BEE Laboratory
570 Payne Branch Rd.
Blowing Rock, NC 28605 **Phone/FAX 828/265-2530**
Ben E. Edwards, Ph.D. email: beeiii@boone.net

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REPORT

Subject: Testing of ***MoistureBloc VOC Water Vapor Reduction System*** by F1869

PURPOSE The object of this test series was to compare one coat application versus two coat for Step 1 ***MoistureBloc VOC Water Vapor Reduction and Fast Track System.*** A standardized block preparation and exposure procedure is being developed. The moisture emission from test blocks as tested by ASTM F1869, Section 7.7 *Quantitative Anhydrous Calcium Chloride Test* is reported.

Summary Results: Half the top surface of three pairs of 18 day-old test blocks was coated as follows:

MoistureBloc VOC Blocks 1 & 2	Step 1 in two coats at 250 ft^2/gal each (total 125 ft^2 /gal)	Step 2 – 250 sq/ft
MoistureBloc VOC Blocks 3 & 4	Step 1 one coat at 154 ft^2 /gal	Step 2 – 250 sq/ft
MoistureBloc VOC FT Blocks 5 & 6	Step 1 in one coat at 154 ft^2/gal	Step 2 – 250 sq/ft
MoistureBloc VOC FT Blocks 3 – 5 – 3 – 6	Step 1 @ 154 sq.ft./gal	Step 3 @ 200 sq.ft./gal

Reduction of Moisture Emission relative to the uncoated halves of the blocks was satisfactory in every case. Experimental variations do not allow for clear distinctions between the treatments.

The F1869 test was repeated on the same blocks at 47 and 68 days. Moisture Emission from the bare surfaces was considerably lower than at 14 days, but the coated surfaces were approximately the same.

All results are tabulated following the description of the experiments.

General Experimental:
Test Specimens: - The blocks were prepared in rectangular metal molds (7" x 10 ¾" x 1 ¼") from C 109 mortar (water: cement: sand :: 0.485: 1.0: 2.75), leveled by shaking the molds gently and dropping them several times from a height of ½", struck off with a wood float and stored for 4 hours at laboratory temperature in a 100% humidity chamber.

The surfaces were then finished with a steel trowel with minimum strokes to achieve a closed surface, and returned to the 100% humidity chamber for the balance of three days. The blocks were then demolded and stored in the 100% humidity chamber. When they were 14 days old, the blocks were placed in plastic storage boxes (12 7/8" x 7 3/8" x 4 ¼") supported above the bottom of the box by two 2"pvc pipe tees laid on their sides. This supports the surface of the blocks about ¼" above the rim of the plastic box. The boxes were filled with water to a height sufficient to cover the bottom 3/8" of the blocks and the edges of the assembly were loosely sealed with strips of duck tape. (In the second run, blocks 1,3 and 5 had an air space between the bottom of the block and the water and 2,4 and 6 were immersed. The ME results for the bare areas of the immersed blocks were higher [~12# vs ~10#] but the coated areas were nearly the same.)

F1869 Set Up: - The coated specimens were allowed to dry for 48 hours. Approximately 5 g. of anhydrous calcium chloride was placed in a dish (50 mm diameter x 8 mm deep, cut from the bottom of a "Solo cup"). The weighed dishes of anhydrous calcium chloride were placed on each specimen atop an unfolded paperclip to provide air circulation under the dish, and each dish was covered with a 90 mm inside diameter culture dish lid, sealed to the surface with hot paraffin. The specimens were held for three days at laboratory temperature, after which the calcium chloride dishes were removed and reweighed.

Results

The following table shows the results of four separate F1869 determinations on the same set of blocks. The *b* value is for the bare side of the block.

F1869 Results (ME in #/1000sq.ft.-24 hours)

Product	Specimen	25 days	47 days	68 days
MoistureBloc VOC	1	1.2	1.4	1.4
	1b	17.3	9.8	8.9
	2	2.2	2.3	3.1
	2b	17.6	13.0	13.8
MoistureBloc VOC	3	2.0	2.4	lost
	3b	16.7	10.0	9.5
	4	2.2	2.1	2.2
	4b	15.9	11.6	12.8
MoistureBloc VOC FT	5	2.5	2.5	3.4
	5b	24.6	10.6	11.5
	6	1.8	2.3	2.9
	6b	20.5	13.6	12.1
MoistureBloc VOC FT Step 3	3-5	4.44		
	3-5b	39.64		
	3-6	4.34		
	3-6b	33.43		

Interpretation

All coating systems exhibit, greater than 85% reduction of moisture at 72 hours testing. The coatings exhibit a desired constant breathing of water vapor through the film regardless of the moisture drive in the block.

