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EPS Earns New Respect for Below Grade Applications

Like comedian Rodney Dangerfield, who lamented over and over again that he couldn't get "no respect," manufacturers of expanded polystyrene insulation (EPS) have been fighting a decades-long battle for acceptability.

One of the most serious obstacles has been the wide- spread belief among builders, architects, and code officials that EPS deteriorates in the presence of water (i.e., wet soils), especially when the water undergoes freeze- thaw cycles. That perception has severely limited the use of EPS in below-grade applications and propelled the use of more expensive alternatives, such as extruded polystyrene (XPS) --for example, Dow Styrofoam.

But a new field study conducted by Canada's Institute of Research in Construction (Ottawa, Ontario), an adjunct of the National Research Council (NRC), shows that EPS used as exterior basement insulation is quite durable, even in wet soils that freeze and thaw. The findings should open up rich new markets to the EPS industry as builders and architects realize that they have a new, cost-effective option for below-grade applications.

"NRC's work will make a tremendous difference in correcting 20 years of mischaracterization of the product," says Tom Greeley, business development manager of BASF's Styropor Business Group. BASF (Mt. Olive, New Jersey) does not manufacture EPS directly, but supplies resins to manufacturers worldwide.

"It's a real breakthrough for EPS," agrees Jim Whalen, technical marketing manager for Plasti-Fab, an EPS manufacturer based in Calgary, Alberta. "We've already noticed a difference in the way people consider our product."

As ***EDU*** went to press, the Expanded Polystyrene Association of Canada (Mississauga, Ontario) and various EPS manufacturers were gearing up their advertising, public relations, and technical support people to help spread the good news.

Two Years Underground

The Canadian field study began in October 1995 when NRC researchers installed eight types of exterior insulation on the basement walls at test hut 1 in Ottawa. The test specimens included glass fiber, mineral fiber, sprayed polyurethane foam, and two different types of EPS (Types 1 and 2 as described under CAN/ULC- S701-97). As shown in Figure 1, a cementitious board protected the insulation to about a foot below grade.

After placing sensors and carefully backfilling the walls, the researchers monitored the installation for more than two years, recording weather conditions, soil temperature, soil moisture content, and the thermal performance of the insulation. After two complete heating seasons, the specimens were retrieved, sent to a lab, and compared to their original condition and performance.

"All of the specimens remained stable over the two-year test period, and their thermal resistances weren't affected in any significant way by the movement of water across the exterior face of the insulation," reports NRC scientist Mike Swinton. "We found no deterioration in their mechanical properties or loss of R-value after retrieval of the specimens from the exterior of the basement wall."

The test results are especially impressive in view of the fact that the soil around the basement had a heavy clay content, which retains moisture. Nonetheless, the eight specimens weathered periods of heavy rain and major thaws without any degradation. Oddly, the thermal performance of EPS was slightly improved during the second year of the test. "We're not sure why that happened," Swinton says. "Perhaps it was because the soil was somewhat dryer the second year."

The researchers also found no difference in the performance of EPS board that was grooved on the backside compared to the sample without grooves. "Neither of them showed any evidence of being wetted on the backside," Swinton reports. "If the EPS is properly installed, there's not likely going to be enough moisture or hydrostatic pressure forming on the backside to war- rant the use of grooved board."

The Laws Must Change

Canadian code writers have already made good progress in eliminating the institutional bias against EPS. Canada's National Building Code was recently amended to permit the use of low-density EPS (CAN/ULC-S701-97, Type 1) below grade in residential applications. All of the provinces and territories have followed suit, except for Ontario and Alberta, which require provincial legislative action to make the change. (Both are expected to approve the change during the 2001 code cycle. No restrictions existed in Canada on the use of EPS in nonresidential applications.)

NRC's research is also having a big impact internationally. "Up until now, the European countries -- especially Germany -- have been severely derating EPS performance in

below-grade applications," Whalen says. "These findings, coming from an internationally recognized research facility, will help dispel the notion that there's a significant loss in R-value." Whalen tells ***EDU*** that the NRC findings are also being reviewed by the International Organization for Standardization committee that is drafting a new international standard on geofoams.

In the US, building codes have never prohibited the use of EPS for below-grade applications, except in certain areas of the South where the danger of termite infestation is high. That prohibition, adopted by the Council of American Building Officials in 1997, applied to *all* foam plastic insulations (see ***ED***U, December 1997). Just recently, an exception was made for AFM's Perform Guard Insect Resistant EPS (see attached story).

While there's been no written law against using EPS below grade in most parts of the US, the unwritten law has been strong and pervasive. Gene Ledger, who served as a building inspector in Merrimack County, New Hampshire, for many years, says that he routinely told homebuilders that they couldn't use any type of EPS below grade.

"It wasn't stated in the building code, but conventional wisdom had it that using EPS below grade was a no-no," Ledger says. "In those days, we wouldn't allow anything but Dow Styrofoam [XPS]."

Like thousands of other building inspectors and code officials around the country, Ledger had seen test results—supplied by Dow—suggesting that EPS would deteriorate and lose its R-value when subjected to water and freeze-thaw conditions, while XPS, with its higher density, would retain its performance characteristics.

