CONCRETE SURFACE PREPARATION & SELECTION

GUIDE FOR ALLUVIUS POLYMERIC COATINGS

Paramount to the successful installation of any cementitious or resinous coating system is surface preparation. You can use the finest products and materials available but without adequate surface preparation, the chances of a successful installation are unlikely and can become a costly, time consuming chore.

The purpose of this Technical Bulletin is to outline the many available surface preparation techniques and methods that can be used and to help the installer select the best solution for the given installation. This Technical Bulletin should be used as a guide only. It is the responsibility of the installer to inspect and evaluate the site and substrate to the best of their ability prior to commencing installation. If laboratory testing is necessary, core samples can be mailed to Alluvius for further analysis at a fixed cost. See TECHNICAL BULLETIN CORE ANALYSIS.

Environmental factors, work site access and time restraints may dictate the available techniques and methods to be utilized for a successful installation. In some cases there may be one method available, in other cases it may be necessary to adopt multiple techniques for satisfactory results. In any case it is up to the installer to make the decision how to best prepare the substrate prior to its installation while taking into account the function, use, requirements and demands of the given system as well as the limitations specified in the product(s) Technical Data Sheet (TDS).

SURFACE CONDITION INSPECTION & EVALUATION

By making a thorough, well planned inspection, the likelihood of a satisfactory installation is greatly increased as well as the longevity of the selected coating or system. Most projects will entail unique conditions and obstacles. Inspection of the surface conditions, work site conditions as well as consideration of environmental conditions and system/coating requirements need to be evaluated prior to making material selections.

A sound and thorough inspection will include the following:

- Calculation of surface area.
- Identification of structural stability, including static or moving surface cracks.
- Identification of spalling, pop outs, aggregated surfaces and other surface abnormalities.
- Identification of surface depressions, lumps, slope and general flatness.
- Identification of foreign surface contaminates.
- Ascertainment of the surface integrity and soundness. If not suitable, removal or repair of unsound and deficient surface must be carried out.
- Ascertainment of surface hardness via MOHS hardness testing for concrete substrates.
- Ascertainment of the presence of surface salts. A Litmus test for pH will determine presence of chloride or acid contamination, if the pH is below 10. Low pH is also a common indication of contamination.
- Ascertainment of the moisture conditions through relevant testing. See TECHNICAL BULLETIN ST-1.

- Ascertainment of existence of coatings, release agents, curing agents, sealers and surfacing materials.
- Ascertainment of the presence of Alkali Aggregate Reaction (AAR) or Alkali Silica Reaction (ASR).
- Observation of atmospheric conditions which includes surface temperature, humidity, dew point as well as air circulation patterns. Observation of these conditions during time of application is especially critical and must remain within the products limitations as specified in the TDS.

Laboratory testing is available if the substrate is questionable. Core samples may be mailed to Alluvius for further investigation and evaluation at a fixed cost. See TECHNICAL BULLETIN CORE ANALYSIS for further information.

For further, more in-depth site surveying standards consult ICRI No. 310.1R.

SURFACE CONDITION INSPECTION & EVALUATION

Prior to coating a concrete substrate, evaluation of the strength of the concrete must be made. If the strength of the concrete is insufficient, the performance and longevity of the polymeric coating or system to be applied will not be reached and will be suspect to premature deterioration and possibly failure. Surface laitance, spalling, large cracks, corrosion, pop outs, condition of joints, lack of joints, divots and other irregularities must be addressed and repaired prior to the application of the polymeric coating or system. Concrete surfaces that are heavily deteriorated and damaged are quite often sound beneath the suspect surface and make for suitable host to polymeric coatings and systems. Removal of deficient concrete must be performed and replaced with suitable polymeric repair resins and or mortars. See TECHNICAL BULLETIN SP-2 for further information.

SURFACE CONTAMINATION IDENTIFICATION & REMEDY

Substrates that are suitable for polymeric coatings and systems must be free of any surface contaminates that will impede adhesion or cause loss of adhesion at a later period. Evidence of contamination may include lower pH readings (concrete is normally alkaline in the range of 11 pH to 13 pH while most contaminates are neutral to acidic), excessive moisture levels within the concrete and corrosion are all prospective problems that can occur during or past the time of installation. Although the appearance of the substrate may be clean, it does not guarantee that the substrate is free of contamination or in a suitable condition for the installation of a polymeric coating or system.

