

Progressive Foam Technologies Insulated Siding with Fullback Technology

Product Selection and Description

In 1992, Progressive Foam Technologies, Inc. developed ThermoWall, an expanded polystyrene (EPS) foam-contoured material designed to enhance the performance characteristics of vinyl siding. Since then, Progressive Foam has launched ThermoWall's next generation product, the Fullback Thermal Support System. The manufacturer reports that this product improves the thermal performance of the external wall system by eliminating any voids behind the vinyl's hollow siding, thereby saving energy during its use. Use of the Fullback is also intended to discourage mold growth and repel termites with the help of an insecticide.

Progressive Foam's Insulated Siding with Fullback Siding Insulation product is evaluated in BEES. It is comprised of compressed EPS beads, which are purchased and expanded into foam board at Progressive Foam's Beach City, Ohio plant, and then laminated onto vinyl siding. The siding modeled for BEES is 19.54 kg (43.08 lb) per 9.29 m² (100 ft²), and it is typically installed with galvanized nail fasteners placed 41 cm (16 in) on center. Siding is generally specified in terms of 'squares' of siding, or 9.29 m² (100 ft²) of siding. For the BEES system, the functional unit is 0.09 m² (1 ft²) of siding. Progressive Foam's Insulated Siding product line has thermal resistance values ranging from R-2 to R-4, and the product modeled in BEES has a value of 2.57 according to ASTM, International Standard 1363 test results. Despite the added insulation and reduced thermal bridging, the building still requires base insulation. Thermal performance differences among exterior wall finish alternatives are not accounted for in BEES, but should be considered when interpreting BEES results.

Flow Diagram

The flow diagram below shows the major elements of the production of this product as it is currently modeled for BEES.

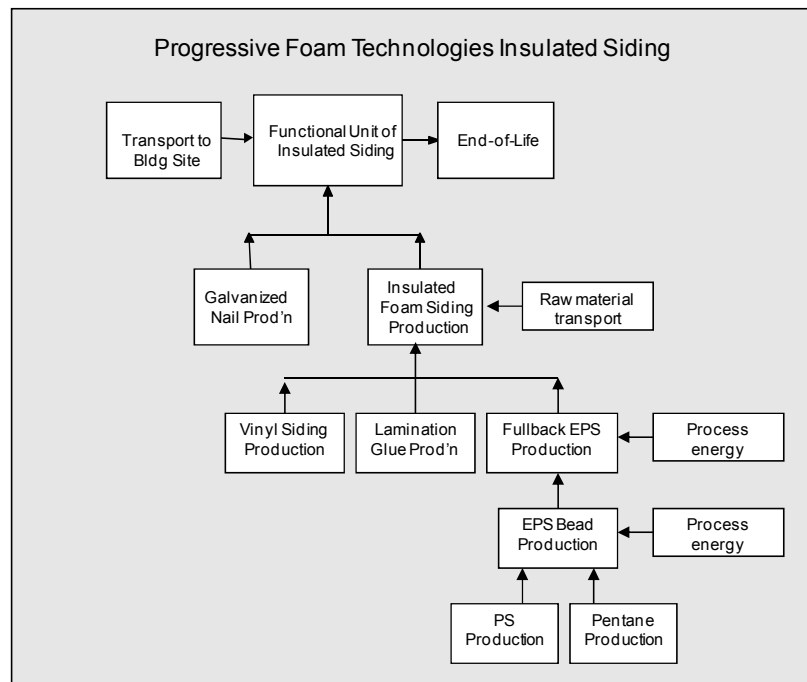


Figure 1: Progressive Foam Insulated Vinyl Siding System Boundaries

Raw Materials

Progressive Foam's insulated vinyl siding is comprised of three main components: EPS foam, vinyl siding, and lamination glue, as shown in the table below.

Table 1: Progressive Foam Insulated Siding Constituents

Constituent	kg/functional unit	% by mass
Foam backing	0.0303	15.5 %
Vinyl siding	0.1631	83.5 %
Lamination glue	0.0020	1.0 %

EPS Foam Board Production. Progressive Foam receives compressed EPS foam beads from several suppliers and expands them using steam from a natural gas-fired steam generator. The energy used at the foam plant is summarized below.

Table 2: Energy Requirements for Progressive Foam Production

Energy source	Quantity per kg foam
Electricity	3.68 MJ (1.021 kWh)
Natural Gas	14 MJ (13,032 Btu)
Propane	0.4 MJ (394 Btu)

Propane is used for the forklifts, and natural gas is used for steam generation for foam expansion and general plant heating. Data for these are based on total plant use divided by total output. Electricity production, fuels, and combustion come from the U.S. LCI Database.

During expansion, 0.0443 kg pentane/kg EPS foam is released, which initially comes from the pentane used to expand the polystyrene (upstream). Solid waste is generated at the plant as well. This waste, 0.04 kg/kg foam, is non-hazardous, miscellaneous plant trash, and whatever part of this trash cannot be recycled goes to a landfill.

