

# Moisture dome test on trial

In this first of a two-part series, one of the nation's foremost experts in the forensic examination of concrete and related building products illustrates how vapor emission and moisture dome tests increase pressure on defendants in the battle against frivolous concrete defect claims.

Since the flow of Source 2 and Source 4 vapor in a dome test is caused by the test itself, there is no practical significance in attempting to relate these vapor sources to concrete permeability. The most significant single factor affecting the results of a moisture dome test appears to be soil/concrete temperature. This strongly suggests that, in general, moisture dome test results will tend to be significantly higher in the summer and lower in the winter.

The use of calcium chloride vapor emission tests—specifically the moisture dome test in concrete defect litigation—is on the rise, and it has become the most significant weapon in the plaintiffs' arsenal. It's like a double-barreled shotgun, because while it is usually used as "proof" of water damage from so-called "porous and permeable" concrete, it can also be used by plaintiff attorneys to make sulfate attack an issue. Never mind that the use of the dome tests to demonstrate defects in concrete was found to constitute "junk science." Results of such tests were excluded from being made evidence in the *Castron, et al. v Fieldstone, et al.* (2006) trial, as in the *Spitz v YL Brighton Associates I* (2001) case before it, and challenged in other cases. Orange County, Calif., engineering consultant Geoffrey Hichborn was an expert witness for the defense in *Castron* and *Spitz*, and began a search for whether there was relevance in the tests to the concrete construction or materials on which the test was conducted.

However, exclusion in those cases does not preclude plaintiffs from using dome tests in future trials. In fact, it is likely their use will continue because they are inexpensive; and, the results, application, and interpretation of them are widely disputed. Using these tests, plaintiffs have historically claimed significant consequential and dollar damages. Moreover, defending against the dome tests is expensive because it often requires hiring consultants from many disciplines who later may

become designated expert witnesses. The combination of these and many other factors makes it more likely defendants will settle rather than go to trial. Starting in San Diego and expanding into the California counties of Orange, Los Angeles and the Inland Empire, the dome test trend is common as the frequency of these types of cases moves northward and eastward into the high and low California desert communities from regions of southern California, such as Palmdale/Lancaster and Coachella Valley (Palm Springs) into Arizona and Nevada.

## TEST ORIGINS

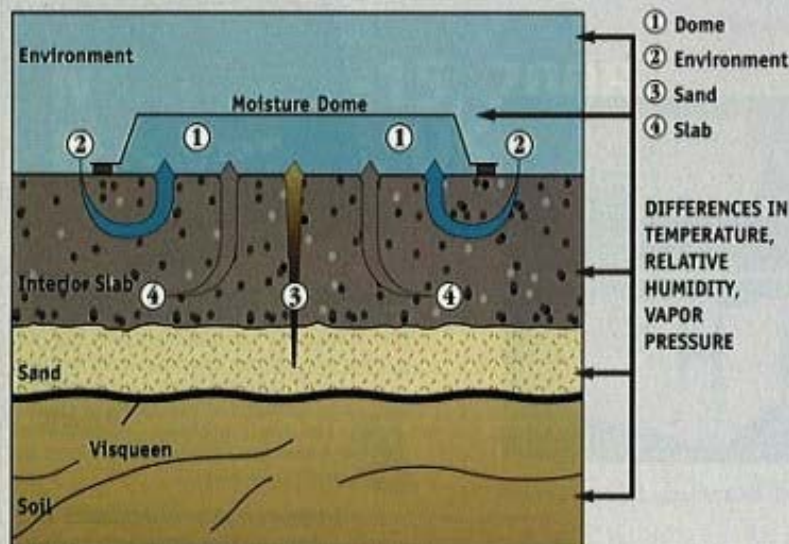
The moisture dome test was developed in the mid-1950s by flooring manufacturers (specifically the rubber industry) in the attempt to obtain a quantitative measure of the relative wetness of the surface of a concrete slab, i.e., some indication of suitability for installation of various types of flooring.

In the early 1990s, plaintiff attorneys in residential defect litigation began regular use of the test as evidence that sulfates in the soil entered and destroyed concrete and adjacent improvements and property. In 2000, Hichborn and forensic investigator Ken Bondy completed a 16-month study of the dome tests, studying whether they provided some measure of concrete slab permeability or vapor migration from below the slab into residential spaces, as the plaintiffs' experts were commonly claiming. Hichborn and Bondy concluded that dome tests had no validity for these purposes. Further, their work showed there was no relationship between test results and the moisture content of concrete or its permeability, and that to conclude otherwise is junk science and an unsupportable assertion.

The forensic examiners found that the primary source of water vapor measured in dome tests on a mature slab is activated by the test itself. In fact, most of the water vapor measured in the test has not migrated through the slab, but is water in equilibrium in the top pores of the slab, drawn into the dome by the pressures created by the test itself. Portland Cement Association's H.W. Brewer reported in 1965 that very little water vapor passes through mature concrete slabs, even those with very high water-cement ratios and those exposed to an inexhaustible water surface directly below the slab.

