Generic Oriented Strand Board Sheathing

Product Selection and Description

Oriented strand board (OSB) is made from strands of low density hardwoods and softwoods. OSB sheathing is a structural building material used for residential and commercial construction. The OSB panels must be grade-stamped to meet building code. Each panel has a third party certification and a grade stamp that provides such information as the grading agency, the manufacturer, the product type (in this case, sheathing), wood species, adhesive type, the allowable roof and floor spans, and panel thickness. A wax, primarily a petroleum-based wax, is used as an additive to OSB to provide temporary water holdout. Phenol-formaldehyde and methylene–diphenyl-isocyanate (MDI) resins are used as binder materials to hold the strands together.

For residential construction, the building code requirement is typically for a rated sheathing panel of either OSB or plywood of 0.95 cm (3/8 in) thickness when sheathing is required, such as for shear wall sections; however, common practice is to use sheathing thicknesses greater than specified by code, which is referred to as “code plus.” The most common sheathing thickness for OSB is 1.1 cm (7/16 in).

For the BEES system, 0.09 m^2 (1 ft^2) of OSB measuring 1.1-cm (7/16-in) thick is studied. BEES performance data are provided for both roof and wall sheathing; life-cycle costs and environmental performance data are essentially the same for the two applications.

Flow Diagram

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

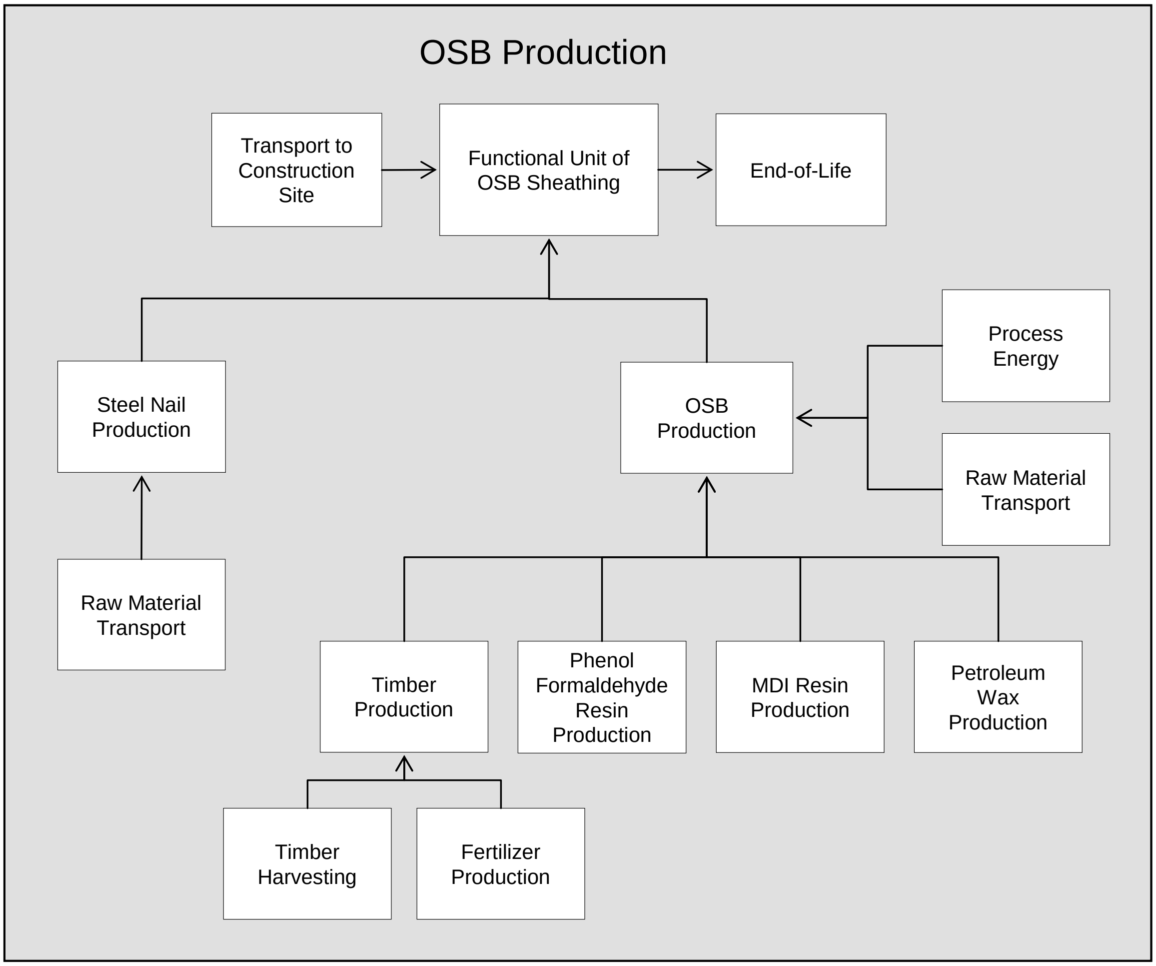

Figure 1: OSB Sheathing System Boundaries

Raw Materials

The OSB data for BEES are based on a study performed by CORRIM.[1] The following Table shows the constituents of 0.09 m^2 (1 ft^2) of 1.1 cm (7/16 in) thick OSB sheathing, in terms of percentage of final product.

Table 1: OSB Constituents

Constituent	***Mass kg/m²* (*lb/ft²*)**	***Mass Fraction (%)***
Wood	6.76 (1.38)	94.5
PF resin	0.237 (0.049)	3.34
MDI resin	0.043 (0.009)	0.66
Wax	0.108 (0.022)	1.5
Totals	7.15 (1.46)	100

The BEES model includes timber production, which includes raising seedlings, planting, fertilizer, and harvesting. Energy use and life cycle data on timber production are based on a study by CORRIM of tree production and harvesting in the Southeastern United States for southern pine.[2] The growing and harvesting of

[1] Kline, D.E. "Southeastern oriented strandboard production," Module A, Life Cycle Environmental Performance of Renewable Building Materials in the Context of Residential Construction (Seattle, WA: Consortium for Research on Renewable Industrial Materials-CORRIM, Inc)/University of Washington, 2004). Found at: http://www.corrim.org/reports.

