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Polystyrene Insulation: Does It Belong in a Green Building?

Polystyrene, in both extruded and expanded forms, is very widely used as rigid insulation in North America and worldwide. In below-grade applications, owing to its good insulation value, superb moisture resistance, strength, performance, and affordability, polystyrene dominates the market.

Rigid mineral wool can be an excellent substitute for polystyrene, owing to its moisture repellency and insect resistance.

But a chemical that's added to polystyrene to provide fire resistance has recently raised significant concerns. Indeed, the European Union may be on the verge of significantly restricting the use of this chemical—HBCD. Given other environmental concerns about polystyrene, this latest development raises the question of whether this insulation material belongs in green buildings at all.

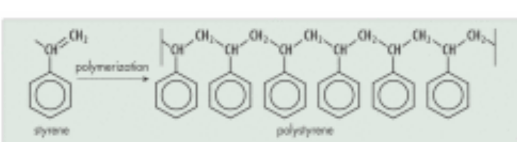
This article describes why polystyrene is such a popular insulation material, reports on new information about health and environmental concerns about the material, and examines alternatives that are available to the building industry—especially in below-grade applications where polystyrene is ubiquitous.

About Polystyrene

Polystyrene had its origins in 1839 when a German apothecary, Eduard Simon, accidentally formed a jelly-like substance from resin he had collected from a Turkish sweetgum tree. It was not until the early 1920s that another German chemist, Hermann Staudinger, figured out that the mysterious substance Simon created was a polymer and developed his theories of polymer chemistry, for which he was later awarded the Nobel Prize in chemistry. In 1930, scientists at the pioneering German company Badische Anilin & Soda-Fabrik (known today as BASF) figured out how to synthesize this hard plastic—polystyrene—and the company remains one of the leading manufacturers of polystyrene chemicals today.

In 1937, Dow Chemical introduced polystyrene plastic to the United States, and in 1953 the company introduced a lightweight, *foamed* version of the polymer as an insulation material, trademarked Styrofoam. Dow chemist Ray McIntire invented Styrofoam by accident when he sought to make a new rubber-like polymer by mixing styrene with isobutylene under pressure.

Polystyrene Molecular Structure



As shown in the molecular diagram, polystyrene is a long-chain polymer in which every other carbon atom has a phenyl group (an aromatic benzene ring) attached. It is a rigid plastic that is widely used in consumer products—such as clear plastic cups and CD "jewel" cases. For recycling, it is identified by the number 6 and abbreviation PS. Like polyethylene and polypropylene, it contains only the elements carbon and hydrogen, but polystyrene is considered a dirtier plastic because of the aromatic rings.

When polystyrene is foamed, it creates a rigid insulation material. Styrofoam, mentioned above, is an *extruded* polystyrene (XPS). Most XPS in North America is produced at a density of 2 lb/ft^3 (32 kg/m^3). Dow, along with Owens Corning (Foamular) and others, produces the vast majority of XPS in North America. The material is widely available in building supply yards.

Polystyrene insulation can also be produced in an *expanded* form, EPS, which is also known as *beadboard*. EPS is made by taking polystyrene beads that are impregnated with pentane and expanding them using steam. The expanding beads fuse together into large billets that are then cut into slabs of any desired dimensions using a hot wire that melts through the EPS. Compared with XPS factories, EPS facilities are inexpensive to build, so EPS manufacturers tend to be small, regional companies, with few products distributed nationally and sold through building supply yards.

Both XPS and EPS are commonly used in buildings. XPS offers better thermal performance at R-5 per inch vs. R-4 to R-4.5 per inch for most EPS—with higher-density EPS achieving higher R-value. XPS is known for its excellent moisture resistance, high compressive strength, and uniformity, and these properties make it popular for insulative wall sheathing, roof sheathing, exterior foundation insulation, and sub-slab insulation. In commercial buildings, XPS is the insulation material of choice for the inverted roof membrane assembly system developed by Dow—the rigid insulation is installed *on top of* the roof membrane, protecting the membrane and increasing the likelihood that the insulation will be reclaimed and reused when the membrane is repaired or replaced.

