

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, that if followed, 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:

- Use bricklaying techniques that reduce mortar smears during construction
- Use construction practices that prevent debris from splashing onto brickwork and minimize water penetration into unfinished masonry

Prior to Cleaning:

- Match the cleaning method and cleaning solution to the type of brick
- Protect adjacent materials that may be damaged by cleaning
- Remove large mortar tags using wooden paddles or non-metallic tools
- Test the cleaning method and materials on a 20 ft² (2 m²) sample area and allow wall to dry before evaluation
- Determine the environmental impact and appropriate removal method of cleaning effluent

For All Cleaning Methods:

- Select the gentlest effective cleaning method
- Follow the brick manufacturer's recommended cleaning procedure
- Do not use unbuffered muriatic acid
- Clean new masonry as soon as possible after mortar hardens, typically 7 days. More aggressive cleaning methods, such as abrasive blasting, may require a longer mortar curing time prior to cleaning
- Clean from the top of the wall section to the bottom
- For consistent results, do not overlap areas being cleaned

Bucket and Brush Cleaning:

- Saturate the area to be cleaned and brickwork below with water prior to applying cleaning solution and keep wet until final rinse
- Mix and apply cleaning solution according to manufacturer's instructions
- Do not allow cleaning solution to dry on brickwork
- After cleaning, thoroughly rinse the area being cleaned and the area below with water

Pressurized Water Cleaning:

- Determine appropriate water pressure, nozzle type and distance between wall and nozzle by trial cleaning; maintain consistently throughout cleaning
- Saturate the area to be cleaned and brickwork below with water prior to applying cleaning solution, and keep wet until final rinse
- Apply cleaning solution according to manufacturer's instructions with a low-pressure sprayer, 30 to 50 psi (200 to 350 kPa) using a 50° fan-shaped sprayer, or by brush
- Do not use high pressure to apply cleaning solution
- Do not allow cleaning solution to dry on brickwork
- Thoroughly rinse using a maximum water pressure of 200 to 300 psi (1,400 to 2,100 kPa) with a 25° to 50° fan-shaped tip

Abrasive Blasting:

- Do not use abrasive blasting on brick with a sand finish or decorative surface coating
- Brickwork should be dry and well cured prior to abrasive cleaning
- Determine appropriate air pressure, abrasive, distance and angle between wall and nozzle by trial cleaning; maintain consistently throughout cleaning

Efflorescence Control:

- Allow one year of weathering to naturally remove new building bloom
- Remove light efflorescence by dry brushing or 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 cleaner 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. Recommended cleaning methods and materials vary depending on the type of brick, mortar, construction and reason for cleaning. For example, cleaning the newly constructed brickwork of an entire building requires a different approach than removing stains from an isolated portion of an existing wall.

An effective general approach to ensuring clean brickwork includes the following steps before the cleaning operation begins:

- Reduce the need to clean through detailing and construction techniques that reduce water penetration and staining.

- Account for any special considerations, such as decorative coatings or finishes, water repellents, mortar type, mortar color or historic significance.
- Repair leaks contributing to staining.
- Identify the stain or discoloration and select appropriate cleaning materials and methods that will produce desired results.
- Clean a sample test area or panel, carefully following brick manufacturer's directions, and allow to dry before evaluating and applying to larger areas.

The selection of effective cleaning solutions, as well as the use of consistent and appropriate cleaning procedures throughout the job, are 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. It should be noted however that cleaning agents and processes may be hazardous and may cause injury if used carelessly. Cleaning operations should only be performed by persons familiar with and equipped to handle the safety risks associated with the work.

CLEANING NEW BRICKWORK

Brickwork is often cleaned soon after construction is completed to remove mortar smears and construction dirt that detract from the appearance of the masonry. With new construction, keeping the masonry clean as it is erected can be very cost-effective by eliminating the need for extensive cleaning after construction. When it is determined that brickwork needs to be cleaned, the brick cube identification card and other pertinent manufacturer information should be consulted first to ascertain the recommended cleaning procedures for the brick. As discussed under **Suggested Cleaning Methods** below, recommended cleaning materials and methods vary with the type of brick.

Keeping Brickwork Clean During Construction

Some general practices that can be used to construct a cleaner wall are:

- Protect site-stored brick from mud. Store brick off the ground under protective 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 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 at other work stoppages to prevent mortar joint wash out and entry of water into the completed masonry.
- Protect newly constructed brickwork from adjacent construction practices that may cause staining, such as placing concrete or spraying curing agent.

It is always advisable for masons 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 practices below 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 surface, preferably using a medium-soft bristle or fiber brush. Brushes with steel bristles are not recommended as they may leave behind small particles which can rust. Brushing is preferable to bagging or sacking. Avoid any motion that will result in rubbing or pressing mortar particles into the brick faces.

