# Preparing Concrete Floors for Painting

## Cure of new concrete floors

Description: Concrete floors are initially very alkaline having a pH of 13 to 14. A curing period of at least 30 days before painting is required for the concrete to react and become less alkaline. This curing period also allows the initial high moisture content to drop or normalise. PH paper should be used to verify curing. When adequately cured, the pH of the concrete should be around 9.0 to 10.0. In the event that the pH has been determined not to have dropped sufficiently, additional curing time, acid etching, and/or the use of an alkali resistant primer, such as an epoxy type, will be necessary.

## Excessive moisture in concrete slabs

No matter at what stage of cure, concrete must test negative for excess moisture before coating. The following test "Plastic Sheet Method", is an easy, fairly reliable method to detect the presence of moisture. If, on inspection, condensation appears on the underside of the plastic or if the underlying concrete is darker, excessive moisture in the concrete is indicated. Under such conditions, painting should not be undertaken.

## 'Plastic sheet method' test for excessive moisture

Tape a plastic sheet (45 x 45cm) onto the concrete surface being tested; ensuring an airtight seal between the concrete and the plastic is formed. After 24 hours remove the plastic sheet. Concrete can be coated if no moisture / condensation is present on the underside face of the sheet, or if concrete has not darkened (compared to adjacent concrete). If moisture is present, re-test after another 14 days.

Relevant standard – Moisture Test. ASTM D4263 "Plastic Sheet Method" test.

## Excessive moisture is present in the slab

Excessive moisture may be present in the slab. The following need to be considered:

- Where can the moisture enter the slab from?
- Is the slab below the water table?
- Is there hydrostatic pressure forcing water into the slab?
- Is there an effective vapour barrier/seal under the slab?

A slab with excessive moisture or hydrostatic (water being forced through) pressure should not be coated. A coat of paint applied on the inside of a leaking hull does not stop the ingress of water. The same applies to a leaking slab of concrete. You must determine where the ingress of water is coming from, and if possible remove the source.

Another possible cause of moisture on a slab is if the slab's temperature is close to the dew point temperature. A surface at or below the dew point will attract condensation; a surface that is 3°C above the dew point will remain dry. For example, if you remove a bottle of water from the fridge, moisture from the atmosphere can form on the outside of the bottle.

## Curing agents

The optimum method of curing concrete is by keeping it wet for as long as possible, usually 7 – 10 days after pouring. If concrete can't be wet or moisture cured; curing agents are often used. If the wet cure is improper or inadequate, the concrete will have a tendency to crack more than normal and carbonate more extensively.

Curing agents may be used to seal concrete surfaces and retain water during hydration. These agents may range from oils to chlorinated rubbers to moisture tolerant epoxies. Normally these products are not compatible with the coatings that are to be applied and must be removed prior to surface preparation.

## Form bond breakers

Forms used in concrete placement are normally coated with a 'bond breaker' to allow for easy removal after cure. The 'bond breaker' utilised may be oils, grease waxes, silicones, Teflon, or similar coatings. When using any 'bond breaker', all residues must be removed off the cured concrete prior to surface preparation. Small quantities of oil contamination that can't be seen may be able to be detected by a water break test.

## Water repellent compounds

To reduce water permeability of the concrete, water-repellent compounds, such as silicones, silanes and siloxanes are some times applied. They can be detected by the water break test. When detected, remove prior to coating.

## 'Water break test' for detecting contamination on concrete

A thin layer of clean water needs to be applied over the surface to be tested. A sprayer/sprinkler/hose can be used to apply the water. Apply the water to the concrete, until the water forms a thin layer on the surface with no breaks present in the layer. Any beading (similar to rain drops on a polished car) or breaks in the water film indicate contamination is present.

## Surface hardeners/hardened surfaces

Surface hardeners may be added to provide harder, more abrasion resistant finish. It is difficult to distinguish from concrete with no hardeners. Where a hardener has been used, surface profiling needs to be more aggressive to expose the pores underlying the hardened concrete. This will ensure a good coating penetration and adhesion is achieved.

Metal trowel finishing can also sometimes create a hard dense surface that is difficult to clean and profile. As above a more aggressive surface profiling is required.

Other relevant literature regarding Concrete cure/Moisture test/Curing agents/Form bond breakers/Water repellent compounds:

- Moisture Test, ASTM D42633 'Plastic Sheet Method' test
- SSPC: The Fundamentals of Cleaning and Coating Concrete, Randy Nixon, Dr Richard Drisko
- JPCL, March 1998: Measuring and Removing Moisture in Concrete, Don J, Schnell.

