How Confident Are You In Moisture Testing?
by Ray Thompson, Jr.
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Over my four-plus decades in the flooring industry I have seen many changes in the way we prepare for the installation of flooring materials. I have observed calcium chloride testing done under a glass dome, bond tests, rubber matt tests, plastic sheet tests, phenolphthalein, calcium carbide bomb tests, moisture meter testing (both destructive and non-destructive), calcium chloride MVER tests, and now the internal relative humidity (in-situ) tests. These tests represent subjective, quantitative and qualitative types of testing. After all these years the question persists: Which type works best?

Let's look at some of the tried and true methods that often pre-dated much of the technology we take for granted today.

Calcium Chloride Under A Glass Dome

The anhydrous calcium chloride test for moisture emissions was developed in the early '40s as a qualitative evaluation of concrete floor moisture conditions. It was conducted by drilling three holes in a concrete slab in about a 6" perimeter and using anhydrous calcium chloride crystals to determine the presence of moisture. The crystals were sealed in place using clock glass and a ring of plumber's putty. After a period of time, you'd look for changes in the crystals. No change meant the slab was dry. If the crystals caked-up that meant there was moisture in the slab. The larger the caking of the crystals, the wetter the slab. Standing water in the clock glass was a clear indication the slab was extremely wet. The results are extremely subjective and required an experienced person to conduct and evaluate these tests.

Bond Tests

Bond tests were just that: A square yard of material was installed on a predetermined area of the slab where the installation was to take place, with the adhesive and material that was going to be used. The material was placed and left for a period of 72 hours. Then the material was removed and the condition of the adhesive was checked. Some versions required the use of a water-soluble adhesive in the center of the test. If the adhesive was dry and the material difficult to remove and the adhesive in the center of the test was also dry, the installation could commence. Like the early calcium chloride testing, results of this type of test were extremely subjective and required an experienced person to conduct and evaluate.

Rubber Mat Tests

Rubber mat testing required the placement of a rubber mat on the surface of the concrete. It was to be left on the surface of the concrete for 24 hours and then removed. Upon removal the surface of the concrete was examined for moisture. A slight darkening meant a marginal moisture level, and water droplets meant extreme moisture. Unfortunately, this test could be misleading because 24 hours is too short of a time to properly measure changes. The test is very subjective and influenced by temperature, humidity and dew point.

Plastic Sheet Tests

The plastic sheet tests are even worse than the rubber mat tests. In this test a sheet of plastic about 24” by 24” is taped to the surface of the concrete and left for 24 hours. It is then examined for moisture darkening or water droplets. Plastic sheeting, especially recycled plastics, vary in permeability and allow for moisture to pass through the material. The amount of time for placement is too short and the results are extremely subjective. This test is also highly influenced by temperature, humidity and dew point.

Phenolphthalein

Phenolphthalein is a chemical that, when poured on the surface of the concrete, turns from pink to red to purple if the concrete is too wet to install. The color change is an interaction of the alkaline salts reacting with Phenolphthalein, creating the color change. This too is extremely subjective.

Calcium Carbide Bomb Tests

In the mid ‘80s there was a surge in a European test called the Calcium Carbide Bomb Test. This test involved placing chips of concrete, fresh from the slab, into a small chamber along with a glass vial containing Calcium Carbide crystals and some steel balls. The chamber was sealed and shaken until the steel balls broke the glass vial. Then the moisture in the concrete chips would mix with the calcium carbide and create acetylene gas, which would register on a pressure gauge. A low reading was required for an installation to begin. These tests were expensive and subjective. Even though there was a quantitative result, it required the concrete to be removed from the surface which was affected by temperature, humidity and air movement. The results of this test were often inaccurate.

Moisture Meter Testing

There are two types of moisture meter testing:

Destructive type testing requires the concrete surface to be broken, drilled or nailed. The meters probes are placed on the contact area and measure a low-level electrical current between the two contact points.

Non-destructive testing relies on a low level electrical impulse which travels between two sensors. The impedance of the impulse determines the moisture content of the surface of the concrete down to about 1”. Moisture meters do not measure the moisture deep down in the slab which may not be in equilibrium. Once covered with a flooring material, this moisture may migrate to the concrete surface and affect the adhesive and material

Calcium Chloride Moisture Vapor Emissions Rate (MVER) Test

The modern day calcium chloride test measures the moisture vapor emissions rate (MVER) and became a quantitative test in the ‘60s. This test has become very popular; there are nearly half a million of these tests performed in the U.S. annually. In the past 10 years however, we have become aware that the test can be unreliable, capable of producing both high and low false results. This is

because the test is dependent on a variety of factors, including ambient temperature, humidity, presence of residuals on the concrete surface, and even the hardness of a trowel finish. It is estimated that up to 80 percent of the calcium chloride tests yield an inaccurate result.

Internal Relative Humidity (In-Situ) Tests

RH for floor testing is not new to the flooring industry. Though it has only truly come to our attention in the last decade, the original tests date back to the ‘50s. First used in research by the Portland Cement Association (PCA), RH instruments can be independently calibrated and are directly traceable to national standards. More importantly, RH testing give a much more useful picture of actual moisture conditions within the concrete regardless of mix design, aggregate types, floor thickness or surface conditions. While there are many types of RH testing equipment available (and yes, they are often more costly than calcium chloride test kits), they can prevent premature flooring installation failure, costly repairs and litigation. Recently one electronics manufacturer developed a disposable RH probe that does not require periodic calibration and readings that can be obtained on demand.

While still considered new, this type of testing is the most accurate in the industry. Understandably, flooring manufacturers are slow to establish a “tiered system” for the various flooring products. But once such a system is established, it will allow for more successful installations without all the guesswork.

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