Generic Nylon Carpet

Product Selection and Description

For the BEES analysis, nylon carpet with an 11-year life (broadloom) or 15-year life (tile) is studied. The mass for 0.09 m^2 (1 ft^2) of broadloom carpet is approximately 2.2 kg/m^2 (0.45 lb/ft^2), while the mass for 0.09 m^2 (1 ft^2) of carpet tile is approximately 5.3 kg/m^2 (1.1 lb/ft^2). Four different product combinations are included in the BEES database.

Flow Diagram

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

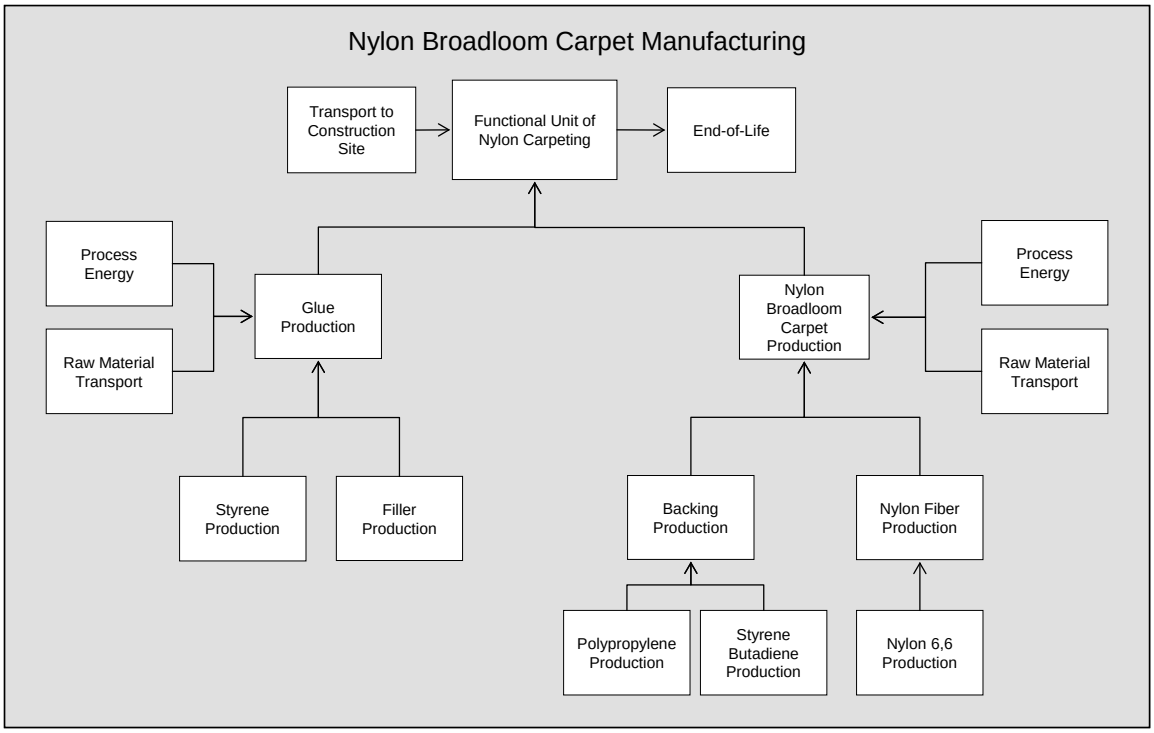

Figure 1: Nylon Broadloom Carpet System Boundaries

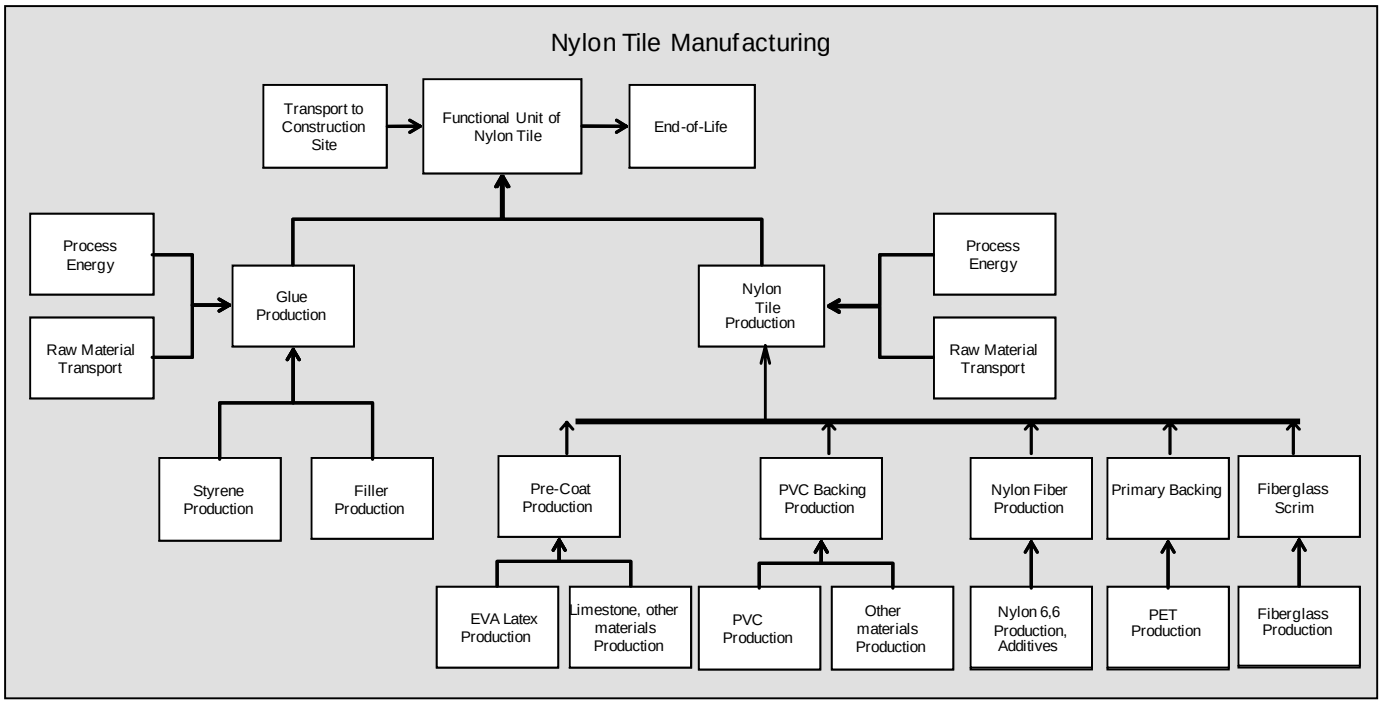

Figure 2: Nylon Carpet Tile System Boundaries

Raw Materials

Nylon carpeting consists of a mix of materials that make up the face and the backing of the product. The composition of broadloom carpet and carpet tiles differs significantly; specifications are provided in the following table.

Table 1: Nylon Carpet Constituents

Constituent	*Material*	*g/m^2 (oz/ft^2)*
Broadloom		
Face Fiber	Nylon 6,6	1 029 (3.37)
Backing	Polypropylene	227 (0.74)