## Surface preparation before painting new floors?

Remove efflorescence/laitance from substrate to be coated.
Laitance and efflorescence are two terms that are often confused with each other, although they are distinctly different. Laitance occurs during concrete placement, finishing and curing. Efflorescence occurs much later.

## Efflorescence

Efflorescence is white crystalline or powdery deposit on the surface of concrete. It is a result of lime (or calcium hydroxide) leaching out of a permeable concrete mass over time, which reacts with carbon dioxide and airborne acid pollutants. Efflorescence often occurs where water has leaked into the concrete, and often shows itself as a white crystalline deposit around the crack or pinhole. This raises the question on how to prevent efflorescence re-occurring. The source of the efflorescence (water ingress), into concrete needs to be identified and plugged, prior to any surface preparation and coating operations. Efflorescence is preferably removed as for laitance.

## Laitance

Laitance is a weak non-durable layer of material containing cement and fines from aggregates. It is brought by bleeding water to the top of over-wet concrete at the time of pouring. Unlike efflorescence it is virtually invisible to the untrained eye. The amount of laitance is generally increased by over-working or over-manipulating the surfaces of the concrete by finishing staff. The layer is not adhered well to the concrete proper, and must be removed prior to coating.

Failure to remove the laitance will prevent good adhesion to the coatings. Such 'coating failures' normally have a thin layer of cement or fines adhered to the back of the 'failed' paint – in fact this is a concrete failure rather than a paint failure.

Laitance is usually eliminated mechanically. Thin layers are best removed by abrasive basting and diamond grinding, although acid etching can be used when laitance is limited to surface deposits, provided that no significant surface profile is required for the coating application. With thick layers of laitance, filling materials may be required/used to restore the concrete to its original dimensions.

## Acid etching

Concrete is alkaline, therefore it can be cleaned and etched with acid. For the acid to work properly grease, oil, waterproofing materials and other surface contaminants must be firstly removed. Proper etching will permit good adhesion of many thin film coating systems, provided the coated surface will not be exposed to impact, heavy methods can not be utilised. Acid etching of concrete slabs containing steel or synthetic fibres is not recommended.

Ensure when using an acid cleaner that all instructions regarding application, removal and safety requirements are understood and followed. Personal Protective Equipment must be used.

Note: All spent abrasive, chemical residues etc must be completely removed after surface preparation has been completed. If wet, the concrete must be allowed to dry before coating operations can start.

Surfaces must be checked after all surface preparation methods to ensure a suitable clean, dry, smooth, bug hole free surface is suitable for application of coatings.

## Abrasive blasting

Blasting methods and equipment are quite varied. The common methods of are:

- Dry abrasive blasting . Vacuum recovery-blasting systems.
- Wet abrasive blasting . Centrifugal wheel (shot blasting).

Blasting removes any loose contamination (including laitance) from the surface and exposes sound tightly adhered underlying concrete/aggregate. Care must be taken when selecting what abrasive blasting method to utilise. Access to the surfaces being prepared, spent abrasive, dust etc need to be considered when utilising this method of preparation.

## Water cleaning

There are various equipment and pressures available on the market. Water jetting, which utilises pressures in excess of 10,000 psi is not covered in this report. The two methods covered, low and high pressure water cleaning can be effective for cleaning but have no or little effect on the surface profile.

Low pressure water cleaning (often referred to as waterblasting) removes dirt and other loose friable material. High-pressure water cleaning removes more tightly held dirt and other surface contaminants.

## Scarification

Machines with cutters mounted on steel discs are used commonly on floor surfaces to rip the top layer of the concrete and profile the surface prior to coating. Care must be taken not to allow high points or edges to form when preparing the surface. Usually using machine in one direction then coming back perpendicular across the first series of cuts prevents this.

Rectification of any exposed defects, e.g. large bugholes after surface preparation, must be completed and allowed to fully cure, prior to application of any coatings.

Relevant standard – ASTM D4258 – Practice of surface cleaning concrete for coating.
Relevant standard – ASTM D4259 – Practice for abrading concrete.

