PIMA Technical Bulletin #201

Polyiso Insulation: The Clear Winner

A Comparison of Polyiso Insulation and Extruded Polystyrene Insulation

About Polyiso Insulation

Polyiso is a rigid foam insulation used in over 70% of commercial roof construction, in commercial sidewall construction and in residential construction.

The Benefits of using Polyiso include:

- *Low environmental impact*
- *Virtually no global warming potential*
- *Zero ozone depletion potential*
- *Cost effective, optimized energy performance*
- *Long service life*
- *Recyclable through reuse*
- *Recycled content (amount varies by product)*
- *Regional materials (nationwide production network)*
- *Meets new continuous insulation (ci) standards*
- *Quality Mark™ certified LTTR-values*
- *High R-value per inch of thickness*
- *Thinner walls and roofs with shorter fasteners*
- *Excellent fire test performance*
- *Extensive building code approvals*
- *Preferred insurance ratings*
- *Compatible with most roof and wall systems*
- *Moisture resistance*
- *Dimensional stability*
- *Compressive strength*

PIMA and polyiso products have received many environmental awards. These include an honorable mention in the Sustainable Buildings Industry Council's (SBIC) - "Best Practice" Sustainability Awards Program and the U.S. EPA's Climate Protection Award for the association's leadership in promoting energy efficiency and climate protection. The EPA also awarded PIMA and its members the Stratospheric Ozone Protection Award for "leadership in CFC phase-out in polyiso insulation and in recognition of exceptional contributions to global environmental protection."

POLYISO
The top performer.

Thermoset vs. Thermoplastic — Is Your Value Melting Away?

Foam plastic insulations are either thermoplastic or thermoset materials. Polyiso insulation products are thermoset, which means that once manufactured, they are rigid, will not soften or melt and remain strong, even at elevated temperatures. In fact, they can withstand elevated temperatures without losing their insulating power.

Extruded polystyrene is a thermoplastic material which softens at 165°F and melts in the 200°F to 210°F range. These temperatures are extremely close to those found on walls and roofs. If the material is gone, so is the insulation value.

Is Insulation Affected by Construction Materials?

Extruded polystyrene can be attacked by many petroleum-based solvents in adhesives, paints, stains, water repellent and preservative coatings, and in bituminous waterproofing. Solvents should be allowed to evaporate before touching the foam.

However, as many contractors have discovered, the application of these common construction materials causes the extruded polystyrene to dissolve. This problem is solved by using polyiso insulation. It is not affected by these materials and therefore offers a level of comfort that the insulation value will remain in place year after year.

Fire Test Performance — Are All Foam Plastic Insulation Products Alike?

Not all foam plastic insulations perform equally in fire tests. In roofing applications, polyiso insulation can withstand high temperatures which accounts for its successful performance in FM 4450, ANSI/UL 1256 and CAN/ULC-S126 test. Other foam plastic insulations, like polystyrene, are thermoplastic materials, which soften at 165°F and melt between 200°F to 210°F, long before the standard 30 minute fire exposure ends. Because of the high temperatures reached in the FM 4450 test, polystyrene melts through the seams of the steel deck, spreads fire on the underside of the deck and liberates flaming particles into the furnace. Accordingly, the FM Approval Guide does not list any Class 1 Roof System Approvals for the use of polystyrene insulation in a direct to steel deck application (i.e., without the use of a thermal barrier).

Polyiso is still the only foam plastic insulation product to have direct to steel deck approvals from both FM and UL/ULC. FM Approval for Class 1 Roof Systems was granted to polyiso for passing FM 4450, UL/ULC

classification was earned by passing ANSI/UL 1256, and ULC classification by passing CAN/ULC-S126. All of these tests are specifically referenced in many building codes.

Tunnel Test

Often referred to as the "Tunnel Test," ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials is a standard method to assess the spread of flame on the surface of a material. Since ASTM E84 is a standard laboratory fire test on a single material, numerical ratings derived from E84 are not intended to reflect hazards presented by the test material under actual fire conditions.

Polyiso insulation, a thermoset material, stays intact during the fire exposure and successfully performs by forming a protective char layer and remaining in place during the tunnel test, meeting the necessary ratings prescribed by building codes.

Thermoplastic materials, such as polystyrene, perform much differently in the tunnel test. Because the material softens at 165°F and melts between 200°F to 210°F, polystyrene melts ahead of the fire front and drips to the floor of the tunnel where it can continue to burn and spread the fire.

Although many polystyrene insulations claim a flame spread of 5, an examination of a testing laboratory certification label[1] for an extruded polystyrene insulation reveals:

Max. 1-inch thickness	**Max. 4-inch thickness**
Max. 1.86 pcf density	**Max 4 pcf density**
Unfaced	**Faced or Unfaced**
Flame spread 5**	**Flame spread 5++**
Smoke developed 115**	**Smoke developed 165 ++**

** Flame spread and smoke developed recorded while material remained in original test position. Ignition of molten residue on the furnace floor resulting from flame travel equivalent to calculated flame spread classification of 45 and smoke developed classification of 350.

++ Flame Spread and Smoke Development recorded while material remained in original test position. Ignition of molten residue on the furnace floor resulting from flame travel equivalent to calculated flame spread classification of 90 and smoke developed classification of over 500.

Ultraviolet Light — What's the Effect?

