



Expanded Polystyrene

The Best Choice for Environment

Interest in, and indeed mandates for, environmentally responsible (sustainable) building and packaging products continues to grow. While many product manufacturers may promote their products as "green", many fail to be able to back up their claims. To help clients, shippers, contractors, architects, and engineers evaluate the environmental impact of products they acquire or install, the American Society for Testing Materials developed the "Standard Practice for Data Collection for Sustainability Assessment of Building Products" (ASTM E2129). This document provides a set of instructions for collecting data to be used in assessing the sustainability of building products, and whether or not products meet the guidelines of programs such as the United States Green Building Council's Leadership in Energy and Environmental Design system (LEED) consistency with BEES (Building for Environmental and Economic Sustainability).

Expanded polystyrene (EPS) rigid insulation manufactured by PermaTherm has always been a "green" product. The highest environmental attribute is the ability to insulate, and thus reduce energy loss. Additionally, EPS has never contained any ozone depleting chemicals and is 100% recyclable and environmentally safe.

The following discussion addresses the criteria set forth in ASTM E2129-05:

1.0 Criterion No. 1 - Materials

1.1. Environmental impacts in obtaining raw material for this product

PermaTherm has chosen to manufacture EPS with Modified Expanded Polystyrene Beads because of their fire performance, structural performance, and environmental advantages. UL ratings on this product, as well as the sustainability commitments of our suppliers, are available upon request. Modified polystyrene beads contain no formaldehydes or toxic chemicals, and use fewer resources to manufacture than raw



materials for other insulation products. No CFC's or HCFC's are used in the manufacture of polystyrene beads or expanded polystyrene.

PermaTherm also purchases raw materials from local suppliers whenever possible, thus minimizing transportation and contributing to the local environment.

1.2. Volatile organic compounds (VOC's)

The EPA has not found it necessary or appropriate to regulate the VOC content in EPS resin at this time, and PermaTherm's emission of VOC's so small that it is not regulated.

Yet in a framework of full disclosure, PermaTherm uses EPS beads as a raw material, and EPS beads typically contain 5%-7% pentane by weight¹, which is defined as a VOC by the EPA. EPA document 540/3-90-020 states that 85% of the pentane contained in the EPS bead is emitted within 48 hours starting with the expansion process (which occurs within the PermaTherm facility). The remaining pentane is released over time, but considering PermaTherm's extended curing process, there is likely negligible pentane content in the foam when it leaves our facility.

Styrene is also considered a VOC by the EPA. While Certificates of Analysis from PermaTherm's bead suppliers typically do not state a styrene monomer content of EPS bead, several EPS bead suppliers (not necessarily PermaTherm suppliers) have established that EPS beads typically contain styrene monomer, 900 to 1000 ppm by weight.

More about Pentane

Pentane is a VOC as defined by EPA since in certain environments it can be tied to the formation of ozone in the "troposphere" (i.e. the region from ground level to 6-10 miles above) when VOCs and nitrogen oxides (NOx) meet in the presence of sunlight. Ozone is a naturally occurring molecule consisting of three oxygen atoms bound together, and its odor can sometimes be detected during thunderstorms when lightning creates ozone.

Yet all three pentane isomers have zero Ozone Depleting Potential (ODP). They also

¹ <http://cat.inist.fr/?aModele=afficheN&cpsidt=13725654>: A method for determination of residual styrene monomer and other volatile organic compounds in expanded polystyrene (EPS) was developed using HS SPME and gas chromatography with FID. The extraction products were identified by GC/MS. Good reproducibility of the measurements with RSD values between 3.2-3.6%. The contents of residual styrene monomer in two samples of EPS were 153.2 and 65.7 mg/kg, respectively. Other compounds identified in EPS were pentane, benzene, toluene, ethylbenzene, isomers of xylene, n-propylbenzene, 1,2,4-trimethylbenzene, o-methylstyrene, benzaldehyde, benzyl alcohol, and acetophenone.



have either a zero or very low Global Warming Potential (GWP) potential - - significantly less the HCFC chemicals still used in “extruded” polystyrene products such as Styrofoam².

To add perspective, VOC emissions from mobile sources (i.e. mainly motor vehicles) are significantly larger than from EPS manufacture. For example, if VOCs from mobile sources were lowered by a mere 1%, air quality would be improved substantially more than with a 100% elimination of all pentane emissions from all EPS processing plants.

Additionally, pentane is a VOC only to the extent it helps create ozone, which only occurs when significant NOx is present, such as in urban areas with significant automobile emissions. PermaTherm’s manufacturing facilities are located far from urban areas, where nitrogen oxides are insignificant; which leads to the conclusion that PermaTherm EPS does not contribute to problematic ozone even at ground levels.