	Styrene butadiene latex	263 (0.86)
	Limestone ($CaCO_3$) filler	909 (2.98)
	Stainblocker	0.24 (0.001)
	Other additives	2 (0.01)
Tile		
Face Fiber	Nylon 6,6	815 (2.67)
	Additives (Fluorochemical)	109 (0.36)
Primary Backing	Polyester (PET) woven	166 (0.55)
Precoat	EVA latex	333 (1.09)
	Limestone ($CaCO_3$) filler	66 (0.22)
	Other additives (aluminum trihydrate, soap)	500 (1.64)
PVC Backing	PVC	676 (2.22)
	Limestone ($CaCO_3$)	1 994 (6.53)
	Diisononyl phthalate	658 (2.16)
	Other additives (lime, colorant)	13 (0.04)
Fiberglass	Fiberglass	66 (0.22)

Data for Nylon 6,6 come from EcoInvent, whose data are based on those from Eco-profiles of the European plastics industry (PlasticsEurope). Data for polypropylene, PET, and PVC come from the Plastics Division of the American Chemistry Council.[1] Styrene butadiene latex is compiled using butadiene and styrene unit process data from the same ACC study. Limestone data come from the U.S. LCI Database. Data for the remaining nylon carpet materials are derived from elements in the SimaPro and EcoInvent databases.

