VOLCLAY WATERPROOFING PRODUCTS
AS VAPOR BARRIERS

Introduction. CETCO is often asked whether Volclay Waterproofing membranes function as vapor barriers. Based on the research and information presented herein, the answer to this question is no, although certain Volclay products can provide a vapor retarding function in addition to their normal use for below-grade waterproofing. The purpose of this reference document is to describe the characteristics of Volclay waterproofing products as vapor barriers and to interpret the meaning of vapor permeance tests that have been performed on these products.

What is a vapor barrier? ASTM defines a vapor retarder as a material or construction that impedes the transmission of water vapor under specified conditions (the term “barrier” is no longer used within ASTM to describe such products). ASTM E 1745, Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs, requires that the vapor retarder exhibit a permeance no greater than 0.3 perms. This specification also lists tensile strength and puncture strength requirements corresponding to three different classes of vapor retarders. The permeance value, however, is the same for all three classes.

Another standard is used to ensure that the vapor retarder retains its performance characteristics across a wide range of field conditions (ASTM D 154, Test Methods for Water Vapor Retarders Used in Contact with Earth under Concrete Slabs, on Walls, or as Ground Cover). This method describes tests that expose the product to heat, cold, cyclical wetting and drying, and soil organisms. Taken together, ASTM E 1745, D 154, and E 96 (discussed below) lay the foundation for evaluating vapor retarders in terms of baseline water vapor transmission and whether certain exposure scenarios affect these baseline values.

Measuring vapor flow. Water vapor transmission across a membrane is typically measured in accordance with ASTM E96, Standard Test Methods for Water Vapor Transmission of Materials. This standard describes both the “desiccant method” and the “water method.” The desiccant method involves measuring the weight gain by a dish of desiccant placed over the test membrane; whereas the water method involves measuring the weight loss from a container of water placed under the test membrane. ASTM E 96 allows for testing to be performed at room temperature (Procedures A and B) or at elevated temperatures (Procedures C, D, and E). Most vapor barrier manufacturers use Procedure B, which is the water method at room temperature.

It is important to distinguish between vapor emission quantified via in-situ testing and vapor transmission quantified through laboratory testing. Vapor emission includes vapor released from
concrete in addition to vapor moving through a vapor retarder (if present) and the concrete. Vapor transmission includes only the vapor moving through the vapor retarder. The calcium chloride (CaCl) test described in ASTM F 1869 (Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride) is similar to the desiccant method in ASTM E 96 except that the desiccant is placed on a concrete surface and sealed from external moisture sources. This is the most common vapor emission test, and the flooring industry has relied upon it for many years in order to determine if moisture-sensitive floor systems can be safely installed on new concrete slabs. The industry-accepted maximum vapor emission rate as per ASTM F 1869 is 3 lbs/1,000 sqft/24 hrs (Suprenant and Malisch, 1998).

**Plastic membranes as vapor barriers.** Most commercially available vapor barriers are plastic films, ranging from 6 to 12 mil (0.15 – 0.30 mm) in thickness. The perm ratings for these products typically range from 0.01 to 0.04 perms. The plastic component of Voltex DS and Ultraseal measures from 0 to 0.3 perms. This is a wide range of values and is believed to be indicative of the variability of test results between different laboratories. Refer to CETCO's TR-212 for more information on the problems associated with vapor permeance testing.

![Graph showing range of values obtained for plastic components of Voltex DS and Ultraseal](image)

It is interesting to note that the relative vapor retarding abilities for all of these materials, even for the high end of the range of results obtained from testing CETCO's products, is still below the value of 0.3 perms as required by ASTM D 1745. It is also interesting to note that the industry-accepted value of 3 lbs/1,000 sf/24 hrs can be converted to 2.24 perms, assuming room-temperature conditions. Again, the vapor retarding materials in question are easily able to achieve this requirement.
**Bentonite as a vapor barrier.** Some interesting issues arise when considering bentonite as a vapor barrier:

- **Hydration state.** Delivered to a job site, bentonite is dry, with large spaces between bentonite granules. Vapor can easily pass through the material. Only when hydrated can bentonite be considered a vapor barrier. Thus it is necessary to determine whether the bentonite will be hydrated in its service conditions. In some slab-on-grade applications, it is possible that hydration will not occur.

- **Moisture retention/emission.** Bentonite is well-known to absorb liquid water. It is not known whether bentonite will release this water as vapor, or whether it will absorb subgrade moisture from below and release it into the concrete layer above. It is also possible that the bentonite will achieve an equilibrium state where it neither absorbs or releases water and water vapor. Current test methods cannot evaluate these issues, and research by Donnelly (2003) on this subject is inconclusive.

- **Panel continuity.** It is not known whether the overlapped seams of CETCO's bentonite products contribute to increased vapor flow, or whether there a relationship between liquid water seam flow and vapor seam flow.

Because of these issues, CETCO does not recommend bentonite-only products for vapor-barrier applications. Only those Volclay Waterproofing products containing a plastic membrane could be considered as viable vapor retarders.

**Conclusions.** CETCO's bentonite-only Volclay waterproofing products should not be considered as vapor retarders. Only those Volclay Waterproofing products that include a plastic geomembrane (Voltex DS, Ultraseal ST or BT, or Swelltite) should be considered for use as vapor retarders. Special precautions should be taken to ensure that the field seams of these products are taped or otherwise secured to prevent preferential vapor flow.

**References**
