

# Architectural Precast Association

## Stain Removal Guide

### REMOVING STAINS FROM CONCRETE

Most externally caused stains can be removed from concrete surfaces without difficulty, although sometimes it is necessary to repeat the treatment until the desired result is attained. Removal of old, long-neglected stains may require patience and, when the staining matter is not known, some experimentation. After removal, in many cases evidence of the stain may remain as a shadow because of the depth of its penetration into the pores of the concrete.

### METHODS

Stains can be removed from concrete by either dry (mechanical) or wet (chemical or water) methods or a combination of them.

Common dry methods are sandblasting, flame cleaning, shotblasting, and mechanical cleaning methods such as grinding, scabbing, planing, and scouring. Steel-wire brushes should not be used because they can leave metal particles on the surface that later may rust and stain the concrete. Nonmetal brushes, such as nylon, are preferred.

Wet methods involve application of specific chemicals according to the nature of the stain or the type of chemical used. The treatment acts in one of two ways: (1) it dissolves the staining substance so it can be blotted up from the surface or driven more deeply into the concrete; or (2) it bleaches or changes the staining substance chemically to a product that will not show.

The chemicals are either brushed on or applied as bandages or poultices. A *bandage* consists of layers of soft, absorbent, white, cotton cloth soaked in chemicals and pasted over the stain. A *poultice* is a paste made with a solvent or reagent and some finely powdered, absorbent, inert material. Selection of the solvent or reagent depends on the type of stain. The inert material can be calcium carbonate (whiting), calcium hydroxide (hydrated lime), talc (talcum powder), fly ash, fuller's earth diatomaceous earth (kieselguhr), or seasoned oak sawdust. Portland cement can also be used to make a poultice with solutions that do not contain water, acids, or trichloroethylene. The powder for any poultice must not react with the solvent or reagent. Enough of the solvent or reagent is added to a small quantity of the inert material to make a smooth paste. The paste is spread in a 1/4-in. to 1/2-in. thick (6- to 13-mm) layer onto the stained area with a trowel or spatula and allowed to dry. The solvent dissolves the staining substance and absorbs it into the poultice. There it migrates to the surface where the solvent evaporates and the stain is left as a loose, dried, powdery residue that can be scraped or brushed off. The chief advantage of a poultice is that it prevents the stain from spreading during treatment and tends to pull the stain out of the pores of the concrete. Solutions are usually proportioned by volume (for example, 1 part acid to 10 parts water). Always add acid to water, not

water to acid. For aesthetics, a pigmented coating can be applied to cover some stains or discoloration that cannot be adequately removed (see the section "Covering Stains").

**CAUTION.** Most of these chemicals are toxic, carcinogenic, flammable, or generally hazardous and require adequate safety precautions: Skin contact and inhalation must be avoided. As a general precautionary rule, safety goggles and rubber or plastic gloves and clothing (i.e., rain gear) should be worn. If not used outdoors, adequate ventilation must be provided. Respirators (air supply) or gas masks with an organic vapor canister and full faceplate should be used with highly toxic, vaporous chemicals. Storage and handling instructions printed on contained labels must be followed. Unused portions that have been taken from the original containers should be discarded; they should never be put back into the original containers. Chemicals should never be stored in unidentified containers.

The following methods of stain removal represent a good starting point, although at times it is necessary to adapt them to circumstances encountered in the field.

Some stains can be removed by more than one method. The most effective method in each case is best determined by trial and error. Before large stains are tackled, a small quantity of the removing agent should be prepared and applied to an inconspicuous area to assess its effectiveness. It is advisable where possible to try a few different agents before making a choice; however, the agents from one treatment must be completely removed before a new agent is applied to avoid stain-producing or toxic reactions. Also, to avoid hazardous conditions, do not mix different agents together. The effectiveness of the method on the sample area should not be judged until it has dried for at least one week.

