NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Coal Railcar, 244000 lbs Net Capacity, Construction

Reference Flow: 1 piece (pcs) of Coal Railcar, 244000 lbs Net Capacity

Brief Description: The amount of aluminum and steel used in the construction of one 244,000-lb capacity railcar to be used to haul coal. The railcar was estimated/assumed to be composed of 82% aluminum and 18% steel plate, with a total mass of 18,983 kg.

Section I: Meta Data

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

Year Data Best Represents: 2008

Process Type: Manufacturing Process (MP)

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

Allocation Applied: No

Completeness: Individual Relevant Flows Captured

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:

Percentage of Aluminum in Railcar	*Percent of railcar that is constructed of aluminum*
Percentage of Steel Plate in Railcar	*Percent of railcar that is constructed of steel plate*

Tracked Input Flows:

Aluminum sheet [Metals]	*Aluminum used in construction of railcar body*

Steel plate, BF, (85% Recovery Rate) [Metals]	*Steel plate from blast furnace (BF), assumes 85% recovered/recycled steel*

Tracked Output Flows:

Railcar, 244000 lbs Net Capacity [Construction]	*Construction of a single, 244,000-lb net capacity railcar*

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_Stage2_C_Coal_Railcar_244000_lbs_Net_Capacity_2009.01.xls*, which provides additional details regarding relevant calculations, data quality, and references.

Goal and Scope

The scope of this unit process covers the materials required for the construction of a single, 244,000lb capacity railcar used to haul coal from the coal mine to the power plant under Life Cycle (LC) Stage #2, as described below. The cargo bed portion of the railcar is assumed to be composed entirely of aluminum, while the railcar's trucks (i.e., wheels and bottom structure) are assumed to be constructed entirely of steel plate. By default, all steel within this study was assumed to be steel plate, based on available GaBi profiles, unless other steel types were specified per available data, or a higher grade of steel would be required, per NETL engineering judgment. Therefore, all steel in this unit process was assumed to be steel plate. This unit process is based on the reference flow of 1 piece of railcar, as described below and shown in **Figure 1**.

This unit process is used under Life Cycle (LC) Stage #2 to assist in the transport of coal from the coal mine (LC Stage #1) to the energy conversion facility (LC Stage #3). It is combined with other relevant equipment for LC Stage #2 in a separate construction assembly process, DF_Stage2_C_Assembly_Coal_Unit_Train_100_Cars_2010.01.doc. The assembly process quantifies the fraction of each piece of equipment needed under LC Stage #2 to transport 1 kg of coal.

Boundary and Description

The total weight for one empty railcar was estimated to be 18,983 kg (41,850 lbs). This figure represents an average weight of two railcars, each with a capacity of approximately 120 short tons: the BethGon II and Trinity Rail railcar models (FreightCar America 2008; Trinity Rail 2008). The weight of the truck system is estimated at 3,357 kg (7,400 lbs) (Amsted Rail 2008). Assuming the railcar cargo bed is made of aluminum and the truck system is made of steel, the percent material composition of the railcar was calculated by subtracting out the weight of the trucks from the total railcar weight, and assuming that the result

represented the cargo bed. Thus, one railcar is constructed out of 15,626 kg (34,499 lbs) aluminum and 3,357 kg (7,400 lbs) steel.

The total weight of a railcar is readily available from published sources, but only minimal data for the material breakdown of railcar subcomponents were found. Therefore, the railcar is assumed to be composed entirely of aluminum and steel plate, according to the amounts indicated above. This is equivalent to approximately 82% aluminum and 18% steel plate. Two adjustable parameters were included in the unit process to allow the user to vary the proportion of aluminum and steel plate. Default values are 82% and 18% respectively, as discussed above. Parameter values may be varied from 0% to 100%, such that the total amount of aluminum plus steel plate does not exceed 100%.

Figure 1 provides an overview of the boundary of this unit process. Emissions related to the physical assembly of the railcar (e.g., emitted while assembling the components of a railcar, including transport of those components) are not considered in this study. Upstream emissions from the production of raw materials used for the construction of the railcar (e.g., steel plate and aluminum) are calculated outside of the boundary of this unit process, based on proprietary profiles available within the GaBi model. As shown in Figure 1 and discussed above, the railcar constructed in this unit process is incorporated into the assembly process for rail transport of coal under LC Stage #2.

Table 1 summarizes the relevant properties and assumptions used to calculate the amount of aluminum and steel plate contained in a single railcar. **Table 2** provides a summary of modeled input and output flows. Additional detail regarding input and output flows, including calculation methods, is contained in the associated DS.