OIL AND GREASE CONTAMINATION

Removal of oil and grease should be performed prior to mechanical preparation of surface profile so as not to impede adhesion of subsequent polymeric coatings. Removal may be accomplished by solution scrubbing with rags, stiff bristle brushes, brooms or mechanical scrubbing machines. This method may need to be repeated as required to meet desirable results. Steam cleaning oils and greases that are not soluble with water or are emulsifiable with detergents and cleaning solutions may be necessary . Clean the surface with fresh water following the introduction of detergent or cleaning solution in order to remove any residual material that is potentially harmful to the surface or polymeric coating and system. Consult SSPC-SP 1, ICRI No. 310.2, ASTM D 4258-05 (2012) for further information.

SALT CONTAMINATION

Surfaces contaminated in soluble salts are a leading cause of polymeric coating failures. Unfortunately there is no easy solution for the removal of soluble salts. Abrasive blasting can in some cases remove these contaminates but in other cases the source is below the surface and often related to corrosion of reinforcing steel bars (rebar or reo) and can continue to mitigate towards the surface causing detrimental effects. When in doubt, a core analysis should be performed.

CHEMICAL DEGRADATION

Concrete is typically in an alkaline state (pH 11-13) and can react chemically. Organic and inorganic solutions, animal fats and oils, salt solutions, acidic and alkali minerals and many other substances can detrimentally react and deteriorate concrete substrates. Identification and removal of these substances must be made prior to establishing a suitable repair method.

ALACALI SILICA REACTION (ASR)

ASR is a well known and common type of concrete degradation. Three conditions must be simultaneously present in order for ASR to manifest; 1) Silica or silicates in a reactive state; 2) Alkali, typically in the form of potassium (K) or sodium (Na); 3) Moisture.

The use of lithium solutions has proven to remedy cases of ASR. The concrete must first be abrasive blasted and then the solution of lithium can be applied. Sufficient calcium hydroxide must be present in the concrete with which the lithium can react, in turn forming calcium silicate hydrate (C-S-H).

CARBONATION

Carbonation is a natural occurrence to all atmospherically exposed concrete surfaces. Excessive amounts of airborne carbon dioxide can have detrimental effects on concrete substrates. This condition is often generated by exhaust produced from petrol or gas operated heating devices. Although this is not the only source of excessive airborne carbon dioxide, it is the most common. A telling sign of carbonation is a weak, powdery surface on the concrete substrate. Mechanical removal of the surface is generally a sufficient measure to remedy this surface phenomenon.

MOISTURE

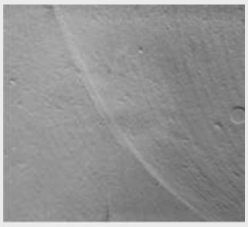
Moisture vapour emission (MVE) needs to be held to specified levels if a non breathable polymeric coating or systems are to be applied or the likelihood of polymeric coating failure will be highly susceptible. Resinous and cementitious polymeric solutions are available to help remedy, combat and limit MVE. These polymeric solutions are typically topically applied to the concrete substrate. Consult TECHNICAL BULLETIN ST-1 for further information.

CONCRETE SURFACE PROFILE

During the curing process of polymeric coatings on concrete substrates, surface adhesion is primarily related to mechanical bonding. In order to receive sufficient bonding, the concrete must be open, porous and profiled as specified in the products TDS. The tensile strength of finished concrete is weakest at the surface. Laitance or weak concrete paste must be removed (typically mechanically) in order to achieve maximum tensile strength (pull off strength) for the polymeric coating or system. Weak, uneven concrete must be removed. This includes but is not limited to; protrusions, splattering, bulges, lips and fins.

Selection of a suitable method of surface preparation is dependant on 3 major considerations; 1) Substrate condition; 2) Material requirements; 3) Job site conditions. Each polymeric coating and system will have its own preferential Concrete Surface Profile (CSP), this information should be available in the products TDS. Suitable profiling of concrete prior to the installation of film building polymeric coatings and system have been established and addressed by the International Concrete Repair Institute (ICRI). ICRI have created a standardised system for determining concrete surface profile requirements for a given polymeric coating or system thickness.


