U.S. General Services Administration

Removing Efflorescence from Concrete

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371016S
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Historic Concrete: Investigation & Repair - Pre-Conference Training Course, APT Annual Meeting, 1989.
Division:
Concrete
Section:
Concrete Cleaning
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PREFACE

The cleaning or removal of stains from concrete may involve the use of liquids, detergents or solvents which may run off on adjacent material, discolor the concrete or drive the stains deeper into porous concrete. Use the products and techniques described here only for the combinations of dirt/stain and concrete specified.

PART 1---GENERAL

1.01 SUMMARY

A. This specification provides guidance on removing efflorescence from concrete using chemical solvents.

B. Efflorescence is a condition wherein white deposits form on the surface of the concrete. These deposits often contain calcium, sodium and potassium hydroxides or carbonates, bicarbonates, chlorides and sulfates of calcium and magnesium.

C. The surface deposits may originate as soluble compounds within the concrete or in the soil. These compounds combine with water and gradually migrate in solution to the wall surface, where they remain when the water evaporates. Surface deposits may also result from acid etching with hydrochloric acid, which is sometimes applied to roughen the concrete surface.

D. Surface deposits originating from within the concrete are usually soluble and may be removed by scrubbing with water alone or hosing with water under high pressure.

E. Surface deposits composed mainly of calcium acid carbonate and magnesium acid carbonate from the soil or of calcium hydroxide should be washed off with water as soon as possible. These deposits are water-soluble for only a brief period of time after reaching the atmosphere, after which the carbon dioxide converts them to water-insoluble calcium

carbonate and magnesium carbonate, which are impossible to remove without the use of acids.

F. Safety Precautions:

1. DO NOT save unused portions of stain-removal materials.
2. DO NOT store any chemicals in unmarked containers.
3. NOTE: EXCELLENT VENTILATION MUST BE PROVIDED WHEREVER ANY SOLVENT IS USED. USE RESPIRATORS WITH SOLVENT FILTERS.
4. No use of organic solvents indoors should be allowed without substantial air movement. Use only spark-proof fans near operations involving flammable liquids.
5. Provide adequate clothing and protective gear where the chemicals are indicated to be dangerous.
6. Have antidote and accident treatment chemicals readily available where noted.

G. Read "General Project Guidelines" along with this specification. These guidelines should be reviewed prior to performing this procedure and should be followed, when applicable, along with recommendations from the Regional Historic Preservation Officer (RHPO). The guidelines cover the following sections:

1. Safety Precautions
2. Historic Structures Precautions
3. Submittals
4. Quality Assurance
5. Delivery, Storage and Handling
6. Project/Site Conditions
7. Sequencing and Scheduling
8. General Protection (Surface and Surrounding)

PART 2---PRODUCTS

2.01 MATERIALS

NOTE: Chemical products are sometimes sold under a common name. This usually means that the substance is not as pure as the same chemical sold under its chemical name. The grade of purity of common name substances, however, is usually adequate for stain removal work, and these products should be purchased when available, as they tend to be less expensive. Common names are indicated below by an asterisk (*).

A. Use one of the following solvents (see Section 3.02 A. below for mixing proportions):

Acetic Acid ($C_2H_4O_2$):

1. A colorless pungent liquid acid that is the chief acid of vinegar and that is used especially in synthesis (as of plastics).

2. Other chemical or common names include Vinegar acid*. (Vinegar itself, which contains about 4% acetic acid, may be suitable for some purposes requiring acetic acid.)
3. Potential hazards: CAUSTIC TO FLESH; CORROSIVE TO CONCRETE, STEEL, WOOD AND GLASS.
4. Available from chemical supply house (both commercial and scientific), drugstore or pharmaceutical supply distributor, grocery store or supermarket, or hardware store.

