminate the need for extensive cleaning after construction. Brickwork should be cleaned soon after construction is completed to remove mortar smears and construction dirt that detract from the appearance of the masonry. When it is determined that brickwork needs to be cleaned, the manufacturer's identification card on the brick cube and other pertinent manufacturer information should be consulted first to ascertain the recommended cleaning products and procedures for the brick. As discussed in the "Select Cleaning Method by Brick Category" section, recommended cleaning materials and methods vary with the type of brick.

Keeping Brickwork Clean During Construction

When constructing new brick masonry, it is important to use construction practices that will minimize the amount of cleaning required. The following are some general practices that can be used to construct a cleaner wall:

- Protect site-stored brick from mud. Store brick off the ground and under a waterproof covering.
- Erect scaffolding far enough away from the wall to allow mortar droppings to fall to the ground. Scaffold boards closest to the wall should be angled away from the wall or removed at the end of the day to remove excess mortar droppings and to prevent rain from splashing mortar and dirt directly onto the completed masonry.
- Protect the base of the wall from rain-splashed mud and mortar splatter. Use straw, sand, sawdust, plastic sheeting or fabric spread out on the ground, extending 3 to 4 ft (0.9 to 1.2 m) from the wall surface and 2 to 3 ft (0.6 to 0.9 m) up the wall. Keep this protection in place until final landscaping.
- Cover wall openings and tops of walls with a waterproof membrane at the end of the workday and during other work stoppages to prevent mortar joint washout and entry of water into the completed masonry. Extend covering a minimum of 2 ft (0.6 m) down each side of the wall.
- Protect newly constructed brickwork from adjacent construction practices that may cause staining, such as placing concrete or spraying curing agent.

It is always advisable to keep brickwork as free from mortar smears as possible. Masons should also be careful to prevent excessive mortar droppings from contacting the face of the wall or falling into the air space. In addition to the bricklaying techniques described in *Technical Note 7B*, the following practices should be followed:

- After spreading mortar, but before laying brick, the trowel edge should be used to cut mortar even with the wall face, preventing excessive extrusion of mortar onto the face of the wall as the brick are laid.
- After tooling joints, excess mortar and dust should be brushed from the wall surface, preferably using a medium-soft bristle or fiber brush. Brushes with steel bristles are not recommended, as they may leave behind small particles that can rust. Brushing is preferable to bagging or sacking—the practice of rubbing a damp burlap material across the face of the masonry. Avoid any motion that will result in rubbing or pressing mortar into the brick faces.
- Large clumps of mortar that adhere to brickwork should be allowed to dry and become firm before removing by hand with wooden paddles or nonmetallic tools.

Select Cleaning Method by Brick Category

Generally, the cleaning method that effectively cleans the brickwork while being the gentlest, or least harmful to the masonry, is the most appropriate. Try cleaning masonry by hand with a bucket and brush or pressurized water before using chemical cleaners.

Always consult brick manufacturers for recommendations on cleaning specific brick. This information is usually on the identification card located on the brick cube, in the product data literature or on the manufacturer’s website. In some cases, the manufacturer’s recommendations will permit the contractor to proceed to a specific cleaning product and method. When more than one type or color of brick is used, the brick manufacturer can aid in identifying a cleaning method that will be safe for all the brickwork. **Table 1** recommends appropriate cleaning methods for various brick types when guidelines are not available from the brick manufacturer. These are general recommendations and may not be effective on all brick described in each category. As noted in **Table 1**, the use of colored mortars may require special consideration.

Multiple methods may be required on the same wall to achieve an adequate level of cleaning. Once the method(s) of cleaning are selected, refer to the section “General Cleaning Procedure.”

