CertainTeed Corporation Fence and Exterior Railing Products

CertainTeed Corporation manufactures building materials that include roofing, vinyl and fiber cement siding, trim, fence, railing, decking, foundations, insulation, gypsum, ceilings, and pipe products. CertainTeed has approximately 70 facilities throughout the United States and Canada. CertainTeed's Chesterfield Vinyl Fence is evaluated in BEES for the Fence category and CertainTeed's Kingston Vinyl Railing and Panorama Composite Railing products are evaluated for the Exterior Railing System category. All three products are manufactured at CertainTeed's Buffalo, NY, fence, rail, and deck plant. They are modeled as having a white finish. The Chesterfield is modeled as an average of the Chesterfield finish textures, and for BEES is modeled with no accent (e.g., lattice top). The functional unit for the rail and fence categories is 1 linear foot of product used for 50 years. The height of the products used for BEES, their mass per linear foot (excluding packaging and installation materials), and their density are as follows:

Table 1: Product Specifications per Functional Unit

Product	***Height in m (ft) & Description***	***Mass kg/0.3 m (lb/ft)***	***Density[note 1] kg/cm3 (lb/in3)***
Chesterfield Vinyl Fence	1.8 (6.0) – pickets, posts & rails	4 (8.8)	1.4 E-3 (0.05)
Kingston Vinyl Railing	0.9 (3.0) – pickets, posts & rails	1.5 (3.4)	1.4 E-3 (0.05)
Panorama Composite Railing	0.9 (3.0) – balusters, posts & rails	2.9 (6.4)	1.1 E-3 (0.04)

Note 1 – The whole product (excluding installation materials and packaging) is made up of the same composition.

The products are installed with stainless steel hardware, steel or aluminum inserts, and PVC post caps. The fence posts require a concrete footing.

Flow Diagrams

The flow diagrams below show the major elements of the production of these products as they are modeled in BEES.

