

BY TED CUSHMAN

A One-Way Vapor Barrier?

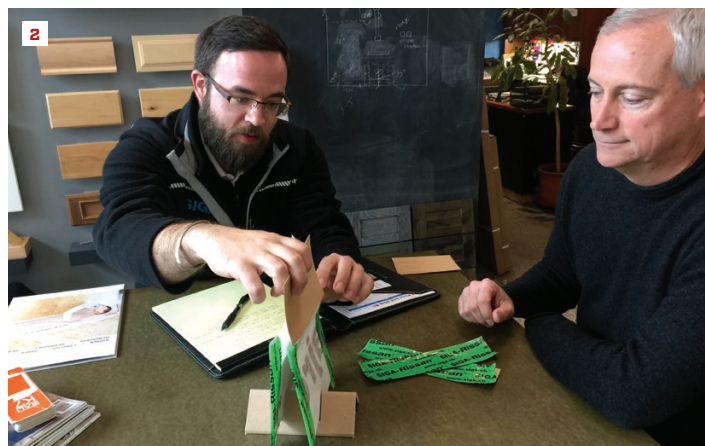
Vapor barriers are a complex subject, and often a confusing one for contractors and tradespeople. In recent years, as new materials have entered the industry, the topic has only gotten more complicated.

A few years ago, *JLC* took a look at the new crop of “smart” vapor retarders, represented by products such as ProClima’s Intello and CertainTeed’s MemBrain (see “Understanding ‘Smart’ Vapor Retarders,” Dec/15). This year, there’s yet another entry in the market, and it’s a distinctly different category of product: Majrex, introduced by the Swiss firm Siga, is an advanced vapor control membrane that not only adjusts to variable humidity like Intello and MemBrain, but actually has a greater moisture permeability in one direction than in the other. The material is intended for use in cold climates, where its purpose is to protect insulated wall and roof assemblies from indoor-generated moisture during winter, but still allow the insulated cavities to dry out towards the occupied space during summer.

Based on “dry-cup” and “wet-cup” ASTM testing, the less-permeable face of Majrex is rated at just 0.16 (“dry”) to 1.3 perms (“wet”); that’s the side you install facing the conditioned space. The more permeable face opens up from 0.17 (“dry”) to as much as 3.8 perms (“wet”); that side is placed facing into the fiber-insulated wall or roof assembly. So all else being equal, moisture can move out of the wall or roof into the conditioned space three times faster than it can move in the opposite direction, into the walls or roof. Siga rep Keith Bidwell showed *JLC* a simple demonstration (left): If you seal wet wood into two envelopes made of Majrex, one with the vapor-open side in, and one with the vapor-open side out, only one piece of wood will dry out.

And like Intello and MemBrain, Majrex also responds to moisture conditions. In winter, when the indoor space tends to be dry, the material becomes more vapor-closed to help keep the structure dry. If the sun drives vapor inward during summer, the membrane opens up. So the effective difference between the two faces is more than triple: Depending on conditions, the variation from winter to summer could be a factor of 10 or more. The idea is that over time, insulated walls and roofs, even if they’re built wet, will dry out during summer, and then stay dry year round.

Siga sales manager Keith Bidwell conducts a training for contractors at Performance Building Supply, in Portland, Maine (1). At a meeting with *JLC* (2), Bidwell explains Siga’s kitchen-table demonstration of the Majrex membrane’s directional drying properties.



Photos: Ted Cushman (1, 2); Collective Carpentry (3); Kim Weaver (4); Nate Dorris (5)

How does it work? The science behind Majrex is similar to the principles that make Intello and MemBrain work. All the products rely on the moisture-sensitive properties of polyamide, a relative of nylon that has the special characteristic of opening up more to the rapid passage of moisture as more water vapor contacts and penetrates it. In humid conditions, Majrex, like Intello and MemBrain, transports moisture faster through its polyamide layer.

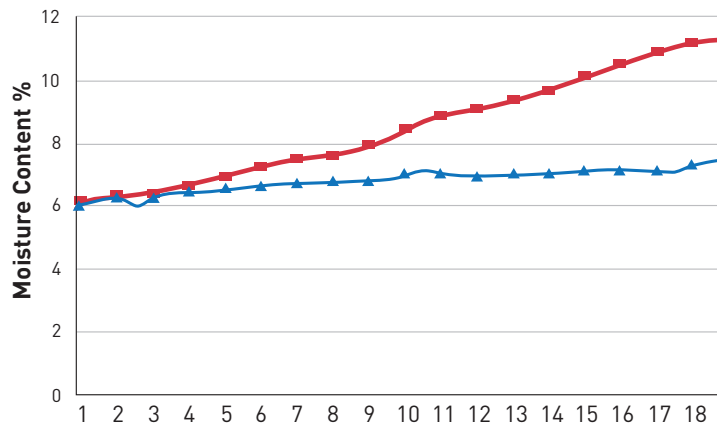
But unlike the others, Majrex has a relatively impermeable control layer laminated to its indoor-facing side; the perforations in this surface lamination let moisture pass out of the polyamide into the room air faster than it can pass from the air into the polyamide.

But there's a price to be paid for designing this indoor-facing face with a more vapor-closed baseline: At its most vapor-open, even the open side of Majrex is still quite a bit less permeable than either MemBrain or Intello in their most vapor-open states. Whether that fact matters is an open question, and it could influence a builder's thinking about which type of membrane—if any—to use.