Styrene Monomer

Styrene is a naturally occurring substance that has been known since the time of the ancient Greeks. It is found in many foods and beverages, such as milk, beer, coffee, strawberries, peas, tomatoes, olives, and various nuts. Styrene is, in fact, approved by the Federal Food and Drug Administration (FDA) for use as a flavoring agent. The low levels of residual styrene found in expanded polystyrene products are environmentally safe for use in packaging. Independent research shows no adverse health effects in animals exposed for their lifetimes to styrene at concentrations of up to 250,000 parts per billion, 10,000 times higher than potential exposure from food service products.

1.3. Does the product meet the requirements of South Coast Air Quality Management District Regulations for content of VOC's?

This criterion refers to Southern California requirements and is not relevant to PermaTherm’s manufacturing facilities in Georgia.

1.4. Cancer Causing Chemicals (Carcinogens)

Neither the Agency for Toxic Substances and Disease Registry (ATSDR), the Environmental Protection Agency (EPA), nor the National Toxicology Program (NTP) define pentane, styrene, or any other chemical within EPS as a carcinogen.

² Styrofoam is a registered trademark of the Dow Chemical Company



Expanded polystyrene is approved by the Federal Food and Drug Administration for use in food contact packaging. It has been shown in several studies to be more sanitary than reusable ware. Many health organizations, in fact, encourage use of polystyrene because it does not support the growth of bacteria, as reusable ware does.

2.0 Criterion No. 2 - Manufacturing

2.1. Non-renewable energy used in manufacturing

The manufacture of EPS requires very little energy, of any kind, compared to alternative products. The energy used to make one unit of EPS, for example, would only allow the manufacture of $\frac{1}{3}$ to $\frac{1}{2}$ the volume of cardboard material.

The low density EPS also equates to light weight, thus reducing energy costs related to transportation.

Additionally, the vast majority of PermaTherm deliveries are to jobsites well under 500 miles from the manufacturing facility, thus reducing the environmental impact of transporting the product across the country.

The annual per capita usage of EPS in Europe is equivalent to just 0.6 liters of crude oil. This amount of crude oil represents one car journey of just five miles.

2.2. Reclamation

Currently at PermaTherm, approximately 65-70% of the post-industrial waste in the manufacturing of EPS can be reused in the manufacturing process. EPS can contain up to 25% recycled material and still meet the physical properties of ASTM C578 for polystyrene rigid insulation. EPS containing recycled content is often incorrectly portrayed in the marketplace as a lower quality product, even if meeting ASTM standards. As this stereotype fades, more EPS can be sold with a higher reprocessed content and a higher percentage of post-industrial waste can be reused. PermaTherm continuously searches for new markets for unused waste such as densified foam products, children's toys, beanbag chairs, or any other application to reduce the waste taken to landfills. It should also be noted that EPS disposed of in landfills does not leach toxic chemicals, heavy metals, or create decomposition gases.

2.3. U.S. EPA's Toxics Release Inventory

PermaTherm's manufacturing process avoids the release of any substances included in the Toxics Release Inventory.



2.4. Limiting negative environmental impacts relating to the manufacturing process

Over the past several years, PermaTherm has invested in new, state-of-the-art equipment and instituted new procedures to produce high quality product reducing environmental impacts.

2.5. Water used in the manufacturing process

Water is used as a coolant is recovered and reused in the production process. The manufacture of EPS results in considerably less water pollution than cardboard, for example: 17 critical water volumes used per cubic metric of cardboard material versus 0.6 for EPS.^{3 4}

2.6. Has the manufacturer undertaken any of the following actions?

1. A production process to minimize greenhouse gas emissions

EPS has never utilized any greenhouse gases in the manufacturing process, nor does the manufacturing process result in emissions of greenhouse gases. Combustion equipment is well maintained and efficiently operated in order to minimize CO₂ emissions.

2. A production process that minimizes liquid effluents

Cooling water is recycled.

3. A production process to utilize less toxic materials

No toxic materials are used in the production process

4. Safe solvents in a production process

No solvents are used in the production process

5. Stringent dust controls

Advanced dust-collection systems have been installed to remove dust when EPS

³ EPS Molders Association, EPS Building and Construction Recycling Fact Sheet

⁴ Polystyrene life cycle study conducted by the BASF in 2006/7



is ground up to be reused.

6. Smoke-stack particulate collectors or gas scrubbers

PermaTherm uses very clean fuels and highly efficient boilers and exhaust clean-up equipment. "Smoke stack" emissions are substantially under any state or federal guidelines.

7. In-plant solid and toxic waste reduction programs

EPS waste created in the production process is collected, reground, and reused in the manufacturing process.

2.7. OSHA requirements

PermaTherm meets all OSHA regulations and its compliance has been audited by OSHA.