Figure 1: Unit Process Scope and Boundary

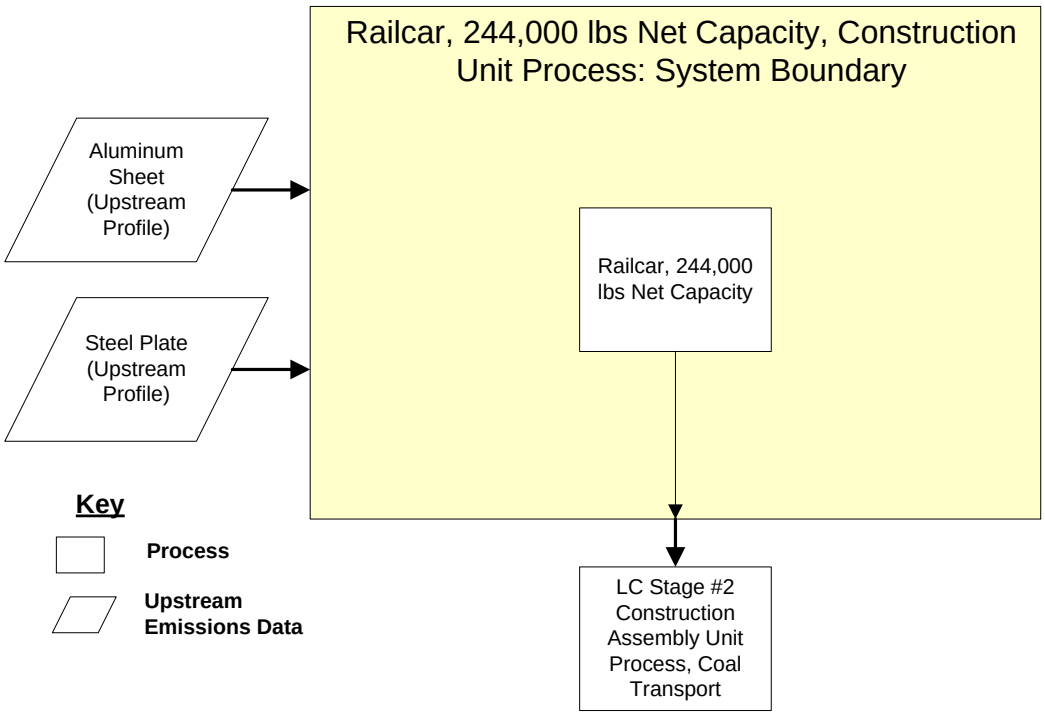

Table 1: Properties of a Single Railcar

Material Composition and Weights			
Material	**Weight**	**% Composition**	**Reference**
Average Weight of 1 Railcar, kg (lbs)	18,983 (41,850)	100%	FreightCar America, Inc. 2008; Trinity Rail 2008
Aluminum Weight, kg (lbs)	15,626 (34,450)	82%	NETL Engineering Calculation
Steel Weight, kg (lbs)	3,357 (7,400)	18%	Amsted Rail 2008; NETL Engineering Calculation

Table 2: Unit Process Input and Output Flows

Flow Name	Value	Units (Per Reference Flow)
Inputs		
Aluminum Sheet [Metals]	**15,626.26**	**kg**
Steel Plate, BF (85% Recovery Rate) [Metals]	**3,356.58**	**kg**
Outputs		
Railcar, 244000 lbs Net Capacity [Construction]	1	pcs

* **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 1.

Embedded Unit Processes

None.

References

Amsted Rail 2008 — Amsted Rail. 2008. *ASF Truck Assemblies, Side Frames, Bolsters.* Amsted Rail. http://www.amstedrail.com/freightcar/sideframesbolsters.asp (Accessed August 15, 2008).

FreightCar America, Inc. 2008 — FreightCar America, Inc. 2008. *The BethGon II.* FreightCar America, Inc. http://www.freightcaramerica.com/Aluminum-BethGonII.htm (Accessed August 14, 2008).

Trinity Rail 2008 — Trinity Rail. 2008. *4,402 Cubic Foot Aluminum Rotary Gondola.* Trinity Rail. http://www.trinityrail.com/railcars/coal/pdfs/Web%204402%20Alum%20Rotary%20Gondola%20Spec.pdf (Accessed August 14, 2008).

Section III: Document Control Information

Date Created: February 12, 2009

Point of Contact: Timothy Skone (NETL), Timothy.Skone@NETL.DOE.GOV

Revision History:

Original/no revisions

How to Cite This Document: This document should be cited as:

NETL (2009). *NETL Life Cycle Inventory Data – Unit Process: Coal Railcar, 244000 lbs Net Capacity, Construction*. U.S. Department of Energy, National Energy Technology Laboratory. Last Updated: December 2009 (version 01). www.netl.doe.gov/energy-analyses (http://www.netl.doe.gov/energy-analyses)

Section IV: Disclaimer

Neither the U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL) nor any person acting on behalf of these organizations:

A. Makes any warranty or representation, express or implied, with respect to the accuracy, completeness, or usefulness of the information contained in this document, or that the use of any information, apparatus, method, or process disclosed in this document may not infringe on privately owned rights; or

B. Assumes any liability with this report as to its use, or damages resulting from the use of any information, apparatus, method, or process disclosed in this document.

Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by NETL. The views and opinions of the authors expressed herein do not necessarily state or reflect those of NETL.