## Contaminants

Contamination of the concrete can cause premature failure of the coating system, usually in the form of delamination. Contamination can be introduced to the concrete from other sources after placement. Examples of such contamination are fats/oils/contamination from boots/building materials/spillage. Other sources of contamination may be present on aged concrete surfaces. Dust, dirt, grease, oil, chalk, chemicals, etc, are examples of the contamination that must not be forced deeper into the concrete or spread over a larger area.

A number of or combination of different cleaning methods may be utilised to remove the contamination. The contamination may be so severe that the affected area may have to be removed and reinstated with new concrete. A number of contaminants are obvious to the eye but a number cannot be seen, the following test may aid detection of the unseen contaminants.

## 'Water break test' for detecting contamination on concrete

Refer above.

## Removing contaminants

**Steam cleaning:** (With or without an emulsifier) is usually utilised on areas with deep ingrained oil or grease contamination present. Cleaning is more effective if used in conjunction with an emulsifying solution. Care must be taken not to force the contamination deeper into the concrete.

**Degreasing:** Water or solventborne products are available to remove areas of light to medium areas of contamination. Repeated applications may be required to achieve an acceptable finish suitable for coating.

**Reinstatement:** For areas that cannot be successfully cleaned to an acceptable finish, complete removal and reinstatement with concrete may required.

Care must be taken when using any of the above cleaning methods not to allow any residues to contaminate adjacent areas or allowed to flow into drains. Disposal of any waste materials must be in accordance with relevant environmental/legislation requirements.

Mould/mildew/fungal growth can occur on coated or uncoated concrete surfaces with weathering. The growths are more pronounced in damp, cool areas, usually on the southern faces of structures. The organisms are best killed by washing with 5-10% sodium hypochlorite in an aqueous, non-ammoniated detergent solution. Appropriate PPE (Personal Protective Equipment) must be used, and care taken to ensure no contact with the chemical and eyes/skin occurs.

## Concrete defects

To achieve a smooth/fair surface to be coated, defects as listed below, must be either removed or filled prior to surface preparation. Common defects are voids/rough finish/bug holes/honeycombs/tie rod holes/protrusions/spatter. Removing defects or preparing cavities for filling is usually achieved with hand or power tools. Suitable fillers can include grout plaster, mortars, putties, surfacers and fillers. Selection of the 'right' filler for the job depends on a number of factors.

Points to consider before selecting the filler:

- It is compatible with selected coating systems?
- Does it have good adhesion to the concrete?
- Does it have similar strength to the concrete being filled?
- Is it easily applied?
- Is it sag resistant (on vertical surfaces)?
- Does it have no or minimum shrinkage during cure/is it reasonably fast cure?

## Expansion joints

Joints comprise an integral part of concrete structural design, particularly for floors and pavement. Often freshly laid concrete is surface cut, providing controlled break-points to allow for contraction during cure. Also larger slabs may be split into smaller discreet sections or have joints retro-fitted by cutting as above. Most such joints are moving-joints, rather than slab to slab adhesive joints.

Flexible expansion/compression joints are usually not overcoated with a coating system. Over coating these types of joints usually results in splitting or delamination of the coatings at the joint. Where possible it is recommended that the coating system be applied to the floor, and at least the top section of each face of the joint, prior to application of the sealant.

## Sealants

The following lists are features that the selected sealant must have:

- Good flexibility
- Good adhesion to the side but not to the bottom of joint/cracks.
- Compatible with concrete/filler material.
- Compatible with coatings if being overcoated.

- Be compatible to the environment/expected exposure that the sealant will be exposed to.

## Cracks

Cracking of the concrete surface can be broken into two types, structural or nonstructural. Structural cracks can be the result of a number of factors, some of the factors can be:

- Setting of the slab.
- Poor design.
- Excessive compression/expansion. Incorrect mix/ratio of concrete.

If the structural crack is dynamic (still moving), overcoating with a coating system will lead to premature failure at the crack site. The majority of cracks are non-structural cracks and are caused by improper concrete mix, structural design (e.g. insufficient number of joints), or concrete curing. Shrinkage cracks are the most common non-structural cracks. A high water-cement ratio is typically responsible for these cracks. As the excess water is not needed for hydration it evaporates during curing and shrinkage occurs. Therefore, the more the excess water, the greater the shrinkage.

Cracks need to be sealed prior to any surface preparation/coating operation. Suitably prepared prior to coating, usually with a suitable filler, such as grouts, plasters, mortars, putties, surfacers and fillers, non-structural cracks can be successfully overcoated.