

PREPARATION of CONCRETE SUBSTRATES

General Instructions for Surface Preparation of Concrete Substrates for Application of a Polymer Floor Coating or Overlay System - 2001 IG

General

There are many factors that can affect the adhesion and bonding capabilities of a polymer system to the substrate. In order to achieve optimum adhesion, the substrate **MUST** be clean and prepared properly. Therefore, it is absolutely necessary to check the conditions of the substrate in order to correctly identify the proper and correct method of preparation. In many instances it will be necessary, and is always advisable to field test the suitability of the substrate for adhesion prior to the actual installation.

Surface Conditions

In general, the following conditions should be checked and considered:

Condition of Concrete

Newly placed portland cement concrete (PCC) is designed to develop its full design strength typically in 28 days, at which time a polymer system can be applied. A light steel troweled finish produced with a minimal working of the surface is most desirable. Existing concrete should be structurally sound and void of any detrimental materials and any surface contaminants. Unsound concrete, typically found as cracks, delaminations or eroded joints, must be repaired or replaced. **DO NOT** apply a polymer system over any concrete modified topping, underlayment system, or patches unless otherwise approved by the manufacturer.

Curing Compounds

The presence of compounds or agents that have been applied to the surface of the concrete to aid in the curing process may function as a bond breaker if not properly removed. Most curing agents are based on silicones, hydrocarbon oils, sodium silicates or paraffins that can impede the adhesion of a polymer system. Caution should always be taken with regard to new construction projects, and it is always best to assume that the concrete has been cured with a compound that is incompatible with proper polymer adhesion. Even if an approved method of concrete cure was originally specified, the surface should be tested and cleaned as appropriate.

Laitance

Laitance is the top layer of concrete, consisting of cement, water and fine aggregates, and it may vary in thickness from 0.01" to 0.1" depending on several factors such as overworking the placed concrete or by excessive vibrating. Laitance, regardless of thickness, can create a weak surface layer that is insufficient for a proper bond, and it must be removed in order to achieve optimum adhesion to the actual PCC substrate.



Moisture

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Moisture in the form of vapor or liquid, can be the cause of adhesion failure and/or blistering at the bond line. As liquid, water can move through the concrete slab by means of channels such as cracks, honeycombs or similar voids, or even expansion and control joints. To achieve proper adhesion of the polymer system, repairs must be made to eliminate this water. Moisture in the form of a vapor can travel through a concrete slab that has no protective vapor barrier between the soil and underside of the slab, or has an existing vapor barrier that has become damaged. Vapors may also be transmitted through a porous slab where a substantial variation in humidity or temperature, below and above the surface of the slab, exists simultaneously. A typical concrete slab retains 3 to 5% of the migrating moisture that is always present, and generally will not effect adhesion, however, excessive amounts of moisture vapor are of critical concern. To determine if the amount of moisture vapor being emitted from the concrete is at an acceptable level for achieving adhesion of the polymer system, various testing devices for measuring the moisture content are available.

pH Values

The pH level of a concrete substrate, whether too high or too low, will also effect the overall system adhesion or bond strength. The ideal pH value for applying a polymer system is 7, although 6.5 to 9.9 is acceptable and is necessary for obtaining optimum adhesion. When the pH level is 10 or higher, acid etching is required, and when the pH value falls below 6.5, a caustic etch will be required.

Surface Contaminants

These include a variety of foreign compounds which can penetrate into the concrete surface and can include curing compounds, free form release agents, surface hardeners, greases, oils, food by-products, chemicals, previously applied coatings or simply dust and dirt. Any of these contaminants which are present **MUST** be removed so they will not impede or interfere with the ultimate bond of the polymer system to the concrete substrate.

Carbonation

Carbonation in PCC is the result of carbon dioxide in the air reacting with Calcium Hydroxide in the presence of moisture. Carbonation is an on-going process, and over a period of time can cause the surface to chalk or powder thereby creating a bond breaker which will, ultimately, cause the polymer system to lose adhesion and fail.