- Large clumps of mortar that adhere to brickwork should be allowed to become firm, then removed by hand with wooden paddles, a loose brick or nonmetallic tools.

Trial Cleaning

Before cleaning, it is beneficial to test potential cleaning procedures and solutions on a sample area of about 20 ft² (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 helps to identify the most effective procedures that cause the least damage to the masonry. Optimal concentrations of cleaning products and 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. Thus, it is safer 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. If trial cleaning must be performed on a building, select an inconspicuous location. Trial cleaning should be performed at temperature and humidity conditions that closely approximate the conditions that will be experienced during cleaning.

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 about one week. Approval of the trial area should precede application to any additional areas.

Suggested Cleaning Methods

Generally, the cleaning method that effectively cleans the brickwork while being the gentlest, or least harmful to the masonry is the most appropriate. Commonly used cleaning methods for new masonry include bucket and brush hand cleaning and pressurized water cleaning.

Always consult brick manufacturers for recommendations on cleaning specific brick. 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 of the brickwork. **Table 1** suggests appropriate cleaning methods for various brick types, which can be used 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. The use of colored mortars may require special consideration, as noted in Table 1.

Special Considerations. 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, cleaning methods that involve water should not be used during freezing weather or when it is expected.

Do not allow cleaning solutions to dry on brickwork. In hot weather, the cleaning crew can avoid this by working on small or shaded areas. The size of the work area should be determined after a trial run. For consistent results, avoid overlapping work areas.

Some chemicals used to clean brickwork and their fumes may be harmful. Use protective clothing and accessories, proper ventilation and exercise safe handling procedures. Comply with federal, state or local laws regulating the use and disposal of chemicals and cleaning wastewater. Strictly observe the cleaner manufacturer's material safety data sheet and recommended handling requirements.

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. These brick include die skin extruded brick, glazed brick, water-struck molded brick and dry-pressed brick. They are easier to presoak and rinse because their unbroken surfaces are more likely to display poor rinsing, acid staining and poor removal of mortar smears. Mortar and dirt tend to penetrate deeper into textures. Brick that are wire-cut, 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 complete rinsing of rough textured brick.

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 removing stains from existing masonry.

TABLE 1
Quick Guide for Cleaning Brickwork

Brick Category	Cleaning Method	Remarks
Red and Red Flashed	Bucket and Brush Hand Cleaning Pressurized Water Abrasive Blasting	Water, detergents, emulsifying agents, or suitable proprietary compounds may be used.
White, Tan, Buff, Gray, Pink, Brown, Black, Specks and Spots	Bucket and Brush Hand Cleaning Pressurized Water Abrasive Blasting	Clean with water, detergents, emulsifying agents, or suitable proprietary compounds. Unbuffered muriatic acid solutions tend to cause stains in brick containing manganese and vanadium. Light colored brick are more susceptible to "acid burn" and stains, compared to darker units.
Sand Finish or Surface Coating	Bucket and Brush Hand Cleaning	Clean with water and scrub brush using light pressure. Stubborn mortar stains may require use of cleaning solutions. Abrasive blasting is not recommended. Cleaning may affect appearance. See Brick Category for additional remarks based on brick color.
Glazed Brick	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 supply for final washing. Use detergents where necessary and proprietary cleaners only for very difficult mortar stain. Consult brick and cleaner manufacturer before use of proprietary cleaners on salt glazed or metallic glazed brick. Do not use abrasive powders. Do not use metal cleaning tools or brushes.
Colored Mortars	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.

1. Decide when to clean. Mortar must harden 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. Prolonged time periods between the completion of the masonry and cleaning should be avoided. After one month, mortar smears and splatters left on brickwork become increasingly difficult to remove.
2. 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.
3. Select the proper cleaning solution. There are many types of proprietary cleaners available that are formulated to remove specific stains or for use with a particular type of brick. Be careful to select cleaning products suitable for the brick, mortar and adjacent materials and follow the cleaner manufacturer's recommended instructions. Each product being considered should be evaluated as discussed previously in **Trial Cleaning**.

Do not use unbuffered muriatic acid. Use of unbuffered muriatic acid solutions tend 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.

4. 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 run-off from contacting plants or the surrounding soil.
5. Saturate the area to be cleaned. Flush with water from the top down. Saturated brick masonry will not absorb the cleaning solution or dissolved mortar particles. Areas below the area being cleaned should also be saturated and kept wet until after the final rinse to prevent streaking and absorption of the run-off from above.