## **CLEANING CONCRETE SURFACES**

The method selected for cleaning concrete depends on the purpose of the cleaning and on the extent of the work to be done. It may entail a bucket and brush, a hammer and chisel, water-pressure and steam washing, grit blasting, chemical cleaning, flame cleaning, or special mechanical power tools.

When faced with the decision to clean concrete, a careful investigation is advisable, which may bring to light unexpected facts. Accurate diagnosis of the problem is essential for effective and successful cleaning. There is no really simple technique for normal situations: Water and chemical cleaners can lead to other problems caused by excessive moisture or unanticipated chemical reactions; grit blasting and flame cleaning will change the texture and appearance of the surface; power tools can damage thin sections or remove more concrete than is desirable. Oils, grease, and certain penetrating chemicals must sometimes be removed before water or abrasive cleaning methods are used.

When cleaning concrete is necessary, the following will provide some guidance for selecting the least damaging method. The methods described below have merit for

removing stains from concrete for appearance purposes. For stain removal and some coating applications, it is desirable to minimize abrading of the concrete surface.

Before deciding on a particular method, clean a relatively small, inconspicuous area to assess the efficiency of the method and the appearance and condition of the surface after the treatment. The reasons for cleaning must be considered carefully because results with methods intended to improve only the appearance can differ substantially from results with methods to prepare the surface for a coating or concrete overlay.

## **ABRASIVE BLASTING**

**Dry (Sandblasting).** Dry abrasive blasting, such as sandblasting, drives an abrasive grit at concrete surfaces to erode away dirt, paint, various coatings or contaminants, and any deteriorated or damaged concrete. (See also "Metallic - Shot Blasting").

Sandblasting changes the appearance of the concrete surface. It is left with a rougher texture that may hold even more dirt and pollutants than before and hasten the need for recleaning. Sandblasting removes the edges at arises and the sharp detail on moldings and ornaments. Even the flat surface of hard, polished aggregate will become scarred and dulled. Sandblasting can provide an excellent rough-textured surface for bonded repair work. Where gentler blasting is desired, corn cob or walnut shell grit may be used.

Although the sandblasting operation is not complicated, certain procedures and precautions known to experienced operators should be followed to ensure a uniformly clean surface.

Sandblasting equipment is available in various capacities. A venturi-type nozzle should be used on the gun for its solid-blast pattern rather than a straight-bore nozzle that produces lighter fringe areas. A remote control system attached to the sandblast pot gives the operator instant control of starts and stops as well as direction. The man operating the gun must be protected from dust and rebounding grit by a well-fitting air-line hood in which a positive pressure of clean, filtered air is maintained. Other members of the blasting team should wear suitable protective clothing and equipment such as an approved respirator under a hood. Silica dust is a particularly dangerous substance because free silica can cause lung damage. The grit and dust particles must be removed by air blasting, brooming, pressurized water, or vacuum methods before a coating or repair material is applied.

**Wet.** Wet abrasive blasting is very similar to dry abrasive blasting (sandblasting) except that water is introduced into the air-grit stream at the nozzle. An adapter is secured to the nozzle for attaching to city water supply. The water eliminates most of the visible dust but smaller, harmful particles remain a hazard to health and the same protective equipment and clothing are needed as for dry abrasive blasting. The wet-abrasive-blasting method will avoid the nuisance of dust but it involves an extra

operation of rinsing off the surface after blasting to remove residual dust and dirt scum.

## **Chemical Cleaning**

The materials used in chemical cleaning can be highly corrosive and frequently toxic. They require special equipment for their application and protective clothing for workers. In addition, protection may be necessary for adjacent areas, nearby building, and lawns, trees, and shrubs. For these reasons, chemical cleaning is best left to the specialist. If, however, a non specialist undertakes the cleaning job, he should read the directions on the cleaner carefully and follow them closely.

