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VAPOR RETARDERS: The Little Differences Could Mean A Lot

By Frank Bitting - LAMTEC CORPORATION

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Extended service life and maximum energy savings in a pre-engineered building will result from specifying the correct facing for the insulation system. ASTM E-241-90 states "observations have shown that apart from structural errors, a high percent of building construction problems are associated with water."

Pre-engineered building specifiers and engineers realize that Water Vapor Transmission Rate (WVTR) is a vital property because it protects and enhances the overall effectiveness of the insulation system. To understand the crucial role that an insulation facing plays in a pre-engineered building system, it is important to understand the meaning of WVTR.

WVTR controls the rate of water vapor diffusion through the facing and into the insulation. The lower the WVTR, the better the vapor retarder. During changes in temperature and humidity, a difference in water vapor pressure exists between the inside and outside of a building. This vapor pressure difference is the driving force causing water vapor diffusion. Water vapor passing through the facing and into the cold side of the insulation can condense and adversely affect insulative properties. A good vapor retarder (facing) will resist this water vapor transfer caused by the vapor pressure difference.

Liquid water resulting from condensation has a thermal conductivity approximately fifteen times greater than most commercial thermal insulations. The thermal conductivity of ice is almost four times greater than water. This demonstrates the need to select facings with very low WVTR properties in climates and applications where condensation may occur.

It is also important that all vapor retarder closure systems or seams be sealed correctly. Even the best vapor retarder can be rendered inadequate from leaky seams. All punctures, penetrations, and holes must be repaired with tape to maintain continuity of the vapor retarder.

The chart below shows the relationship between U.S. perm rates and the quantities of moisture that can diffuse through the various facings. The calculations are based on 50,000 sq. ft. of facing, no leaks at the seams, inside and outside temperatures at 73º F, with a 50% RH on one side of the facing and 0% RH on the other (as outlined in ASTM E-96, Procedure A).

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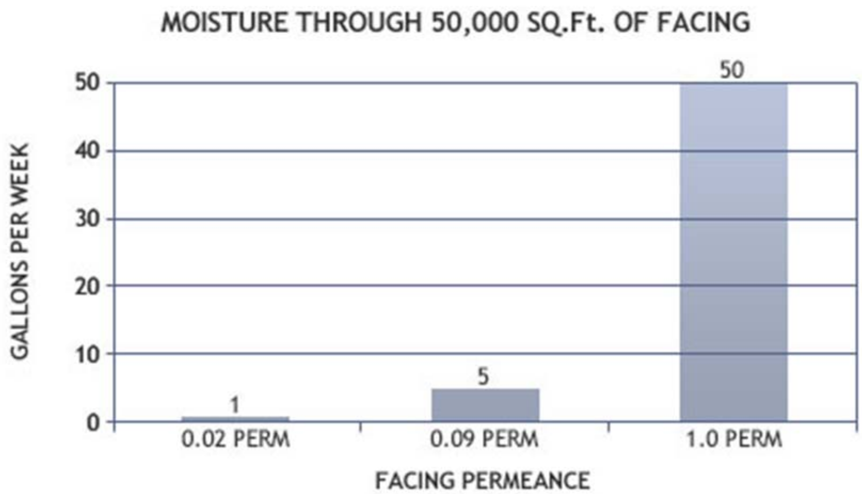

According to the calculations, a facing with a WVTR of 1.0 U.S. perms will allow 50 gallons of water to permeate into the insulation per week. This compares to 5 gallons per week for a facing with perm rating of .09 and only 1 gallon per week for facing with perm rating of .02. These figures, based on test conditions, show the difference a facing can make in retarding moisture migration.

Results from full scale WVTR tests on roof sections, conducted by Ron Raab at Johns Manville's Research Center, show that with identical vapor retarders, as insulation thicknesses increase, more moisture is diffused through the retarder and a greater volume of water vapor can be held in the insulation cavity. Raab's results point out the need for better vapor retarders on thicker insulation systems.

Vapor retarder facings are available in a wide variety of styles and performance properties. Styles range from plain white vinyl film to laminated composites containing various combinations of aluminum foil, plastic films, kraft papers, reinforcing yarns and fabrics. The facings differ in strength, color, light reflectivity, and their ability to retard moisture migration into the insulation.

Properly designed pre-engineered buildings are highly energy efficient and cost effective structures. By examining the properties available in the various facings; architects, contractors, and builders can provide a pre-engineered building with optimum thermal efficiency, structural integrity, and enhanced interior aesthetics with minimal cost impact on the overall project.

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Addendum
Since this article was published, ASTM has developed C1136, "Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation". This specification addresses the need for better vapor retarders and includes the following minimum requirements.

Physical Property	TYPE I	TYPE II	TYPE III	TYPE IV
Permeance, (Perm) ($ng.Pa^{-1}s^{-1}m^{-1}$)	0.02 (1.15)	0.02 (1.15)	0.10 (5.75)	0.10 (5.75)
Puncture Resistance, min Beach units (metric units)	50 (58)	25 (29)	50 (58)	25 (29)
Machine Direction Tensile Min, lb/in. width (N/mm width)	45 (7.9)	30 (5.3)	45 (7.9)	30 (5.3)
Cross Direction Tensile Min, lb/in. width (N/mm width)	30 (5.3)	20 (3.5)	30 (5.3)	20 (3.5)

Vapor retarders with water vapor transmission rates greater than 0.10 perms are no longer acceptable for low permeance applications.

In addition, NIAMA (North American Insulation Manufacturing Association), formerly TIMA (Thermal Insulation Manufacturing Association), recommends that metal building insulation be faced with a vapor retarder having a permeance of not greater than 0.10 US perm.

Editor's Note: Frank Bitting has over 36 years of industrial experience and currently serves as Director of Research and Development for Flanders, New Jersey based Lamtec Corporation. The company manufactures UL listed fire retardant vapor retarders for use as insulation facings. Previously, he worked with Johns-Manville Corporation from 1957-70 and Nashua Corporation from 1970-77 before joining Lamtec Corporation in 1977 when the company began manufacturing.

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