EPS is less expensive than XPS, but its performance properties are not as good. Because standard EPS at 1 lb/ft^3 density (16 kg/m^3) may absorb moisture over time, higher-density EPS—minimum 1.5 lb/ft^3 (25 kg/m^3) and up to 2 lb/ft^3 (32 kg/m^3)—is recommended for below-grade applications. A big advantage of EPS is that it can readily be molded into insulated concrete forms (ICFs) and specialized architectural trim for exterior insulation and finish system (EIFS) detailing, and it is by far the most common core material for structural insulated panels (SIPs).

What's Wrong with Polystyrene?

Like all insulation materials, polystyrene (both XPS and EPS) plays an extremely important role in improving the environmental performance of a building by boosting energy performance. But polystyrene also has some problems.

Polystyrene insulation contains HBCD

Both XPS and EPS contain the brominated flame retardant hexabromocyclododecane (HBCD—referred to as HBCDD in Europe) at concentrations of between 0.5% and 1.2% by weight, according to the American Chemistry Council. While there is still much to learn about the health and environmental impacts of HBCD, enough information has come to light in recent years to prompt the European Chemicals Agency, the coordinating body of the European Union's REACH program, to classify the compound as a chemical of "very high concern" and recommend that its use be restricted (see *EBN* July 2009).

Toxicologist Linda Birnbaum, Ph.D., a longtime researcher on brominated flame retardants and now the director of both the National Institute of Environmental Health Sciences in the U.S. and the National Toxicology Program, is concerned about HBCD, citing its classification as persistent, bioaccumulative, and toxic in animal studies. "Those three characteristics cause it to be of concern," she told *EBN*, though she said its relative toxicity, compared with other persistent organic pollutants (POPs), is hard to assess at this time.

Human Health and Environmental Concerns with Polystyrene Constituents

Chemical	Classification	Agency
Benzene	Known human carcinogen	International Agency for Research on Cancer California Proposition 65 U.S. Environmental Protection Agency European Commission
	Developmental and reproductive toxicant	California Proposition 65 European Commission
	Likely mutagen	European Commission
	Suspected asthmagen	Association of Occupational and Environmental Clinics
Ethylbenzene	Known human carcinogen	California Proposition 65
	Possible carcinogen	International Agency for Research on Cancer
Toluene	Developmental toxicant	California Proposition 65 European Commission
Styrene	Possible carcinogen	International Agency for Research on Cancer
	Known asthmagen	Association of Occupational and Environmental Clinics
	Endocrine disruptor	European Commission
HBCD	Persistent organic pollutant	Stockholm Convention on Persistent Organic Pollutants
	Persistent, bioaccumulative toxin (PBT)	European Chemicals Agency

According to Birnbaum, HBCD affects the liver and thyroid, it appears to cause neurodevelopmental problems, and there is some new evidence of effects on the reproductive system. "It also appears to be a CAR/PXR [constitutive androstane receptor and pregnane X receptor] inducer, many others of which are liver carcinogens," she said. HBCD itself has not yet been tested for carcinogenicity, according to Birnbaum. "I am concerned about the use of HBCD in consumer products, since it is escaping into the environment."

Chemist Arlene Blum, Ph.D., who carried out groundbreaking research on flame retardants in the 1970s that was instrumental in the banning of tris and Fryol from children's sleepwear, says that given the very high volume of HBCD use, its persistence in the environment, its toxicity, and that fact that it's being found at rapidly increasing levels in the arctic and in wildlife globally, the chemical "should only be used with caution and when absolutely necessary." She describes HBCD as a semi-volatile organic compound that is not covalently bonded to polystyrene, so she believes that leaching into the soil when in ground contact would be likely. "We need further research to determine the extent to which it can escape during the life of a building," she told *EBN*.

The fact that HBCD bioaccumulates in biological systems has been demonstrated by researchers around the world. Scientific reports that *EBN* examined from the European Chemicals Agency, the Stockholm Convention on Persistent Organic Pollutants, and the Scientific Committee on Health and Environmental Risks (SCHER) of the Health and Consumer Protection Directorate-General of the European Commission describe numerous studies of fish, seabirds, and marine mammals showing significant concentrations—particularly in Europe, where the largest quantities of HBCD are used. While HBCD bioaccumulates in the food chain, the primary means of human exposure to HBCD is believed to be inhalation of airborne dust and skin contact, according to SCHER's risk assessment report.

Although significant research on HBCD and its effects on human health and the environment remains to be done, some suggest that there is enough information available today that—following the precautionary principle—we should try to phase out this chemical or seek alternatives to polystyrene insulation (see Rethinking Polystyrene Insulation).