Chemical cleaners are often water-based mixtures formulated for use on specific types of concrete and masonry. Most of them contain organic compounds called surfactants (surface-active agents) that work as detergents to allow the water to penetrate the surface dirt or stain more readily, thus hastening its removal. In addition, the mixtures contain a small amount of either acid or alkali, which assists in separating the dirt from the surface. Solvent-based (non water) cleaners are also used.

Cleaning with proprietary compounds, detergents, or soap solutions generally requires the same procedure as given here for acid etching.

Acid etching is often suggested as a satisfactory method for cleaning a concrete surface. Hydrochloric acid, also known as muriatic acid, is widely used because of its ready availability. Hydrochloric acid should not be used in areas where chlorides are prohibited.

The procedure for cleaning concrete using a diluted acid solution is as follows:

1. Mix 10% solution of muriatic acid (1 part acid to 9 parts clean water) in a nonmetallic container. Pour the acid into the water to mix. Stronger acid solutions may have to be used if the etching action is insufficient.
2. Mask or otherwise protect windows, doors, ornamental trim, and metal, glass, wood, and stone surfaces from acid solutions.
3. Remove dust and dirt from the area to be cleaned and presoak or saturate with water.
4. Apply the acid solution to the damp surface with spray equipment, plastic sprinkling cans, or a long-handled stiff-fiber brush. Allow the solution to remain for 5 to 10 minutes. Nonmetallic tools may be used to remove stubborn particles.
5. Rinse thoroughly. Flush the surfaces with large amounts of clean water before they can dry. Acid solutions lose their strength quickly once they are in contact with cement paste or mortar; however, even weak, residual solutions can be harmful to concrete. Failure to completely rinse the acid solution off

the surface may result in efflorescence or other damaging effects. Test with pH paper and continue rinsing until pH of 7 or higher is obtained (see ASTM D-4260 and D4262).

## Flame Cleaning

Flame cleaning can be used to remove substances such as oil, old paint, and dirt from concrete surfaces to give a new look or to improve bond with a new surface coating. Flame cleaning is accomplished by moving a special multiflame blowpipe over the concrete surface. The blowpipe burns acetylene and oxygen, producing a flame of very high temperature - approximately 5600° F (3100° C). The hot flame causes the surface layer of concrete to spall and shave off the aggregates. Oil, paint, and other impurities are burned away while the moisture in the surface is evaporated. The high-pressure gas blows away the loose material and exposes a new, clean surface.

A manual blowpipe for smaller surfaces, hard-to-reach places, and walls is available in 6- and 10-in (150- and 250- mm) widths. A rolling carriage blowpipe 20 in. (500 mm) wide is used for cleaning larger surfaces. If the concrete is of such quality that the surface partially melts, a rotating wire brush should be used to remove residual material.

Because the surface undergoes extremely rapid heating, particles in the concrete may erupt with great force. The operator of the flame equipment must wear protective clothing, gloves, a hard-hat with neck protection and visor, and, if necessary, welding goggles.

## Steam Cleaning

In steam cleaning, water is pumped to a flash boiler where it is converted to steam and then directed onto the concrete. Brushes and abrasive stones usually are necessary to assist in removing dirt. Today, improved methods and cleaning products have largely supplanted steam cleaning for building, although steam can sometimes help remove deep-seated soiling after acid etching and reach awkward areas. Steam cleaning essentially leaves the concrete surface intact.

## Water Spray

**Low Pressure.** In low-pressure water spraying, only enough water is sprayed onto the surface to keep the deposits of dirt moist until they soften. Larger amounts of water are no more effective, and they might over-saturate a wall and penetrate to the building interior, curing additional problems. Cleaning should begin at the top of the structure so that surplus water will run down and presoften the dirt below. How long it will take to soften the dirt is found by trial; it could be a few minutes or days. On some surfaces the softened dirt can then be removed by hosing down the

concrete, but usually it is necessary to assist removal with the gentle use of bristle brushes and nonferrous or stainless-steel-wire brushes. Abrasive stones can be used to remove stubborn dirt from some surface areas.

