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Please note

Concrete is a versatile and widely used building material, but it is porous and the hydrated cement in it has a very high surface area. External agencies such as stains tend to soak into it on contact and may react with the hydrated cement. As a result, removal of the stain often becomes difficult and requires special treatment.

This Digest will discuss forms of stain that may appear on concrete surfaces after a building has been in use, stains resulting from accidental spillage of materials such as oil, blood, ink, beverages, asphalt, or from natural exposures such as corrosion, growth of microorganisms, etc. It will not deal with protective coatings applied to concrete surfaces as a preventive measure against surface attack, and is meant only as a guide to measures available for removing the more common forms of unwanted stain.

Stain Removal

When a stain has been identified, care must be taken to select the best possible means of removing it. Further, the method should be tried on an inconspicuous area to allow for possible modification for improving its effectiveness before the more exposed surfaces of concrete are treated.

There are two general methods of removing stains, one mechanical and one chemical, and a combination of the two may sometimes be necessary.

1. Mechanical methods include sand blasting, grinding, steam cleaning, brushing, scouring and, sometimes, use of blow torches. Use of wire brushes is seldom recommended because they tend to leave small metal particles that may subsequently produce rust stains.
2. Chemicals act as solvents to dissolve stains or react with them to form a compound that will not show as a stain. As solvents, they are applied in one of three ways: directly on the surface; by soaking cotton batting or cloth placed on the concrete (the bandage method); or by making a poultice of the solvent and a finely ground powder such as whiting (calcium carbonate), hydrated

lime (calcium hydroxide), talc, fuller's earth (saponite), or diatomaceous earth and spreading it on the stained area in a ¼- to ½-in. layer.

The bandage method is used where chemicals are intended to interact with staining material and keep just enough chemical at the surface to complete the interaction. It acts to hold the solvent on the surface of the stain until enough has been drawn into the pores of the concrete to dilute the stain to an acceptable level. If, on evaporation of the solvent, some of the stain reappears, the poultice method can overcome this difficulty by drawing the staining substance out of the concrete.

A summary of types of stain and methods of removal is given in Table I. The detailed procedure for each is discussed below.

Table I. Common Types of Stain and Their Removal

No.	Type of Stain	Nature	Treatment
1	Algae, fungi, moss	Biochemical	Sodium hypochlorite; household bleaches; formalin; copper nitrate or sulphate; ammonium sulphate; laundry detergent, trisodium phosphate and laundry bleach.
2	Aluminum	Inorganic	10 to 20 per cent hydrochloric acid.
3	Asphalt and bitumen (emulsified)	Organic	Kerosene, carbon tetrachloride or trichloroethylene; cooled and chipped.
	Asphalt (cut-back)	Organic	Poultice of toluene or benzol.
4	Beverages: coffee, tea, alcohol and soft drinks	Organic	Bandage soaked in glycerine and water plus isopropal alcohol; poultice with trichloroethylene.
5	Bitumen	Organic	See 3.
6	Blood	Organic	Scrub with water and apply a layer of sodium peroxide, trisodium phosphate or hydrogen

			peroxide solution over stain.
7	Bronze	Inorganic	Poultice of ammonium chloride or aluminum chloride, diatomite and ammonium hydroxide.
8	Confectionery	Organic	Synthetic detergent; ammoniacal alcohol.
9	Copper	Inorganic	See 7.
10	Fade film	Inorganic	Weak hydrochloric acid; abrasive rubbing.
11	Fire, smoke and wood tar	Organic	Scrub with dilute glycerol, poultice with trichloroethylene; poultice of trisodium phosphate and bleaching powder with talc.
12	Fruit	Organic	Powdered detergent and warm water.
13	Grease	Organic	Scrape and scrub; see also 16.
14	Ink (fresh)	Organic-Inorganic	Oxalic acid; ammonium oxalate; citric acid; sodium or ammonium citrate; sodium borate plus ammonia solution; bleaching powder with acetic acid.
	Ink (old)	Organic-Inorganic	Poultice of ammonium hydroxide with whiting; poultice of sodium perborate.
	India ink	Organic-Inorganic	Scrub with strong soap.

15	Iron rust (light)	Inorganic	Oxalic acid, ammonium bifluoride; 10 per cent muriatic acid; phosphoric acid.
	Iron rust (deep)	Inorganic	Poultice of whiting, sodium or ammonium citrate and glycerine; poultice of sodium hydrosulphite and fuller's earth.
16	Lubricating and petroleum oils	Organic	Scrub with soap and trisodium phosphate and apply poultice paste with benzol; scrub and poultice with 5 per cent sodium hydroxide solution.
17	Microorganisms	Biological	See 1.
18	Oils	Organic	Hydrated lime or fuller's earth; poultice of trisodium, sodium perborate and talc.
19	Paints (fresh stain)	Organic	Absorbent cloth and scouring powder.
	Paints (old stain)	Organic	Scrub with steel wool and sand blast, poultice with benzol plus hydrogen peroxide.
20	Petroleum	Organic	See 16.
21	Smoke	Organic	See 11.
22	Tar	Organic	See 3 and 11.
23	Tobacco	Organic	Scrub with abrasive, lemon juice and water; poultice of trisodium phosphate and bleaching powder with talc.

