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XPS Industry Perspective on Sustainability and Environmental Awareness

Background

Members of the Extruded Polystyrene Foam Association (XPSA) hold sustainability as a core business strategy and are committed to keeping the environment, health, and safety as key criteria in the selection of materials. This selection process also includes climate change, higher energy consumption due to population growth, and energy supply factors such as price volatility, security, and production impact.

Building construction and operations account for significant energy consumption and, consequently, generation of greenhouse gas (GHG) emissions. Existing buildings are responsible for over 40% of the world's total primary energy consumption and account for roughly 38% of global carbon dioxide (CO_2) emissions.[1]

One of the most effective strategies for improving sustainability in buildings, as measured by the marginal abatement cost per ton of avoided CO_2-equivalent (CO_2-eq) emissions, is to increase the use of thermal insulation. Insulation products are net GHG emission savers and are recognized by many energy experts including McKinsey & Company. As illustrated by the cost abatement curve in the 2009 McKinsey publication "Pathways to a Low-Carbon Economy," insulation will be one of the most cost effective solutions for reducing GHGs.[2]

Extruded polystyrene (XPS) has superior properties and thermal insulation capabilities that make it a green choice from the building envelope perspective. There are several issues related to the composition of the products that the XPSA is working to improve upon, including increasing regulation on blowing agent compounds and investigating alternatives for HBCD.

XPS Insulation

XPS foam is used to insulate the building envelope (walls, roofs, foundations, and basements) and also is used for thermal and moisture protection of infrastructure, cold storage, and transportation shipping containers. When comparing insulation options, it is important to understand that in many buildings or structures the insulation selected must perform additional roles, apart from reducing heat flow. XPS foam is often found to be the most suitable insulation choice in cases when superior moisture control and compressive resistance requirements render other insulation products unsuitable for use. The unique attributes of XPS provide an advantage over other insulation materials.

Due to its formulation and chemical properties, XPS foam has very high compressive strength and moisture resistance. As a consequence, XPS is often a suitable insulation choice for applications where water or compressive loadings are present, such as foundation walls and slabs, exterior walls of residential and commercial buildings, commercial roofing, or for use in providing infrastructure protection such as in rail systems and cold storage facilities. These moisture and insulating performance characteristics are essential for below grade, humid, or moisture-contact applications. XPS's matrix of closed cells makes it highly resistant to moisture and low in water-vapor permeability and water absorption while maintaining high insulating capabilities.

Blowing Agents

XPS insulation employs a blowing agent that is captured in the closed cells and contributes to its insulating capability. Over the many years of its production, XPS foam insulation has evolved in which compounds are used as blowing agents and has reduced its environmental impact through these changes. In the early 1990s, the use of chlorofluorocarbons (CFCs) was discontinued and the XPS industry converted to hydrochlorofluorocarbons (HCFCs), resulting in a 90% reduction in ozone depleting potential. With major investment in developing new technology, the XPS industry discontinued the use of HCFCs in North America in 2010, in accordance with the Montreal Protocol. Current XPS insulation uses hydrofluorocarbons (HFCs) as the blowing agent, which results in zero ozone depleting formulations and 50-70% reduction in global warming potential (GWP) formulations. All of the blowing agents currently used by the industry have a life cycle positive benefit, as measured by greenhouse gas emissions. The current North American industry range for the GWP of the different blowing agents used as equivalent CO_2 is 740 to 1340.

The phase-out of HCFC under the Montreal Protocol was accelerated from an original deadline of 2020 to January 1, 2002 in the European Union (EU) and January 1, 2010 in other developed countries, including the United States and Canada. Montreal Protocol's phase-out of HCFCs in developing countries is scheduled for 2030. The Montreal Protocol on Substances that Deplete the Ozone Layer assessment panel reported that HFCs are critical to the safe and cost-effective execution of phasing out CFCs and HCFCs, as they are an essential substitute for these compounds.

There are several reasons why North American does not simply jump to the EU technology using CO_2. The reasons include the differences in construction practices, dissimilar application requirements, different building codes and standards, and varied product mixes. Use of the CO_2 technology employed in the EU would produce a product that does not meet the requirements of the current North American market.

It is certain that there will be added costs associated with developing replacement blowing agents. Some of the companies that produce XPS are investing in technologies to reduce the global warming potential of their blowing agent formulations as well as to transition to non-ozone depleting formulations in countries outside of the EU and North America. However, in the absence of regulation, attempting to move ahead of standard practice is likely neither competitive nor economically feasible; companies that work to make these changes without a level playing field across the industry could find themselves shut out of the market and unable to sustain business. Due to these market constraints it would be helpful for regulators to work with the industry to accelerate GHG reduction in XPS both in the US and around the world.