TABLE 1
Quick Guide for Cleaning Brickwork

Brick Category	Cleaning Method	Remarks
Red and Red Flashed	<ul style="list-style-type: none"> • Bucket and brush hand-cleaning • Pressurized water 	Clean with water, detergents, emulsifying agents or suitable proprietary compounds. Do not clean with unbuffered muriatic (hydrochloric) acid solutions. Abrasive blasting is not recommended for heavy sand finishes.
White, Tan, Buff, Gray, Pink, Brown, Black, Specks and Spots	<ul style="list-style-type: none"> • Bucket and brush hand-cleaning • Pressurized water 	Clean with water, detergents, emulsifying agents or suitable proprietary compounds. Do not use unbuffered muriatic (hydrochloric) acid solutions. Light-colored brick are more susceptible to “acid burn” and stains compared with darker units. Abrasive blasting is not recommended for heavy sand finishes.
Sand Finish or Surface Coating	<ul style="list-style-type: none"> • Bucket and brush hand-cleaning 	Clean with water and scrub brush using light pressure. Stubborn mortar stains may require use of cleaning solutions. Use of pressurized water or abrasive blasting is not recommended. Cleaning may affect appearance. See “Brick Category” for additional remarks based on brick color.
Glazed Brick	<ul style="list-style-type: none"> • Bucket and brush hand-cleaning • Pressurized water 	Wipe glazed surface with soft cloth within a few minutes of laying units. Use a soft sponge or brush plus ample water for final washing. Use detergents where necessary and proprietary cleaners only for very difficult mortar stains. Consult brick and cleaner manufacturer before using proprietary cleaners on salt glazed or metallic glazed brick. Do not use abrasive powders. Do not use metal cleaning tools or brushes.
Colored Mortars	<ul style="list-style-type: none"> • Method is generally controlled by brick category 	Many manufacturers of colored mortars do not recommend chemical cleaning solutions. Unbuffered acids and some proprietary cleaners tend to bleach colored mortars. Mild detergent solutions are generally recommended. Evaluate effects as part of cleaning trials.

Bucket and Brush Hand Cleaning. This is a popular but misunderstood method used to clean brick masonry. Its popularity is due to the simplicity of execution and the availability of proprietary cleaning compounds. This cleaning method is the least aggressive of the methods listed here and is applicable to virtually all brick types. Hot water (temperature of 120 °F [49 °C]) can be used to improve effectiveness of cleaning with water. If a chemical cleaning solution is used, then it should be compatible with the brick.

Pressurized Water Cleaning. The brick manufacturer should be consulted before use of pressurized water to clean brick. Cleaning contractors often use pressurized water because it is less labor intensive than bucket and brush cleaning and permits large areas to be cleaned much more quickly. Pressurized water cleaning permits the operator to spray clean water on a wall over 100 ft (30 m) from the tank and compressor. However, the method requires more skill than the bucket and brush method, because effective results depend on maintaining a consistent, appropriate pressure, water flow rate, distance from the wall, and angle between the nozzle and the wall. It is also important to use uniform horizontal strokes. The effects of pressurized water cleaning on each project or type of brick should be carefully considered, because excessive pressure may damage brick surfaces, erode mortar joints, and remove finishes or other surface coatings, resulting in a different appearance. The following definitions apply for pressurized water cleaning:

- Very low pressure: Less than 100 psi (700 kPa); 4 to 6 gal per minute (15 to 23 L per minute).
- Low pressure: 100 to 400 psi (700 to 2800 kPa); 4 to 6 gal per minute (15 to 23 L per minute).
- Medium pressure: 400 to 800 psi (2800 to 5600 kPa); 4 to 6 gal per minute (15 to 23 L per minute). Medium pressure water cleaning may be appropriate in some cases, with certain types of brick. Use only if permitted by the brick manufacturer.
- High pressure: Greater than 800 psi (5600 kPa). High-pressure water cleaning is not appropriate for brick and may damage the brickwork.

Pressures should be measured at the tip of the nozzle to determine conformance. Use a 25 to 50 deg. fan-shaped stainless steel nozzle tip, and maintain a distance of 12 in. (305 mm) minimum between the nozzle tip and the brick surface.

Hot water can also be used in pressurized water cleaning. However, note that some pressure-washing equipment may not be capable of providing or using hot water.

General Cleaning Procedure

The following general cleaning procedure is applicable to a variety of cleaning methods and is commonly used for new brickwork, as well as for existing masonry.

