NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Conveyor System, 48 Inch, Construction

Reference Flow: 1 piece (pcs) of Conveyor System, 48 Inch

Brief Description: This process encompasses the materials necessary for the construction of one steel cord conveyor belt with rubber facing (1.21 m wide), pulleys, and idlers based on manufacturers' specifications for a 1.21 m (48 inches) conveyor system.

Section I: Meta Data

Geographical Coverage: US **Region:** N/A

Year Data Best Represents: 2003

Process Type: Basic Process (BP)

Process Scope: Gate-to-Gate Process (GG)

Allocation Applied: No

Completeness: Individual Relevant Flows Recorded

Flows Aggregated in Data Set:

☒ Process ☐ Energy Use ☐ Energy P&D ☐ Material P&D

Relevant Output Flows Included in Data Set:

Releases to Air:	☐ Greenhouse Gases	☐ Criteria Air Pollutants	☐ Other
Releases to Water:	☐ Inorganic Emissions	☐ Organic Emissions	☐ Other
Water Usage:	☐ Water Consumption	☐ Water Demand (throughput)	
Releases to Soil:	☐ Inorganic Releases	☐ Organic Releases	☐ Other

Adjustable Process Parameters:

Conveyor Belt Length (Belt_Lgnth)	*Length of the conveyor belt, one-way*

Tracked Input Flows:

Steel cold rolled (St) [Metals]	*Cold-rolled steel used to construct conveyor body.*
Hot-dip Galvanized Steel [Metals]	*Hot-dip galvanized steel used to construct conveyor cord, idlers, and pulley.*
Natural rubber (vulcanized) [Plastic parts]	*Natural rubber (vulcanized) used in construction of conveyor belt.*

Tracked Output Flows:

Conveyor System, 48 Inch [Construction]	*Construction of a single, 48-inch conveyor system*

Section II: Process Description

Associated Documentation

This unit process is composed of this document and data sheet (DS) *DS_Stage1_C_Conveyor_System_48_Inch_2010.01.xls*, which provides additional details regarding relevant calculations, data quality, and references.

Goal and Scope

The scope of this unit process encompasses the materials and weights of those materials necessary to construct a single, 48-inch conveyor system, used to carry coal from an underground coal mine to the surface during extraction of Illinois No. 6 bituminous coal. The unit process is based on the reference flow of 1 piece of conveyor system, 48 inch, as described below and shown in **Figure 2.** The conveyor system is assumed to be constructed of cold-rolled steel, hot-dip galvanized steel, and natural rubber. Other materials are assumed to be negligible.

This unit process is combined with other coal mine equipment construction unit processes in an assembly unit process for Illinois No. 6 bituminous coal, DF_Stage1_C_Assembly_Coal_2010.01.doc. The assembly unit process quantifies the fraction of each piece of equipment needed under Life Cycle (LC) Stage #1 to produce 1 kg of Illinois No. 6 bituminous coal ready for transport (LC Stage #2).

Boundary and Description

Construction of the conveyor system is based on manufacturer specifications for a single conveyor system, having a 1,554.48-m long and 1.2192 m-wide steel-cord belt (Roberts 2007). Extraction of coal biomass from the Illinois No. 6 bituminous underground coal mine requires conveyor systems, which are used to carry coal from underground longwall mine operation to a coal stockpile on the surface during the coal extraction process.

Figure 2 provides an overview of the boundary of this unit process. Emissions related to the physical assembly of the conveyor system (e.g., emitted while assembling and transporting conveyor components) are not included in the study boundary. As shown in **Figure 2**, the conveyor system constructed in this unit process is incorporated into the coal mine construction assembly processes for LC Stage #1 for coal biomass.

The major components of the conveyor belt system are the conveyor frame, the brackets on which the belt is carried, the rotating parts (rollers) on which the belt travels, the drive and tail pulleys that move the belt, the steel cord inside the belt, and the rubber compound that surrounds the belt cord and provides a surface to carry loaded coal. There are two individual idler systems in this conveyor system: the main idlers that carry the belt and the coal from the mine to the surface, and a return idler system that loops below the idlers and carries the belt back to the underground mine.

The total weight of major components in a conveyor system is readily available but reliable data for the materials breakdown of subcomponents were not. Therefore, the conveyor system was assumed to be composed of three main materials: cold-rolled steel, hot-dip galvanized steel, and natural rubber. The life cycle emissions of raw materials used for the construction of the conveyor system (e.g., cold-rolled steel) are calculated outside the boundary of this unit process, based on proprietary profiles available within the life cycle inventory (LCI) databases.