A small amount of the insecticide Preventol is used in the foam. No data were available to model the production of the Imidachloprid in this insecticide, but the quantity of Preventol, 1.3×10^{-4} kg/kg (1.3×10^{-4} lb/lb) of foam (0.01% of the final product) falls beyond the cut-off criteria.¹

Other materials production. Progressive Foam does not manufacture its own vinyl siding, but does specify the siding it does use. Since data on the production of this specific vinyl siding is not available, the BEES generic vinyl siding data are used. Refer to the Generic Vinyl Siding product summary for its description.

The lamination glue used at Progressive Foam is made up of the following components:

Table 3: Progressive Foam Laminated Glue Constituents

Constituent	% by mass
Tackifying Resins	47.0 %
Mineral Oil	20.0 %
Polymer Solids	27.0 %
Carbonic Acid	3.0 %
Talc	3.0 %

These materials are modeled based on elements of the U.S. LCI database, the EcoInvent database, the SimaPro database, and U.S. Department of Agriculture and U.S. Department of Energy study on biodiesel and petroleum diesel fuels.²

¹ A check for sensitivity using a biocide as a proxy was made, and the results did not change.

² Sheehan, J. et al., Life Cycle Inventory of Biodiesel and Petroleum Diesel for Use in an Urban Bus, NREL/SR-580-24089 (Washington, DC: US Department of Agriculture and US Department of Energy, May 1998).

Manufacturing

Process energy. At the manufacturing stage, the EPS foam board and a sheet of vinyl siding are hand fed on to a table of rollers. Lines of glue are applied to the foam and then the foam and vinyl are run through a compression roller sealing the foam to the vinyl. Prior to lamination, the foam is trimmed to match the vinyl profile. These pieces are then boxed and shipped. The whole process relies primarily on human labor, with only a tiny bit of electricity being used. The small amount of electricity required for the roller machine has been included as part of the foam production process (described above in the Raw Materials section), since electricity is reported on a total facility basis.³ Foam trim, 0.29 kg/kg foam, is recovered and sent to a recycler.

Transportation. Transport of the EPS foam beads from Progressive Foam's several suppliers, of the vinyl siding, and of the lamination glue are taken into account in the model. Ocean freighter, rail, and truck are modeled for the foreign supplier of EPS beads, and these distances are approximately 7 000 km (4 351 mi), 3 800 km (2 362 mi), and 100 km (62 mi) by ocean freighter, rail, and heavy-duty diesel truck, respectively. Heavy-duty diesel truck is the assumed transportation mode for the remaining beads, and distances range from 241 km (150 mi) to 1 866 km (1 160 mi). The vinyl siding is sourced from a location approximately 483 km (300 mi) from Beach City, and the lamination glue is sourced from a location approximately 764 km (475 mi) from Beach City. All transportation modes are modeled based on the U.S. LCI Database.

Transportation

According to Progressive Foam, the insulated foam board is transported an average of 442 km (275 mi) by diesel truck to the building site. The nails are assumed to be transported 241 km (150 mi) by diesel truck to the building site.

Installation

Installation of siding is done primarily by manual labor. Nails and a nail gun are used to install the siding. Nails are installed 41 cm (16 in) on center. Similar to the generic vinyl siding product in BEES, the nails are modeled as galvanized steel, and for installation 41 cm (16 in) on center, 0.0024 kg (0.0053 lb) per 0.09 m² (per 1 ft²) of siding is used. The energy required to operate compressors to power air guns is assumed to be very small and is not included in the analysis. Installation waste with a mass fraction of 5 % is assumed, and this waste is assumed to go to a landfill.

While sheathing, weather resistive barriers, and other ancillary materials may be required to complete the exterior wall system, these materials are not included in the system boundaries for BEES exterior wall finishes.

Use Phase

Consistent with the generic vinyl siding product in BEES, Progressive Foam's insulated siding is assumed to have a useful life of 50 years. No routine maintenance is required to prolong the lifetime of the product, although cleaning is recommended to maintain appearance. Cleaning would normally be done with water and household cleaners. Information on typical cleaning practices (e.g., frequency of cleaning, types and quantities of cleaning solutions used) are not available; maintenance is not included in the system boundaries.

End-of-Life

Progressive Foam Insulated Siding is assumed to be disposed of in a landfill at end of life.

³ Quantifying energy for the process in terms of electricity per total output ensured that all of the electricity was accounted for. This approach was considered more important than trying to quantify a negligible amount of energy in the lamination process, relative to the Fullback foam production.

References

Life Cycle Data

National Renewable Energy Laboratory (NREL): *U.S. Life-Cycle Inventory Database*. 2005. Golden, CO.

Found at: <http://www.nrel.gov/lci/database>

PRé Consultants: *SimaPro 7.0 LCA Software*. 2005. The Netherlands.

Sheehan, J. et al., *Life Cycle Inventory of Biodiesel and Petroleum Diesel for Use in an Urban Bus*, NREL/SR-580-24089 (Washington, DC: US Department of Agriculture and US Department of Energy, May 1998).

Industry Contacts

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