Ultraviolet light degrades extruded polystyrene. When installed on the job and left exposed to the rays of the sun, the surface of extruded polystyrene becomes yellow and dusty. In these cases, you can take a brush and dust an insulation value right off the extruded polystyrene board.

The facers on polyiso insulation protect the foam core from UV degradation.

The Freeze/Thaw Myth — What is ASTM C666?

Extruded polystyrene manufacturers often refer to ASTM C666 as the basis for data, which shows that the R-value of polyiso degrades with repeated freeze/thaw cycles. In fact, ASTM C666 is known as the "Standard Test Method for Resistance for Concrete to Rapid Freezing and Thawing." As the title of the method indicates, it is of no relevance in determining the R-value retention of an insulation board.

Thermal Performance — On a per inch basis, polyiso always exceeds polystyrene!

In every recommended application, polyiso insulation delivers more R-value per inch of thickness than extruded polystyrene products. For example, when both products are used as wall sheathings,

1 *Underwriters Laboratories Inc, Classifications Certificate D-369 for Styrofoam Brand Insulation Manufactured by Dow Chemical U.S.A.*

the ASHRAE Design R-value for 1" foil faced polyiso is 6.0 per actual inch versus 5.0 for polystyrene, when tested at 75°F mean temperature.

In roof applications, permeable facers are preferred and the average thickness of foam used is 2 inches. At this thickness, the advantage in thermal performance of polyiso over polystyrene is at least 20%. This benefit produces meaningful savings in energy consumption as well in installation costs.

Does Moisture Matter?

Moisture can be present in a wall or roof system as liquid water or water vapor — two distinct and separate phases of water that can behave very differently.

The real enemy of insulation performance is water vapor. If water vapor passes into and condenses in the insulation, the overall thermal performance will decrease. The questions that should be asked are:

- Will water vapor pass into and condense in insulation used as roof insulation or side wall sheathing?
- How can you determine if insulation is prone to water vapor problems?

A material's resistance to water vapor is determined by testing the product via ASTM E96, a measure of water vapor transmission. This method produces permeance ratings, or perms. Typically, polyiso foil-faced sheathings have perm ratings of less than 0.03, or 22 times better than extruded polystyrene. This means extruded polystyrene is more likely to let water vapor penetrate into their cells. If this happens and the dew point temperature is reached, water will condense inside the cells reducing the insulation value.

Liquid water should never be present in a building system. If an insulation, polyiso or polystyrene, is submerged in water, the insulation benefit disappears as the water short circuits around the insulation. Insulations must be kept dry. If minor contact does occur, the foil facings and closed cells of polyiso provide excellent water resistance.

Construction Costs

Energy Conservation Management, Inc. (ECM) — an independent energy analysis firm in Baltimore, Maryland has performed a number of case studies comparing the construction costs of polyiso insulation and other materials in roof and wall assemblies. Below are the summaries from those studies.

Roof Construction

Polyiso insulation emerged as the decisive winner over extruded and expanded polystyrene insulations in a recent study that compared the cost benefits of using various insulation products in commercial roofing systems. The study completed by ECM revealed pertinent information about factors, such as return on investment, installation costs and payback rates, which determine the cost effectiveness of using different insulation products in construction applications. The bottom-line numbers showed why polyiso has become the leading insulation product in the marketplace today, as well as why it is the preferred choice for specifiers, architects, and contractors.

Wall Sheathing

ECM performed a case study comparing exterior wall systems using polyiso wall sheathing to exterior wall systems using wood composite sheathing. The study demonstrated that the polyiso wall sheathing system using proper shear bracing out performs the wall system using conventional sheathing, by offering lower construction costs while delivering higher effective R-values. The bottom-line numbers of this study reinforced why polyiso is one of the leading insulation sheathing products in the marketplace today.

Final Score: Advantage Polyiso

Whether the application is roofing, sheathing, cavity wall, EIFS, metal buildings, commercial, or residential, polyiso is the product of choice.

Polyiso insulation products are easy to specify and meet the requirements of both ASTM C1289, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board and CAN/ULC-S704 Standard for Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced. By referencing ASTM C1289 or CAN/ULC-S704 in your insulation specifications, you can be assured that you have the best insulation product for the project.

PIMA

For over 20 years, PIMA (Polyisocyanurate Insulation Manufacturers Association) has served as the unified voice of the rigid polyiso industry proactively advocating for safe, cost-effective, sustainable and energy efficient construction.

PIMA produces technical bulletins in an effort to address frequently asked questions about polyiso insulation. PIMA's technical bulletins are published to help expand the knowledge of specifiers and contractors and to build consensus on the performance characteristics of polyiso. Individual companies should be consulted for specifics about their respective products.

PIMA's membership consists of manufacturers and marketers of polyiso insulation and suppliers to the industry. Our members account for a majority of all of the polyiso produced in North America.

SAFETY

Polyiso insulation, like wood and other organic building materials, is combustible. Therefore, it should not be exposed to an ignition source of sufficient heat and intensity (e.g., flames, fire, sparks, etc.) during transit, storage or product application. Consult the product label and/or the PIMA members' Material Safety Data Sheets (MSDS) for specific safety instructions. In the United States, follow all regulations from OSHA, NFPA and local fire authorities; in Canada, follow all regulations from Health Canada Occupational Health and Safety Act (WMHIS) and local fire authorities.

For more information on polyisocyanurate insulation, visit www.polyiso.org

PIMA
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