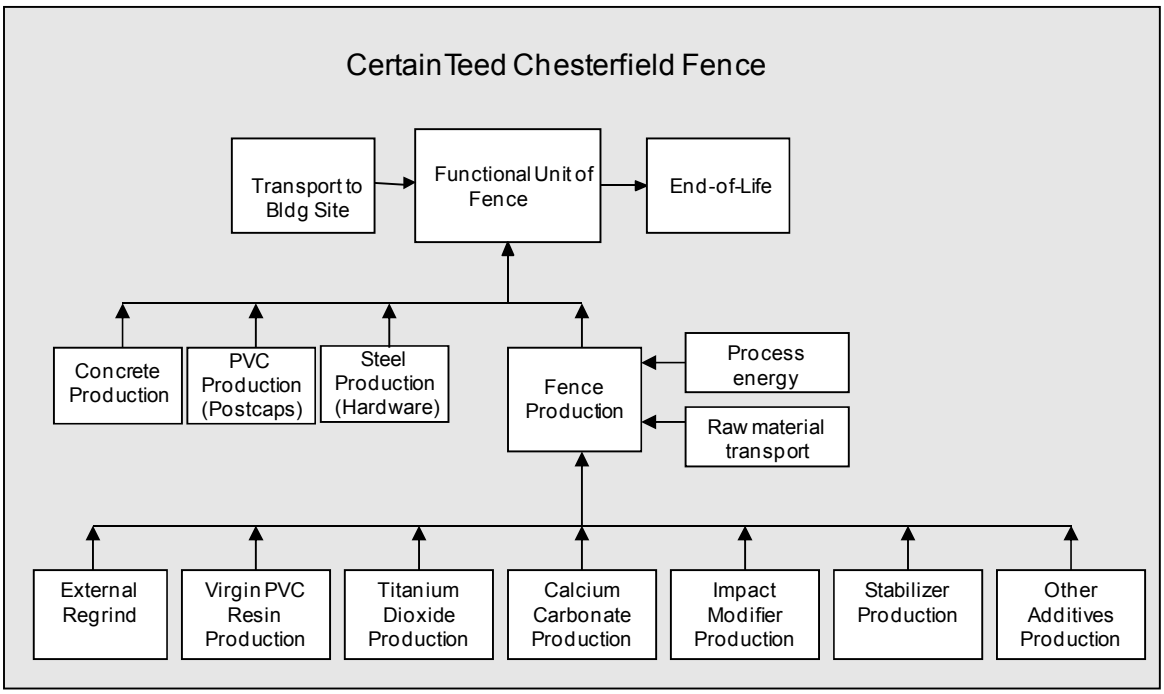

Figure 1: CertainTeed Chesterfield Fence System Boundaries

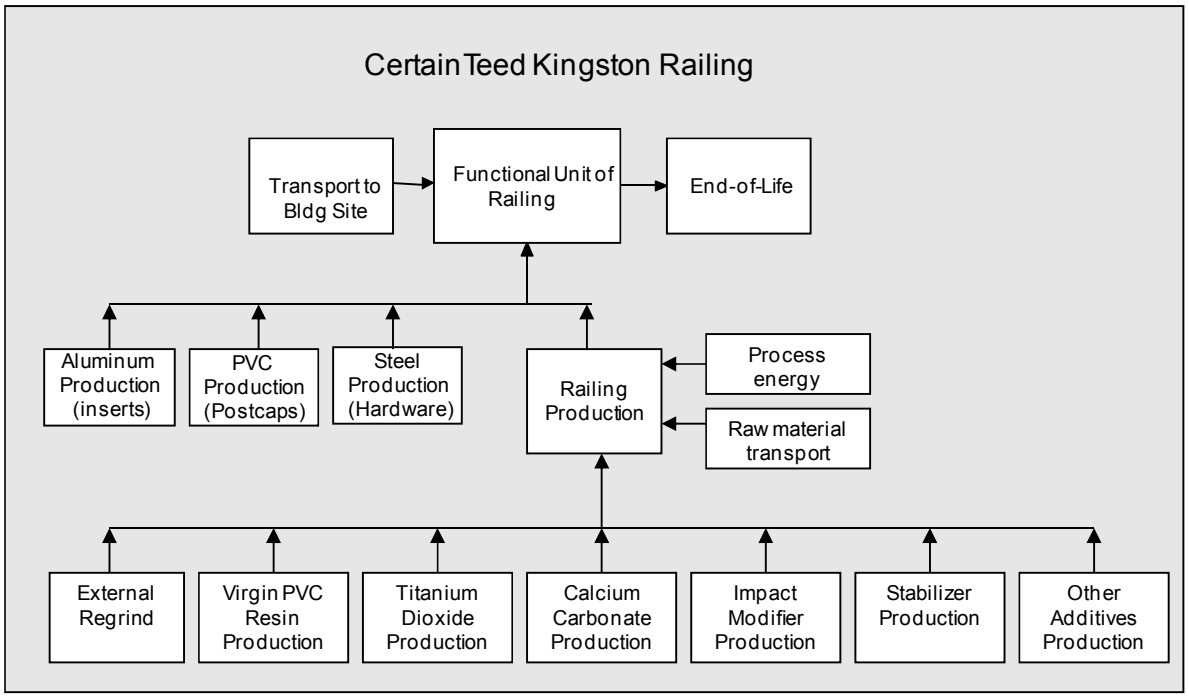

Figure 2: CertainTeed Kingston Railing System Boundaries

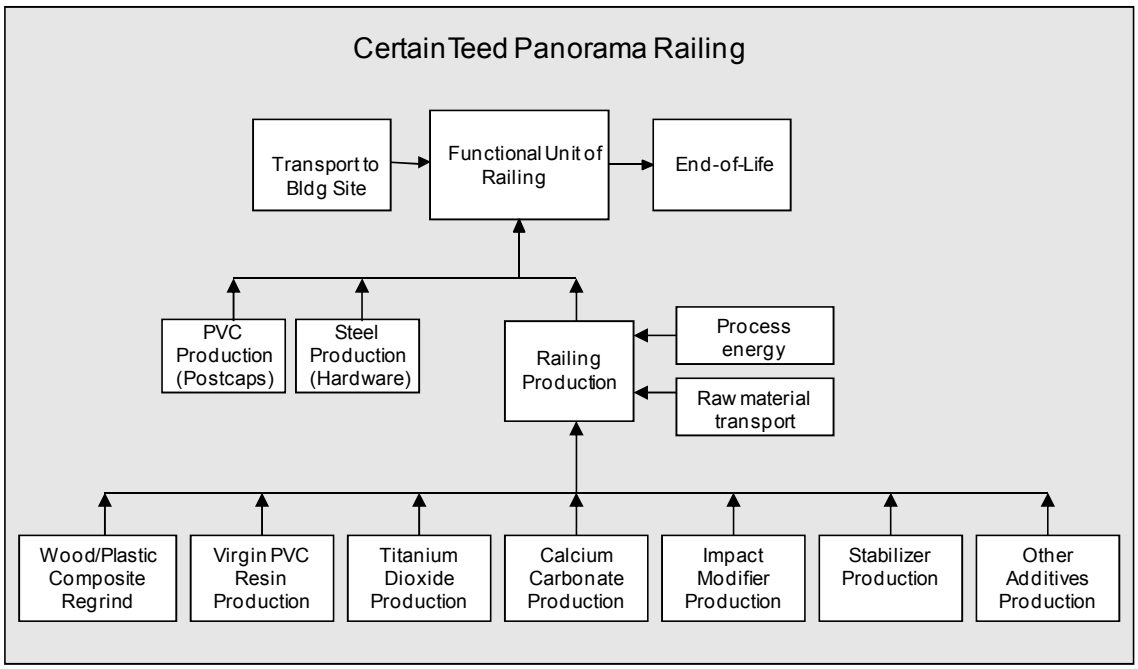

Figure 3: CertainTeed Panorama Railing System Boundaries

Raw Materials

The bills of materials are presented in the following tables.