3.0 Criterion 3 - Operational Performance of Installed Product

3.1. Compliance with EnergyStar and/or Federal Energy Management Program

Unfortunately and inexplicably, neither the Environmental Protection Agency (via their EnergyStar Program) nor DOE's Federal Energy Management Program include "insulation" as category among the spectrum of products covered, even though insulation can have more impact on energy savings, air pollution, and dependence on foreign petroleum products than any other product in their product spectrums. For example, buildings in the U.S. consume between 66-76% of all electricity in the U.S., and if all buildings were insulated to EPA standards, more than half of the coal-fired power plants in the country could be retired.

Nevertheless, PermaTherm will soon be qualified as an EnergyStar Partner.

3.2. Routine maintenance

When installed properly, PermaTherm EPS insulation should be maintenance free. If maintenance on the equipment beneath the insulation is required, the EPS insulation can generally be readily removed and reinstalled. New vapor retarders and jacketing may be required unless they can be removed without damage.

3.3. Product longevity

The performance of PermaTherm EPS products does not deteriorate over the life cycle.



Unlike other rigid foam insulation, the thermal protection of EPS will not decay or drift overtime. For a sample copy of the warranty, please contact your local PermaTherm sales representative. EPS discourages the development of mold, and has no nutritive value so is resistance to rodents and termites. EPS is treated with a fire retardant and also offers superior noise reduction.

3.4. Guidelines for the proper use

Please consult most current printed literature and application specifications. Please review all applicable local, state, and federal building codes when installing EPS rigid insulation.

Expanded polystyrene products are inert and safe in landfills, although they will not decompose. In fact, nothing readily degrades in landfills — not EPS, nor paper, not food, or yard waste. Landfills are designed to entomb material and prevent bio-degradation due to the lack of oxygen required for decomposition. Furthermore, Martin B. Hocking, Associate Professor of Chemistry at the University of Victoria, British Columbia, reports in "Science," 2/1/93, that when it does occur, 1,000 lbs. of paper will degrade to 394 lbs. methane (a greenhouse gas) and 545 lbs. carbon dioxide.

4.0 Criterion No. 4 - Indoor Environmental Quality

4.1. Indoor environmental quality

The biological inertness of expanded polystyrene is especially suited for most applications, including building insulation. EPS does not off-gas and does not negatively impact indoor air quality.

5.0 Criterion No. 5 - Corporate Environmental Policy

5.1. Written environmental policy

For a copy PermaTherm's environmental policy, please contact your local PermaTherm sales representative.

5.2. Reclamation program, recycling or reuse of its product at the end of its useful life

PermaTherm strives for an integrated, balanced approach involving source reduction, recycling at the plant level, post-use recycling, re-use/takeback, and effective disposal of waste.

Source reduction: PermaTherm works with its clients to consider:



1. Designing products and packaging in such a manner that less material is used in production and/or transportation.
2. Increasing the useful life of products (including making products reusable).
3. Replacement of single-use products that cannot be recycled effectively with recyclable or compostable alternatives.

Recycling:

Polystyrene is a thermoplastic, which allows it to be repeatedly melted and reformed, making EPS a highly recyclable product. PermaTherm is committed to recycling, and we channel 100% of our EPS off-fall or waste from our manufacturing processes to some form of recycling. It is either processed into other EPS products or densified and sent to a recycling plant where it is returned to polystyrene resin.

PermaTherm has customer participation programs to retrieve post-consumer product from our customers for the reuse in new product. While other plastic foam insulations can only use chemical components with recycled content or use recycled facers to claim recycled content, EPS can be recycled after its useful life directly back into the manufacturing process.

5.3. Product packaging

While the packaging with EPS is minimal, PermaTherm continuously searches for ways to reduce the packaging materials used.

5.4. Return, reuse, recycling, or composting of the product's packaging

Reusing or recycling packaging is a priority. For example, the large canvas totes that contain the EPS beads purchased by PermaTherm are returned to our supplier for reuse.

5.5. Documentation and substantiation of claims herein

Please contact your local PermaTherm office for more information, invoices, data sheets, or other documentation?

5.6. Service life of the product

PermaTherm expects its EPS products to have a nominal service life of 20 years when properly installed and operate. A qualified engineer should be consulted to confirm service life in a particular installation.



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5.7. Natural disaster mitigation (e.g. performance of the product during a natural disaster or appropriate response after a natural disaster)

EPS is versatile enough to be used as lightweight fill and ground stabilization, effective in helping mitigate the impact of earthquakes on surrounding structures.

5.8. Environmental quality of the building product or element

EPS uses pentane which does not deplete the stratospheric ozone or contribute to global warming. Extruded polystyrene, on the other hand, continues to use HCFC's, which do negatively impact air quality.