Fatty Acids

Fatty acids are saturated monocarboxylic acids that occur naturally in animal, vegetable and many petroleum based products, and they are capable of rapid penetration into the cement portion of the concrete. The infiltration of these acids cause deterioration of the cement molecules resulting in the loss of adhesion to the concrete and produces discoloration on the upper surface area of the concrete which must be removed by means of abrasive blasting or chipping. The clean looking surface below this discolored layer is nonetheless saturated with fatty acids, and they must be emulsified in order to lift out the contaminants in order to achieve proper adhesion of the polymer system.

Concrete Cleaning Procedures

Abrasive Blasting

The preferred method for concrete surface preparation is by use of an abrasive shot-blasting machine on all horizontal surfaces. Chemical preparation, although acceptable and commonly used, is a less desirable method of surface preparation due to the potential for insufficient recovery of the cleaning solutions and the surface being left un-abraded. Shotblasting of a concrete substrate is by far the most effective surface preparation technique available, both from a cost and environmental standpoint.

Shotblasting the top surface, however, can introduce additional concerns that can influence the quality of the finished product. Shotblasting can produce a pattern or rows that can be conspicuously visible, especially when coated with a thin mil system. Although these lines will not affect the performance of the coating, they may be unacceptable to the owner from an appearance standpoint and can add unexpected costs in order to correct the problem. In addition, shotblasting can also result in opening the pores of the concrete. This allows entrapped air to escape more readily, and with the application of a non-breathable coating or topping, the escaping air can create bubbles or craters in the cured coating. To minimize this potential, it may be necessary to apply an additional base or prime coat, or by applying the base coat when the concrete and air temperatures are the same, reducing out-gassing from the slab.

Scarifiers may be used where thick coating exists or when a very aggressive profile is desired. Scabblers are not recommended except where special circumstances require this type of preparation. The pounding blows delivered by scabblers can cause micro-fissures in concrete that can lead to potential bond failure or delamination under conditions of thermal expansion and/or thermal shock.

While it is important to be aware of these potential problems, keep in mind that abrasive preparation of concrete is still the best means of surface preparation. It is also important to note that abrasive preparation alone may not always be enough, in specific instances BOTH shotblasting and chemical preparation may be necessary.

NOTE: It is always best to contact the manufacturer of the abrasive equipment, the equipment rental dealer, or your surface preparation subcontractor directly for more specific information on the use and capabilities of this type of equipment.



High Pressure Water Blasting

High pressure water blasting is an acceptable method of concrete surface preparation when abrasive blasting is impractical or cannot be used. There is a major difference between washing concrete and preparing concrete to receive an epoxy/urethane coating. When water blasting concrete in preparation for a coating, the pressure washer must be capable of delivering greater pressure than the compressive strength of the concrete being cleaned. Otherwise, the water pressure will not be great enough to remove concrete laitance or produce a profile. In addition to high pressure water blasting, fatty acids or oils must be removed using Thermal-Chem's ArmorClean.

CAUTION: Care should be exercised not to cut or remove more concrete than necessary using high pressure water blasting methods.



Allow the surface to dry thoroughly before proceeding. The use of portable fans will speed up the drying process. Most Thermal-Chem primers and base coats can be applied to moist (but not wet or free-standing water) surfaces. Refer to the individual Product Description Sheet before applying to a moist surface.

Chemical Preparation

1. Clean the concrete surface of all dust, dirt and loose debris.
2. New concrete surfaces should be cured and must be cleaned and free of all curing compounds and any form of contaminants.
3. Determine pH value (approx. one (1) reading per 1,000 sq. ft.), plus the ambient and surface temperatures should be noted. DO NOT apply an etching solution unless necessary.

 **NOTE:** Etching is not required when the pH value is between 6.5 and 9.9; when the value is 10 or greater - acid etch with a 10% solution of commercial muriatic or phosphoric acid at a rate of one gallon per 40 sq. ft. When the value is 6.4 or less - etch with 10% solution of caustic soda in water (water temp. should be 150° to 200° F (66° to 93° C)), at a rate of one gallon per 40 sq. ft.