[2] Bowyer, J., et al., *Phase I Final Report: Life Cycle Environmental Performance of Renewable Building Materials in the Context of Residential Construction*. (Seattle, WA: Consortium for Research on Renewable Industrial Materials--CORRIM, Inc./University of Washington, 2004). Found at http://www.corrim.org/reports. 600+ pp.; data also submitted to US LCI Database.

wood is modeled as a composite comprised of a mix of low-, medium-, and high-intensity managed timber. Energy use includes electricity for greenhouses to grow seedlings, gasoline for chain saws, diesel fuel for the harvesting mechanical equipment, and a small amount of fertilizer. Fertilizer production data is adapted from European data in the U.S. LCI Database. Emissions from tractors and those associated with production of diesel fuel as well as production and delivery of electricity are included and taken from the U.S. LCI Database. Electricity use for greenhouse operation is based on the grids for the regions where the seedlings are grown. The mix of wood resources for the OSB mills is southern pine softwood (75 %) and several different southern hardwoods (25 %). The average density of this mix, on an oven-dry basis, is 558 kg/m^3 (34.82 lb/ft^3).

BEES modeling accounts for the absorption of carbon dioxide by trees as they grow; the carbon becomes part of the wood, and the oxygen is released to the atmosphere. The "uptake" of carbon dioxide from the atmosphere during the growth of timber is about 1.84 kg (4.06 lb) of carbon dioxide per kilogram of harvested wood (oven-dry weight).

Data representing the production of the phenol formaldehyde (PF) resin and MDI are derived from American Chemistry Council 2006 data developed for submission to the U.S. LCI Database, The ATHENA Institute, and the SimaPro database. The wax used in the production of OSB is assumed to be petroleum wax. Production of the petroleum wax is based on the SimaPro database and includes the extraction, transportation, and refining of crude oil into petroleum wax. Electricity for greenhouse operation is regional for the Southeastern United States, whereas electricity for fertilizer production and other inputs is a U.S. average based on fuel source breakdown values.

Manufacturing

Energy Requirements. The energy for the OSB manufacturing process comes from burning the wood waste, which was generated during processing, and use of natural gas. Other fuels used include propane, diesel, fuel oil, and gasoline to operate mechanical equipment, as well as purchased electricity. The site energy and electricity used are shown in the Table below.

