CONTINUOUS WALL INSULATION IN HOMES AND BUILDINGS

REPORT
2020

PATHWAY TO A MORE SUSTAINABLE PLANET

Eneref Institute examines how polyisocyanurate continuous wall insulation can help reduce carbon emissions.

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CONTINUOUS WALL INSULATION IS AN ENERGY-SAVING HVAC SOLUTION FOR HOMES & BUILDINGS

Polyiso CWI insulation can reduce the energy demand of heating and cooling systems and also add structural integrity and moisture resistance.

Constructing energy-efficient high-performance homes and buildings is necessary to reduce global CO2 emissions and mitigate climate change. As such, insulation should be a priority. However, while homeowners are naturally well-attuned to their home's aesthetics, too often they fail to invest in tighter insulation technologies that would greatly reduce their home's heating and cooling energy demand. And commercial builders are often reticent to change construction practices even when new technologies may offer better solutions.

Building codes should therefore mandate the healthiest, most energy-efficient and most structurally sound insulation systems for commercial and residential construction. Continuous Wall Insulation, examined in this report, is a cost-effective solution that provides strong resistance to thermal air flow and moisture infiltration while supplementing structural integrity.

Walls, of course, function to separate the interior from the exterior, restricting the movement of heat, air and moisture through the building envelope. Continuous Wall Insulation (CWI) has the benefit of sealing all the surfaces of a home or building, including the walls and roof, to prevent thermal tunnels—the leaking of heat. CWI systems can be installed on either the interior or exterior surface of the building envelope.

CWI is made of a semi-rigid closed-cell foam typically manufactured of polyisocyanurate, which the industry terms "polyiso." The foam is formulated by combining two liquid chemicals: polyol and isocyanate.

POLYISO INSULATION MARKET

Because of its rigidity, water resistance and overall strength, polyiso foam insulation is often used for energy-efficient low-slope commercial roofs. Today, already 75 percent of US commercial roofs use polyiso insulation. The United States represents the largest market for polyiso insulation worldwide, followed by Europe. The major US manufacturing brands of high-quality polyiso include Carlisle, Atlas Roofing, Firestone, GAF, IKO, Johns Manville, Rmax and Soprema. With the recently heightened interest in Continuous Wall Insulation, the worldwide market for polyiso insulation is expected to grow. The Polyisocyanurate Insulation Manufacturers Association represents the group in Washington DC, headed up by its President, Justin Koscher.

Yet, despite the commercial market gains and technological advances of polyiso, the residential insulation market is still dominated by fiberglass and mineral wool. The major players in residential insulation include Owens Corning, CertainTeed, Johns Manville, Knauf and Rockwool.

Lower cost, complacency and industry inertia are the primary reasons that fiberglass and mineral wool cavity insulation are more common than polyiso in home and building construction, but the market strength of the major players is a significant contributing factor as well. NAIMA, the organization representing traditional insulation companies, has also gathered years of research documenting the benefits of fiberglass and mineral wool.

However, as Eric Rexrode explains, "Polyiso is definitely the preferred choice for the roof, so why wouldn't you use it to insulate the rest of your building,

too?" Rexrode is R&D Manager of Rigid Raw Materials at Covestro, a leading manufacturer of polymers to the insulation market and polyiso manufacturers. Cavity insulation, of course, isn't going away. However, installers can now take advantage of a trend and increase revenue by installing CWI.

THE CWI SOLUTION

All insulation basically performs the same function: to provide resistance to heat flow. While this report examines polyisocyanurate foam (polyiso), a variety of insulation materials with different properties can be used to create Continuous Wall Insulation, including expanded polystyrene (EPS) and extruded polystyrene (XPS). Polystyrene products compete with polyiso for market share in the residential rigid foam market. Extruded polystyrene has been popularized by Owens Corning's use of the Pink Panther but is also sold by DuPont and Kingspan.

Most polyiso boards are about 2 to 2.5 inches thick, with some boards as thin as half an inch. In Europe, polyiso is made as thick as 7 inches. Typically, the polyiso used in Continuous Wall Insulation has a facer material, which acts as an additional barrier to air, moisture vapor and water. Polyiso is manufactured with a variety of facer materials for different functionality, many of which are made from recycled components.

While the various insulation materials compete for market share, in an effort to drive demand for a strong thermal envelope, the insulation industry collaborates on developing energy codes. The competing materials are specified for different applications but can potentially provide the same thermal performance as each other, albeit with appropriate thicknesses to accommodate their differing R-values.