1. **Timing.** Identify the appropriate time frame to begin cleaning. Mortar must be hardened prior to cleaning. It is generally best to schedule cleaning at least seven days after brickwork is completed. In some cases, it may be possible to clean earlier; however, effects on the masonry and influencing factors such as weather conditions and the type of brick and mortar should be carefully considered. If cleaning with water only (no chemicals added), cleaning may begin 24 to 36 hours after completion of brickwork. Avoid waiting too long between the completion of the masonry and cleaning. After one month, mortar smears and splatters left on brickwork become increasingly difficult to remove.
2. **Remove Mortar Clumps.** Remove larger clumps of mortar using wooden paddles or nonmetallic tools. Metal tools may damage the brickwork or leave behind fragments that oxidize and cause rust stains. Remove smaller particles using a fiber bristle brush.
3. **Select Cleaning Solution.** Select the proper cleaning solution for the condition/application. There are many types of proprietary cleaners available that are formulated to remove specific stains or are for use with a particular type of brick. Be careful to select cleaning products suitable for the brick, mortar and adjacent materials. Strictly follow the cleaner manufacturer's recommended instructions, including recommendations for cleaning procedure direction (top-down or bottom-up) during all stages of the project, such as saturating the wall, applying the cleaning solution and rinsing. Verify compatibility of the cleaning solution with the application equipment to be used. The cleaning solution should be approved by the architect/engineer and/or brick manufacturer. Each product being considered should be evaluated as discussed in "Trial Cleaning." It is recommended to evaluate the effectiveness of

cleaning solutions for overall cleaning, starting from the gentlest solution and method, in the following order:

- a. Water only
- b. Mild detergents/surfactants
- c. One-step chemical cleaners
- d. Two-step chemical cleaners

Treatment of specific stains does not necessarily need to follow this order of cleaning solution application, but the overall premise of starting with gentler cleaning methods still applies. If overall cleaning will be performed on the project, then complete it prior to treatment of the specific stains. The overall cleaning may reduce the intensity or area of the specific stain, allowing the stronger chemicals to be used on a smaller area.

Do not use unbuffered muriatic (hydrochloric) or hydrofluoric acid. Use of unbuffered high-strength acid solutions such as these tends to cause further stains and damage mortar joints. Many proprietary cleaners contain acids; however, their formulations include other chemicals that make them safer, easier to use properly and more environmentally responsible. Be aware that some cleaning solutions use compounds that will convert to these acids when combined with water. Review product safety data sheets to determine whether these compounds are present.

4. **Protect Surroundings.** Protect adjacent materials and nearby plants. Mask or otherwise protect windows; doors; and materials such as sealants, metal, glass, wood, limestone, cast stone, concrete masonry and ornamental trim from cleaning solutions. Cleaning chemicals may also damage plants and grass. It may be necessary to prevent the cleaning solution and runoff from contacting plants or the surrounding soil. Use protective clothing, equipment and accessories, in addition to proper ventilation and safe handling procedures in accordance with OSHA requirements to protect applicators.
5. **Saturate with Water.** Thoroughly saturate the area to be cleaned with water to keep it from absorbing the cleaning solution or dissolved mortar particles to a depth where they will be difficult to remove. When using pressurized water, a very low pressure (no more than 100 psi [700 kPa]) is recommended. Surfaces below the area being cleaned should also be saturated and kept wet until after the final rinse to prevent streaking and absorption of the runoff from above. If the wall surface appears to be drying, then reapply water until ready to apply the cleaning solution. Cleaning solutions containing dissolved mortar particles can be drawn into dry masonry and cause staining.
6. **Apply Cleaning Solution.** Mix and apply the cleaning solution in strict accordance with the cleaner manufacturer's instructions. Clean 20 sq ft (2 m²) of wall area at a time. The solution may be applied using a masonry cleaning brush or chemical pump/tank sprayer. Brushes should be long handled with stiff bristle fibers. Do not use metal brushes, which may damage mortar joints or result in further staining. If spraying, use a wide-angle fan-shaped sprayer nozzle tip and a pressure of 30 to 50 psi (200 to 350 kPa). No more than 50 psi (350 kPa) of pressure should be used, because higher pressure can force the cleaning solution deep into the masonry to become a source of future staining. For proprietary compounds, follow the cleaner manufacturer's instructions for application, dwell time and cleaning technique. Depend on the chemical reaction of the cleaner rather than the scrubbing action of the brush or pressure of the sprayer. If stubborn mortar smears are not removed, reapplication is often more effective than harder scrubbing or applying more pressure.
7. **Rinse Thoroughly with Water.** Flush walls with large amounts of clean water, in strict accordance with the cleaner manufacturer's instructions, before cleaned surfaces can dry (approximately 5 to 10 minutes after application). For pressurized water cleaning, low pressure (less than 400 psi [2800 kPa]) is recommended to flush the cleaning solution from the brickwork. If trial cleaning or prior experience with the selected brick has established that no damage will result, then higher pressures may be used. No matter what method is used, a thorough and uniform rinse is critical. Failure to completely flush the wall of cleaning solution and dissolved matter may result in the formation of "white scum." During rinsing, monitor the appearance of the runoff. Clear runoff at the base of the wall indicates adequate rinsing. In addition, the pH of the wall surface and the water runoff should

be checked periodically with pH paper to confirm that both are returned to neutral (pH 6.5 to 7.5). Additional rinsing is needed if the pH is outside these values in either direction (too acidic or too basic). Measure the pH of the wall surface again 48 hours after cleaning has been completed, when the wall is dry. If the pH is not neutral, then rinse the surface until neutral pH is achieved.