4. The etching solution should be mechanically scrubbed into the surface and allowed to effervesce for 3 to 5 minutes. DO NOT allow the solution to dry on the surface before rinsing thoroughly. Recheck pH and if desired values were not achieved, repeat the process . . . BUT do not increase the solution percentages.
5. Thoroughly flush the entire surface with a sufficient volume of potable water, while mechanically scrubbing the surface to remove the etching solution and any loose particles; this is necessary, and generally sufficient, to neutralize the etching solution on the surface.
6. Contaminants such as oil based chemicals and greases can usually be removed by using trisodium phosphate (TSP) or a quality degreaser.
7. Thermal-Chem ArmorClean should be used to remove any animal, vegetable, or petroleum fatty acids that are present and have penetrated into the PCC. This product will loosen and emulsify these fatty acids for complete removal.
8. Scrub the surface with the appropriate chemicals as directed, thoroughly rinsing with copious amounts of potable water, to remove all traces of cleaning solution, contaminants, and/or emulsifier. Do not allow the surface to dry prior to removal of the residue.
9. Blow off excess rinse water with oil free compressed air, by squeegee, or with a vacuum and allow the surface to dry adequately for the application of the specific polymer system being installed.

Always refer to specific INSTALLATION GUIDES for proper product recommendations and/or for additional installation guidance.

Prepared Surfaces

1. Repairs of surface irregularities (including cracks, delamination, deteriorated joints, pitching for drainage, etc.) can be accomplished after the surface preparation is complete, and must be done prior to the application of the polymer system. These repairs should be appropriate and consistent with the system and method of application that will be used. (Refer to the product catalog for additional Thermal-Chem repair products)

 **NOTE:** Depending on the individual project, repairs may need to be done prior to the surface preparation and should be considered before commencing work. Be sure that all

demolition is complete and finished prior to the surface preparation.

2. The cove base should be installed prior to the application of the polymer base coat system for best results. (Refer to Cove Base Installation Guide for installation procedures.)
3. It is recommended that, as a general practice, the cleaned concrete should be tested to confirm that the substrate preparation has been performed adequately for obtaining the proper adhesion of a polymer system. The surface should be tested in accordance with ACI Method 503R-93 and should provide a minimum value of 225psi with 100% concrete failure. This test method will provide recordable values. However, when the ACI Method 503R-93 test is impractical, the use of a simple cup adhesion shear test will determine the cleanliness of the concrete substrate for adhesion of epoxy coatings and overlays. Refer to alternate Concrete Surface Evaluation Test Method guide.

General Precautions

- Wear appropriate eye protection, non-absorbent gloves, and protective clothing when handling any of the chemicals referred to in this INSTALLATION GUIDE. Always read and refer to the supplier's or manufacturer's instructions, warning labels, and MSDS sheets carefully prior to using any of these products.
- In case of contact with the skin, by any products provided by Thermal-Chem Corporation, immediately remove the material with soap and water, and follow all written instructions on the appropriate MSDS sheets for exposure of the material to the body and any medical emergency procedures.
- Work areas should be adequately ventilated, especially in low and confined spaces.
- Any or all of the preparation chemicals referred to in this guide may be classified as hazardous waste and should be handled and disposed of within appropriate local, state or federal guidelines. It is the responsibility of the user of such materials to be aware of, and comply with the appropriate regulations for discarding of any waste.



Additional Reading Material

Please refer to any of the following sources for proper cleaning procedures:

- ASTM D-4258 "Practice for Surface Cleaning Concrete for Coatings"
- ASTM D-4259 "Standard Practice for Abrading Concrete"
- ASTM D-4260 "Acid Etching of Concrete"
- ASTM D-4262 "Test Method for pH of Chemically Cleaned or Etched Concrete"
- ASTM D-4263 "Test Method for Moisture in Concrete / Plastic Sheet Method"
- ACI 308 "Acceptable Methods for Curing of Concrete"
- ACI 309 "Types of Liquid Membrane Curing Compounds for Concrete"
- ACI 503R "Use of Epoxy Compounds with Concrete"

Manufacturer

Any questions or comments regarding the contents of this *Installation Guide*, for technical questions or assistance, and/or questions with regard to specific installation procedures, contact the manufacturer:

**Thermal-Chem Corporation
2120 Roberts Drive
Broadview, IL 60155**

Phone: 800.635.3773
847.288.9090
Fax: 847.288.9091
E-Mail: sales@thermalchem.com
help@thermalchem.com
Website: www.thermalchem.com