Polystyrene is not a "clean" plastic

Very high insulation levels are being achieved in Europe with rigid mineral wool, such as this low-energy house in Zielona Góra, Poland. Mineral wool requires no flame retardants, and the primary raw materials are the natural igneous rock basalt and iron ore slag—a post-industrial waste product.

Even if the flame retardant HBCD weren't a concern, there are other life-cycle concerns with the plastic. "Polystyrene depends on some highly toxic chemicals, including known carcinogens, from the beginning to the end of its life cycle," says Tom Lent of the Healthy Building Network in Berkeley, California. It is made by combining ethylene (made from natural gas or petroleum) and benzene (made from petroleum) to produce ethylbenzene, which is then dehydrogenated to form styrene in a process that produces byproducts benzene and toluene. The styrene is then polymerized to form polystyrene. Health and environmental concerns with these constituent chemicals are shown in the table.

At its end of life, polystyrene can be recycled—though it rarely is. When polystyrene insulation is recycled, the HBCD flame retardants will most likely be incorporated into the new products, compromising their safety. (HBCD is not present in polystyrene packaging materials or cups, however, which are the most common sources of recycled content.) If incinerated under ideal conditions, polystyrene should produce only carbon dioxide, water vapor, and heat. But according to Lent, chromatography experiments have shown that a complex mixture of polycyclic aromatic hydrocarbons (PAHs) are formed during most incineration. As a class of chemicals, PAHs are considered likely carcinogens by the National Toxicology Program.

Ozone-depleting blowing agents have been another big environmental concern with *extruded* polystyrene. Originally, XPS was produced using CFC-12, but to the industry's credit, a less potent ozone-depleting chemical, HCFC-142b, was quickly substituted for CFC-12 when the concerns became widely understood. The XPS industry (in North America), however, hasn't been as quick to move beyond this interim HCFC blowing agents, and this is the last insulation material still made with ozone-depleting chemicals—manufacturers are expected to meet the January 1, 2010, target date for the conversion (see *EBN* Mar. 2009). European manufacturers completed the phaseout of ozone-depleting blowing agents several years earlier.

Finally, there is the issue of persistence in the environment. Oceanographers and environmental activists, including Charles Moore of the Algalita Marine Research Foundation (www.algalita.org), have found vast quantities of plastic waste floating in huge oceanic "gyres." An area between California and Hawaii is known as the "Great Pacific Garbage Patch" that some experts estimate contains as much as 3 million tons of plastic waste, including polystyrene, polyethylene, and polypropylene, all of which are very slow to break down in the environment. Ocean mammals, jellyfish, and pelagic birds ingest and are frequently killed by this plastic waste.

Reformulating Polystyrene Insulation

There are three basic ways to avoid using HBCD-treated polystyrene. The simplest would be to substitute a different, less hazardous flame retardant in polystyrene insulation. *EBN* inquired about this option with several manufacturers and industry associations. According to BASF, "Although HBCD is not regarded as a substance of very high concern, foam manufacturers have made extensive efforts to find viable alternatives. Yet no viable alternative to HBCD has been currently identified." The company told *EBN* that "EPS and XPS producers are committed to finding sustainable alternatives to HBCD as soon as possible."

Christine Lukas, Ph.D., of Dow Building Solutions at Dow Chemical Company UK confirmed this information: "Currently, there is no technically and commercially feasible alternative for HBCD in EPS and XPS applications," she said, "however, intensive research, which the industry is committed to, continues."

Using Non-Treated Polystyrene Below Grade

The second option for avoiding the use of HBCD-treated polystyrene would be to remove the flame retardant for applications where it isn't needed. Currently, all XPS and EPS sold as building insulation carries at least a Class B designation for flame spread and smoke developed (maximum flame spread of 75 and maximum smoke developed of 450). This classification is required for above-grade applications, and there is a perception by many that it's a universal requirement. Both the International Residential Code and the International Building Code, however, specifically exempt foam insulation that will be separated from the building interior by at least one inch (25 mm) of masonry or concrete.

So why not take the flame retardant out of insulation that will be below-grade? Joe Lstiburek, P.Eng., Ph.D, a principal of Building Science Corporation in Massachusetts, argues that we don't need flame retardants to protect insulation that is buried. "Rocks don't burn; dirt doesn't burn; concrete doesn't burn," he said.