Panelization and modular construction may help drive change. One recently introduced dual technology gaining traction with homebuilders employs Continuous Wall Insulation polyiso on the exterior of the home and spray polyurethane foam (SPF) in the wall cavity. Covestro LLC, a spin off of German company Bayer, in collaboration with Hunter Panels, a leading polyiso manufacturer based in Portland, Maine, manufactures and markets this

INCHES OF MATERIAL NEEDED TO REACH R-15

SMALLER NUMBER MEANS A BETTER INSULATOR

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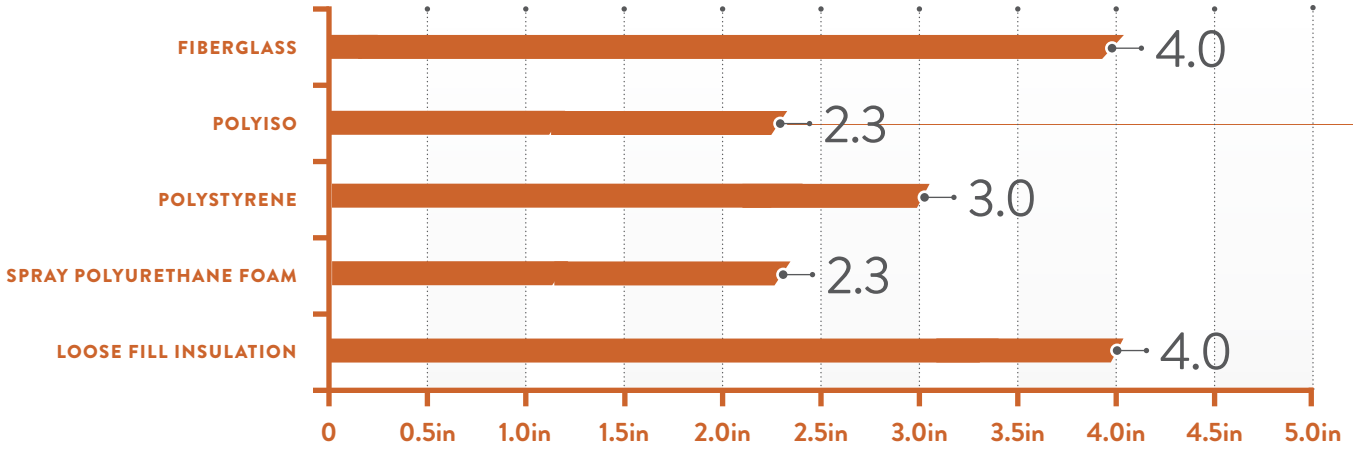

MODULAR WALL CONSTRUCTION

Recently introduced PUReWall combines polyiso on the exterior and SPF in the wall cavity.

insulation solution as PUReWall, a complete wall system for residential construction. Spray polyurethane foam (SPF) is a spray-applied blend of isocyanate and polyol resin that is more costly than fiberglass and cellulose but has a higher R-value per inch. SPF can air-seal buildings, cracks and gaps. The PUReWall self-contained insulated modular wall panel is manufactured with taped joints to create weather-resistant tight tolerances, thereby eliminating the need for additional house wrapping material.

Another all-in-one structural panel with built-in polyiso is Huber Engineered Woods' ZIP System, which also eliminates the need for housewrap.

MARKET OBSTACLES

Because polyiso Continuous Wall Insulation is a practical solution to help reduce global warming, it would benefit from incentive-based financing programs for both residential and commercial construction. The obstacles to faster adoption of polyiso CWI are similar to other energy-saving technologies. While CWI represents the best solution in many applications, the low cost of energy in the US increases the time needed to see a return on investment.

In residential construction, most homebuyers don't fully appreciate the heating and cooling cost savings they would see with better insulation. Large tract homebuilders tend to eschew CWI, even though it has a high R-value per inch when compared to common alternatives, because insulation represents a sizable percentage of the total construction costs for mid-priced homes. However, in commercial construction, polyiso is already commonly specified for roofing insulation and is therefore readily and locally available throughout the US. Today, polyiso is manufactured in 36 plants across North America, with more scheduled in the near future.

