

VAPOUR PERMEANCE

The use and specifications of WALLTITE® Eco v.3 sprayed-in-place polyurethane foam as a vapour barrier must be accomplished in a manner appropriate for the occupancy of the building.

Buildings designed according to Parts 3,4,5, and 6 for Group A through F occupancies (of specified area or height) allow greater flexibility in materials and systems than is provided by prescriptive requirements in Part 9, Housing and small buildings.

Issues relating to the vapour permeance of WALLTITE Eco v.3 sprayed-in-place polyurethane foam focus primarily on its ability to perform the function as the vapour barrier in a wall assembly. Testing at the National Research Council of Canada (NRC) definitively establishes that sprayed-in-place polyurethane foam insulation meets the intent of the National Building Code 2005 with respect to vapour barriers. Herein we will define and discuss the issues, beginning with a review of the pertinent NBC 2005.

SECTION 5.5.1.1 of the NBC states...

"...Where a building component or assembly is subjected to differentials in temperature and water vapour pressure, the properties and position of the materials and components in those components or assemblies shall be such that they control vapour diffusion or permit venting to the exterior so as to minimize the accumulation of condensation in the building component or assembly....Except as provided in Sentence (3), a vapour barrier shall be installed to provide the principal resistance to water vapour diffusion."

"...A vapour barrier is not required where it can be shown that uncontrolled vapour diffusion will not adversely affect any of

- The health or safety of the building users
- The intended use of the building, or
- The operation of building services".

SECTION 5.5.1.2 Vapour barrier properties and installation states...

- 1) The vapour barrier shall have sufficiently low permeance and shall be positioned in the building component or assembly so as to:
 - a. Minimize moisture transfer by diffusion, to surfaces within the assembly that would be cold enough to cause condensation at the design temperature and humidity conditions, or
 - b. Reduce moisture content by diffusion, to surfaces within the assembly that would be cold enough to cause condensation at the design temperature and humidity conditions, to a rate that will not allow sufficient accumulation of moisture to cause deterioration or otherwise adversely affect any of...
 - The health or safety of building users
 - The intended use of the building, or
 - The operation of building services".
- 3) Coatings applied to materials other than gypsum wallboard to provide required resistance diffusion shall conform to the requirements of sentence (1) when tested in accordance with ASTM E-96, "Water Vapour Transmission of Materials" by desiccant method (dry cup).

Testing was performed at the National Research Council of Canada on sprayed-in-place polyurethane foam applied to concrete block wall surfaces. These tests included first measuring vapour permeance on the whole system (a composite of the foam and the substrate) and subsequently, measuring vapour permeance on each of its components separately. Each test involved three specimens tested in accordance with ASTM E-96:



Vapour Permeance

Results (aveg)

| | Thickness (mm) | Permeance Ng/Pa.s.m ² |
|------------------------|----------------|-------------------------------------|
| Spray Polyurethane | 26.5 | 143 |
| Concrete blocks (web) | 21.8 | 271 |
| Polyurethane on blocks | 48.3 | 36.4 |

The results clearly showed that the sprayed-in-place polyurethane foam applied to the surface of concrete blocks has a much higher resistance toward water vapour transmission than the sum of the values obtained on each of the components tested separately. The vapour permeance of the interface layer and the masonry substrate is very significant. The study shows that this interface layer can provide resistance to water vapour diffusion that is greater than the values obtained for the individual components tested separately...

Further, the study goes on to calculate that the vapour permeance for the following thickness of sprayed-in-place polyurethane foam (SPUF) on concrete block back-up and on exterior gypsum board:

| | | | |
|----------------------------|-----------------------------|-----------------------------|---------------------------|
| 50 mm SPUF/Concrete blocks | 29.5 ng/Pa.s.m ² | 50 mm SPUF/Exterior drywall | 52 ng/Pa.s.m ² |
| 75 mm SPUF/Concrete blocks | 24.6 ng/Pa.s.m ² | 75 mm SPUF/Exterior drywall | 39 ng/Pa.s.m ² |

The NRC then applied these results to a hygrothermal computer model of vapour diffusion through this system. They used climatic conditions for the island of Montreal for a 52-week period. The analysis of the results obtained concludes that the SPUF progressively became drier throughout the year covered by the simulation.

TROW Consulting engineers

We have taken this one step further by having Trow Consulting Engineers Ltd. accompany us to perform two separate site investigations in the London, Ontario area, (Trow project: L05112BSC). Retained samples were sent to ORTECH for analysis (Report # 98-IMS-022).

This investigation looked at core samples taken from cavity wall installations, left exposed to the elements to facilitate a thorough investigation. The results for the "Labourers Training Facility," an institutional building, show that WALLTITE[®] had a moisture content by weight of 0.72%. What does that mean? Well, at 2.37 lb/ft³ in-situ density measured from the sample, the weight of foam would be 0.3 lbs, and the weight of the water in the sample would be 0.002 lbs! To put this in perspective, this is equivalent to 0.0000341 gallons of water per square foot of wall area. Trow's investigation also revealed that the foam was "well adhered to the substrate, dry to the touch with no visible evidence of moisture on the sample or in the hole", the interface between the foam and the concrete block wall was dry in a harsh cavity wall environment!

The results of our tests and the research of the NRC (published in the "Journal of Thermal Insulation and Building Envelopes" Vol. 21, issue 3, 1998) are conclusive: an application of sprayed-in-place polyurethane foam on a concrete block wall can perform the function of vapour barrier for institutional buildings.

TECHNICAL ASSISTANCE

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Warning! These products can be used to prepare a variety of polyurethane products. Polyurethanes are organic materials and must be considered combustible.

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