Table 2: Chesterfield Vinyl Fence Constituents

Constituent	*% range*
PVC	1 % - 55 %
Titanium Dioxide	1 % - 2 %
Calcium Carbonate	1 % - 8 %
External Regrind	1 % - 33 %
Impact Modifiers	1 % - 2 %
Stabilizer	0.5 % - 1 %
Other additives	1 % - 2 %
Total	**100 %**

Table 3: Kingston Vinyl Railing Constituents

Constituent	*% range*
PVC	1 % - 55 %
Titanium Dioxide	1 % - 2 %
Calcium Carbonate	1 % - 8 %
External Regrind	1 % - 33 %
Impact Modifiers	1 % - 2 %
Stabilizer	0.5 % - 1 %
Other additives	1 % - 2 %
Total	**100 %**

Table 4: Panorama Composite Railing Constituents

Constituent	*% range*
Wood/Plastic Composite Regrind	1 % - 92 %
PVC	1 % - 9 %
Titanium Dioxide	0.05 % - 1 %
Calcium Carbonate	0.05 % - 1 %
Impact Modifiers	0.05 % - 1 %
Stabilizer	0.05 % - 1 %
Other additives	0.05 % - 1 %
Total	**100 %**

The PVC resin data come from the U.S. LCI database. External regrind is finished product scrap that is sent off-site to be reground. The grinding energy was provided by a PVC regrinding facility in 2012, and amounts to 0.0015 kg (0.0033 lb) natural gas and 0.123 kWh (0.443 MJ) electricity per kg regrind. The composite regrind is comprised of approximately 45 % recycled wood fiber, recovered from another CertainTeed plant, and 65 % PVC. The fiber is ground into wood flour and blended and ground with PVC at a facility off-site. No grinding energy was available to model the production process, so the PVC regrind energy data were used as proxy.

Production data for the other materials in the tables above are based on the U.S. LCI, EcoInvent, and SimaPro databases. The specific stabilizers and impact modifiers used were reported in the questionnaires and modeled according to their Material Safety Data Sheets (MSDSs); their production data are included in the LCA models but are excluded from this documentation to protect company confidential data. "Other additives," including process aids and lubricants, were also reported and modeled according to MSDSs and/or general chemical family composition.

The packaging for the three products is as follows:

Table 5: Packaging per Functional Unit of Each Product

Packaging Type	*Chesterfield Vinyl Fence*	*Kingston Vinyl Railing*	*Panorama Composite Railing*
pallets – kg (lb)	0.22 (0.49)	0.09 (0.19)	0.16 (0.36)
cut to size lumber – kg (lb)		0.35 (0.78)	0.67 (1.48)
cardboard slip sheet – kg (lb)	0.02 (0.04)	5.0 E-3 (0.01)	0.01 (0.03)
PE film – kg (lb)	0.04 (0.09)	0.04 (0.09)	0.08 (0.18)
Polyester green strapping – kg (lb)	5.0 E-3 (0.01)	5.0 E-3 (0.01)	5.0 E-3 (0.01)
PE clear film – kg (lb)		0.01 (0.02)	0.02 (0.04)
Corrugated boxes – kg (lb)		0.01 (0.02)	1.12 (2.46)

The pallets are assumed to be reused and the cardboard slip sheet and corrugated boxes are assumed to be recycled by the installers. The remaining packaging materials are modeled as landfilled once the installation is complete.

Manufacturing

Manufacturing energy for the three products is presented in the table below.