Improper Cleaning

Cleaning failures generally result from one of the following actions:

- **Failure to thoroughly saturate the brick masonry surface with water before and after application of chemical or detergent cleaning solutions.** Dry masonry permits absorption of the cleaning solution and may result in white scum, efflorescence, manganese or vanadium stains. Saturating the surface prior to cleaning reduces the masonry's absorption rate, permitting the cleaning solution to stay on the surface of the brickwork rather than being absorbed. Likewise, thorough rinsing reduces the potential for stains caused by cleaning solution residue.
- **Use of improper chemical cleaning solutions.** Improperly mixed or overly concentrated acid solutions can etch the brick or dissolve cementitious materials from mortar joints. Unbuffered acid tends to discolor masonry units, particularly lighter shades, producing an appearance frequently termed "acid burn," and can also promote the development of vanadium and manganese stains.
- **Excessively aggressive cleaning methods.** Cleaning methods such as abrasive blasting and high-pressure water cleaning, which remove stains from the masonry by abrasion, can etch mortar joints and remove the outer surface of brick, resulting in permanent damage.
- **Failure to protect windows, doors and trim.** Many cleaning agents, particularly acid solutions, have a corrosive effect on metal. If permitted to come in contact with metal frames, the solutions may cause pitting of the metal or staining of the masonry surface and trim materials such as limestone, concrete masonry and cast stone.

CLEANING EXISTING MASONRY

During periodic inspections of existing masonry structures, areas of discoloration or stains should be identified and addressed as a part of routine maintenance. When maintenance cleaning is deferred, pollution and atmospheric conditions can cause stains, dirt and soil to accumulate on masonry surfaces. Accumulated stains will likely require stronger cleaning products and methods to remove them, which can result in increased risk of damage to the masonry.

It is always advisable to collect as much information as possible before attempting to clean existing masonry. In some cases, water repellents may have been applied to the masonry, or there may be other unexpected treatments or conditions that interfere with cleaning. In these instances, professional guidance should be sought in determining how to address these conditions to achieve successful cleaning.

Large-scale cleaning of existing masonry typically occurs as part of a maintenance or repair project. If repairs will be performed, sequencing is important. Consider the intensity of the soiling and other work to be performed to accurately assess needed repairs and to avoid introducing excess water into the wall assembly. Refer to *Technical Note 46* for more information on repairs and maintenance.

Bucket and brush hand cleaning and pressurized water cleaning, discussed in "Select Cleaning Method by Brick Category," are also used to remove general stains from existing masonry. Besides these, other techniques used to remove dirt or specific stains from existing masonry [Ref. 3] are described briefly in this section.

Using a Poultice

A poultice is a paste made with a solvent or reagent and an inert material. It works by dissolving a stain and absorbing or pulling it into the poultice. Poultices are normally effective for deep, localized stains affecting small areas of brickwork. They are not intended for overall cleaning. Poultices tend to prevent stains from spreading during treatment and to pull stains out of the pores of brick.

Poultices for cleaning masonry can be purchased commercially or made on-site. The inert material used in the poultice may be talc, whiting, fuller's earth, diatomaceous earth, bentonite or other clay. Any chemical cleaner can be turned into a poultice. The solution or solvent used depends upon the nature of the stain to be removed. Enough of the solution or solvent is added to a small quantity of the inert material to make a smooth paste. The

paste is smeared onto the stained area with a trowel or spatula to make a coating at least $\frac{1}{8}$ in. (3 mm) thick. The paste is covered with plastic for 24 hours, the plastic is removed, and then the paste is allowed to dry. When dried, the remaining powder, which now contains the staining material, is scraped, brushed or washed off. Repeated applications may be necessary.

If the solvent used in preparing a poultice is an acid, then do not use whiting as the inert material. Whiting is a carbonate that reacts with acids to give off carbon dioxide. While this is not dangerous, the whiting will become extremely foamy and destroy the power of the acid.