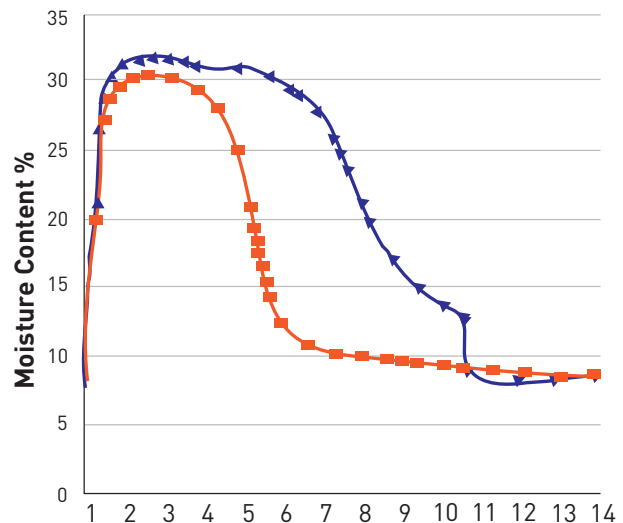
Science first. Understanding the behavior of moisture in buildings is a science. And in the case of smart vapor barriers, it turns out, theory came before practice. According to the website of the Fraunhofer Society, a technical think tank based in Germany, Fraunhofer researcher Hartwig Kunzel used WUFI, the sophisticated simulation program developed by Fraunhofer to analyze building moisture problems, to determine the characteristics of a vapor-control layer that would strike the best balance between cold-climate wintertime performance, when the vapor drive is from the inside out, and summertime performance, when warm outdoor temperatures and sunshine tend to drive moisture inward towards the conditioned space.

Kunzel's simulations led him to look for a material that would be vapor-closed when indoor relative humidity was low during the winter, but 10 times more vapor-open when vapor inside the wall or roof cavity was being forced toward the room. The search led investigators to the food-packaging industry, where polyamide's properties were already known, and then on to the development of reinforced polyamide fabrics that would have the variable permeability qualities desired while also being strong enough to be stapled to studs and rafters. Today's commercial products, MemBrain and Intello, both draw on Fraunhofer's patented technology.

The development of Siga Majrex seems to have followed a similar path. Researchers first identified a concern that even a variable-permeability fabric might expose structures to excessive vapor exposure in winter (especially flat roofs with a vapor-closed top surface). Then they tried to imagine a material that would be more vapor-tight on the indoor-facing side than on the side that faces the insulated



“Winter” Moisture Increase (weeks)



“Summer” Moisture Decrease (weeks)

Controlled conditions. European building-science researchers studied variable-permeability membranes in the lab, using mock-ups of an insulated roof with a vapor-closed roofing material. During simulated “winter” conditions (top), the mock-up with the directional permeability membrane (blue) gained less moisture than the one with a two-way humidity-responsive membrane (red). But the less vapor-open directional-permeability mock-up also took several weeks longer to dry out during simulated “summer” (bottom).

assembly, even when the indoor space was humid. Then they developed a material that they hoped would better achieve the required compromise. In the case of the new “directional” vapor barrier technology, the conceptual work originates with researchers at the Technical University of Dresden in Germany, and the mathematical simulations have been accomplished, not with WUFI, but with that university’s DELPHIN building physics software.

Nick Holbus, a manager in Siga’s tech support department for the U.S. market, emphasizes “air-barrier continuity at the lid.” He recommends Majrex for flat roofs with impermeable roofing—the very problem that inspired the product. Architect Jay Woodworth, who works with Siga in New York, agrees: “In my territory in Brooklyn, where you have a lot of flat roofs with mod bit or EPDM, pretty much 100% vapor-closed, Majrex at those ceiling assemblies on the inside really saves the day. Now you’re not worrying about vapor.”

Siga’s Keith Bidwell emphasizes the value of Majrex’s one-sided protective power for buildings under construction, where moisture evaporating out of concrete or drywall compound can stress a building early in its life. In that situation, he points out, other variable-permeability membranes may open up and expose the structure to indoor moisture.

But Floris Keverling Buisman, a principal with 475 High Performance Building Supply in New York, is quick to counter that ProClima’s Intello fabric will also allow the cavities to dry out when the seasons change.



Early adopters are starting to try out Siga Majrex in projects such as these cathedral ceilings, constructed for high-performance homes in British Columbia **(3)** and Maine **(4)**.



The ideal use for Siga Majrex, the company claims, is the underside of a flat roof in a cold climate with vapor-tight roofing above—the same application where New York architect James Wagman specified Intello variable-permeability membrane **(5)**.

Early adopters. Siga's existing line of weather-resistive barriers and sealing tapes has a strong presence in North America, but Majrex has a long way to go to build a track record. Still, the technology already has a toe-hold. Collective Carpentry, a Passive House panelizer and custom builder in British Columbia, recently tried the product out on one of the company's rare truss roof projects **(3)**. Homeowners Kirt and Kim Weaver chose Siga Majrex for a custom home project in Topsham, Maine **(4)**.

But at this early stage, building-science experts in the United States remain skeptical. "Four perms isn't very impressive when you compare it to all the other products that are designed to open up," said Kohta Ueno of Building Science Corporation. Ueno recommends variable-permeability vapor control layers for structures in cold climates, but he's reserving judgment on materials like Majrex—in part because the wet-cup and dry-cup boundary values in Majrex marketing sheets don't tell us about the material's behavior in controlled mid-range humidity laboratory conditions, much less describe its behavior in more chaotic real-world situations.

Canadian researcher Aaron Grin, a principal at RDH Building Science, in Waterloo, Ontario, says that modeling should be validated by real-world measurements. If you want to use a program like WUFI to predict a building's performance, it's wise to fill in the information gaps with a more detailed and complete set of data.

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