



INNOVATIONS FOR LIVING®

Owens Corning Technical Review: FOAMULAR® RIGID INSULATION AND INSULFOAM R-TECH® COMPARISON A Close look at XPS and EPS with a Polymeric Skinned Surface

Technical Q&A

Performance shouldn't be just skin deep.

For decades, countless building designers and engineers have found extruded polystyrene (XPS) insulation to be the perfect choice for a myriad of applications. XPS insulation has a long term stable thermal resistance of R-5 per inch, measured after real time aging. It's high resistance to moisture is due to its closed cell hydrophobic polystyrene polymer system, which achieves its resistance to water without relying on a facer or skinned surface.

What is INSULFOAM R-TECH® Board?

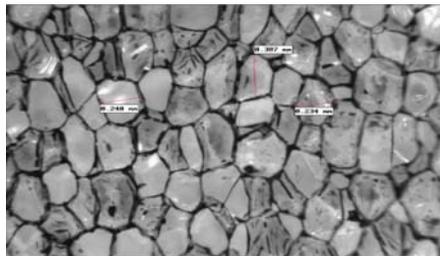
The boards consist of an expanded polystyrene (EPS) core with faces laminated with polyethylene and polypropylene films, or an optional reflective metalized film facer. It is EPS, flat faces, square edges, in various lengths and widths, thicknesses up to 5", fanfold or standard configuration. The boards are ASTM C578 Type I, II, VIII or IX.

How is R-Tech different than FOAMULAR® Rigid Foam Extruded Polystyrene Insulation?

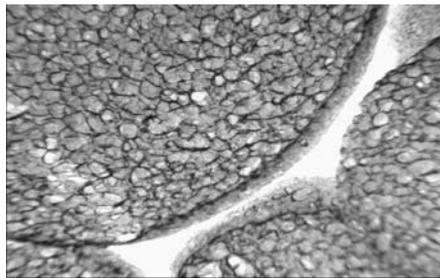
The biggest difference is cell structure, that results in R-Tech having worse (higher) water absorption and worse (lower) R-value per inch. FOAMULAR® Extruded Polystyrene (XPS) rigid foam insulation has very well defined, uniform closed cells with continuous walls. (See picture 1) The hydrophobic (resists water) polystyrene polymer combined

with closed cell walls results in a very low rate of water absorption in the FOAMULAR® rigid foam insulation.

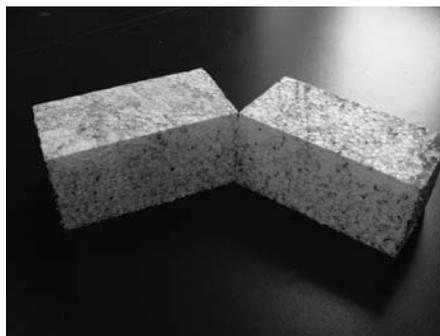
EPS (See picture 2) is comprised of polystyrene beads fused together under heat and pressure.



1. Extruded (XPS)



2. Expanded (EPS)



3. Expanded (EPS) with food color tracing paths of water intrusion

Although the beads themselves are closed cell and hydrophobic, the air spaces between them allow water and air to penetrate the board structure. Unlike the homogeneous structure of XPS,

the voids between EPS beads allow water and air to penetrate deep inside the board structure (See picture 3). The air spaces in EPS contributes to lower R-value per inch of the board. The air spaces also provide a path for water penetration, raising water absorption.

What is the actual water absorption of R-Tech board?

EPS (R-Tech) absorbs more water than XPS (FOAMULAR® rigid foam insulation). This is because of the voids between the beads. Even with the R-Tech film facer, the open edges of the product still allow water to intrude into the voids between the beads. Figure 1 compares ASTM C272 water absorption test results for R-Tech and FOAMULAR® rigid foam insulation.

Is R-Tech board an ASTM C578 Type IV product as implied in some Insulfoam literature?

It is not. Type IV properties require, among other things, a minimum R-value of 5.0 per inch of thickness. In the same literature that states the product name "ASTM C578 R-Tech IV", an R-value of 4.5/inch is claimed. That is not Type IV compliant. Other R-Tech literature claims water absorption of < 1.0 % volume which is also not compliant with ASTM C 578 which requires 0.3 maximum % volume for Type IV material.