Table 6: Energy Requirements per Functional Unit of Each Product

Energy source	*Chesterfield Vinyl Fence*	*Kingston Vinyl Railing*	*Panorama Composite Railing*
Electricity (kWh)	4.01	1.63	2.50
Propane (MJ)	0.42	0.16	0.30

The electricity is used for raw materials mixing, extrusion, machining, lighting, air compressors, cooling water pumps, grinding, cutting, and assembly of the pieces into their respective packaging. The propane is used in the forklifts. The Buffalo facility has a power purchase agreement with the local hydroelectric facility and through that contract they receive all of their electricity via hydropower instead of their local grid within the Northeast Power Coordinating Council (NPCC) subregion of the North American Electric Reliability Corporation (NERC). Propane production and combustion come from the U.S. LCI Database. The following table summarizes other manufacturing-related data:

Table 7: Other Process Data per Functional Unit of Each Product

Process Flow	*Chesterfield Vinyl Fence*	*Kingston Vinyl Railing*	*Panorama Composite Railing*
Input: Water use L (gal)	5.60 (1.48)	2.16 (0.57)	4.09 (1.08)
Output: Wastewater L (gal)	2.27 (0.60)	0.87 (0.23)	1.63 (0.43)
Output: Solid waste kg (lb)	0.05 (0.12)	0.02 (0.05)	9.9 E-4 (2.2 E-3)

The water is used for running the cooling towers and for overhead/domestic and other miscellaneous use. The wastewater, discharged to the sewer, comes mainly from overhead/domestic and other miscellaneous uses; the discrepancy between the reported water in and out is mainly due to evaporation losses in the closed loop cooling water system. This water is assumed to be uncontaminated.

There is no product loss during manufacturing; CertainTeed collects any scrap product and regrinds it to make new product. A small amount of off-spec product is collected and sent to an off-site recycler to be integrated into other products. There are many items used in the plant that are recovered and sent for recycling. The solid waste reported above is non-recyclable, non-hazardous miscellaneous plant waste, and this is sent to waste-to-energy.

Combustion-related air emissions are accounted for in upstream energy use data sets (e.g., propane use). Particulate matter is generated during the process (in the sawing operations, for example), but these are immediately suctioned into a vacuum system and sent back to the regrind silo where it is introduced back into the product formulation. The facility uses a closed pneumatic transfer system for all of their raw materials (silo to mixer to hopper to extruder) which minimizes material loss. The facility is exempt from reporting air emissions so other potential emissions are not available.

Transportation of material constituents. Transportation of the raw materials in the products has been accounted for. The PVC resin is transported by rail a distance of 2 280 km (1 417 mi). The remaining materials are transported by heavy-duty diesel truck, and transportation distances range from 402 (250 mi) to 2 373 km (1 475 mi). Packaging materials are transported under 19 km (12 mi) to the CertainTeed plant. All transportation modes are modeled based on the U.S. LCI Database.

Transportation of Product to Installation

The finished product is transported an average of 1 154 km (717 mi) by diesel truck to customers, based on 2013 sales data. The generic installation materials are assumed to be transported 241 km (150 mi) by diesel truck. The BEES user is free to change the assumed transport distances for the main product.

Installation

The products are installed with stainless steel hardware, steel or aluminum inserts, and PVC post caps. The fence posts require a concrete footing. The installation materials per functional unit are as follows:

Table 8: Installation Materials per Functional Unit of Each Product

Installation Component	*Chesterfield Vinyl Fence*	*Kingston Vinyl Railing*	*Panorama Composite Railing*
PVC Post Caps – kg (lb)	2.0 (4.4)	1.1 (2.4)	0.07 (0.2)
Stainless steel hardware – kg (lb)	0.2 (0.5)	0.05 (0.1)	0.2 (0.5)
Steel Inserts (20% RC) – kg (lb)	0.7 (1.5)		
Aluminum Inserts (25% RC) - kg (lb)		0.8 (1.7)	
PVC – kg (lb)			0.1 (0.3)
Concrete Footing – kg (lb)	5.7 (12.5)		

There is some sawing and drilling during installation, but these energy data were not available. Post caps are manufactured by CertainTeed while the other installation materials are generic. Data for installation materials come from the U.S. LCI database and EcoInvent. The model assumes a loss of less than 1 % of product at installation, and this is assumed to go to a landfill.

Use Phase

Backed by a lifetime warranty, Chesterfield vinyl fence and Kinston vinyl railing are assumed to have a useful life of 50 years. The Panorama composite railing is modeled as having a useful life 25 years. Thus, for Panorama, one initial installation and one replacement are modeled for the BEES functional lifetime. No routine maintenance is required to prolong the lifetime of these products, although cleaning is recommended to maintain appearance. Cleaning would normally be done with water and household cleaners. Cleaning is not accounted for in the models, due to the broad range of practices (e.g., frequency of cleaning, types and quantities of cleaning solutions used, etc.).

End-of-Life

While the products may be recyclable, there are no take-back programs currently in place. Thus, at the end of life, this product is 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 7.0 LCA Software*. 2005. The Netherlands.

Ecoinvent Centre, *Ecoinvent data v3.0* (Dübendorf: Swiss Centre for Life Cycle Inventories, 2007), retrieved from: www.ecoinvent.org.

Industry Contact

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