

# Energy Design Update<sup>®</sup>

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### Ordinary Paint as Replacement for Poly Vapor Retarder

New research evidence and field experience are leading to the conclusion that even in very cold regions, polyethylene vapor retarders are probably overkill and that ordinary paint should provide adequate resistance to moisture diffusion through walls and ceilings. Does this mean it is time to scrap the poly and pass the paint? Probably. Some of North America's leading building scientists are already discussing how building codes should be changed to reflect the new findings. And closer to the building community is a new report, written by the National Association of Home Builders (NAHB) Research Center in Maryland, which concludes that "the level of understanding regarding the movement of moisture, air, and heat through the building envelope at the research level is not yet reflected at the applications level."

The most definitive and conclusive study on the relative need for poly vapor retarders was just published by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE). Written by Achilles Karagiozis and Kumar Kumaran, research associate and senior research officer, respectively, at National Research Council Canada (NRC), the study concludes that the cost of home construction can be reduced by eliminating the poly vapor retarder. Kumaran told *EDU* that, contrary to previous assumptions that only special "vapor barrier" paints should be substituted for poly, his study shows that ordinary latex paint is adequate, even in climates as cold as Winnipeg, Manitoba.

Kumaran's analyses were for walls with wood-chip sheathing. He told *EDU* that if foam sheathing were used, the walls would be warmer during winter, leading to even less moisture condensation potential and probably no need for a vapor retarder.

Kumaran explains that the code requirements for poly vapor retarders are often justified with "steady-state" calculations. But, says Kumaran, houses don't exist in steady-state environments. The outdoor temperature changes with the season. His analyses show that in cold climates, walls that have only latex paint as the vapor retarder will experience some condensation, but that it will dry out again during the following summer. His analysis for eight Canadian cities, published in the most recent *ASHRAE Transactions*,

states: "At all locations, for all cases ... the moisture accumulated during the heating season, due to diffusion, dries out in the summer and avoids any cumulative effect, year after year."

### **Oh yeah, we knew that all along**

These assertions are not new. Canadian building scientist Gus Handegord published similar findings as early as 1950. More recently, a study by Wayne Tobiasson, research engineer at the US Army Cold Regions Research Laboratory in New Hampshire, found that vapor retarders are unnecessary in unvented roofs as long as the indoor humidity levels do not exceed 30% in the northern US and 40%-50% in central US regions. A computer modeling study, performed by Doug Burch at the National Institute of Standards and Technology (NIST), showed that walls without vapor retarders will not experience moisture problems even in the coldest US climate, as long as the indoor relative humidity remains below 50% (see *EDU*, May 1992).

As for the suitability of paint as a vapor retarder, building consultant Joseph Lstiburek, coauthor of the *Moisture Control Handbook* (see review, page 13) has recommended paint as a suitable alternative to poly for over 10 years. Lstiburek developed a system of construction that relied on the solid components in the building envelope to create the air barrier, with paint as the vapor diffusion retarder.

And it's not just computer modeling. Several field studies have also shown that vapor retarders are not necessary.

A side-by-side field test in Calgary, Alberta, sponsored by the Canada Mortgage Housing Corporation, found that 6-inch walls insulated with wet cellulose performed just as well without a vapor retarder as identical walls with a polyethylene vapor retarder. Five months after construction, the moisture content in both wall sections was nearly identical (see *EDU*, October 1989).

One poorly kept secret in the insulation industry is that many cellulose contractors simply do not install any vapor retarders in walls with spray-applied cellulose. Their thinking is that the insulation material retards air movement -- the most important moisture transfer mechanism -- and that the vapor diffusion retarder (poly) is just not necessary. Without the poly, they can install drywall over the damp insulation without concern over whether it will dry properly. Tom Ward, president of American Environmental Products in Culpepper, Virginia, told *EDU* that his contractors have been installing wet-spray cellulose with no vapor retarder for 17 years and have never had a reported moisture problem!