There are also proprietary poultice-like cleaning materials that cure to the consistency of a film and can be pulled from the surface in sheets instead of removing dried paste. These are marketed for cleaning interior surfaces because they do not require the use of water but are also appropriate for exterior applications. The formulation of these materials allows for use over much larger areas than typical poultices.

Abrasive Blasting

Nearly all abrasive blasting procedures, by their nature, will result in silica exposure, potentially from both the blast media and the material removed from the brickwork. The dust created can be harmful if inhaled, which poses health and safety concerns. Respirators should be used in combination with other personal protective equipment during any cleaning involving abrasive blasting methods.

Abrasive methods are not generally recommended for cleaning brickwork. Attempting to remove dirt or stains by abrasion is risky because the outer surface of the masonry may also be removed, resulting in permanent damage and increased water penetration. Abrasive cleaning may erode mortar joints and may also roughen the surface of the masonry, which increases its tendency to hold dirt, becoming dirtier faster and making future cleaning more difficult. Sanded, coated, glazed and slurry-finished brick should not be cleaned by abrasive blasting. This topic is discussed in more detail in "Dangers of Abrasive Cleaning to Historic Buildings" [Ref. 4], which can also be applicable to some newer brick.

In some cases, it may be possible to safely clean brick masonry by abrasive blasting; however, this typically requires a gentle abrasive and a highly qualified operator, in conjunction with proper specifications and job inspection. In a few instances, abrasive blasting is the only method that will remove persistent stains. This method is sometimes preferred over conventional wet cleaning, since it eliminates the problem of chemical reactions with vanadium salts and other materials used in manufacturing brick. Abrasive blasting involves an air compressor, blasting tank, blasting hose and nozzle, as well as protective clothing, a hood and a respirator for the operator. The air compressor should be capable of producing 60 to 100 psi (400 to 700 kPa) at a minimum air flow capacity of 125 ft³ (3.5 m³) per minute. The inside orifice or bore of the nozzle may vary from $\frac{3}{16}$ to $\frac{5}{16}$ in. (4.8 to 7.9 mm) in diameter. The sandblast machine (tank) should be equipped with controls to regulate the flow of abrasive materials to the nozzle at a minimum rate of 300 lb per hour (136 kg per hour).

Methods for cleaning masonry using abrasives may be executed at high or low pressures and with dry abrasives or abrasives added to a stream of water. Abrasives should be selected based on the degree of cutting or cleaning desired and the amount of change in the surface of the masonry permissible. Silica sands, crushed quartz, crushed granite and white urn sand (round particles) are among the harder abrasives at approximately 6 on the Mohs scale. Softer abrasives include crushed nut shells, dry ice and baking soda. If used, these materials should have a gradation appropriate for the intended use [Ref. 2].

Dry abrasive blasting (sandblasting) at high pressure is perhaps the best known of these methods but has a significant potential to damage masonry. Wet sand cleaning depends on water-cushioned abrasive action for its effectiveness. It is similar to sandblasting, with the addition of water into the air stream, which eliminates dust. It is often suggested when abrasion of the surface is permissible. Such instances may include removal of paint or other surface coatings.

Wet aggregates delivered at low pressure through a special nozzle are sometimes used on soft brick and soft stone materials, and are particularly effective on surfaces with flutings, carvings and other ornamentation. Wet aggregate cleaning is a gentle but thorough process, employing a mixture of water and a friable aggregate free from silica, with a scouring action that cleans effectively with less surface damage than sandblasting or wet sand cleaning.

The steps listed in “General Cleaning Procedure” can also be followed for abrasive blasting with the following modifications:

- In step 3, instead of selecting a cleaning solution, select abrasives that are clean, dust-free and sufficiently hard. Test-clean several areas at varying distances from the wall and at several angles that afford the best cleaning job without damaging brick and mortar joints. Workers should be instructed to direct abrasive at the brick and not directly at the mortar joints.
- Omit steps 5 through 7.

Other Methods

Microabrasives. Microabrasive cleaning methods may be better suited to use on masonry than traditional abrasive methods, as they are gentler and less likely to damage substrates. These methods differ from the traditional methods due to the media used and the lower pressures involved. They often include collection and encapsulation of the media after application, resulting in less cleanup. These systems are currently proprietary but have been in use in the United States and Europe since the 1980s.