Table 2: OSB Production Energy

Energy Carrier	*Units*	*Quantity, 0.95 cm (3/8 in) basis*
Electricity - Southeast Grid	MJ/m^2 (kWh/ft^2)	7.360 (190)
Natural Gas	MJ/m^2 (ft^3/ft^2)	8.743 (747)
Diesel fuel	L/m^2 (gal/ft^2)	0.19 (0.01)
Distillate Fuel Oil	L/m^2 (gal/ft^2)	7.74 (0.19)
LPG	L/m^2 (gal/ft^2)	0.030 (0.71)
Gasoline	MJ/m^2 (gal/ft^2)	0.004 (0.03)
Hogfuel/Biomass (50 % moisture)	kg/m^2 (lb/ft^2)	4 078 (836)

Emissions. The process emissions from the OSB manufacturing process (e.g., volatile organic compound (VOC) emissions from drying the OSB) are based on CORRIM data, as reported in the Table below and in the U.S. LCI Database. With the exception of wood residue combustion, emissions from energy combustion at the plant are included upstream.

Table 3: OSB Manufacturing Site Emissions

Air Emission	*Quantity in kg/m^2 (lb/ ft^2), 0.95 cm (3/8 in) basis*
Particulates (unspecified)	3.03E-03 (0.62)
VOC (unspecified)	1.06E-02 (2.18)
Carbon Dioxide (biomass)	1.17E-01 (24)
Acetaldehyde	6.34E-04 (0.13)
Acrolein	2.29E-04 (0.047)
Methanol	1.95E-03 (0.4)
Phenol	1.17E-04 (0.024)
Formaldehyde	5.37E-04 (0.11)

Transportation. For transportation of raw materials to the manufacturing plant, BEES assumes truck transportation of 143 km (89 mi) for wood timber, 932 km (579 mi) for PF resin, 1328 km (825 mi) for MDI resin, and 1149 km (714 mi) for the wax, based on CORRIM survey data. The tailpipe emissions from the trucks and the emissions from producing the fuel used in the trucks are taken into account and are based on the U.S. LCI Database. The delivery distances are one-way with an empty backhaul. For shipping weights to the OSB mill, the moisture content of the logs is taken into account. The PF resin is shipped at 50 % solids (50 % water) on a wet basis. MDI resin and wax are transported as their stated weight.

Waste. There is essentially no solid waste from the OSB manufacturing process. All the input resin (mainly PF resin with some MDI resin) and the wax can be assumed to go into the final product and the excess wood material is assumed to be burned on site for fuel.

Transportation

Transportation of OSB by heavy-duty truck to the building site is modeled as a variable of the BEES system. To determine the shipping weight of OSB, the model assumes the product has a 5 % moisture content.

Installation

During installation, 1.5 % of the mass of the product is assumed to be lost as waste, which is sent to the landfill. For walls and roofs, OSB is installed using nails. Approximately 0.0024 kg (0.0053 lb) of steel nails are used per ft^2 of OSB. Steel h-clips are used in addition to nails for roof sheathing, although only a small number of clips are required per panel. H-clip production is not included within the boundary of the model.

Use

Based on U.S. Census data, the mid-service life of OSB in the United States is over 85 years. As a conservative estimate, CORRIM—and BEES—use a product life of 75 years.

There is no routine maintenance for sheathing over its lifetime. Roofing material and siding over the sheathing should be replaced as needed. Sheathing would only be replaced when the framing is replaced, so no replacement is assumed.

End of Life

All of the OSB is assumed to be landfilled at end of life.

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.

Kline, D.E. "Southeastern oriented strandboard production," Module A, *Life Cycle Environmental Performance of Renewable Building Materials in the Context of Residential Construction* (Seattle, WA: Consortium for Research on Renewable Industrial Materials. (CORRIM, Inc.)/University of Washington, 2004): Found at http://www.corrim.org/reports.

Bowyer, J., et. al., *Phase I Final Report: Life Cycle Environmental Performance of Renewable Building Materials in the Context of Residential Construction*. (Seattle, WA: Consortium for Research on Renewable Industrial Materials. (CORRIM, Inc.)/University of Washington, 2004) Found at http://www.corrim.org/reports.

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