BEST PRACTICES

Despite the potential barriers, Eneref's field research has shown that homebuilders are increasingly adopting CWI. As more products and best practice guides become available, builders are becoming more comfortable with a different technique of fastening polyiso to the studs on the exterior wall. That's because the value proposition for polyiso Continuous Wall Insulation is compelling and persuasive.

CWI can significantly reduce the energy demand of home heating and cooling systems. Traditionally, thermal insulation for walls is installed in the cavities between the 2x4 wall framing. However, this approach allows heat to escape—into or out of the home. Because the wall framing is exposed to changes in outside air temperature, it acts as a "thermal bridge" for heat flow.

Polyiso CWI creates an uninterrupted barrier that reduces thermal bridges by providing a continuous layer of insulation over the entire wall surface. This application method is especially useful with wood- or steel-framed construction, significantly increasing the energy efficiency of a home. By blocking thermal

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bridging, Continuous Wall Insulation increases the overall thermal performance of the wall assembly and the home.

SLENDER, STRUCTURALLY SOUND AND DURABLE

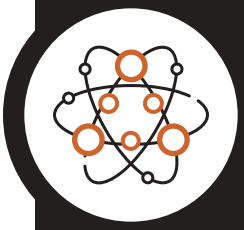
Not only does polyiso deliver a high R-value per inch compared to other types of continuous insulation, but it also adds structural stability, creating a more durable wall. Although polyiso CWI alone is not a structural bracing material, laminating polyiso to structural materials increases the dimensional integrity of the wall. Adding CWI to cavity insulation protects interiors and wall cavities from condensation and keeps moisture from entering the house, reducing the risk of rot and rust. When water vapor cools, it condenses, creating moisture on the wall surface. CWI keeps the inside air from seeing that outside moisture-laden air by warming the studs and maintaining the wall cavity at the same temperature as the interior environment. CWI is also a secondary line of defense against rainwater intrusion.

The higher R-value of polyiso CWI allows for thinner walls, and thus more usable floor area within the footprint of the home or building. And some contractors interviewed for this report found that cladding materials were more easily installed over polyiso CWI.

Lastly, although polyiso is a petroleum-based insulation, the foam is required to pass a number of flammability tests. Major manufacturers custom-develop their polyiso formulations to target specific flammability performance measures and fire standards required by the building code.

LIMITING GLOBAL WARMING

To reduce the carbon emission of heating and cooling systems in homes and buildings, model energy codes need to emphasize higher-performing wall assemblies that insulate the entire wall, like polyiso CWI, rather than just the wall cavity.



THE *SciBox:*

THE CHEMISTRY OF POLYISO

CWI is made of a semi-rigid closed-cell foam typically manufactured of polyisocyanurate.

POLYISOCYANURATE (POLYISO) IS MANUFACTURED *by mixing isocyanate and a polyol blend with a catalyst, along with other performance-boosting additives including blowing agents and flame retardants. Polyiso works as an insulator precisely because it is a closed-cell foam: foam is primarily gas locked inside bubbles, and gases conduct significantly less heat than solids. For polyiso, the ratio is 30 parts gas to 1 part solid material. The gases used in polyiso foams are chosen based on how little heat they conduct. To fabricate polyiso, the chemical components are blended, poured between two pieces of facer material, and then run through a laminator in a continuous process to form the rigid boards.*

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LEAD BY EXAMPLE.

ENEREF CAMPAIGNS ARE DESIGNED TO CREATE A COMMON UNDERSTANDING OF SOLUTIONS TO GLOBAL WARMING AND ENCOURAGE PEOPLE TO TAKE ACTION.

AS A SOCIETY, we're more likely to act on environmental solutions when knowledge is shared. That is, when every member knows the same information—and knows that every other member shares that knowledge, too. A viral argument becomes common knowledge, and common knowledge becomes action. Eneref Campaigns bring about that positive tipping point by creating the dynamic of common knowledge and the perceived social pressure to act responsibly. We'll ignite a movement so that you can lead others.
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Every organization must harness their capacity to improve our planet and society.

Right now, we need to make unprecedented changes to ensure a sustainable and equitable society. Limiting global warming requires rapid and far-reaching transitions in land, energy, industry, buildings, transport and cities. Every extra bit of warming matters to reduce irreversible harm to our ecosystems.

We encourage organizations to grow sustainably and act responsibly by raising awareness for clear, specific solutions that offer an efficient use of natural resources, demonstrate social responsibility and foster a peaceful, earth-friendly economy.

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