-OR-

Hydrochloric Acid (30-35%):

1. A strong corrosive irritating acid.
2. Other chemical or common names include Chlorhydric acid; Hydrogen chloride; Muriatic acid* (generally available in 18 degree and 20 degree Baume solutions); Marine acid*; Spirit of salt*; Spirit of sea salt*.
3. Potential Hazards: TOXIC, CAUSTIC TO FLESH; CORROSIVE TO CONCRETE, STEEL, WOOD AND GLASS; FLAMMABLE.
4. Available from chemical supply house, drugstore or pharmaceutical supply distributor, or hardware store.

OR-

Phosphoric Acid (H3PO4):

1. A syrupy or deliquescent tribasic acid used especially in preparing phosphates (as for fertilizers), in rust-proofing metals, and as a flavoring in soft drinks.
2. Other chemical or common names include Orthophosphoric acid.
3. Potential Hazards: CAUSTIC TO FLESH; CORROSIVE TO CONCRETE, STEEL, WOOD AND GLASS.
4. Available from chemical supply house or hardware store.

B. Calcium Hydroxide:

1. Other chemical or common names include Calcium hydrate*; Hydrated lime*; Lime hydrate*; Slaked lime*.
2. Potential Hazards: SKIN IRRITANT; AVOID INHALATION OF THE DRY POWDER.
3. Available from chemical supply house, construction materials yard, construction specialties distributor, garden and lawn supply center, or hardware store.

C. Filler material such as paper pulp.

D. Mineral water.

E. Plastic sheeting.

F. Clean dry towels for blotting the area after treatment.

G. Masking tape.

H. Accessible source of water, soap and towels for washing and rinsing in case of emergencies associated with the use of

chemicals.

2.02 EQUIPMENT

A. Glass or ceramic container for mixing the poultice solution.

B. Rubber of plastic pale for mixing the acid and water solution.

C. Wooden utensil for stirring the ingredients.

D. Wood or plastic spatula.

PART 3---EXECUTION

3.01 PREPARATION

Protection:

A. Provide adequate wash solutions (i.e. water, soap and towels) before starting the job.

B. Whenever acid is used, the surface should be thoroughly rinsed with water as soon as its action has been adequate. Otherwise it will continue etching the concrete even though the stain is gone.

3.02 ERECTION, INSTALLATION, APPLICATION

NOTE: DO NOT TRY MORE THAN ONE TREATMENT ON A GIVEN AREA UNLESS THE CHEMICALS USED FROM PRIOR TREATMENT HAVE BEEN WASHED AWAY.

A. Mix in a glass or ceramic bowl one of the following combinations:

1. 1 part hydrochloric acid in 9 to 19 parts water, OR

2. 1 part phosphoric acid in 9 parts water, OR

3. 1 part phosphoric acid plus 1 part acetic acid in 19 parts water.

CAUTION: ALWAYS ADD ACID TO WATER RATHER THAN VICE-VERSA. ADDING WATER TO CONCENTRATED ACID CAN CAUSE THE WATER TO BECOME SUPER-HEATED AND TURN TO STEAM, WHICH CAN RESULT IN ACID SPLASHING ON THE USER.

B. Saturate the concrete with clean, clear water.

C. Begin by using the first mixture listed above and apply to the affected concrete surface with a stiff, non-metallic bristle brush.

D. Thoroughly rinse the area with clean, clear water and allow to dry.

E. If the first mixture is unsuccessful in adequately removing the efflorescence, repeat the treatment using the other mixtures listed in the order displayed until successful results are achieved.

F. For concrete heavily laden with potential efflorescence:

1. Remove all visible surface salts, following Steps A-E directly above.

2. Follow by applying a poultice of paper pulp saturated in water and allow to dry.

3. Remove the dried poultice using a wood or plastic spatula.

4. Thoroughly rinse the surface with clean, clear water and allow to dry.

5. Repeat as necessary to achieve the desired level of cleanliness.

3.03 ADJUSTING/CLEANING

If there is a supply of dilute acid to be disposed of when work is complete, neutralize it by stirring in 3 pounds of powdered calcium hydroxide for every gallon of the dilute (1-3) acid. The resulting solution is a harmless mixture of calcium hydroxide and calcium fluoride.

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