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How to Combat Substrate Moisture Failures Using Cementitious Urethane Flooring Systems on Concrete Floors

Blistering in the floor caused by substrate moisture can result in huge cost and sanitation implications, as it could not only lead to operational down time and expenditure on unexpected repairs, but it can also make an area vulnerable to bacterial growth. The heightened contamination risks that stem from floor failures can be a major concern for many workplace environments, especially in the food & beverage and healthcare industries.

These difficulties can be minimized by carefully analyzing the site's substrate and making sure that the floor preparation, build up and materials are tailored to avoid moisture related blistering.

Moisture Failures

One of the main difficulties when evaluating the risk of moisture related failure is that substrate moisture is an inexact science and there are many variables to take into account. In the case of green concrete with an effective vapor barrier, there is a finite amount of moisture within the slab. On the other hand, a slab on grade with no vapor barrier can involve an unlimited amount of moisture.

An old concrete substrate might be contaminated, which can weaken the bond of a floor topping. Therefore dealing with old slab, on grade concrete is generally accepted to be more challenging than green concrete, especially in the case of repairing a floor in a wet environment, when there is no

time to allow the concrete to dry out prior to the application of the flooring system.

Salt contamination from unwashed aggregates can lead to very strong osmotic pressure. Such high salt levels have resulted in several reported blistering issues on resin floors, even in suspended slabs, with measured moisture content lower than limits stated by most resinous flooring manufacturers.

Moisture Testing

There are a variety of different moisture testing procedures, which can be used to provide quantitative or qualitative information regarding the moisture situation within a concrete slab. Some of the most common methods are:

ASTM D4263**Standard Test Method for indicating moisture in concrete by plastic sheet method**

The simple plastic sheet test is also useful because, in a way, it mimics what happens after the application of a non-breathable resin flooring system. Although not recommended as a standalone test, this can help build up an overall picture of the moisture situation in a given concrete substrate.

It should be noted that when measuring the moisture content of green concrete, with an effective vapor barrier, there is a finite amount of moisture. Therefore moisture testing can give a more accurate picture and assessment of the potential for future moisture issues.

In the case of a slab placed on grade it is advisable to do more than one type of test and include this in an overall investigation into the moisture history of the floor. Cutting cores can help look for the presence of a vapor barrier and provide information about the sub-floor.

ASTM F2170-11**Standard Test Method for determining relative humidity in concrete floor slabs using an in-situ probe**

Probe or hygrometer RH tests give more accurate information about the moisture content of the slab, but when dealing with rising (ground) moisture, which is inherently variable, these results are only a snap-shot in time and low results cannot be seen as a guarantee of not having moisture issues in the future.

ASTM F1869**Standard Test Method for measuring the moisture vapor emission rate of concrete subfloors using Anhydrous Calcium Chloride**

The calcium chloride test has been widely used in North America for many years, but is virtually unheard of in other parts of the world.

This test only gives an indication of the moisture level at the surface of the slab and does not give an accurate picture of the moisture situation throughout the slab. The use of this test is slowly declining in North America and is slowly being replaced by RH testing.

ASTM F710**Standard practice for repairing concrete floors to receive resilient flooring**

Measurement of the pH or salt content at the surface of the slab is often carried out. This can offer an indication of the moisture vapor transmission but it is very difficult to quantify the amount of subsequent pressure or predict future moisture related failures.

Differing Construction Practices

Construction practices around the world vary significantly. In certain regions the use of ballast and vapor barriers under concrete slabs is widespread, which significantly reduces the possibility of subsequent moisture related issues. In other regions it is very common to merely compact the soil and to lay the concrete directly on the ground, this is known as 'slab on grade'. This is a practice which can lead to future ground moisture related issues with a floor topping.

TIP:

Choose cementitious urethane systems for protection against moisture related floor failure.



Types of Moisture Mitigation Systems

There are many different types of moisture mitigation systems available on the market. Some, such as water based epoxy sealers, work as breathable layers to allow moisture vapor to transfer through the resin system. Though generally very successful against moisture issues, these types of products are relatively thin film and therefore are not particularly heavy duty. Any attempt to apply a more heavy duty layer on top caps the system, eliminating the breathability.

Other non-breathable, moisture tolerant primers are often employed to deal with high moisture substrates. These generally contain a hydrophobic constituent, which allows the primer to cure and bond tenaciously to the concrete with high moisture content. These primers have a very good proven track record on many installations, but the fact that

they are complete barriers to moisture can be their downfall. If moisture pressure continues to build, the lack of release can lead to blistering of the system and there is not a single foolproof test that can confirm whether such a primer can be effective in preventing blistering on a given concrete slab.

How Does Cementitious Urethane Work in High Moisture Substrates?

Cementitious urethanes have almost unparalleled success on high moisture substrates, whether it is an old, new, on grade or suspended slab. When applied as a slurry or mortar with system thickness of 1/4" or greater, it is generally accepted that these systems, if correctly installed in accordance with the manufacturer's recommendations, are unaffected by substrate moisture.

The reasons that cementitious urethanes have such a great performance in combating moisture issues are:

- The heavy substrate preparation (typically to CSP of 4 or greater) carried out in order to remove surface salts and contamination, can reduce the magnitude of moisture pressure exerted in the flooring system.
- Cementitious urethane systems also bond excellently with concrete. The slurry or mortar is applied directly to concrete when it is completely surface dry at the time of application, helping the floor topping to deal with the pressure of rising moisture.
- Of all factors, the key is the micro-porosity near the bond-line of the cementitious urethane. This creates a 'separation layer' when moisture pressure is released (dissipated) into the matrix of the cementitious urethane rather than being allowed to build up at/or below the bond line of the floor topping.

Floor Finishes

Another valuable benefit of utilizing cementitious urethane systems to deal with substrate moisture issues is the fact that they dissipate pressure and do not rely on the moisture breathing through the entire thickness of the flooring system.

If a broadcast aggregate or flake is incorporated into the cementitious urethane matrix, this property allows other chemistries to be applied as topcoats without affecting the system's ability to deal with the inherent substrate moisture issues.

This opens up the possibility of a multitude of different types of finishes, allowing the system to be tailored to the end users requirements in terms of physical requirements such as chemical, wear, heat and slip resistance as well as the aesthetic finish.

This guide has been produced to give an overview of the factors to consider when specifying cementitious urethane materials within an industrial environment.

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