

Avoiding High-GWP Insulation Materials



NESEA Building
Energy Conference

Calculating the
Global Warming
Potential of
Insulation

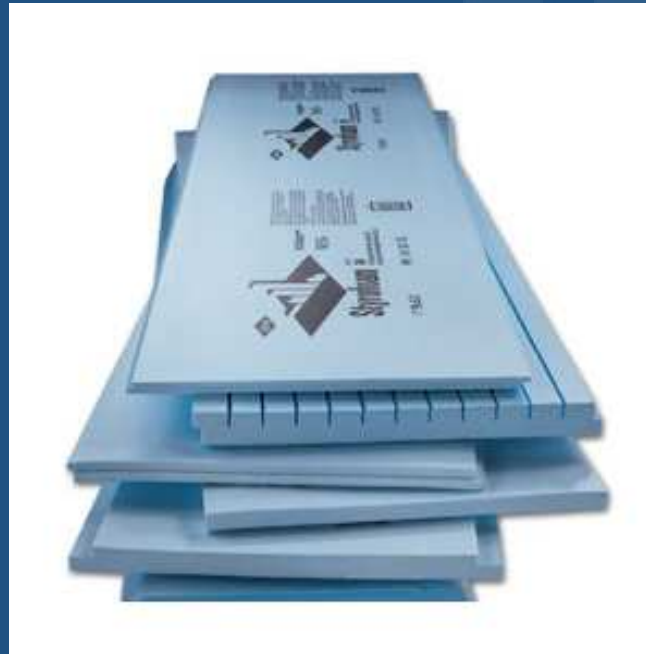
March 10, 2011

Alex Wilson

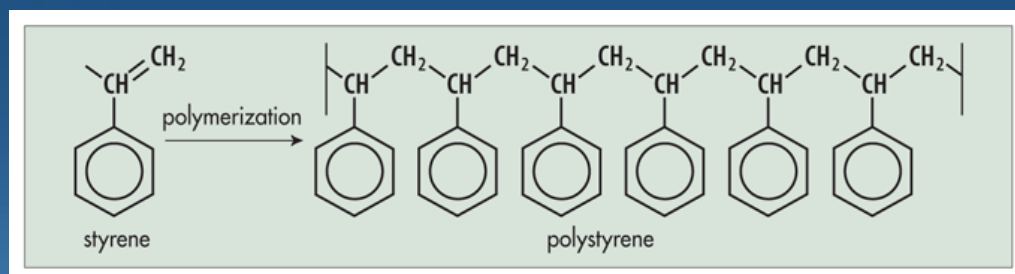
*Hudson Passive House
Photo: Jordan Dentz*

Concerns about extruded polystyrene

- Two concerns
- The first is that the flame retardant HBCD is used in all polystyrene building insulation
- The second is that XPS is made with HFC blowing agent
- Today, focusing on this second issue



Dow Styrofoam - image from HomeConstructionImprovement.com



Global warming – extruded polystyrene

- Relatively new concern
- Solved the ozone-depletion problem, but new blowing agent has high GWP
- Payback of the “lifetime GWP”
- 65-year payback for the lifetime GWP of the XPS in the house shown here



Net-zero-energy house with 4" XPS wrapped around 2x6 walls with cellulose. Photo: Bensonwood



Issue addressed in June, 2010 issue of Environmental Building News

- Dr. Danny Harvey raised the concern in a 2007 scientific paper
- We examined and updated Harvey's assumptions
- Generating a lot of discussion this week
- With certain types of insulation, more isn't always better



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Avoiding the Global Warming Impact of Insulation

Insulation is key to reducing carbon emissions from buildings. But the blowing agents in extruded polystyrene and spray polyurethane foam offset much of that benefit.

by Alex Wilson

TWO COMMON FOAM INSULATION materials are produced with hydrofluorocarbon (HFC) blowing agents that are potent greenhouse gases—extruded polystyrene (XPS) such as Dow Styrofoam or Owens Corning Foamular, and standard closed-cell spray polyurethane foam (SPF). While all insulation materials reduce greenhouse gas emissions (by saving energy), insulating with thick layers of either of these two particular foams results in very long “payback periods” for the global warming potential of the insulation, thwarting even the best attempts to create carbon-neutral buildings. The bottom line is that designers and builders aiming to minimize the global warming impacts of their buildings should choose fiber insulation (cellulose, fiberglass, or mineral wool) or non-HFC foam insulation.