CSP1


CSP2


CSP3


CSP4


CSP5

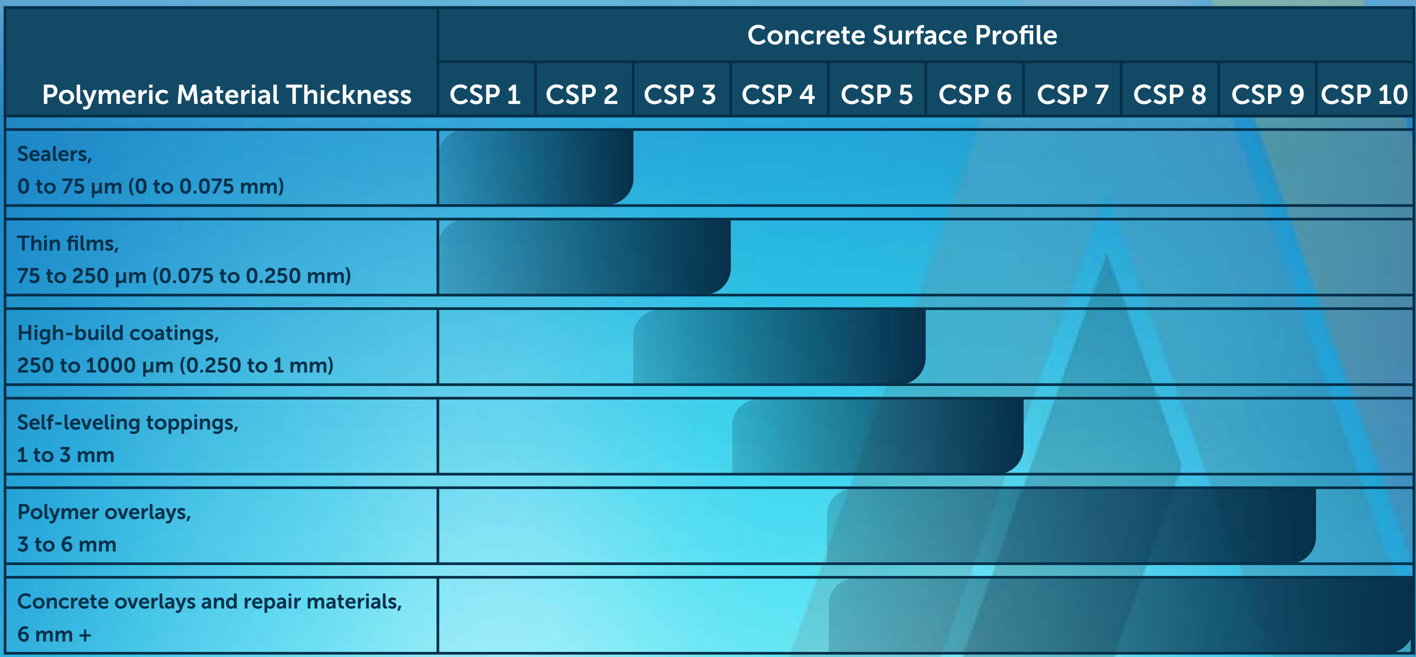

CSP6

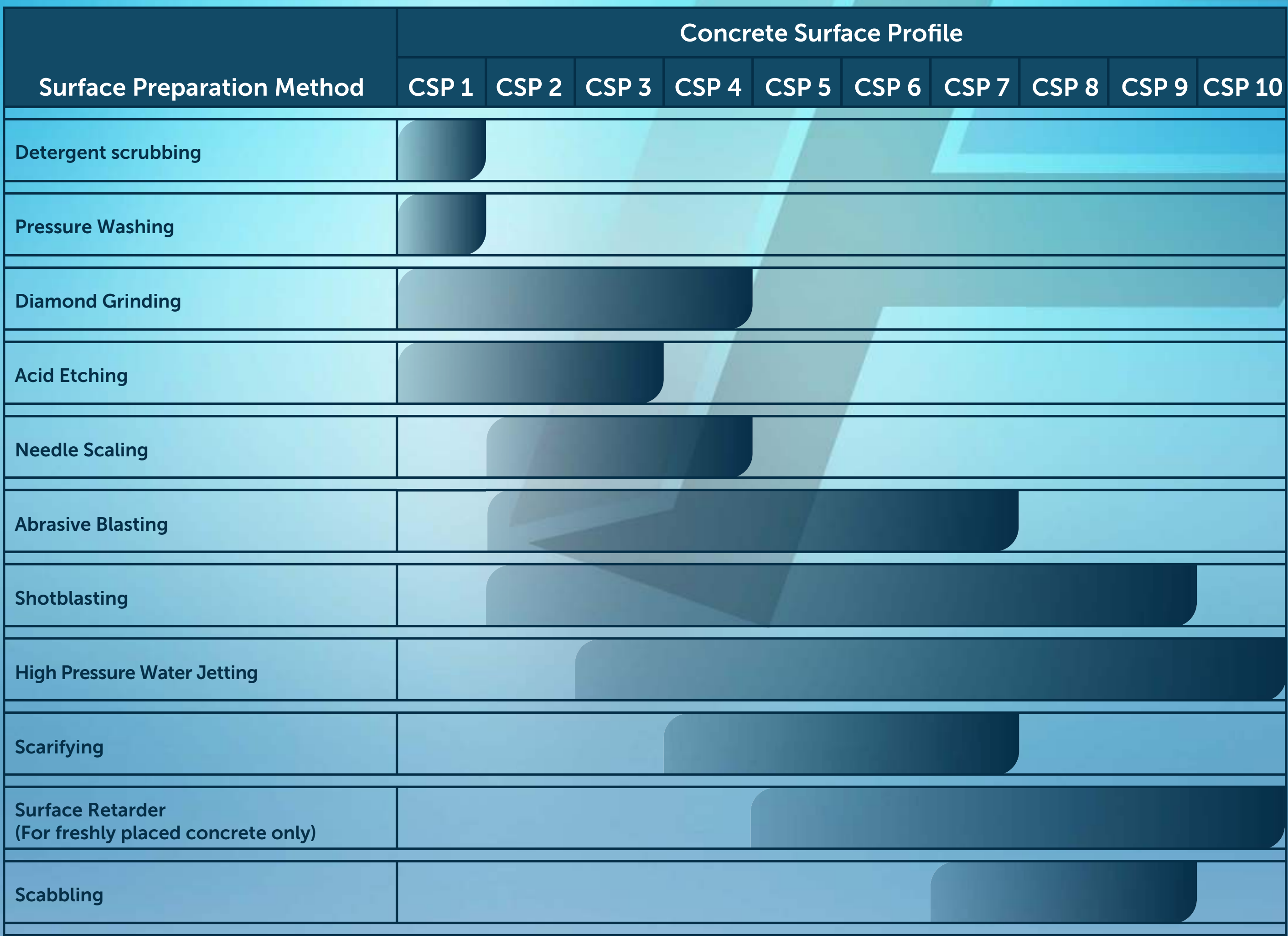

CSP7


CSP8


CSP9


CSP10


Polymeric Material Thickness
Concrete Surface Profile
CSP 1
CSP 2
CSP 3
CSP 4
CSP 5
CSP 6
CSP 7
CSP 8
CSP 9
CSP 10
Sealers,
0 to 75 µm (0 to 0.075 mm)
Thin films,
75 to 250 µm (0.075 to 0.250 mm)
High-build coatings,
250 to 1000 µm (0.250 to 1 mm)
Self-leveling toppings,
1 to 3 mm
Polymer overlays,
3 to 6 mm
Concrete overlays and repair materials,
6 mm +


Surface Preparation Method
Concrete Surface Profile
CSP 1
CSP 2
CSP 3
CSP 4
CSP 5
CSP 6
CSP 7
CSP 8
CSP 9
CSP 10
Detergent scrubbing
Pressure Washing
Diamond Grinding
Acid Etching
Needle Scaling
Abrasive Blasting
Shotblasting
High Pressure Water Jetting
Scarifying
Surface Retarder
(For freshly placed concrete only)
Scabbling

METHODS OF SURFACE PREPARATION PROFILING & CLEANING

SHOT BLASTING

Alluvius's preferential method of surface profiling for polymeric coatings and systems at and above 250 µm is shot blasting. In this method, steel particles are rapidly "shot" at the concrete substrate, removing contamination and leaving behind a uniform surface profile without the introduction of chemicals or water, leaving the concrete dry and virtually dust free. This method also has considerably much higher production rates than other mechanical methods. The surface profile can be adjusted through "shot" size and velocity, giving the operator greater control on the outcome of the CSP. In some instances, blast lines may be visible in the coating and a higher film thickness may be necessary to mask this phenomenon. In the instance of transparent aesthetic coatings, shot blasting is generally not a recommend method of preparation due to the aforementioned blast lines.

