Generic Fiber Cement Shingles

Product Selection and Description

Fiber cement shingles are considered a synthetic equivalent to wood shingles. In general, these roofing materials can last longer that wood or asphalt products. In the past, fiber cement shingles were manufactured using asbestos fibers. Now asbestos fibers have been replaced with cellulose fibers.

For BEES, a 45-year fiber cement shingle consisting of Portland cement, fly ash, silica fume, sand, and cellulose fibers is studied. The shingle size modeled is 36 cm x 76 cm x 0.4 cm (14 in x 30 in x 5/32 in). Two underlayment options are modeled with fiber cement shingles: type-30 roofing felt and polypropylene weave with modified polyolefin coatings (ECP Nova-Seal II). The felt underlayment is described in this product summary while the Nova-Seal II underlayment is described in its own summary. Roof coverings such as fiber cement shingles are evaluated in BEES on the basis of a functional unit of roof area covered, 9.29 m^2 (1 square, or 100 ft^2).

Flow Diagram

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

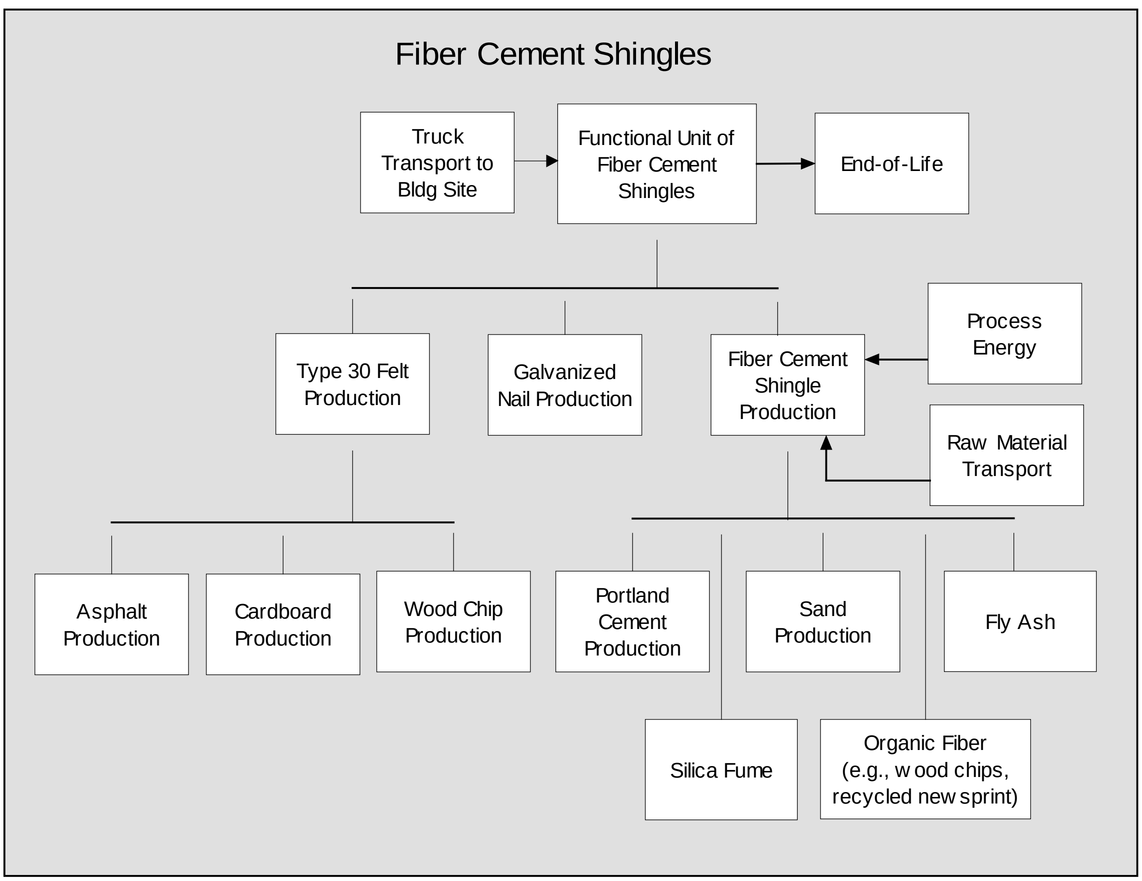

Figure 1: Fiber Cement Shingles System Boundaries

Raw Materials

Fiber cement shingles are composed primarily of portland cement, fly ash, organic fiber, and fillers. The relative proportions of these and other product constituents are provided in the following Table.