6. Apply the cleaning solution. For proprietary compounds, follow the manufacturer's instructions for application, dwell time and cleaning technique. Wooden paddles or other non-metallic tools may be used to remove stubborn particles.
7. Rinse thoroughly. Flush walls with large amounts of clean water from top to bottom before cleaned surfaces can dry. Failure to completely flush the wall of cleaning solution and dissolved matter may result in the formation of "white scum."

Individual cleaning methods and procedures may vary slightly from this general procedure; where appropriate such variations are noted in succeeding sections of this *Technical Note*.

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 applicable to virtually all brick types. The least aggressive method of cleaning is the bucket and brush method with clean water only. If a cleaning solution is used, it should be matched to the specific brick. The **General Cleaning Procedure** given above is applicable to bucket and brush cleaning with the following amendments:

- In Step 1, cleaning can often begin 24 hours after the masonry is completed if only clean water without chemicals is used.
- In Step 6, use a long handled stiff fiber brush or other type as recommended by the cleaning solution manufacturer. Do not use metal brushes which may damage mortar joints or result in further staining. Depend on the chemical reaction of the cleaner rather than the scrubbing action of the brush. If stubborn mortar smears are not removed, reapplication is often more effective than hard scrubbing.

Pressurized Water Cleaning. Cleaning contractors often utilize pressurized water because it is less labor intensive than bucket and brush cleaning and permits large areas to be cleaned much faster. 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, as consistent results depend on maintaining a consistent pressure, water flow rate, distance from the wall and angle between the water jet 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 as excessive pressure may damage brick surfaces, erode mortar joints and remove finishes or other surface coatings, resulting in a different appearance. Nozzle pressures less than 300 psi (2,100 kPa) are typically recommended. The brick manufacturer should be consulted before use of pressurized water to clean brick.

With the following modifications, the **General Cleaning Procedure** described previously is applicable to pressurized water cleaning:

- In Step 3, when selecting a cleaning solution, verify its compatibility with the equipment to be used. Mix proprietary cleaners in accordance with the manufacturer's instructions.
- In Step 5, a maximum pressure of 30 to 50 psi (200 to 350 kPa) with a 25° to 50° fan-shaped nozzle is recommended when using a sprayer to presoak the wall.
- In Step 6, the cleaning solution should be applied by a low-pressure sprayer, (30 to 50 psi [200 to 350 kPa]), with a 50° fan-shaped sprayer nozzle, or by brush. Cleaning solutions applied under high pressure can be driven into the masonry and become the source of future staining.
- In Step 7, use a 25° to 50° fan-shaped nozzle and a maximum water pressure of 200 to 300 psi (1,400 to 2,100 kPa) 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, higher pressures may be used.

Improper Cleaning

Cleaning failures generally fall into one of the following categories:

- **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 has a tendency 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, that 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 (STAIN REMOVAL)

Bucket and brush hand cleaning and pressurized water cleaning discussed above in **Suggested Cleaning Methods**, are also used to remove stains from existing masonry. Besides these, poultices, additional proprietary solutions and a variety of abrasive blasting methods are among the techniques typically used to remove dirt or specific stains from existing masonry [Ref 3]. These are described briefly below.

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 other unexpected treatments or conditions may interfere with cleaning. In these instances, professional guidance should be sought in determining how to address these conditions to achieve successful cleaning.

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 tend to prevent stains from spreading during treatment and pull stains out of the pores of brick. Poultices are normally used for stains affecting small areas of brickwork.

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. 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. 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, do not use whiting as the inert material. Whiting is a carbonate which reacts with acids to give off carbon dioxide. While this is not dangerous, it will make a foamy mess and destroy the power of the acid.

Abrasive Blasting

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 also roughen the surface of masonry, which increases its tendency to hold dirt and makes future cleaning more difficult. Sanded, coated, glazed and slurry-finished brick should not be cleaned by abrasive blasting.

It is possible to safely clean brick masonry by abrasive blasting, however a gentler abrasive than sand and a highly qualified operator are typically required, in conjunction with proper specifications and job inspection. In limited 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, nozzle, and 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 3/16 to 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/hr (0.004 kg/s).

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 that is permissible. Silica sands, crushed quartz, crushed granite and white urn sand (round particles) are among the harder abrasives at approximately 6 on Moh's Scale. Softer abrasives include crushed nut shells, dry ice, baking soda and others. If used these minerals 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. In addition, the dust it creates can be harmful if inhaled, which poses health and safety concerns.

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 **General Cleaning Procedure** can also be followed for abrasive blasting with the following modifications:

- In Step 3, select abrasives that are clean, dust free and sufficiently hard. Test clean several areas at varying distances from the wall and 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.