Manufacturers could offer non-treated polystyrene insulation products for below-grade installations. Along with being safer, such products should cost less to produce. They would require clear labeling, however, as well as greater scrutiny by building officials to ensure that the non-treated polystyrene insulation wasn't used above-grade where its higher flammability could pose an increased fire risk (though no polystyrene should be considered fire-safe). "You'd have to identify very strongly that it's only for below-grade," noted John Straube, P.Eng., Ph.D. of Building Science Corporation.

Alternatives to Polystyrene Insulation

The final option for avoiding HBCD-treated polystyrene is to substitute other insulation materials. Fortunately, there are alternatives to polystyrene in most applications that will not compromise energy performance.

Above-grade boardstock insulation

Both XPS and EPS are commonly used in wall systems, usually as an exterior insulative sheathing. When fiber insulation materials like fiberglass and cellulose are used between stud cavities in walls, there remains significant *thermal bridging* through the wood or steel studs (see *EBN* July 2009). By installing rigid boardstock insulation over the entire wall, spanning those studs, a *thermal break* is provided that reduces the significance of that thermal bridging. While XPS and EPS are often used for this purpose, polyisocyanurate (polyiso) foam insulation works just as well—and often a little better, because it has a somewhat higher R-value per inch and a reflective foil facing (which adds thermal benefit when installed next to an air space).

Rather than using rigid boardstock insulation, a thermal break can be provided using a double stud wall, with the two walls spaced several inches apart and the entire cavity filled with fiber insulation. Spray polyurethane foam (SPF) can also be used, either alone (typically low-density, open-cell polyurethane that fully fills the cavity) or in combination with fiber insulation—in which case the SPF provides a superb air barrier and the fiber insulation provides additional R-value.

Below-grade foundation walls

On exterior foundation walls, while XPS holds the largest market share, it has some drawbacks. Along with the material life-cycle concerns discussed above, polystyrene is degraded by sunlight, and both carpenter ants and subterranean termites will tunnel through it to enter buildings. What are the alternatives?

Spray polyurethane foam is becoming increasingly common as an exterior foundation insulation in Canada and northern states in the U.S. No more than 2” should be applied at a time, though multiple layers can be used to achieve very high R-values.

The simplest alternative for foundation walls is to switch to interior insulation, where you can use any type of insulation. “I don’t think you should insulate on the outside anyway,” says Lstiburek. “Put insulation on the inside.” Lstiburek says that a very good interior foundation insulation system is a layer of rigid insulation, such as polyiso, against the foundation wall and then a frame wall insulated with cavity-fill insulation, such as cellulose.

Where exterior foundation insulation is desired, the substituted material must be moisture-resistant. “Rigid rockwool [mineral wool], at least in vertical applications, has been used for years,” said Straube. “It’s obviously an acceptable alternative.” These materials, such as Roxul Drainboard and Fibrex FBX Drainage Media, are impervious to termites and carpenter ants, and provide very effective drainage of moisture, because mineral wool is *hydrophobic*. The insulation value, at about 4.4 per inch, is lower than that of XPS, so greater thickness is required to achieve comparable performance. With a density of 6–8 lb/ft^3 (96–128 kg/m^3), the compressive strength is perfectly adequate for foundation walls.

For residential building, the biggest drawback to rigid mineral wool is availability. Most building materials dealers in the U.S. do not stock it so it has to be ordered, driving up the cost—though this could begin to change with a July 2009 announcement by Roxul that certain mineral wool products will now be distributed widely in the U.S. Another drawback is that rigid mineral wool today is produced using a urea-extended phenol-formaldehyde binder, and there is some potential for formaldehyde emissions. *EBN* has not heard of efforts by the mineral wool industry to shift to non-formaldehyde binders, as some fiberglass companies have done.

Rigid fiberglass is another option for below-grade foundation walls, though again, availability is an issue. Lstiburek recommends that the standard rigid fiberglass roofing board works fine below-grade, but this material is sold only for commercial-building applications and is not stocked in building supply yards. Rigid fiberglass can also be specified as part of a proprietary Tuff-N-Dri/Warm-N-Dri basement foundation system (from Tremco Brrier Solutions, formerly Koch Waterproofing Solutions), but this system is available only through specialized foundation contractors.