Table 1 shows relevant properties and assumptions used to calculate the amount of materials used to construct the conveyor system. The idler system used is a three-roll, inline, carry-and-impact system. The rollers have a diameter of 152 millimeters (mm) and a bearing size of 6,306. There are two separate aspects to the idler system: the rotating parts (rollers), which are manufactured from cold-rolled steel, and the frame and brackets, which are manufactured from hot-dip galvanized steel. These two aspects of the conveyor system weigh a combined 58.3 kilograms (kg). The rotating parts make up 24.3 kg, while the frame and brackets make up 34.0 kg (Sandvik 2004). The idler systems are assumed to be spaced one meter apart along the entire length of the conveyor belt.

The return idler system consists of a single roller manufactured from cold-rolled steel, and the frame and brackets, which are manufactured from galvanized steel. The rollers have a diameter of 152 mm and a bearing size of 6,306. The return idler system weighs 33.9 kg, with the rotating parts being 20.6 kg and the frame and brackets being 13.3 kg (Sandvik 2004). The return idler systems are assumed to be spaced every 3 meters, running along the same path as the idler systems. Based on this assumption, the rotating parts weigh 6.87 kg/m and the frame and brackets weigh 4.43 kg/m.

This conveyor belt requires both a drive pulley to power the belt and a tail pulley for the belt to return to the mine to carry more coal to the surface. Both the drive and tail pulleys are assumed to be constructed of 100 percent cold rolled steel. The tail pulley has a weight of 1,023 kg, and the drive pulley weighs 1,044 kg (Sandvik 2003).

The conveyor belt consists of hot-dip galvanized-steel cords of a nominal 5.2-mm diameter running the entire length of the belt (Goodyear 2008). Based on manufacturers' instructions, the cords are assumed to be spaced every 11.4 mm on center and for each, seven thin steel cables were grouped together; seven bundles of these cables were then wound together to form a 7x7 cord. The nearest representative cable diameter was 3/16", or approximately 4.76 mm, and each cord has a weight of approximately 9.23 kg/100 m, which was converted to 0.0923 kg/m (Lexco 2006, Loos 2009). Spread evenly over the entire 1.2192-m width of the belt, there will be 106 cords running the length of the belt. To get the weight of the steel cord per meter of belt, the weight of a single cord (0.0923 kg/m) was multiplied by the number of cords based on the belt width for a value of 9.78 kg/m.

The total weight of the conveyor belt was taken from Goodyear's Flexsteel Belt (2008). The belt is constructed of a series of steel cords surrounded by an insulating layer of rubber, which is itself surrounded by a top and bottom cover of rubber. A diagram is shown below (Goodyear 2008a).

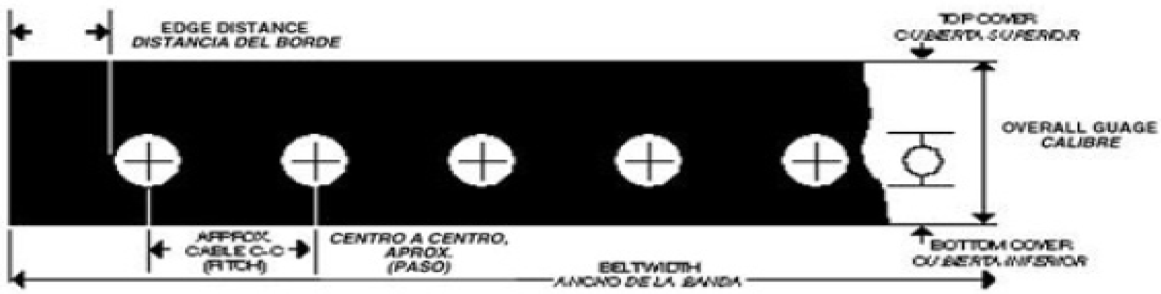

Figure 1. Flexsteel Belt Construction (Goodyear 2008a)

The top rubber cover is assumed to be 4.5-mm thick and the bottom cover 1.5-mm thick. The nominal diameter of the steel cables is 5.2 mm, for a total belt thickness of 11.2 mm. The belt weight is the cover weight (7.5 kg/m^2) plus the carcass weight (14.6 kg/m^2), which comes out to 22.1 kg/m^2 (Goodyear 2008).

The weight of the belt was multiplied by the width of the belt, 1.2192 m, to obtain a value of 26.94 kg/m of belt. The weight of steel cord was subtracted from this value, for a total of 17.16 kg of rubber per meter of belt.

The materials manufactured from hot-dip galvanized steel include the steel cord, the idler frame and brackets, and the return idler frame and brackets. The steel cord weighs 9.78 kg/m, the idler frame 34.0 kg/m, and the return idler frame 4.43 kg/m. Summed, this gives a total of 48.21 kg/m of hot-dip galvanized steel.

The third material in the conveyor system is cold-rolled steel for the idler and return idler rotating parts, the tail pulley, and the drive pulley. Since there is only one of each type of pulley, their weights will be added to the total cold-rolled steel value at the end of the calculations. The idler rotating parts weigh 24.3 kg/m, while the return idler rotating parts weigh 6.87 kg/m – a total of 31.17 kg/m of cold-rolled steel. The idlers are assumed to be spaced 1 meter apart, and the return idlers are assumed to be spaced 3 meters apart.