The message to defendants is this: Don't be fooled by the apparent objectivity and scientific merit of the vapor emission test. It is junk science, as demonstrated in the extensive study Hichborn and Bondy published in 2000. That document can be found at [www.kenbondy.com/images/ProfessionalArticles/MoistureDomeTests1.pdf](http://www.kenbondy.com/images/ProfessionalArticles/MoistureDomeTests1.pdf)

## POTENTIAL SOURCES OF WATER VAPOR



## PERCENT VARIATION BY DOME TEST KIT MANUFACTURER

Phase	Manufacturer A		Manufacturer B		Manufacturer C	
	Range	Variation (%)	Range	Variation (%)	Range	Variation (%)
1	10.4-17.5	68%	8.4	---	---	---
2	8.7-14.8	70%	5.8	---	10.2	---
3	10.2-17.1	67%	7.6-8.0	6%	9.0-10.2	13%

A typical moisture dome test kit includes rectangular clear plastic dome, sealed container of calcium chloride crystals, and a gasket. The crystals are placed under the dome, which is sealed to the concrete slab for 60 to 72 hours, then removed and weighed to determine amount of water vapor absorbed.

The moisture dome test is not reproducible. Adjacent domes Hichborn and Bondy observed commonly had test results that varied by more than 40 percent, some more than 90 percent. A primary reason for the non-reproducibility of the moisture dome test is the lack of uniformity in the particle size (the "grind") of the calcium chloride crystals. It is surprising that neither of the ASTM specifications dealing with this test (F1869 and E1907) requires standardized particle size distributions, since this appears to be a major factor affecting test results

## STANDARDIZED TESTING

The use of dome tests in residential defect litigation is on the rise because the test has the appearance of objectivity, and it has a set of industry standards (ASTM) associated with its use. Interestingly, these ASTM standards are not a part of the universe of standards created by the committees that specialize in cement or concrete, but are from ASTM committees that make no special claim to understanding the performance of concrete as a material, as a finished structure, or as a manufactured product.

The concrete industry first saw the dome tests used nearly two decades ago, but, like any trend, it has gained more and more adherents. Far more people are aware of the dome test methodology today, and unless it is closely examined and properly applied, it does seem objective. Thus, the dome test is being used more in residential litigation because:

- Dome tests always help the plaintiff make a point—The tests always have values most plaintiffs' experts associate with poor performance of concrete. Therefore, any plaintiff can go to any concrete and demonstrate that it is not satisfactory based on a presumptively "objective" test method and values. In the history of moisture dome testing in construction defect litigation, no single test result has ever demonstrated good concrete.

- The test is inexpensive—Because water damage is alleged, consequential mold growth may also be claimed, and concrete repairs can be pricey, this is a low-risk plaintiff tactic. The plaintiff's objective is to drive up the cost of the defense so that costs and certainty of settlement are far more attractive than those involved in the "good fight."

- Dome testing seems objective—It has the appearance of objectivity and acceptability. On the surface, it seems to embrace science, rather than to defy its very premises, so it takes more effort to demonstrate inappropriateness as many apply it. It's a sharper stick for the plaintiff. The defendant has to be more adept to defeat its use than with some of the other plaintiffs' methods, such as computer modeling, which also seems objective. (But, how many weather models and economic predictions don't provide acceptable predictions?) Much like scanning electron micros-

copy (SEM), it is veiled in the objectivity of a computer and a guy with a lab coat, one who can't distinguish a Tums tablet from concrete or a diamond from graphite.

The values for acceptability were established by the flooring industry based on what its stakeholders simply assert are best. Application of their standards reduces liability to the flooring industry and creates some sort of false standard for installation and testing, as demonstrated by their rare use. So the numbers garnered by a typical test are bound to reveal values that demonstrate unsuitable conditions for flooring. Never mind that in the real world, the flooring industry's standard is virtually impossible to meet because the standards are unrealistic. Some members of the flooring industry say that there is no relationship between the results of moisture dome testing and flooring failures and that the average of all moisture dome tests ever run on residential slabs is higher than the limit for glued-on floors and for carpet.

- Dome tests have an apparently legitimate pedigree—You can find written standards in the literature about how to conduct and evaluate the test or its results. (ASTM F 1869 and ASTM E 1907, which conflict with each other.) This, despite the fact that concrete standards developed by flooring manufacturers are completely unrealistic and not typical of concrete floors designed by licensed engineers and installed by experienced concrete contractors. Thus, the flooring industry has a perfect release of liability through a straw man. They have set up a whole system where they can argue they have no liability, no responsibility, and no duty; and, all of the problems, if any, whether real or not, are somebody else's, particularly the concrete contractor's and/or supplier's.

- Dome test is "objective proof" of sulfate attack—As this relates to such cases, the fundamental premise of sulfate attack is that water is coming from the soil below the concrete, bringing along with it destructive sulfates. The dome test "proves" not only water is entering the slab, but also that the water brings sulfates from the environment along with it. Plaintiffs argue that the dome tests "clearly demonstrate" there is a problem. Never mind that false standards have been established, a false test has been set up, and the false test and the false standard lead directly to the conclusion that the concrete doesn't satisfy the false requirement.

*In the concluding second part of this series, Geoffrey Hichborn examines sulfate attack claims, non-sulfate attack claims, and offers final thoughts on dome tests. For more information, contact Hichborn Consulting Group at 714/637-7400; hichbornsr@hichborn.com; www.hichborn.com.*