Iron Rust. The method of removing rust depends on whether it is lightly or deeply embedded in the concrete. The light stain caused by water contaminated with iron is relatively easy to remove. This area should be mopped with a solution containing about 1 lb oxalic acid in a gallon of water (small additions of ammonium bifluoride hasten removal), and scrubbed with clear water. A second application may be needed in some instances. A more direct method involves the use of 10 per cent muriatic acid (hydrochloric acid) or phosphoric acid, but both of these impart a slight roughness to the concrete surface.

Rusts that have penetrated more deeply into the concrete may be removed by the poultice method. A stiff poultice is prepared with whiting and a mixture containing one part ammonium citrate or sodium citrate, six parts warm water and six parts glycerol (glycerine). The poultice is placed on the stained area for a few days with a continual supply of the liquid to keep the mix wet. If the stained area is wetted with a solution of sodium hydrosulphite prior to application of the poultice it will yield better results. A poultice containing a saturated solution of sodium hydrosulphite and fuller's earth can also be applied, but this is not favoured for indoor work because it gives off sulphur dioxide.

If roughening of the concrete surface is not objectionable iron stains may be directly subjected to sand blasting or water jet treatment, followed by a stiff brushing with soap powder.

Copper and Bronze Stains. A dry mix of one part ammonium chloride (sal ammoniac) or aluminum chloride with three to four parts diatomite or talc, plus ammonium hydroxide (household ammonia) to make a smooth paste is effective in removing copper and bronze stains. The poultice is placed over the stain and allowed to dry. The treatment may be repeated if necessary. Finally, the area is scrubbed with clear water.

Aluminum Stains. Scrubbing with a 10 to 20 per cent hydrochloric acid is effective in removing this stain, but on coloured concrete only a dilute acid should be used.

Fade Film. Caused by calcium carbonate, this stain is generally removed by rubbing with abrasives. Alternatively, it may be washed with a weak solution of hydrochloric acid, but this leads to roughening of the concrete surface.

Inks. There are various types of ink, writing ink, synthetic dye inks (red, green, violet and other bright colours), and indelible ink. Ordinary ink spots may be removed fairly easily when they are fresh by using one of the following agents: a 10 per cent solution of oxalic acid, ammonium oxalate, citric acid, sodium citrate, ammonium citrate, 5 per cent sodium borate solution, 1 per cent solution of potassium permanganate followed by 10 per cent sodium bisulphite, an aqueous extract of bleaching powder acidified with acetic acid, a mixture of sodium hypochlorite and talc, etc. The acid treatments should be followed by application of an ammonia solution.

Old ink stains are amenable to the poultice treatment, using a strong hot solution of sodium perborate in water. Poultices may also be made with ammonium hydroxide or chlorinated lime with whiting, or with potassium hypochlorite and potassium chloride. Some indelible inks containing silver salts cause black stains that can be removed by means of an ammonium hydroxide bandage. This treatment is also effective for the blue stains produced by prussian blue. India ink and printing ink stains require vigorous scrubbing with a strong soap or scouring powder.

Fruit Stains. These should be scrubbed with a solution of synthetic powdered detergent and warm water. If a rough spot results it can be removed by rubbing with powdered pumice stone under a block of wood.

Oils. Oils of linseed, soybean and tung penetrate concrete surfaces easily and require immediate attention. The stain should be mopped off with a cloth or a paper towel and covered with an absorbent material such as hydrated lime, fuller's earth or whiting. If the dry absorbent

does not remove the stain a poultice comprising one part trisodium phosphate, one part sodium perborate, and three parts talc in a hot strong solution of soft soap in water should be applied.

Lubricating and Petroleum Oils. Such oils also require immediate action with an absorbent material. Persistent stains may require the following treatment: After liquid and solidified oil has been removed from the surface by scrubbing with soap, scouring powder and trisodium phosphate, a poultice paste containing benzol should be applied. A second application may be required. A poultice with 5 per cent sodium hydroxide solution (caustic soda) followed by scrubbing is also effective.

Grease. Grease does not penetrate into concrete and its removal needs scraping and scrubbing. Any residue may be removed by the method formulated for petroleum oils.