DIAMOND GRINDING

Mechanically diamond grinding concrete removes surface contaminates and subsequently profiles the surface. Diamond grinding smoothes surfaces irregularities which leads to improved levelling of the substrate which also aids in creating a more uniform and even finish of polymeric coatings. Although ICRI list the CSP range of diamond grinding from a CSP of 1 to 2, it has been discovered that with the correct selection of tooling attached to the grinder, a CSP of 3 and greater can be achieved. Alluvius recommends ASTM D7682 "Standard Test Method For Replication and Measurement of Concrete Surface Profiles Using Replica Putty" testing method to determine if a CSP of 3 or greater is achievable for individual grinder tooling setups.

SCARIFYING

By utilising rotating teeth on a drum, scarification creates aggressive surface profiling. Scarifying can be used to "mow" down concrete to remove deep contamination and weak and uneven concrete. Scarifying is often used for the removal of thicker polymeric coatings and systems. Scarifying is often used in conjunction with other means of surface preparation.

SCABBLING

Mechanically scabbing is generally used in the removal of polymeric materials at and above 6 mm of thickness. Scabbling can also be used for surface preparations for heavy profiling but due to the slower production rates compared to other methods, is generally not recommend. Scabbling in some cases can also lead to micro cracking in concrete substrates.

NEEDLE SCALING

Needle scalers are often used in conjunction with other preparation methods. Needle scalers are often utilised in corner work, along edges and hard to reach areas that may not be easily accessed by other methods.

ABRASIVE BLASTING

Abrasive blasting may be used for the removal of surface contaminates and for the creation of a CSP of 2-7. Abrasive blasting is often used on vertical surfaces. Clean, uncontaminated abrasive media must be used.

HIGH PRESSURE WATER JETTING (HPWJ)

High and ultra high water pressure jetting can be used to remove weak and uneven concrete as well as surface contaminants, leaving behind an aggressive surface profile. HPWJ may not be suitable in many instances due to the high consumption of water but should not be over looked.

ACID ETCHING

Acid etching is an economical means of profiling concrete that can help to remove cement paste from the surface. Acid etching can be environmentally hazardous and also problematic to subsequent polymeric coatings if not handle correctly. Caution must be given as surface absorption can lead to the introduction of chlorides and other bond breaking contaminates. The surface must be wet prior to application of the acid so as not to allow absorption into the concrete and must be rinsed (not pressure washed) after use. Surface pH should be tested after rinsing to determine whether neutralising is necessary. It is usually necessary to wait for the surface to be dry prior to application of subsequent polymeric materials. If in doubt, consult the products TDS. For further information consult ASTM D 4260 “Standard Practice for Acid Etching Concrete”.

PRESSURING WASHING

Pressure washing is used for very light profiling (CSP 1) of concrete for polymeric coatings of very thin film but is more commonly used for cleaning and removing contaminates on substrates prior to utilising a more efficient and thorough preparation method. If pressure washing for thin film coatings, it is usually necessary to wait for the surface to be dry prior to application of subsequent polymeric materials. If in doubt, consult the products TDS.

DETERGENT SCRUBBING

Detergent scrubbing assist in the removal of oil, grease, dirt and other foreign contaminates of concrete surfaces. This method is often used prior to acid etching as it assist in the removal of contaminates that may block the acid from reaching the surface. Detergent scrubbing mechanically with still bristles can a very light CSP 1.

HAND TOOLS

Wire brushes, sanders, grinders, chase saws and other hand held tools can be used for the removal of contaminates and for light profiling of concrete where larger equipment cannot reach, is not accessible or practical. Care must be taking when using hand held grinders as to not heavily gauge the concrete.

TORCHING

Heating surface contaminates such as animal fats and some petroleum based materials will help draw them from the pores of the surface and transfer them into a carbon state where they then can be scrubbed and cleaned.