Generic Mineral Wool

Product Selection and Description

Blown mineral wool insulation is made by spinning fibers from natural rock (rock wool) or iron ore blast furnace slag (slag wool). Rock wool and slag wool are manufactured by melting the constituent raw materials in a cupola. A molten stream is created and poured onto a rapidly spinning wheel or wheels. The viscous molten material adheres to the wheels and the centrifugal force throws droplets of melt away from the wheels, forming fibers. The fibers are then collected and cleaned to remove non-fibrous material. During the process a phenol formaldehyde binder and/or a de-dusting agent are sometimes applied to reduce free, airborne wool during application.

BEES performance data are provided for a thermal resistance value of R-13 for a wall application and R-38 for a ceiling application. The Table below specifies mineral wool insulation for these applications.

Table 1: Blown Mineral Wool Mass by Application

Application	*Thickness cm (in)*	*Density kg/m^3 (lb/ft^3)*	*Mass per Functional Unit kg/m^2 (lb/ft^2)*
Wall--R-13	7.9 (3.1)	64.1 (4.00)	5.06 (1.04)
Ceiling--R-38	30.6 (12.1)	27.2 (1.70)	8.34 (1.71)

Flow Diagram

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

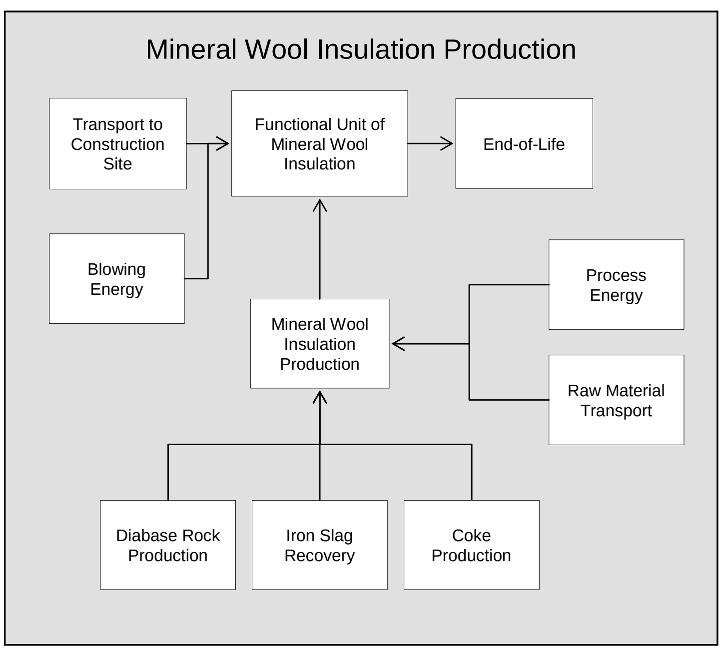

Figure 1: Mineral Wool Insulation System Boundaries

Raw Materials

Mineral wool can be manufactured using iron ore slag (slag wool) or natural diabase or basalt rock (rock wool). Some products contain both materials; about 80 % of North American mineral wool is manufactured using iron ore slag. Loose fill mineral wool insulation is generally unbonded, that is, no resin is used to bind the fibers together. The BEES model for this product represents a weighted mix of the different types of mineral wool insulation used in North America, as given in the Table below.

Table 2: Mineral Wool Insulation Constituents

Constituent	*Mass Fraction (%)*
Diabase Rock/Basalt	22
Iron Ore Slag	78

The life cycle environmental profiles for the constituents of mineral wool insulation are based on surrogate life cycle data in the SimaPro software tool and the U.S. LCI Database.

Manufacturing

Energy Requirements and Emissions. The energy requirements for melting the product constituents into fibers and drying of the fibers involve a mixture of coke and electricity. The energy demands are outlined in the following Table.

Table 3: Energy Requirements for Mineral Wool Insulation Manufacturing

Energy Carrier	*MJ/kg (Btu/lb)*
Coke	6.38 (2740)
Electricity	1.0 (430)
Total	**7.38 (3170)**

The manufacturing process generates air emissions from the combustion of the fuels used to melt the raw materials and from the drying on the insulation material prior to packaging. Emissions from fuel combustion are captured in the fuel use data included in the BEES model; additional emissions are included in the Table below.

Table 4: Emissions for Mineral Wool Insulation Manufacturing

Emission	*Unbonded Loose Fill g/kg (lb/ton)*
Particulates	2.061 (4.122)
Fluorides	0.019 (0.038)

Transportation. The raw materials are all assumed to be shipped 161 km (100 mi) to the manufacturing plant via diesel truck.

Waste. All waste produced during the production process is either recycled into other insulation materials or added back into the melt. Therefore, no solid waste is generated during the production process.

Transportation

Transportation of mineral wool insulation by heavy-duty truck to the building site is modeled as a variable of the BEES system.

Installation

Mineral wool insulation has a functional lifetime of more than 50 years – there is no need to replace or maintain the insulation during normal building use. During the installation of loose fill insulation, any waste material is added into the building shell where the insulation is installed - there is effectively no installation waste.

A diesel generator is used to blow the insulation material into the building shell. For one h of operation, a typical 18 kW (25 hp) diesel engine can blow 818 kg (1 800 lb) of insulation. The emissions and energy use for the generator are included in the system boundaries for this product. No other installation energy is required.

Use

While not accounted for in BEES, it is important to consider thermal performance differences when assessing environmental and economic performance for insulation product alternatives. Thermal performance affects building heating and cooling loads, which in turn affect energy-related LCA inventory flows and building energy costs over the 50-year use stage. Since alternatives for ceiling insulation all have R-38 thermal resistance values, thermal performance differences are at issue only for the wall insulation alternatives.

End of Life

While mineral wool insulation is mostly recyclable, it is assumed that all of the insulation is disposed of in a landfill at end of life.

References

Life Cycle Data

Energy Information Administration, *Short-Term Energy Outlook—November 2006* (Washington, DC: U.S. Department of Energy, 2006), Table WF01.

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.

Petersen, S., *Economics and Energy Conservation in the Design of New Single-Family Housing (NBSIR 81-2380)* (Washington, DC: National Bureau of Standards, 1981).

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