Lasers. In recent years, laser technology has progressed such that handheld units are available and feasible for use on building exteriors. Stain removal occurs by vaporization and/or by breaking the chemical bond of the stain to the substrate. Specialized contractors are required for laser use, and not all laser types are effective on all stains due to incompatibility of the stain color with the laser wavelength. It is expected that laser technology for cleaning brickwork will continue to improve.

REMOVING EFFLORESCENCE

The removal of efflorescing salts is relatively easy compared with some other stains. Efflorescing salts are water soluble and generally will disappear of their own accord with normal weathering. This is particularly true of “new-building bloom,” which tends to occur during construction or shortly after construction is completed due to normal water loss during post-construction drying.

Before efflorescence is removed, any sources of moisture ingress should be repaired and the brickwork allowed to dry. White efflorescence can often be removed by dry-brushing or brushing with a stiff fiber brush and water. Heavy accumulations or stubborn deposits of white efflorescence may be removed with a proprietary cleaner. It is imperative that the manufacturer’s instructions be carefully followed. Refer to *Technical Note 23A* for a more detailed discussion on removing and preventing efflorescence.

REMOVING SPECIFIC STAINS

Whether a stain results from chemical reactions within a brick or external materials being spilled, splattered on or absorbed by brickwork, each is an individual case and must be treated accordingly. When using any cleaner, it is advisable to consult the brick manufacturer for cleaning advice, to follow the instructions of the cleaner manufacturer, and to trial clean in an inconspicuous area before using a cleaning method on an entire project.

There are a variety of proprietary cleaners that effectively remove most of the common substances that stain brickwork, including bronze and copper stains, efflorescence, graffiti, iron stains (rust), lime run, manganese stain, moss, oil and tar stains, paint, smoke and vanadium stain. When available, these are preferred over site-mixed or “homemade” cleaning solutions because they are generally safer, easier to control and more consistent, resulting in successful cleaning. In some cases, these cleaners have been developed in conjunction with brick manufacturers.

In addition to proprietary cleaners, many stains can be removed by scrubbing with kitchen cleansers, bleach or other household chemicals. A combination, such as is found in some kitchen cleansers, may prove most effective. The sections below list some nonproprietary alternatives for removal of common stains. Further information on causes and prevention of stains is contained in the *Technical Note 23 Series*.

Brick Dust

Dust produced from the cutting of brick sometimes adheres to the surface of brickwork. A soft fiber brush is recommended to remove dust particles from the brick surface. Wire brushes should not be used to remove dust because they can damage the brick surface. When removing dust, it is important to wear a dust mask or respirator

to ensure that dust particles are not inhaled. Afterward, the surface should be wiped down using a dust mop or a damp cloth. Use of compressed air to clean dust is not recommended due to the increased risk of particle inhalation.

Dirt and Mud

Dirt and mud stains can be difficult to remove, particularly from textured brick. In addition to proprietary cleaners, scouring powder and a stiff bristle brush are effective if the texture is not too rough. For very rough textures, pressurized water cleaning can be effective.

Egg Splatter

Brickwork vandalized with raw eggs has been successfully cleaned by pre-wetting the stain, applying a saturated solution of oxalic acid crystals dissolved in water, and rinsing with water. Mix the solution in a nonmetallic container and apply with a brush.

If the egg splatter is to be removed from brick that contain vanadium (typically light-colored units), then a solution of 15 oz washing soda (sodium carbonate) per 1 gal of water (113.5 g per 1 L) should be applied to the brickwork following the oxalic acid solution. Without this neutralizing solution, cleaning with oxalic acid may cause more severe staining.

Manganese (Brown) Stain

Besides specially formulated proprietary compounds, an alternate treatment sometimes suggested for new and mild manganese stains is oxalic acid crystals and water. Mix 1 lb of crystals per 1 gal of water (119 g per 1 L). The neutralizing wash mentioned in the “Egg Splatter” section should be considered when oxalic acid is applied to brown or light-colored brick. Another recommended effective treatment for manganese stains is a solution of equal parts white vinegar, hydrogen peroxide (3 percent solution) and distilled water.

Oil and Tar Stains

Oil and tar stains may be effectively removed with commercially available oil and tar removers. For heavy tar stains, mix the agents with kerosene to remove the tar, and then rinse with water to remove the kerosene. After application, the stains can be hosed off. When used in a steam-cleaning apparatus, cleaners have been known to remove tar without the use of kerosene.

Where the area to be cleaned is small, or where minimal cleanup is desired, a poultice using naphtha or trichloroethylene is most effective in removing oil stains.