The low-pressure water spray method is effective only when the dirt lies lightly on the surface or is bound to the wall with water-soluble matter.

**High-Pressure Water Blasting.** With the recent development of ultra-high-pressure water-jetting equipment, water can be used to clean hardened concrete and masonry surfaces effectively. High-pressure water blasting relies on the force of the water rather than on abrasives. Pressures up to 55,000 psi (380 MPa) are available; however, most of the work is accomplished at 5000 to 10,000 psi (35 to 70 MPa). Although usually not needed, sand can be injected into the high-pressure water stream to enhance cutting. Oils and grease are usually removed before water blasting.

A variety of equipment is available for this type of surface cleaning. Nozzles range from flat-fan pattern tips to a straight jet tip. The fan pattern acts as a blade that pries up and lifts away the undesirable surface accumulation. The straight jet could cut a hole completely through concrete. The techniques used are similar to sandblasting: correct distance from the surface, nozzle angle, and pressure are determined by the type and amount of material to be removed. Water blasting can be used to prepare surfaces for coating, remove dirt or stains, or abrade the concrete surface for repairs. It is also very useful in removing weak, deteriorated concrete.

Many commercial sources are available for cleaning methods and materials. A good place to start is APA Associate member Arcal Chemicals, listed in your roster.

See the following chart for some specific cleaning suggestions.

<b><u>STAINS</u></b>	<b><u>TREATMENTS</u></b>
<b>Bitumens</b>	Molten Harden with ice, not dry ice, chip off, follow with scouring powder scrub. Do not use solvents, which will "drive in the stain."
	Emulsified Scouring powder scrub. No solvent. (Water base)
	Cutback See Petroleum oil and grease (Solvent base)
<b>Caulking Compounds</b>	Scrape surface, then use denatured alcohol poultice, follow with scouring powder scrub. (Ask manufacturer for recommendation).
<b>Copper, Bronze</b>	Ammonium Chloride/Ammonium Hydroxide or Sodium/Ammonium Citrate poultice

<b>Dirt</b>	Scrub with: Detergent; dilute hydrochloric acid or phosphoric acid; commercial cleaner; detergent plus acetic acid solution.
<b>Epoxies</b>	Torch burn and/or abrasive blast
<b>Drying Oils (linseed, soy, tung)</b>	Trisodium phosphate/sodium perborate/liquid soap poultice.
<b>Graffiti</b>	Commercial products; Methylene Chloride (hazardous); oxalic acid; hydrogen peroxide poultices; abrasive blast
<b>Inks and Chemicals</b>	Solvent and/or bleaching poultices
<b>Paints (wet)</b>	Soak off, do not wipe in, scouring powder scrub; after residue dries, see paint (dried).
<b>Paints (dried)</b>	Scrape residue; commercial paint remover poultice, solvent gel.
<b>Petroleum oil</b>	Solvent poultice (alcohol, acetone, paint thinner, lacquer thinner, trichloroethane); detergent poultice if lightly stained.
<b>Rust</b>	Sodium hydrosulphite poultice
<b>Smoke</b>	Scouring powder; Trichloroethylene (hazardous) or Sodium/Potassium hydroxide poultice.
<b>Wood Stains</b>	Sodium Hydroxide/Hydrogen Peroxide poultice <b>NOTE:</b> Active bleaching agents include: Ammonium Hydroxide, Hydrogen Peroxide, Sodium Hydroxide, Sodium Hypochlorite (commercial bleach, i.e. Clorox).

### **ASTM STANDARDS**

American Society for Testing and Materials (ASTM)\* documents on cleaning concrete are listed as follows:

D4258 Practice for Surface Cleaning Concrete for Coating

D4259 Practice for Abrading Concrete

D4260 Practice for Acid Etching Concrete

D4261 Practice for Surface Cleaning Concrete Unit Masonry

D4263 Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method

NOTE: The source for most of the above information is in *Removing Stains and Cleaning Concrete*, Portland Cement Association, 1988.