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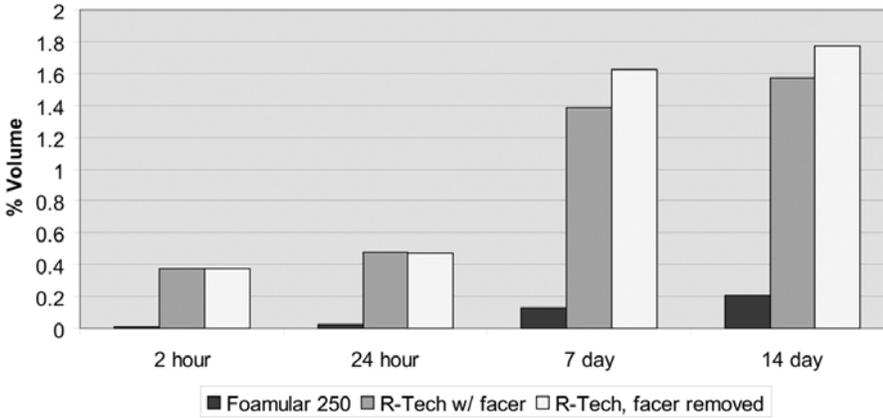
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Water Absorption - % Volume (1" thick samples)



NOTE: Water absorption is measured in accordance with ASTM C272. A sample 12" x 12" x 1" thick is weighed dry, then submerged in water for 24 hours, removed, and immediately weighed wet. Weight gain is calculated and divided by the volume of the sample. 3 samples are tested and results averaged.

In addition to the 24 hour data required by the test standard, 2 hour, 7 day and 14 day data is also graphed to provide additional insight into the effects of longer term exposure to water.

FOAMULAR® 250, 1.64 pcf density, ASTM C578 Type IV
 R-Tech, 0.96 pcf density, ASTM C578 Type I
 Data source: Owens Corning Science & Technology Laboratories

Is it true that XPS has no 20 year warranty position as claimed in R-Tech literature?

It is not true. FOAMULAR® XPS rigid foam insulation is warranted for 90% of the published R-5 at 20 years with no exclusions for exposure to moisture or other conditions. Visit www.foamular.com to view and download a complete warranty for FOAMULAR® XPS rigid foam insulation products.

When EPS like Insulfoam absorbs water it loses R-value, and, it is susceptible to permanent EPS bead damage, or breaking apart, from freezing-thawing cycles. That is cause for concern for EPS products. There is no warranty available to examine on-line for R-Tech, however, there is a warranty available for public inspection on the Insulfoam

website that says the following about Insulfoam EPS roof insulation:

"...this warranty...shall not cover any failure of the insulation to meet the minimum R-value Standard due to... moisture resulting from improper installation, application, or design of the roofing system...(or) Moisture resulting from a malfunction or failure of other roof system components... The warranty is not enforceable if the EPS insulation is damaged by any natural cause...by any act of negligence, any accident...or any intentional or unintentional misuse..."

It is clear that Insulfoam has enough concern about the negative effect of water on its EPS core products, that it is necessary to exclude coverage if exposed to water. If the same concerns and exclusions apply to the EPS core of R-Tech, then its use below grade,

or in cavity walls, or in any other place where it will encounter water is questionable. If the film laminates are damaged during installation or during installation of brick cladding or during backfill, presumably that might also void any warranty. As a minimum, design professionals should ask, "if water gets into EPS insulation, warranty or not, what happens and why the exclusions for some Insulfoam EPS products?"

How effective are insect resistance treated EPS boards?

Not very effective. The Insulfoam literature for "insect resistant rigid insulation" says, "Insulfoam insect resistant EPS has been tested against termites and carpenter ants. It should not be considered a barrier system." That really says it all. There are multiple concerns about insect infestation that treated boards cannot address. Polystyrene (EPS and XPS) does not provide a food source. However, it is a tunneling media conducive to creating the shelter that insects need to forage. Although Insulfoam is not specific about the treatment applied to its board, most EPS producers that claim "insect resistant" base their claims on borate coated beads. Borates abrade the body of some insects which leads to death by dehydration. Insects (termites, carpenter ants) are random foragers. If the insect ahead dies, the insect behind unemotionally pushes the body aside and continues on. Eventually



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the foragers will tunnel through the polystyrene, making their way through the foam to find a food source. Or, they may just as randomly turn away and tunnel another direction. The treatments may slow them down, but it is not a sure stop method.

Further, borates are water soluble. After years of in-situ EPS water absorption, the bead coatings may dissolve and lose effectiveness. And, termites/carpenter ants are just as likely to randomly choose a path behind the board, between the board and the foundation or wall. The concern for the use of any foam plastic is that it conceals the path that insects use to gain access to a building food source. If insects travel behind the treated board, the treatment is ineffective, therefore the Insulfoam disclaimer that the treated board "should not be considered a barrier system." These practical facts are the reason why some property insurers will not warrant "treated" insulation boards on homes, despite building code provisions that may accept treated insulation boards. Without termite insurance, home sale and re-sale is blocked and "treated or not treated boards" are a moot point.