Given that XPS foam insulation still has a positive life cycle as an insulator, it is a more sustainable solution to build with XPS and encourage the market to utilize more insulation; simultaneously, the XPS industry should be moving to blowing agent technologies that have reduced environmental impact. Companies with investment and research technology capabilities are needed in this effort. Encouraging contributions from the full industry can be done more quickly if regulations are enacted sooner, making for a level playing field for all producers. XPSA supports global regulations that will promote these changes.

XPS Foam with HBCD

XPS foams, as well as expanded polystyrene (EPS) foams, are processed to meet stringent fire safety regulations; the use of flame retardants in foams is essential for achieving these safety standards in construction. The flame retardant properties are achieved by adding a small amount of a brominated material, hexabromocyclododecane (HBCD), which is bound into the polymer matrix. HBCD offers unique performance in polystyrene foams because it is effective at low levels, thus enabling fire safety to be ensured without loss of thermal insulation quality.[3] Today, HBCD is the only flame retardant currently available that achieves these performance standards. In foam applications, HBCD is a unique flame retardant used to protect human lives and property from fire.

The safety of polystyrene foam insulation with HBCD has been researched extensively and evaluated by regulatory bodies in numerous countries. A comprehensive risk assessment by the European Union in 2008 identified no health risk to consumers from HBCD use in polystyrene foam insulations.[4] Similarly, a Canadian assessment held that HBCD has low acute toxicity[5] and does not meet the criteria for toxicity to human health.[6]

HBCD remains in the polymer matrix throughout the insulation product's service life so it is unlikely that the use of HBCD in polystyrene foam insulation would result in significant environmental exposure. Studies of both EPS and XPS insulation have reviewed the impact of natural light, rain run-off, and other weather conditions. Although many of these studies amplified real-world conditions of installed polystyrene foam insulation, they still found little, if any, migration of HBCD. The studies indicate that levels of HBCD in the insulation remain essentially constant throughout the duration of the product's life, thus minimizing HBCD emissions to the environment and preserving the insulation's flame retardancy for decades.[7]

Acknowledging concerns about the persistence and bioaccumulation potential of HBCD, XPSA members continue to engage in intensive research to find a replacement. While investment in innovation is ongoing and solutions are on the horizon, there is currently no technically and commercially feasible alternative to HBCD for EPS and XPS applications. Timing of replacements is expected in the next two years, in 2014.

Until a replacement is found, XPSA members have committed to implement all relevant portions of the "Code of Good Practice for the Use of the Flame Retardant (HBCD) in Expandable Polystyrene (EPS) and Extruded Polystyrene (XPS)" and to monitor the usage and handling of HBCD, using the lowest amount necessary to meet fire safety standards in the product and to minimize release and exposures in manufacturing facilities and final production.

XPS has good thermal properties and its continued use in buildings will improve building envelope and corresponding GHG emissions. XPSA would like to see accelerate blowing agent technology advancements through increased regulation. HBCD has been thoroughly examined and not deemed a major environmental threat but due to bioaccumulation concerns the XPS industry continues to search for an alternative that will not decrease fire safety or thermal insulation properties and will continue to use HBCD as safely as possible until then.

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[1] June 2012, United Nations Environment Programme Sustainable Buildings and Climate Initiative, Building Design and Construction: Forging Resource Efficiency and Sustainable Development. http://www.usgbc.org/DisplayPage.aspx?CMSPageID=2124

[2] Pathways to a Low-Carbon Economy, Version 2 of the Global Greenhouse Gas Abatement Cost Curve, executive summary found at http://www.epa.gov/statelocalclimate/documents/pdf/mckinsey_summary_11-19-09.pdf.

[3] European Flame Retardants Association Fact Sheet Hexabromocyclododecane (HBCD) http://www.cefic-efra.com/Objects/2/Files/bromine%20-%20hbcd.pdf

[4] Swedish Chemicals Agency (Kemi). Risk Assessment conducted under Council Regulation (EEC) No 793/93 of 23 March 1993 on the evaluation and control of the risk of existing substances. OJ L 84, 5.4. 1993, p. 1-75.

[5] http://www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=A27E7A60-1&offset=11&toc=show

[6] Draft Screening Assessment, Cyclododecane, 1,2,5,6,9,10-hexabromo-; Chemical Abstracts Service Registry Number 3194-55-6; Environment Canada/Health Canada, August 2010.

[7] HBCD in Polystyrene Foams: Product Safety Assessment, April 2009 HBCD Industry Working Group – Submission to European Chemicals Agency (ECHA).

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