An alternative to rigid boardstock insulation on exterior foundation

Spray polyurethane foam can be used on foundation walls and under slabs as an alternative to polystyrene.

walls is spray polyurethane foam. This application is growing in popularity, especially in Canada, according to Laverne Dalgleish, executive director of the Canadian Urethane Foam Contractors Association in Winnipeg, Manitoba.

According to Mike Richmond, a building science specialist at Kappeler Masonry Corporation in Waterloo, Ontario, one of the drivers of the growth in SPF foundation insulation is the Canadian Building Code, which now requires R-12 on foundation walls. His company has been using SPF foundation insulation for the past five years, with about 40 house foundations insulated with SPF during this period, including 14 in 2009 through mid-year.

Richmond told *EBN* that SPF tends to be higher-density than polystyrene, is more dimensionally stable, and has greater tensile strength. "When matching SPF against those extruded products that have the same physical characteristics, the SPF is also less expensive," he said. "Typically, we spray two inches, however, we are increasingly spraying more—three inches is now prevalent, and we have sprayed four inches in some instances."

Dalgleish warns that no more than 2" (50 mm) of SPF can be sprayed at a time and no more than 4" (100 mm) can be sprayed in a day. Foam curing is an exothermic (heat-generating) reaction, and thick layers can heat up too much. "Total thickness is not limited, but how you achieve it is," he said.

Rick Duncan of the Spray Polyurethane Foam Alliance (SPFA), in Fairfax, Virginia, says that below-grade SPF is frequently used in northern climates where insulation requirements are higher and termites are not an issue. SPF has been used as exterior foundation insulation in thousands of homes in Minnesota, Wisconsin, Iowa, and Michigan, according to Duncan. South of about the 42nd parallel, about 6" (150 mm) of the foundation above grade needs to be exposed, he notes, to inspect for termite tracks (protected earth tunnels that termites use to access a building). SPFA recommends that SPF, when applied below-grade, should be covered with dampproofing materials, such as asphalt-based coatings.

Sub-slab insulation

While XPS is the most common insulation material for foundation walls, it has a virtual lock on the sub-slab market, at least in the U.S. Both Lstiburek and Straube suggest that rigid mineral wool or rigid fiberglass would be fine under a slab, but *EBN* could find no builders in North America who are actually using such an insulation system. According to Roxul, rigid mineral wool is used for this application to some extent in Europe. Several U.S. code officials *EBN* contacted said they would approve the use of rigid mineral wool under slabs.

In Canada, and to a very minor extent in the colder reaches of the U.S., SPF is being used as a sub-slab insulation. Under slabs, Richmond installs 1" or 2" (25 or 50 mm) of foam on compacted gravel, and after the foam cures, he pours the concrete directly on top of it. He has had very good success with the system, he told *EBN*, and has found cracks in the slab to be less of a concern with this option than with XPS. The only problems he has run into have occurred when the gravel was not properly compacted—allowing foam to get underneath some of the gravel and lift it during curing. With sub-slab installations, it is important to achieve consistent foam thickness so that the concrete slab will be uniformly thick. "SPF thickness is, and always will be, a function of the sprayer," says Richmond. "Without trained installers, thicknesses can vary."

While Duncan is aware of using SPF for sub-slab insulation in the northern U.S., the application is relatively new. One of the challenges, he suggests, is that it will usually require a separate trip for the foam contractor—one to insulate beneath the slab and another for perimeter walls. When it is done, some applicators have used high-density roofing

SPF, because that has a higher compressive strength than medium-density wall foam—2.5–3.5 lb/ft^3 (40–56 kg/m^3), vs. 2.0 lb/ft^3 (32 kg/m^3).

A final option for sub-slab insulation would be Pittsburgh Corning's FoamGlas product, a totally inorganic, high-compressive-strength, moisture-resistant boardstock product. FoamGlas (www.foamglas.com) is marketed as building insulation in Europe but only for industrial uses in North America. Were it available here, cost would be significantly higher than that of other materials.

Structural Insulated Panels

The majority of SIPs are produced using a layer of EPS between skins of oriented strand board (OSB), though several manufacturers, including Winter Panel in Brattleboro, Vermont (www.winterpanel.com), and Murus Panel in Mansfield, Pennsylvania (www.murus.com), use polyurethane as the insulation core. Polyurethane-core SIPs are usually made in a continuous-lamination process, and the superb adhesive properties of polyurethane result in very strong panels. With this process, it is more difficult to alter the thickness, so offering a wide range of thicknesses (R-values) is more difficult than with EPS-core SIPs.