Appendix

ASTM F1869 Standard Practices for Determining Moisture-Related Acceptability of Concrete Floors to Receive Moisture-Sensitive Finishes, Section 7.7 *Quantitative Anhydrous Calcium Chloride Test*

7.7 *Quantitative Anhydrous Calcium Chloride Test*:

7.7.1 *Summary of Method*—Test moisture emission by measuring the mass of water absorbed by anhydrous calcium chloride ($CaCl_2$) during a specific period of time. A container of anhydrous calcium chloride is exposed to the atmosphere adjacent to a concrete floor under a vapor-retardant cover.

7.7.2 *Significance and Use*:

7.7.2.1 See Section 5.

7.7.2.2 The anhydrous calcium chloride test was developed by the Rubber Manufacturers Association, Inc., in the early 1950's.[1,2]

7.7.3 *Apparatus*:

7.7.3.1 A scale for weighing anhydrous calcium chloride with a minimum resolution of 0.1 g.

7.7.3.2 A transparent, hole-free plastic canopy, square or circular in shape, 70 in^2 (450 cm^2) ± 10% in area, depth greater than the depth of the cylindrical container of anhydrous calcium chloride, and with approximately 0.5 in (12 mm) flanges around the perimeter of the cover.

7.7.4 *Reagents and Materials*:

7.7.4.1 One cylindrical plastic container of anhydrous calcium chloride with a cover area of 6 in^2 (40 cm^2) ± 10%. The anhydrous calcium chloride shall be tape-sealed in the container against moisture or heat-sealed in an air-tight bag to prevent moisture absorption (Fig. 2). The mass of the container, the anhydrous calcium chloride, and the tape seal shall be 30 g ± 10%.

7.7.4.2 A pressure sensitive label to be used to identify the location of the container of anhydrous calcium chloride and to record the location and the date, time the procedure is started and completed, and its mass.

7.7.4.3 Moisture-tight sealant (gun-grade) or sealant tape to secure and seal the canopy to the concrete floor.

7.7.4.4 A brightly colored “CAUTION” label to be placed on the canopy as a protective warning while the procedure is being conducted.

7.7.5 *Preparation of Apparatus*:

7.7.5.1 Apparatus may be purchased from a proprietary supplier or assembled by the test agency.

7.7.6 *Calibration and Standardization*:

7.7.6.1 The scale shall be re-calibrated prior to each procedure sequence.

7.7.6.2 Weighing shall be done with the same scale for each procedure sequence.

7.7.7 *Procedure*:

7.7.7.1 If the anhydrous calcium chloride is separately packaged, pour it into the container without spilling the contents. Using a scale, determine the mass of the container of anhydrous calcium chloride, the tape (if used) to seal the container, and the cover label to the nearest 0.1 g. Record the value. If sealing tape is used, save the tape to reseal the container after the procedure is completed.

7.7.7.2 Remove the lid of the anhydrous calcium chloride container, and place it underneath the container on the floor.[3]

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[1]The Rubber Manufacturers Association (RMA) is no longer involved with floor coverings and has no records regarding the history of this procedure, although its origins are widely attributed to the RMA. It has been widely used and accepted by the flooring industry since the early 1950's, and quantitatively measures the rate of moisture transmission through or out of a concrete slab.

[2]The World Floor Covering Association describes this as “the only objective quantified test that is practical to run” (Moisture Guidelines for the Floor Covering Industry). The Resilient Floor Covering Institute “subscribes to the use” of this procedure (Addressing Moisture Related Problems Relevant to Resilient Floor Coverings Installed Over Concrete). The Carpet and Rug Institute (CRI 104 - 1994, Standard for Installation of Commercial Textile Floor ycovering Materials) states, “All concrete floors should be tested to determine the moisture emission rate by utilizing a calcium chloride moisture test kit available from installation supplies and accessories distributors.”