REMOVING EFFLORESCENCE

The removal of efflorescing salts is relatively easy compared to some other stains. Refer to *Technical Notes 23 Series* for a detailed discussion on efflorescence. 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 shortly after construction is completed (or during construction) due to normal water loss during post-construction drying.

Before efflorescence is removed, any leaks should be repaired and the brickwork should be allowed to dry. White efflorescence can often be removed by dry brushing or 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 are carefully followed.

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, follow the instructions of the cleaner manufacturer, and trial clean in an inconspicuous area before using 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 non-proprietary alternatives for removal of common stains. Further information on causes and prevention of stains is contained in the *Technical Notes 23 Series*.

Brick Dust

Dust produced from the cutting of brick sometimes adheres to the surface of brickwork. Compressed air, such as from a portable cylinder, has been found effective in removing this dust.

Dirt and Mud

Dirt can be difficult to remove, particularly from a 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 prewetting the stain, applying a saturated solution of oxalic acid crystals dissolved in water and rinsing with water. Mix the solution in a non-metallic container and apply with a brush.

If the egg splatter is to be removed from brick that contain vanadium (typically light colored units), a solution of 1.5 oz (10 g) washing soda (sodium carbonate) per gal (1 L) of water 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, manganese stains have been effectively removed and their return prevented by carefully mixing a solution of acetic acid (80 percent or stronger), hydrogen peroxide (30 to 35 percent) and water in the following proportions by volume: 1 part acetic acid, 1 part hydrogen peroxide, and 6 parts water. After wetting the brickwork, brush or spray on the solution. Do not scrub. The reaction is usually very rapid and the stain quickly disappears. After the reaction is complete, rinse the wall thoroughly with water.

Caution: Although this solution is very effective, it is a dangerous solution to mix and use. Acetic acid-hydrogen peroxide may also be available in a premixed form known as peracetic acid.

An alternate treatment sometimes suggested for new and mild manganese stains is oxalic acid crystals and water. Mix 1 lb of crystals (0.45 kg) to 1 gal (3.79 L) of water. The neutralizing wash mentioned above in **Egg Splatter** should be considered when oxalic acid is applied to brown or light colored brick.

Oil and Tar Stains

Oil and tar stains may be effectively removed by commercially available oil and tar removers. For heavy tar stains, mix the agents with kerosene to remove the tar, and then 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 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 enough 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 organic growth. Applications of household bleach, ammonium sulfate or weed killer, in accordance with furnished directions, have been used successfully for the removal of such growths.

Paint 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. For very old dried paint, organic solvents may not be effective, in which case the paint must be removed by sandblasting or scrubbing with a non-metallic abrasive pad. 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 potassium or sodium hydroxide, consisting of 0.5 lb (0.23 kg) hydroxide to 1 qt (0.95 L) water or 2 lb (0.91 kg) per gal (3.79 L) to brickwork is an alternative treatment for vanadium stains. The solution should be allowed to remain for two or three days and then washed off. Use a hose to wash off 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 rise off after the stain disappears.

Oxalic acid is another chemical known to remove vanadium stains. A mixture of 3 to 6 oz (20 to 40 g) oxalic acid per gal (1 L) of water (preferably warm) should be applied to the brickwork, followed by the neutralizing wash described in **Egg Splatter**. 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 (0.45 kg) oxalic crystals and 0.5 lb (0.23 kg) of ammonium bifluoride per gal (3.79 L) of water 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 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. Laboratory tests of unknown stains maybe necessary to determine their composition. Then the appropriate method may be implemented to clean the brickwork. The application of a cleaning agent without identifying the initial stain may result in 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*.

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. 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 substance to be cleaned, the type of soiling/staining to be removed and the desired results.

These issues are discussed in detail in "Assessing Cleaning and Water-Repellent Treatments for Historic Masonry Buildings" [Ref. 4].

CLEANING BRICK PAVING

Cleaning of brick pavements is essentially the same as for brickwork in walls and other applications. The methods described above can be used successfully to remove stains that also affect pavements such as efflorescence, hardened mortar, plant life, oil and tar, etc. However, after construction is complete, dirt and stains resulting from

deicing salts or materials tracked onto or spilled on pavements typically build up more quickly than other brick applications. Frequent sweeping and washing with clean water will help reduce the need for more aggressive cleaning methods and solutions.

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 remaining residue.

Chewing gum can usually be removed from brick pavements by wire brushes, carefully applied high 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 proprietary cleaner.

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 recommended by the brick or cleaning agent manufacturer should also be trial tested before being committed to an entire project. The effects of any cleaning process on people and the environment should be carefully evaluated before 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.

In conclusion, nothing is quite as effective as careful attention exercised during construction to keep brickwork relatively clean. If this is successful, 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.

REFERENCES

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