"The problem with those tests results," Greeley explains, "is that they were derived from a test procedure that was designed to test concrete immersed in water, not foam insulation affixed to a vertical wall and exposed to intermittent soil moisture. The test Dow used essentially immersed the EPS in water and put it through 1,000 freeze-thaw cycles, driving ice in between the beads and mechanically destroying the material." Greeley tells ***EDU*** that Dow did a "great job" of getting its test results into the hands of architects, builders, specifiers, and code officials, while the EPS industry, made up of smaller companies, lacked the marketing muscle to counter Dow's claims. "Those old test results are still being circulated today," he laments. "We have a long, uphill battle before us to counter that. But the NRC test results will go a long way toward setting the record straight."

EPS manufacturers are also prepping to do battle on another performance issue related to below-grade applications --compressive strength -- which comes into play on underslab installations. "XPS manufacturers have been trying to create a compressive strength standard of 25 psi for below-grade applications because it favors their product," says Robert Vasseur, sales and marketing manager at Beaver Plastics (Edmonton, Alberta). "Such a requirement would effectively eliminate EPS as an option for underslab use. But if you do the math, Type 2 EPS, which will take a vertical load of 16 psi, has plenty of compressive strength to support concrete, which, at 145 pounds per cubic foot, exerts

about 1 pound per square inch." (Other types of EPS have even greater compressive strength -- up to 25 psi -- so designers can select a density to accommodate virtually any type of structural slab application. In each specific case, the designer must consider the compressive loads actually being transferred to the insulation.)

Of course, when it comes to R-value per inch, EPS can't match the thermal performance of XPS. While Type I and Type II EPS have minimum R-values, respectively, of 3.7 and 4 per inch, XPS is rated at R-5. "In situations where thickness counts, that becomes a disadvantage," Vasseur admits. "But in most below-grade applications, thickness doesn't matter. That's where builders can get a real bang for their buck by using EPS."

Designers and builders working in the US should be aware that, while the material properties for Type 1 EPS under CAN/ULC-S701-97 are similar to those required for ASTM C 578 Type I, the properties for Type 2 under CAN/ULC-S701-97 differ from ASTM's Type II.

Editor's Note: The American Society for Testing Materials Subcommittee C-16 is developing a new standard on environmental cycling that will help characterize the durability of all thermal insulation types. A C-16 subcommittee has completed work on a freeze-thaw test protocol for foam plastics that will go out for ballot in October. On another front, the American Society of Civil Engineers and the National Association of Home Builders are developing a new standard for frost-protected shallow foundations that will detail the performance requirements for EPS and XPS. That standard is expected to go out for public ballot before year's end.

Perform Guard EPS Approved for Below-Grade Use in Termite Country

Until very recently, homebuilders in the South were forbidden by code to use any type of rigid foam insulation below grade in areas where the risk of termite infestation is severe (see ***ED***U, December 1997). The Southern Building Code Congress International (SBCCI), which administers the Standard Building Code, and the Council of American Building Officials, which administers the One- and Two-Family Dwelling Code, imposed the ban in 1997 because subterranean termites can dig hidden tunnels up through foam insulation to reach wooden framing above. Alarmed by the code changes, the Society of Plastics Industry teamed up with the National Association of Pest Control Operators to identify techniques and technologies that might be exempted from the ban. Indeed, their task force succeeded in winning three such exemptions:

1. An approved [read "documented"] method of protecting the foam plastic and structure from subterranean termites
2. Type 1, 2, and 4 construction are exempted (e.g., non- wood structures built of steel, concrete, masonry, etc.)
3. Structures where the foam insulation is affixed to the *interior* side of basement walls

Now comes news that Perform Guard insect-resistant insulation, manufactured by AFM R-Control Corp. (Excelsior, Minnesota), has won a special exception for its product (under category 1 above) and can now be used for below-grade, exterior applications. It becomes, at least for the time being, the *only* rigid foam insulation on the market that is code approved for below-grade, exterior use in areas where termites are especially active. Perform Guard is an expanded polystyrene foam (EPS) with a patented difference. During the manufacturing process, the EPS is infused with borate, a US Environmental Protection Agency registered termiticide and fungicide. As shown in Figure 2, termites (as well as carpenter ants) are discouraged from munching or tunneling through the foam.

"Our company's leaders had the vision to start long- term product testing in the early 1990s,l" says Todd Bergstrom, R-Control's technical director. "When the ban was imposed, we already had about five years of real-world, in-ground testing that proved our product's effectiveness against termites."

Because R-Control now has a strong competitive advantage in some of the hottest construction markets in the South, other EPS manufacturers are looking hard at the possibility of developing treated EPS products of their own. While they may be able to circumvent the R-Control patent by using different termiticides, they would still have to thoroughly test the product, seek a code exemption, and finally bring the product to market. Meanwhile, R-control has announced that it is willing to license the technology to manufacturers of insulated concrete forms.

We should note that builders who use Perform Guard for exterior basement insulation, slab edge foundation, etc., must affix it with AFM R-Control's Do-All-Ply adhesive,

because that is the adhesive that was used to NEWS BRIEFS test the system, and it is an integral part of the SBCCI code evaluation report.

We should also note that as an offspring of AFM's test work, the company has developed a new test standard for treated foams that is being released as a public document.

Builders and others who would like to receive a copy of the Perform Guard evaluation report or get other information can contact AFM R-Control, Box 246, Excelsior, MN 55331. Tel: (800) 255-0176; Fax: (612) 474-2074; E-mail: tbergstrom@r-control.com.