Dry ice or compressed carbon dioxide may be applied to make tar brittle. Then light tapping with a small hammer and prying with a putty knife generally will be adequate to remove thick tar splatters.

Organic Growth

Occasionally, an exterior masonry surface remains in a constantly damp condition, thus encouraging moss, algae, lichen, or other microbial or organic growth. Manufacturers of masonry cleaning products offer biocides targeted to remove organic and microbial growth on masonry surfaces. Applications of household bleach, ammonium sulfate or weed killer, in accordance with furnished directions, can also successfully remove organic material in some cases.

Paint, Coatings and Graffiti

Commercial and proprietary paint removers and organic solvents are most effective at softening or dissolving paint so that it can be removed with a scraper and a stiff bristle brush or rinsed away with water. Specialized cleaning systems designed for encapsulation and peeling of applied coatings are also effective. For very old dried paint, organic solvents may not be effective, in which case the paint may be removed by abrasive blasting or scrubbing with a nonmetallic abrasive pad. Try removing paint and coatings using nonabrasive methods first before proceeding to abrasive methods. Note that methods involving scraping and abrasive blasting are not recommended when there is a risk that lead paint is present unless abatement protection procedures are

included, as the lead paint particles can be dispersed into the air. Graffiti that has penetrated into masonry is best removed by a poultice, paste or gel that can cling to the masonry, extending its working time on the stain.

Smoke

Scrubbing with scouring powder (particularly one containing bleach) and a stiff bristle brush is often effective.

Vanadium (Green) Stain

Applying a solution of either potassium hydroxide or sodium hydroxide, consisting of 0.5 lb hydroxide per 1 qt of water (240 g per 1 L) to brickwork is an alternative treatment for vanadium stains. The solution should be allowed to remain on the brickwork for two or three days and then washed off. Use a hose to remove any white residue remaining on the brickwork after this treatment.

Sodium hypochlorite, the active ingredient in household bleaches, can also be used to remove mild vanadium stains. Spray or brush onto the stain, and then rinse off after the stain disappears.

Oxalic acid is another chemical known to remove vanadium stains. A mixture of 3 to 6 oz oxalic acid per 1 gal of water, preferably warm, (22.4 to 44.8 g per 1 L) should be applied to the brickwork, followed by the neutralizing wash described in the “Egg Splatter” section. More severe staining may result if the oxalic acid solution is applied without the neutralizing wash.

Welding Splatter

When metal is welded too close to brick stored on-site or completed brickwork, molten metal may splash onto the brick and melt into the surface. A mixture of 1 lb oxalic crystals and 0.5 lb of ammonium bifluoride per 1 gal of water (119 g and 61 g per 1 L) is particularly effective in removing welding splatters. This mixture should be used with caution, as it generates dangerous hydrofluoric acid, which can also etch brick and glass.

Scrape as much of the metal as possible from the brick. Apply the mixture in a poultice and remove when it is dried. If the stain has not disappeared, use sandpaper to remove as much as possible and then apply a fresh poultice. For stubborn stains, several applications may be necessary.

Stains of Unknown Origin

Stains of unknown origin can be a real challenge. Applying a cleaning agent without identifying the initial stain may result in additional stains that are more difficult to remove. The visual characteristics of a stain may be the first clues as to its source. Identification of stains is discussed further in *Technical Note 23*.

To determine the composition of an unknown stain, samples of the stain should be extracted from the wall and sent to a testing laboratory. Then the appropriate method may be implemented to clean the brickwork.

CLEANING HISTORIC STRUCTURES

Improper cleaning can cause irreparable damage to historic brickwork. Therefore, cleaning of structures with historic significance should be overseen by a restoration specialist. Such a specialist will be able to identify previous treatments, determine appropriate cleaners and cleaning methods, and provide quality assurance for the project.

Before a historic structure is cleaned, consider the purpose of cleaning: to improve the appearance, to slow deterioration, or to provide a clean surface for evaluation or further treatments. With historic structures, it is imperative to use the least harmful cleaning method that will achieve the desired results. Cleaning methods and materials must be carefully matched to the substrate to be cleaned, the type of soiling/staining to be removed and the desired results. It is recommended to use cleaning trials to evaluate the effectiveness of various cleaning products and methods. It is also recommended to determine the level of cleanliness appropriate for the historic brickwork and structure. These issues are discussed in detail in the National Park Service Preservation Brief “Assessing Cleaning and Water-Repellent Treatments for Historic Masonry Buildings” [Ref. 5].