Manufacturing

Energy Requirements. Carpet manufacturing consists of a number of steps, including formation of the synthetic fibers; dyeing of the fibers; and construction, treatment, and finishing of the carpet. For both nylon carpet types, the nylon material is made into fibers and then 'tufted' to produce the carpet face. The face yarn is attached, using a primary coating and tufting needles, to the polymer backing. The energy requirements for these process steps are provided in the following Table.

Table 2: Energy Requirements for Nylon Carpet Manufacturing

Energy Carrier	***Broadloom MJ/m^2 (Btu/ft^2)***	***Tile MJ/m^2 (Btu/ ft^2)***
Electricity	0.39 (34)	2.2 (197)
Fuel Oil	5.0 (437)	3.5 (306)
Heating Steam	1.67 (145)	2.4 (207)

Emissions. Emissions associated with the manufacturing process arise from the production of electricity and the combustion of fuel oil and natural gas, and are based on the U.S. LCI Database.

Solid Wastes. Approximately 9 % and 7 % waste is generated from the production of nylon broadloom carpet and carpet tile, respectively. Included in these figures are customer returns and off-specification production. All waste is assumed to be disposed of in a landfill.

Water Consumption. Approximately 0.96 kg/m^2 (0.20 lb/ft^2) and 0.93 kg/m^2 (0.19 lb/ft^2) of water is consumed during the manufacture of nylon broadloom carpet and carpet tile, respectively.

Transportation. Transport of raw materials to the carpet manufacturing plant is assumed to cover 402 km (250 mi) by truck.

Transportation

Transportation of nylon carpet by heavy-duty truck to the building site is modeled as a variable of the BEES system.

Installation

Nylon broadloom carpet and nylon carpet tiles are installed using either a standard latex glue or a low-VOC latex glue. For the tile, typical glue application is 0.012 kilograms (0.026 lb) of glue per ft^2 of installed tile. For the broadloom carpet, two applications of glue are required – 0.624 kg/m^2 (0.128 lb/ft^2) is applied to the product and then spots of glue are applied to the floor space at a rate of 0.022 kg/m^2 (0.004 lb/ft^2).

No glue is assumed to be wasted during the installation process, yet 5.7 % of the broadloom carpet and 2 % of the carpet tile are assumed to be lost as landfilled waste.

[1] Franklin Associates, a Division of ERG, for the Plastics Division of the American Chemistry Council: *Cradle-to-Gate Life Cycle Inventory of Nine Plastic Resins and Four Polyurethane Precursors* (Prairie Village, KS, 2010).

Use

The use phase of this product is either 11 years or 15 years depending on the type of nylon carpeting, broadloom or tile, respectively. As with all BEES products, life cycle environmental burdens from these replacements are included in the inventory data. Volatile Organic Compound (VOC) off-gassing from the carpet and both traditional and low-VOC adhesives are included in the BEES modeling.

End of Life

At end of life, a recycle rate of 0.7 % is assumed for broadloom carpet, while none of the carpet tile is recycled. The nylon carpet and its adhesives are assumed to be disposed of in a landfill.

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 6.0 LCA Software*. 2005. The Netherlands.

EcoInvent Centre: *EcoInvent data v2.0* (Dübendorf: Swiss Centre for Life Cycle Inventories, 2007). Found at: www.ecoinvent.org.

Franklin Associates, a Division of ERG, for the Plastics Division of the American Chemistry Council: *Cradle-to-Gate Life Cycle Inventory of Nine Plastic Resins and Four Polyurethane Precursors* (Prairie Village, KS, 2010).