Table 1: Fiber Cement Shingle Constituents

Constituent	***Mass*** ***kg/m²*** ***(lb/ft²)***	***Mass Fraction (%)***
Portland cement	6.35 (1.30)	40
Fly ash	5.27 (1.08)	33
Silica fume	1.29 (0.26)	8
Filler (sand)	1.61 (0.33)	10
Organic fiber (including wood chips, recycled newsprint)	1.29 (0.26)	8
Pigments (oxides)	0.11 (0.02)	1
Total	**15.93 (3.26)**	**100**

Production of portland cement is described under the Portland Cement Concrete Products documentation. Fly ash is a waste product from coal combustion in electric utility boilers, and silica fume is a waste product from the manufacture of silicon and ferrosilicon alloys. These waste products are assumed to be environmentally "free" input materials; however, transport of these materials to the shingle plant is included. Data for the production of other input materials is from the SimaPro LCA database and U.S. LCI Database.

Sources of organic fiber include wood chips and recycled newsprint. The amount of each is likely to vary by manufacturer; one manufacturer reports that recycled newsprint accounts for 3 % of the mass fraction of their product.

For the underlayment, Type II No. 30 roofing felt is used, which consists of asphalt and organic felt as listed in the Table below. The organic felt is assumed to consist of 50 % recycled cardboard and 50 % wood chips. The production of felt materials is based on the SimaPro LCA database and U.S. LCI Database.

Table 2: Type-30 Roofing Felt Constituents

Constituent	***Kg/m²*** ***(lb/square)****	***Mass Fraction***
Asphalt	0.57 (11.5)	45 %
Organic Felt	0.51 (10.4)	10 %
Limestone	0.13 (2.6)	5 %
Sand	0.06 (1.3)	40 %
Total	1.27 (25.9)	100 %

*One square is equivalent to 9.29 m^2 (100 ft^2)

Manufacturing

Energy Requirements and Emissions. Fiber cement is manufactured by blending the raw materials; the blend is then cured to produce shingles. Energy—of the types and amounts given below—is required for blending and for curing of the final product. Data on production and combustion of fuels, including electricity generation, is from the U.S. LCI Database.

Table 3: Energy Requirements for Fiber Shingle Manufacturing

Energy Carrier	***MJ/kg (Btu/lb)***
Natural Gas	2.08 (894)
Electricity	0.69 (297)
Total	**2.77 (1 191)**

No manufacturing data for felt underlayment were available, so its contribution to the life cycle may be underestimated.

Transportation. Most shingle raw materials are assumed to be transported to the manufacturing plant 402 km (250 mi) by truck. A small percentage, assumed to be approximately 2 %, of the shingle material inputs may be transported more then 3 219 km (2 000 mi); due to economic constraints, it is assumed that these products are transported by rail rather than by truck. Roofing felt raw materials are also assumed to be transported 402 km (250 mi) by truck.

Waste. No data were available on types and quantities of solid wastes generated from the shingle manufacturing process; no waste was assumed to be generated.

Transportation

Transportation of fiber cement shingles by heavy-duty truck to the building site is modeled as a variable of the BEES system.

Installation

Installation of fiber cement shingles is assumed to be primarily a manual process, however, equipment such as conveyors may be used to move the roofing materials from ground level to rooftop, and compressors may be used to operate nail guns used to install roofing materials. The energy and emissions from the potential use of equipment and tools is not included within the system boundaries of the BEES model.

The mass of fiber cement shingles is assumed to be 16 kg/m^2 (325 lb/square), based on 36 cm x 76 cm x 0.4 cm (14 in x 30 in x 5/32 in) size shingles. One layer of Type-30 felt underlayment is used under the shingles. To install the shingles and underlayment, 13 galvanized steel nails per m^2 (120 nails per square) are assumed to be used for the underlayment, and 32 nails per m^2 (300 nails per square) are used for the shingles. Each galvanized steel nail is assumed to weigh 0.002 kg (0.004 lb). Installation scrap is estimated at 5 % of the installed weight and is assumed to be landfilled.

Use

The product is assumed to have a useful life of 45 years. At replacement, it is assumed that a new layer of felt is applied beneath the new shingles.

End of Life

When the shingles and underlayment are removed after 45 years, all materials (shingles, underlayment, nails) are assumed to be disposed of in a landfill, and are modeled as such.

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.

Industry Contacts

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