[3]Some users of this procedure have advocated placing the container over a $0.05 U.S. coin, washer, or similar spacer. A U.S. $0.05 coin is approximately 0.07 in (2.0 mm) thick by 0.83 in (21.0 mm) diameter. Any coin, washer, or spacer with a thickness greater than 1.5 mm and a diameter less than 25 mm will suffice. Whether or not the use of a spacer affects the results has not been proven, but the consensus of users is that it does not.

7.7.7.3 Measure and record the area under the canopy.[4]

7.7.7.4 Broom, brush, or vacuum the procedure area just prior to placement to remove any dust or debris which could interfere with the sealant bond. Apply the moisture-tight sealant in a continuous bead to flanges of the plastic canopy. If the sealant is tape-type, do not butt-joint; overlap ends to assure there are no gaps. Test for air-tightness by pressing firmly on the center of the canopy. The canopy should resist pressure if properly sealed air-tight. Air-tightness can also be tested by laying strips of tissue paper around the perimeter of the canopy. If the tissues are not disturbed by air movement when the canopy is depressed, it is properly sealed air-tight.

7.7.7.5 On the container cover label record the procedure number, location of the procedure on the floor, the mass, and the date and time the procedure was started.

7.7.7.6 Place the caution label on outside of the canopy as a protective warning, and allow the unit to remain undisturbed for a period of 60 to 72 h.

7.7.7.7 Remove the plastic canopy and immediately place the top back on the anhydrous calcium chloride container. Reseal the container with the original sealing tape. Record on the cover the date and time the procedure was completed.

7.7.7.8 Do not spill any of the anhydrous calcium chloride from the container. If any is spilled, the procedure must be re-run with a new pre-weighed moisture test unit.

7.7.7.9 Weigh the sealed container at the procedure site, along with the tape used to seal it. Record the mass on the label on the container cover, and determine the mass gain.

7.7.8 *Calculation or Interpretation of Results*:

7.7.8.1 Compute moisture emission (ME) as follows $ME = 24000\ ^{\circ}M/453.6A \cdot T = 52.91\ ^{\circ}M/(A \cdot T)$ **(1)**

where

$^{\circ}M$	=	mass gain of anhydrous $CaCl_2$ in g
A	=	contact area of $CaCl_2$ on concrete in ft^2
T	=	exposure time in h
ME	=	moisture emission in lb/(1,000 ft^2·24h)

7.7.8.2 To convert results to SI, multiply by 56.51 to obtain :g/(s·m^2).

7.7.8.3 To calculate ME in SI units, use the formula ME = °M/ A·T, where ME is in g, T is in s, and A is in mm^2.

7.7.8.4 If the plastic canopy is found punctured, the anhydrous calcium chloride in the container has a continuous crust, liquid water is present in the container, or the anhydrous calcium chloride crystals are dissolved, computations will probably indicate an excessively high moisture level but with a higher margin of error than with lower levels of moisture.[5]

7.7.8.5 Most flooring product manufacturers recommend that the maximum ME considered acceptable for moisture-sensitive flooring systems is 3.0 lb/[1,000 ft^2 · 24 h] (170 :g/(s·m^2), although 5.0 lb/[1,000 ft^2 · 24 h] (280 :g/(s·m^2)) is considered acceptable for some products.[6]

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[4]Some users of this procedure advocate subtracting the area covered by the anhydrous calcium chloride container if the container is placed directly on the floor rather than over a spacer. Whether or not the subtraction of the covered area affects the results has not been proven, but the consensus of users is that it does not.

[5]For greater accuracy in ascertaining moisture emission above the level of normal acceptability or in diagnosing high levels of moisture emission with a lower margin of error, repeat the procedure at the same location with either a shorter duration (60 h minimum), a larger diameter anhydrous calcium chloride container, or both. If the anhydrous calcium chloride container is approximately 3.5 in (90 mm) in diameter, use approximately 30 g of anhydrous calcium chloride. If the anhydrous calcium chloride container is approximately 5 in (130 mm) in diameter, use approximately 40 g of anhydrous calcium chloride. The purpose is to expose optimum surface area to water vapor.

[6]Armstrong Commercial Flooring, Technical Services Report No. 15, June 1994, recommends 5.0 lb for 1/8 in vinyl composition tile and felt-backed commercial sheet flooring.