Finally, the weight of each material was multiplied by the length of the belt to obtain a total weight. The belt has a given length of 1,554.48 m, which was doubled to 3,108.96 m to account for the fact that the belt actually makes a large loop to return to the underground mine. The total weight of rubber for the belt was 53,362.52 kg. The weight for hot-dip galvanized steel was 149,893.99 kg. The weight of cold-rolled steel was 31.17 kg/m times 3,108.96 m added to the weights of the drive and tail pulleys, for a total weight of 98,962.92 kg. **Table 2** provides a summary of modeled input and output flows. Additional details regarding input and output flows, including calculation methods, are contained in the associated DS.

Figure 2: Unit Process Scope and Boundary

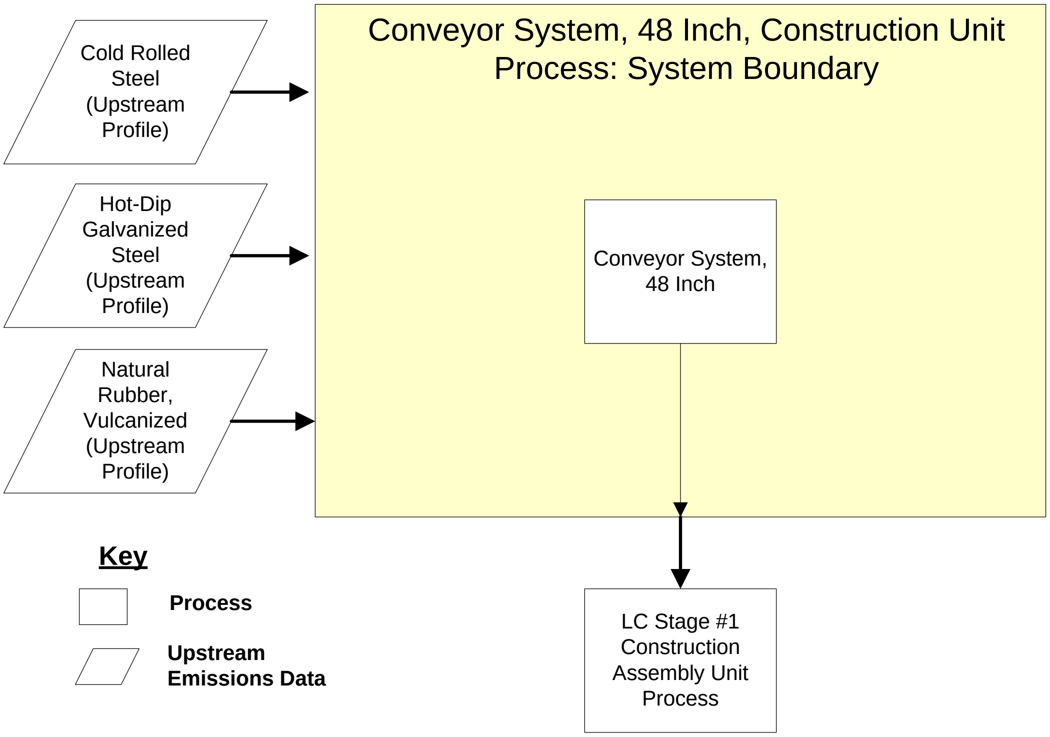

Table 1: Properties of the Conveyor System, 48 Inch

Total Weight of Single Tractor	Value	Reference
Conveyor Belt Length, m (ft)	1,554.48 (5,098)	Illinois, 2006
Natural Rubber, kg/m (lb/ft)	17.16 (11.53)	Bucyrus, 2008a & 2008b
Weight Hot-Dip Steel kg/m (lb/ft)	48.21 (32.39)	NETL Engineering Calculation
Cold Rolled Steel kg/m (lb/ft)	31.16 (20.94)	NETL Engineering Calculation
Weight of Tail Pulley, kg (lb)	1,023 (2,555.32)	Sandvik 2004
Weight of Drive Pulley, kg (lb)	1,044 (2,301)	Sandvik 2004

Table 2: Unit Process Input and Output Flows

Flow Name*	Value	Units (Per Reference Flow)
Inputs		
Steel Plate, BF (85% Recovery Rate) [Metals]	**98,962.92**	**kg**
Hot-dip Galvanized Steel [Metals]	**149,893.98**	**kg**
Natural rubber (Galvanized) [Plastic parts]	**53,362.52**	**kg**
Outputs		
Conveyor System, 48 Inch [Construction]	1.00	piece

* **Bold face** clarifies that the value shown *does not* include upstream environmental flows. Upstream environmental flows were added during the modeling process using GaBi modeling software, as shown in Figure 2.

Embedded Unit Processes

None

References

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Section III: Document Control Information

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