“The more insulation the better” is a common refrain in the green building industry. EBN has long advocated very high levels of insulation, particularly in residential and small commercial buildings, which are skin-dominated. At the furthest end of the spectrum is the Passive House movement (see EBN Apr. 2010), where it is not uncommon to provide R-50 under a floor slab, R-60 in the walls, and as much as R-100 in the attic. High levels of insulation are seen as a key strategy for achieving net-zero-energy and carbon-neutral performance—the latter meaning that the building will have no net contribution to climate change.

How we achieve high levels of insulation is a very significant issue, however. We rarely pay attention to the fact that insulation materials themselves contribute to greenhouse gas emissions and global warming. This happens in two ways: through the embodied energy of the insulation (the energy use and greenhouse gas emissions that result from manufacturing

(continued on p. 9)



Photo: Benetton

Unaware of the recently reported GWP implications of certain foam insulation materials, builder Todd Benson specified four inches of extruded polystyrene over 2x6 studs insulated with dense-pack cellulose in this net-zero-energy home.

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Quote of the month:

“Specifying a high-GWP insulation completely defeats the point of using it.”

—Scott Shell, FAIA of BHDD Architecture commenting on new information on the global warming potential of insulation materials (page 12)

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June 2010 EBN

ODP and GWP of Blowing Agents

Type of Insulation	Blowing Agent	Atmospheric lifetime (yr)	ODP ¹	GWP ²
Polyisocyanurate				
Original	CFC-11	45	1	4,750
2nd Generation	HCFC-141b	9.3	0.11	725
3rd Generation	Pentane, cyclopentane	A few days	0	7 ³
Spray Polyurethane				
Original	CFC-11	45	1	4,750
2nd Generation	HCFC-141b	9.3	0.11	725
3rd Generation	HFC-245fa	7.2	0	1,030
3rd Generation	CO ₂	variable	0	1
Extruded Polystyrene (XPS)				
Original	CFC-12	100	1	10,900
2nd Generation	HCFC-142b	17.9	0.065	2,310
3rd Generation	HFC-134a ⁴	13.8	0	1,430

*Charts from
Environmental
Building News,
June, 2010*



Alternatives to XPS: Polyisocyanurate



- Blowing agent has a GWP of 7 instead of over 1,400
- Chlorinated rather than brominated flame retardant
- It may be possible to meet codes without any flame retardant
- Thermoset plastic rather than thermo-plastic



Fine Homebuilding photo

Polyisocyanurate roof insulation



John Straube photo

- Most appropriate above-grade
- Occasionally used for foundations
- Highest R-value of any common insulation material
- Possible to superinsulate without a lot of added weight

Alternatives to XPS – *Expanded polystyrene*



Photo: John Straube

- Negligible GWP (pentane as blowing agent)
- Higher-density EPS for below-grade
- This is PolyForm's tongue & groove EPS insulation
- R-10 for 2.5" thickness
- Cost-competitive with XPS

Expanded polystyrene – for below-grade



Photo: John Straube



Alternatives to XPS: rigid mineral wool



Rockwool International

- Growing interest in rigid mineral wool
- Zero GWP – no blowing agent
- No flame retardant
- Totally fire-safe
- Inert
- Superb drainage below-grade
- Resistant to termites
- High recycled content
- Contains phenolic binder, but very low emissions



Thermafiber Mineral Wool



Thermafiber rigid mineral wool insulation products

www.thermafiber.com



Rigid mineral wool – below-grade?



- Roxul Toprock
- Mainly used for roofs, but recent test applications beneath slabs
- Should be cost-competitive with XPS
- Not widely available for residential use

Toprock installation in British Columbia - Photo: Roxul



www.roxul.us

Rigid mineral wool – below-grade?



Photo: Roxul



Alternatives to XPS: Foamglas

- Cellular glass – has been made since 1937 (not marketed as a building insulation in U.S. until now)
- 100% inorganic
- Noncombustible without flame retardants
- CO₂ as fills the cells, not HFC (GWP of 1 vs. 1,400)
- 2-1/2 times as expensive as XPS
- Not stocked, but made in the U.S. and can be shipped anywhere



Photo: Pittsburgh Corning



Foamglas



www.foamglas.us



Photo: Pittsburgh Corning

Foamglas - properties



Photo: Foamglas

From Environmental
Building News

Physical Properties	I-P Units	SI (metric)
Moisture absorption (% by vol.) ¹	0.2%	0.2%
Water vapor permeability	0.00	0.00
Acid resistance	Impervious to common acids except hydrofluoric acid	
Capilarity	None	None
Combustibility	Noncombustible	
Compressive strength	90 psi	600 kPa
Density (average)	7.5 /b/ft ³	120 kg/m ³
Dimensional stability	Does not shrink, swell, or warp	
Coef. of linear expansion (25°C)	5.0 x 10 ⁻⁶ /°F	9.0 x 10 ⁻⁶ /°K
Maximum service temperature	+900°F	480°C
Melting point	1,832°F	>1,000°C
Modulus of Elasticity (approx)	1.3 x 10 ⁵ psi	900 MPa
Specific heat	0.20 Btu/lb°F	0.84 kJ/kg·°K
Thermal conductivity	Btu/hr·ft ² ·°F 0.29 @ 75°F 0.28 @ 50°F	W/mK 0.039 @ 0°C 0.040 @ 10°C
Thermal resistance	R-3.44/inch	RSI-0.26/cm

1. The only retained moisture is that adhering to surface cells after immersion.
2. Wet-cup method, procedure B Data from Pittsburgh Corning.

