Measuring the RH in Concrete Slabs

By Peter Craig

Moisture-related problems with floor coverings and coatings continue to be a serious and costly construction-related problem. The importance of accurately establishing the moisture-related suitability of a concrete subfloor is critical to a successful flooring installation.

For decades, the flooring industry relied solely on measuring the moisture vapor emission rate (MVER) of slabs as the determining factor for flooring installations. However, much has been learned about what the calcium chloride method (ASTM F 1869) does and does not indicate. Research shows MVER testing only provides an indication of how much moisture is present in the top 1/2 to 3/4 inches of the concrete.

MVER test results are greatly affected by ambient conditions that the slab is exposed to prior to performing the test. Many industry experts suggest doing away with the test method altogether. This author is not among that group. However, if the only piece of information one has is a properly measured MVER, it alone is insufficient information to base a flooring installation upon.

Measuring concrete moisture

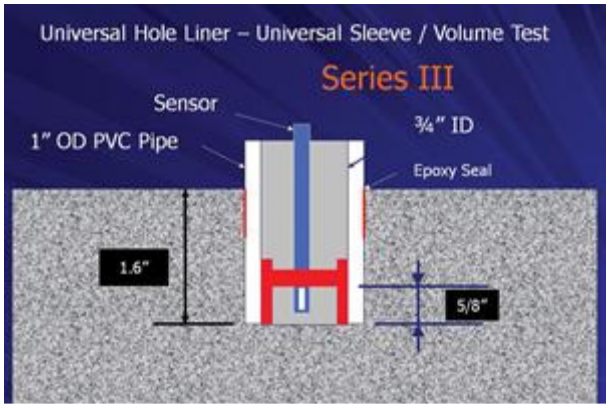
So how else should moisture in concrete be measured? In Europe it was discovered that measuring the concrete's internal relative humidity using in-situ probes is a much better predictor of the concrete's moisture-related suitability for floor coverings. In 2002, an ASTM standard for this method of testing was developed in the U.S. and published as ASTM F 2170. In-situ RH test equipment from Europe made its way here along with similar gear produced by American manufacturers. Flooring manufacturers began to recognize the test method and set acceptance levels.

As use of the F 2170 RH test method began to grow in this country, a reoccurring issue began to be noticed on projects where multiple firms provided testing services. There was a disparity in measurements being reported, well outside the tolerance limits for the equipment or the test method. As this issue began to be better known and widespread across the country some equipment was prohibited on projects, not due to inaccuracy, but due to results being higher than if another type of equipment was used. Although the desire to reach acceptable moisture level is understandable, it's more important to know the measurement one is basing a flooring installation upon is accurate.

To that end, several members of ASTM Committee F6, Resilient Floor Coverings, other industry experts, and manufacturers of in-situ equipment embarked on a study to determine what was causing the disparity between equipment measurements. The study was performed in an environment of 70°F and 50% RH at the W.R. Grace Laboratories in Cambridge, Mass. New NIST calibrated equipment was provided to the study group by the equipment manufacturers and the calibration of the probes was double checked before and after each series of tests in a calibration chamber at Simpson, Gumpertz & Heger of Waltham, Mass. In the calibration chamber all the probes provided measurements within the acceptable F 2170 tolerance range of ±2%.

Three series of tests were performed. In each of the first two series the equipment was tested exactly as supplied and recommended by the manufacturers. The disparity from high to low between equipment in the same parent concrete was as great as 11% (photo). This disparity is well beyond the ±2% tolerance allowable by the test method. In series three, the

hole liners were discarded and replaced with a universal sleeve totally isolating moisture measurements to the target depth, keeping air from rising above 5/8 inches in the liner, equal volumes of air was being measured by all of the probes. Bingo! All of the measurements fell within the acceptable tolerance range of the measurement considered to be most accurate. The study ended with the conclusion that it was the differing designs of the various hole liners that contributed to the disparity in measurements.



Based on the results of this study, the ASTM F 2170 test method was rewritten in 2011 with a stronger emphasis on the hole liner totally isolating the measurement to the bottom of the drilled hole. Also, moisture from the target depth would not be allowed to migrate outside of the hole liner or to a height greater than 5/8 inches inside of the liner.

These changes are implemented now by more than half of the equipment manufacturers who participated in the study with others soon to follow. A precision and bias study for the test method will be performed in the near future.

In closing, it's this author's opinion there will soon be no reason to question that any manufacturer's equipment can provide accurate test results, assuming that the calibration of the probes is checked and maintained according to the test method requirements. Low permeance vapor retarders installed in contact with the underside of slabs on ground assure the measurements can be relied upon for flooring installations.

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Peter Craig has over 37 years experience as concrete construction and repair specialist. In addition to providing consulting and quality assurance services for specialized aspects of concrete construction, maintenance, repair & protection.