Three extensive field studies conducted by George Tsongas, professor of mechanical engineering at Portland State University, found virtually no relationship between vapor retarder presence and moisture content in walls. (A fourth study, conducted by Tsongas last year, did find a correlation between air leakage sites in walls and moisture problems (see *EDU*, May 1989 and November 1991).

These and other studies are leading building scientists to a consensus that current recommendations and building code requirements concerning vapor retarders are inappropriate and that code changes are in order. Though most agree in private that paint is adequate and that even ordinary latex paint should be okay, they typically add that it is not easy to translate this knowledge into new code regulations.

### **When building scientists meet code officials**

The problem with building codes is that "they are like trying to drive tacks with a sledgehammer," says Bill Brown, researcher at NRC Canada. Brown serves as research advisor to the Canadian agency that is responsible for revising the national building code every five years.

Brown explains that code officials and building scientists now know that current requirements for moisture control are not appropriate for many situations. The problem is that it is very difficult to define and describe a new system that can be expressed in building code terms and that could be enforced by building code officials. How do you inspect for proper paint coverage?

The situation is more complex in the US with its varied climate, four model building codes, and hundreds of local and state variations, than in Canada, which has a single national code, only 10 provincial variations, and much less climate variation.

### **The inevitable confusion between vapor diffusion retarders and air barriers**

Probably the single most difficult obstacle for changing building practice is the confusion between "vapor diffusion retarders," which control vapor diffusion through solid surfaces, and "air barriers," which control vapor transport by controlling air movement. The confusion arises largely from the common practice of using polyethylene sheeting for both purposes. Even the new American Society of Testing and Materials (ASTM) manual on *Moisture Control in Buildings* (see review, page 13) confuses the distinction between vapor diffusion retarder and air barrier, stating that the "vapor retarder" must not allow air leakage.

Building scientists agree that air leakage is the most important mechanism of moisture transport into walls and ceilings, and that to prevent problems, an effective air barrier (retarder) is absolutely necessary. If polyethylene is used as the air barrier as well as the vapor retarder, then it cannot be eliminated unless some other means for controlling air leakage is added. Conversely, if there is some other effective air barrier, such as the interior drywall, exterior sheathing, or exterior housewrap, and the poly is serving only as a vapor diffusion retarder, then it is dispensable and can be replaced with paint.

## **Building code requirement for poly vapor retarder did not come from moisture problems**

An article in the October 1992 *EDU* described a somewhat amusing account of the origins of the poly vapor retarder requirement in building codes as related by Cliff Shirtliffe, research scientist at NRC in Ottawa. Shirtliffe explains that years ago, some unscrupulous contractors found that they could get double mileage from batts by peeling off the facers, installing the "unfaced" batts in one house, and just the kraft facers in another house. To stop the cheating, the kraft-faced batts were banned and translucent poly was required so that inspectors could verify the presence of insulation in the wall cavities. Thus the poly vapor barrier was born.

## **Changes on the horizon**

At the most recent meeting of ASTM Committee C-16 on thermal insulation, the group in charge of Standard C755 on vapor barriers began work on a new revision. Committee members Cliff Shirtliffe and Kumar Kumaran, both of NRC Canada, will apply recent research findings to identify those elements of the standard that need to be revised.

## **Required reading for builders and moisture mavens**

The ultimate solution to the problem will probably not be a blanket recommendation to forget about vapor retarders, but rather a systems analysis approach that defines when, where, and what type of vapor retarders are necessary for various situations. Two new publications provide guidance.

Chapter 26 of the new ASTM moisture manual, written by Mark Bomberg and Cliff Shirtliffe of NRC Canada, describes a new way to apply current understanding of physics to building practice to create problem-free construction systems. Though not directed at builders, it provides the conceptual framework for new design approaches.

For builders, designers, and code officials in any climate, the new edition of the *Moisture Control Handbook* by Joseph Lstiburek and John Carmody (see review, page 13) should be required reading. Though probably conservative in some of its recommendations, it provides specific examples of wall, roof, and foundation designs for cold-, moderate-, and warm-region construction, with and without vapor retarders. Oak Ridge National Laboratories is now completing computer modeling of each of those designs to verify their effectiveness.

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