Asphalt and Bitumen. A surface stain of this nature can be removed by scrubbing with warm kerosene oil followed by carbon tetrachloride or trichloroethylene. A stain that has penetrated deeply into the concrete will be more difficult to remove. If the ambient temperature is high petroleum asphalt should be cooled with ice to make it brittle so that it may be chipped away with a chisel followed by scraping. Finally, it should be scrubbed with an abrasive scouring agent. Although emulsified asphalt may be removed by scrubbing, cut-back asphalt (asphalt cut back with linseed oil) resists removal by most methods. It requires repeated treatments with poultice of toluene or benzol and diatomaceous earth, followed by scrubbing with scouring powder and water.

Paints. A stain only a few days old may be removed by means of an absorbent cloth and scrubbing with scouring powder. Solvents should not be used to remove fresh stains since there is every possibility that the paint will spread. Old dried paint may need scrubbing with steel wool, sand blasting or burning off with a blow torch, followed by poulticing with a solvent such as benzol and bleaching with hydrogen peroxide. This can also be used for stains produced by enamel, lacquer or linseed oil-based varnishes. Urethane varnishes are removed by mechanical abrasive techniques.

Tobacco Stains. Some of these stains may come off by means of scrubbing with powdered pumice, grit or similar material, followed by washing with water or even a solution of lemon juice and water. If this method fails, a poultice may be prepared and applied as follows: one part trisodium phosphate in five parts water mixed with one part bleaching powder in five parts water. The mix is stirred and lime paste allowed to settle. The liquid is added to powdered talc to form a thick paste. This may be applied with a brush by adding a teaspoonful of sugar for each part of talc. When the paste is dry scrape off and scrub with water.

Fire, Smoke and Wood Tar Stains. A poultice made with trichloroethylene or that suggested for tobacco stains is effective against these stains. Deep stains may require several applications. Removal of wood tar stains may be accelerated by scrubbing them first with a dilute glycerol solution in water.

Blood. Blood stains should be washed with water and a layer of sodium peroxide, sodium hydrosulphite, trisodium phosphate or hydrogen peroxide solution in water applied with sprinkled water or a wet bandage over it. After a few minutes the stain may be washed with water and scrubbed. Any alkaline traces that may be left can be dissolved by vinegar (acetic acid).

Coffee, Tea, Alcoholic Beverages and Soft Drinks. A fresh stain can be removed by placing over it a cloth saturated with one part glycerine and four parts water. Two parts of isopropyl alcohol may be added to this mixture to hasten the removal action. Stains that are very difficult to remove may require the poultice method suggested for fire stains.

Confectionery Stains. Candy stains are best removed with a scrubbing pad and synthetic detergent. Ammoniacal alcohol (nine parts denatured alcohol and one part 26 per cent ammonia) should be used for chocolate stains.

Microorganisms. Organisms such as algae, lichens and mosses may be destroyed by the application of sodium hypochlorite solution (5 per cent), household bleach solutions, or 2 per cent formalin (formaldehyde with a small amount of methanol in an aqueous medium) or by a 3 to 5 per cent aqueous solution of copper nitrate or sulphate. For mildew an application of the following solution is recommended: 1 oz commercial laundry detergent, 3 oz trisodium phosphate, 1 qt commercial laundry bleach dissolved in 3 qt of water. Moss stains may require the application of ammonium sulphamate.

Precautions

Chemicals suggested for stain removal are generally available from chemical suppliers, drug stores, hardware stores, supermarkets, or service stations. Some are flammable, toxic, or both, so that general precautions should always be observed. (It is impossible to include all safety precautions for every conceivable situation). As a general rule it is best to avoid skin contact and inhalation of any chemical. Rubber or plastic gloves as well as safety goggles should be worn, particularly when handling hazardous (flammable or toxic) chemicals. Storage and handling procedures printed on container labels must be followed; good ventilation while working indoors should be provided; dilution with water always carried out by pouring acid to water; and hands thoroughly washed on completion of the work.

Conclusions

Stains on concrete surfaces may be caused by both organic and inorganic chemicals or by growth of microorganisms. The more common types and their removal have been discussed. Most are unsightly and can be removed easily, but deep stains or those neglected over a long period tend to require patience and repeated treatments. A combination of methods is often successful. In spite of the best efforts, however, some stains leave their mark. The methods of removal suggested should not be construed as final; new and more efficient alternatives may be discovered or may, in fact, already be in use.

When a stain is removed dirt and other matter on the surface are also removed. This can look like a stain in itself but it usually disappears after a time.

It is only too clear that the best method of maintaining an area stain free is to prevent any from occurring; in this light the corrective measures described in this Digest are only second best. "Prevention is always better than cure."