CLEANING BRICK PAVING

Some of the methods already described for cleaning brick walls, such as pressurized water cleaning or using a bucket and brush, can be used successfully to remove stains that also affect pavements such as efflorescence, hardened mortar, plant life, oil and tar, etc. However, acid-based cleaning solutions may not be appropriate for pavements containing joint sand stabilizers or polymeric sand-filled joints. Prior to selecting a cleaning solution for brick pavements, it is recommended to verify the compatibility of the cleaner with the paver manufacturer. Most paver manufacturers will provide literature on recommended cleaning procedures.

Most paving systems can be kept clean in most environments by regular sweeping. In situations that lead to a greater degree of grease buildup, stains from deicing salts, materials tracked or spilled onto the pavement, tire marks or other stains, frequent sweeping or pressurized water cleaning at low pressure will help reduce the need for more aggressive cleaning methods and solutions. Low-pressure water cleaning can be more effective when hot water is used and when mild detergents are applied to the pavement surface.

Fresh mortar stains can be removed from existing or mortarless pavements before they set by covering the pavement with clean, slightly damp, washed sand and sweeping toward the edges. When the surface is almost clean, sweeping with dry sand should remove the remaining residue.

More stubborn stains, including food and paint, can be cleaned by scraping off the hard residue and then scrubbing with a stiff bristle brush and scouring powder. Chewing gum can usually be removed from brick pavements with nonmetallic tools, carefully applied medium-pressure water or freezing each piece of gum with compressed carbon dioxide or dry ice, and then scraping or chiseling it off the pavement. Food stains and tire marks are typically removed by scrubbing with a detergent or a proprietary cleaner. In damp or shady areas where moss and lichens have grown in the joints, these can be killed using bleach and water mixed in a ratio of one to one or proprietary biocide treatments.

Stains from polymeric sand can occur on paver surface adjacent to joints. To prevent this during construction, it is critical to remove all sand or dust from the surface before and after activation. Leaf blowers on the lowest setting held at a low angle can help redirect remaining sand and water into the joints. Using a shop vacuum can also be effective in removing sand or dust from the paver surface. If the sand is not removed after activation and haze stains appear on the paver surface, it is recommended to use a nonmetallic bristle brush with hot water (approximately 180 °F or 82 °C) or vinegar to remove the haze. Proprietary cleaning products formulated for haze removal are also available. Be aware that typical cleaning products formulated for masonry may react adversely with the polymer in the sand and should not be used to clean the haze. In addition, many cleaning products marketed by polymer sand manufacturers consist of unbuffered hydrochloric (muriatic) acid and should not be used on clay pavers.

Cleaning solutions, polymeric sands or other products applied directly to clay pavers should always be tested on a small, inconspicuous area before application to the entire project. Some of these products have been known to haze, stain or discolor certain pavers. Stabilized sand-filled joints are generally resistant to pressure washing if the nozzles are kept clear of the surface and the water jet is not aimed directly along the joints. Aggressive pressure washing can cause localized removal of joint sand.

SUMMARY

Testing of cleaning procedures and chemicals as suggested in this *Technical Note* is strongly recommended. Such testing should be performed under conditions of temperature and humidity that closely approximate the conditions under which the brick masonry will be cleaned. Cleaning solutions and methods recommended by the brick or cleaning agent manufacturer should also be trial tested over a small area before being committed to an entire project. To minimize the risk of damaging the brickwork, begin by selecting the gentlest cleaning methods and materials appropriate for the situation. The effects of any cleaning process on the brickwork, people and the environment should be carefully evaluated before any cleaning begins.

The recommendations in this *Technical Note* should be used as a guide for successful cleaning of brick masonry. Due to the diverse nature of cleaning solutions, procedures and problems, the Brick Industry Association cannot accept responsibility for the final success or effectiveness of these procedures.

Nothing is quite as effective as careful attention exercised during construction to keep brickwork relatively clean. If this is successful, then it will eliminate the need for costly cleaning procedures.

The information and suggestions contained in this Technical Note are based on the available data and the combined experience of engineering staff and members of the Brick Industry Association. The information contained herein must be used in conjunction with good technical judgment and a basic understanding of the properties of brick masonry. Final decisions on the use of the information contained in this Technical Note are not within the purview of the Brick Industry Association and must rest with the project architect, engineer and owner.

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