According to Straube, some specialized European companies make SIPs for high-temperature industrial applications using metal skins and rigid mineral wool cores. While no such panels are known to be used for conventional construction in North America, this suggests that OSB-faced rigid mineral wool SIPs could be a viable product.

Insulated concrete forms

Insulated concrete forms (ICFs) today are nearly all made from polystyrene. With most products, two faces of EPS about 2" (50 mm) thick are held apart by spacers; after the ICFs are stacked, concrete is poured to create a structural wall system providing at least R-16, and with some products, significantly higher values. A few ICFs are made with XPS, but most are high-density EPS.

The only non-polystyrene ICFs use a cement-wood fiber material. Such products include Durisol (www.durisol.com) and Faswall (www.faswall.com). While these ICFs do not provide as much insulation as polystyrene ICFs, they are both available with mineral wool insulation inserts that improve the thermal performance to some extent. Some experts *EBN* contacted seemed intrigued about the idea of a rigid mineral wool ICF, though no company is known to be working on such a product.

Exterior insulation and finish systems (EIFS)

Today, nearly all EIFS use EPS (most common) or XPS as the insulation substrate. Architectural trim details are also often made from EPS and installed prior to applying acrylic stucco. The insulation does not have to be EPS, though. In fact, EIFS originated in Sweden in the 1940s with rigid mineral wool, and this substrate could easily be used again.

Final Thoughts

Insulation is one of the most important components of buildings and absolutely critical in creating buildings that will minimize environmental impact. Polystyrene insulation, both XPS and EPS, has played an important role in insulating buildings. But polystyrene is the least green of common insulation materials, particularly due to the HBCD flame retardant used to impart a (moderate) level of fire resistance.

When we can do so without sacrificing energy performance, green designers and builders may want to look to alternative materials and methods that are better from a health and environmental standpoint, such as those discussed in this article. While taking this precautionary approach, we should also continue research on these materials and others to identify assemblies that are high-performing without entailing significant environmental tradeoffs.

– Alex Wilson

For more information:

Canadian Urethane Foam Contractors Association
Winnipeg, Manitoba
204-956-5888
www.cufca.ca

Spray Polyurethane Foam Alliance
Fairfax, Virginia
800-523-6154
www.sprayfoam.org

Roxul, Inc.
Milton, Ontario
800-265-6878, 905-878-8474
www.roxul.com

Fibrex Insulations, Inc.
Sarnia, Ontario
800-265-7514, 519-336-7770
www.fibrexinsulations.com

Checklist: Avoid XPS and EPS that is treated with HBCD

Checklist of Recommendations for Reducing Impacts of Polystyrene

As long as doing so will not compromise energy performance of a building, seek alternatives to XPS and EPS. In some places there may be no alternative.

Contact XPS and EPS manufacturers about HBCD-free products

Try to convince manufacturers to shift to safer flame retardants. Until such products become available, ask manufacturers to introduce non-flame-retardant XPS and EPS that is labeled for below-grade applications only.

Specify rigid mineral wool for below-grade exterior foundation insulation

Along with being free of flame retardants, rigid mineral wool offers superb drainage and is resistant to termites and carpenter ants.

Consider interior foundation insulation

XPS and EPS can be avoided on foundation walls by moving the insulation to the interior, where less moisture-resistant insulation can be used, such as polyisocyanurate, fiberglass, and cellulose.

Specify SPF or rigid mineral wool beneath slabs

High-density spray polyurethane foam (SPF) is acceptable as a sub-slab insulation material. Rigid mineral wool is also used in this application in Europe, and could become accepted here.

Look for SIPs, ICFs, and EIFS made with rigid mineral wool

Such products are not known to be available today, but could be excellent products were manufacturers to introduce them. Talk to manufacturers and let them know you would be interested in such products.

Convince rigid mineral wool manufacturers to switch to non-formaldehyde binders

Rigid mineral wool today is produced with urea-extended phenol-formaldehyde binder. Converting to a non-formaldehyde binder would result in a greener product.

Do not sacrifice energy performance in seeking to avoid flame retardants

While brominated flame retardants, including HBCD, are believed to be harmful to human health and the environment, failing to achieve very high levels of energy performance contributes to climate change. If you avoid XPS or EPS is avoided due to health or environmental concerns, switch to an option that offers equally good or better energy performance.

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