Foamglas – Brattleboro, Vermont installation



Photo: Mindel & Morse Builders

Foamglas – bitumen-faced ReadyBoard



Photo: Pittsburgh Corning

2030 Challenge for Products



- Goal to reduce the embodied carbon of building materials 50% by 2030
- Rolled out on Valentine's Day by Ed Mazria and Architecture 2030
- BuildingGreen is partnering with Architecture 2030 on metrics and product listings

Discussion Questions

- How significant a concern is all this?
- Would you specify or use an XPS insulation material that had less than R-5 per inch?
- Would you spend more for something like Foamglas?

Resources from BuildingGreen

BuildingGreen.com

Green Topics > Resources and Materials > Recycled or Salvaged Materials > Post-consumer Recycled Materials

greenscreen Trellising System

Greenscreen(TM) is a three-dimensional, welded-wire trellis system that can be installed freestanding or wall-mounted. The basic trellis module is 4' wide, 2" or 3" thick, and 6', 8', 10', or 12' long. Custom-sized panels can be ordered in 2" increments. Greenscreen is available in a wrinkled matte finish of green or black, as well as a glossy finish of green, black, silver, or white. Various accessories, such as planter straps, edge trim, and specialty shapes, are also available. Thoughtful plant selection may be important for success of the system. In addition to the numerous environmental benefits of encouraging the growth of vegetation and that of energy savings from shading, Greenscreens can also play an important role in making the most of growing area in small-space and rooftop applications.

What makes this product green:

- Reduces energy loads
- Post-consumer recycled material

LEED Credits:

- MR Credit 4 - Recycled Content
- EA Credit 1 - Optimize Energy Performance
- SS Credit 7 - Landscape & Exterior Design to Reduce Heat Islands

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Air Filtration in Buildings

AIR FILTRATION GETS A WHOLE lot more attention than it used to. Over the past two years, the health concerns of those working or living near Ground Zero after the destruction of the World Trade Center and the anthrax attacks that followed in Washington, D.C., have given air filtration a high profile. Add to this the rising incidence of asthma and other respiratory illness, growing concern about mold, and the LEED™ Rating System's focus on filtration as a component of construction indoor air quality (IAQ) management, and we can be fairly certain that air filtration will be an increasingly important component of building design, construction, and operation.

Clearly, air filtration has an important place in buildings—both commercial and residential—but just how far should we take it? How significant are the benefits, what are the costs, and how does air filtration relate to other IAQ priorities? How do commercial and residential strategies differ, and what's new in the filtration industry? You won't emerge from this article an expert in air filtration, but perhaps you will learn some of the questions to ask in planning, designing, or implementing an air filtration strategy.

Why Filter Air?

Air filtration first emerged in the 1930s in this country as a strategy to protect mechanical equipment from the buildup of dust and fibers that could lower performance, reduce operating life, or—worse—cause fires. Keeping walls, carpets, and furnishings clean and reducing cleaning costs followed as motivations, particularly in urban areas. All of these reasons for filtering air are still valid today, but for the past several decades the primary driver of air filtration has been the desire to protect human health. (continued on page 12)

Product Review: Mineral Silicate Paints Tops for Durability (see page 9)

Restoration of Chicago's historic Humboldt Park Boulevard Pavilion, by the Flouret Architects Studio, included extensive masonry repair and finishing using mineral silicate paints.

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Quote of the month:

"AGS has not described its writing here. It does its analysis, and therefore it is not possible to meaningfully interpret their results or compare them with results from other laboratories."

Had issues on the GreenSpec certification program (page 9)

YOUR GREEN HOME

A Guide to Planning a Healthy, Environmentally Friendly New Home

ALEX WILSON
FOREWORD BY JOHN ABRAMS

A MOTHER EARTH NEWS Book for Wise Living

For information, visit www.BuildingGreen.com or call 800-861-0954



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- Not supported by product mfgs.



BuildingGreen offices in the old Estey Organ Factory, Brattleboro



Thank you!



Old Lyme, Connecticut - Alex Wilson photo