Do reflective foil facers add R-value?

Yes, but only if installed in the rare proper application. As stated in R-Tech literature, reflective films can add thermal resistance if the metallic film is placed toward a

dead air space. What is not stated in R-Tech literature are other important caveats necessary to gain thermal resistance from reflective surfaces. Chapter 25 of the ASHRAE Fundamentals Handbook states the "...air space (must be) of uniform thickness, bounded by plane, smooth, parallel surfaces with no air leakage to or from the space..." Those conditions rarely exist in real construction, such as masonry cavity walls, where the back of the brick is neither plane, smooth nor parallel due to mortar extrusion from joints. Also, air spaces in masonry cavity walls are typically ventilated to allow for drainage and air circulation. All of these details minimize the value of reflective surfaces in most masonry wall air spaces. And, it must be noted that cavities in masonry walls exist to drain water. They are often wet. A wet masonry cavity is not a good place for EPS insulation that absorbs water.

Is it necessary to treat polystyrene board to make it mold and mildew resistant?

No. Untreated, unfaced FOAMULAR® XPS rigid foam insulation was tested according to ASTM Method C665-98 and CI338-00. This is a 28 day comparative test to determine whether insulation materials support no greater growth of fungi than the surrounding materials of the structure being insulated. For ASTM Method

CI338-00, five fungal cultures are used: *Aspergillus niger* (American Type Culture Collection 9642), *Aspergillus versicolor* (ATCC 11730), *Chaetomium globosum* (ATCC 6205), *Aspergillus flavus* (ATCC 9643) and *Penicillium funiculosum* (ATCC 11 797). Microscopic examination of the test insulation material after 28 days incubation showed no fungal growth.

That said, mold and mildew can grow on any surface if mold spores (abundant in the environment), adequate temperature (40° to 100° F), food (such as dust films), and moisture, are present. Mold spores, temperature and dust are beyond our control. So, the key is to choose insulation materials such as FOAMULAR® XPS rigid foam insulation that discourage water absorption and accumulation.

Is it true that R-Tech is "CFC Free"?

It is true, just as it is true that FOAMULAR® XPS rigid foam insulation is also CFC free and has been since 1992, the year of the international mandate of the Montréal Protocol. In 1992 FOAMULAR® rigid foam insulation converted to an HCFC blowing agent, known to be 90% less ozone depleting than the previous CFC system. By January 2010, HCFC's will be eliminated and replaced with an even more environmentally friendly blowing agent system.



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While expanded polystyrene (EPS) is not made with CFCs or HCFCs, it has the environmental drawback of pentane emissions during manufacturing. EPS is produced by expanding styrene beads using pentane gas, a hydrocarbon that contributes to localized smog production. Pentane gas can contribute to low-level smog formation.

An important fundamental point is that all insulations save energy. In so doing, insulation lowers the demand for energy generation which lowers the overall production of green house gases. All insulations are a net benefit to the environment.

Is R-Tech awarded LEED® points for transportation in the NW?

No. Individual products are not awarded LEED points. The regional extraction and manufacture credit in LEED is a weight and cost based calculation based on all materials (not individual materials) used on a given project. Even if included, light weight and relatively low cost foam plastic insulation products contribute little relative to the entire project calculation compared to other heavier and

more costly materials like steel, glass, and concrete. Further, not only must the product must be manufactured within 500 miles of the job site, but the raw materials must also be harvested within 500 miles to be included in the LEED calculation. It is not stated from where R-Tech raw materials originate, so, its value in the LEED calculation is uncertain.

With those caveats stated, FOAMULAR® rigid foam insulation will, by mid-2009, be manufactured at a new plant opening in Gresham, Oregon, making much of the west coast within the 500 mile radius defined by LEED for regional manufacture consideration. Just as with R-Tech, certain portions of FOAMULAR® rigid foam insulation raw materials will likely originate within the 500 mile radius. Other portions likely will not. A project by project assessment must be made to determine a products potential contribution to LEED points.

InsulFoam R-Tech is a registered trademark of Insulfoam LLC, A Carlisle Company.

LEED is a registered trademark of U.S. Green Building Council.



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OWENS CORNING INSULATING SYSTEMS, LLC

ONE OWENS CORNING PARKWAY
TOLEDO, OHIO 43659

1-800-GET-PINK™
www.owenscorning.com

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