NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Diesel Locomotive, 4400 Horsepower, Construction

Reference Flow: 1 piece (pcs) of Diesel Locomotive, 4400 Horsepower

Brief Description: Based on specifications for a GE Evolution Series diesel locomotive, rated at 4,400 HP with a 12-cylinder AC engine, quantifies the amount of steel plate and stainless steel used to construct one locomotive to haul a generic type of coal.

Section I: Meta Data

Geographical Coverage: US **Region:** Not Applicable

Year Data Best Represents: 2008

Process Type: Manufacturing Process (MP)

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:

Percent Carbon Steel (C_St_%)	*Assumed percent of total steel that is carbon steel*
Percent Stainless Steel (S_St_%)	*Assumed percent of total steel that is stainless steel*

Tracked Input Flows:

Steel Plate, BF (85% Recovery Rate) [Metals]	*Steel plate from blast furnace (BF), assumes 85% recovered/recycled steel*
Steel, Stainless, 316 2B (80% Recycled) [Metals]	*316 cold-rolled stainless steel*

Tracked Output Flows:

Diesel Locomotive, 4400 Horsepower [Construction]	*Construction of a single 4,400 HP, diesel locomotive*

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_Stage2_C_Diesel_Locomotive_4400_HP_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 locomotive needed to haul railcars full of a generic type of coal under Life Cycle (LC) Stage #2. The locomotive is used, as modeled in a separate operations unit process, to haul coal loaded at the coal mine under LC Stage #1 to the energy conversion facility, where it is unloaded. Coal processing following unloading is included in LC Stage #3. This unit process is combined with other LC Stage #2 construction unit processes under an assembly process, DF_Stage2_C_Assembly_Coal_Unit_Train_100_Cars_2010.01.doc, which quantifies the fraction of a single locomotive needed to transport 1 kg of coal.

Steel plate and stainless steel are considered to be the sole input flows for the construction of a locomotive, with other materials considered to be negligible. 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, the majority of steel in this unit process was assumed to be steel plate, with a small portion assumed to be stainless steel. The stainless steel was included to account for portions of the engine and drive train requiring a higher grade steel than the rest of the locomotive.

Boundary and Description

Figure 1 provides an overview of the boundary of this unit process. Emissions related to the physical assembly of the locomotive (e.g., emitted while putting together the components of a locomotive, 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 locomotive (e.g., steel plate and stainless steel) are calculated outside the boundary of this unit process, based on proprietary profiles available within the GaBi model. As shown in Figure 1 and discussed above, the locomotive constructed in this unit process is incorporated into the construction assembly process for LC Stage #2.

The total weight of a locomotive is readily available, but reliable data for the material breakdown of locomotive subcomponents were not. Therefore, the locomotive was assumed to be composed of two types of steel: 90% steel plate (Steel plate, BF (85% Recovery Rate) [Metals]) and 10% stainless steel (Steel, Stainless, 316 2B (80% Recycled) [Metals]). These two types of steel are included as adjustable parameters, and can be varied from 0% to 100%, where the sum of steel plate + stainless steel must equal 100%.

Table 1 shows relevant properties and assumptions used to calculate the amount of steel plate and stainless steel contained in a single locomotive. Total weight for one locomotive is estimated to be 188,241 kg (415,000 lbs) (GE Transportation 2008). Based on this weight, and the assumed composition, it was calculated that one locomotive is constructed out of 169,417 kg (373,501 lbs) steel plate and 18,824 kg (41,500 lbs) stainless steel. **Table 2** provides a summary of modeled input and output flows. Additional detail regarding input and output flows, including calculation methods, are contained in the associated DS.

Figure 1: Unit Process Inputs, Outputs, and Boundaries

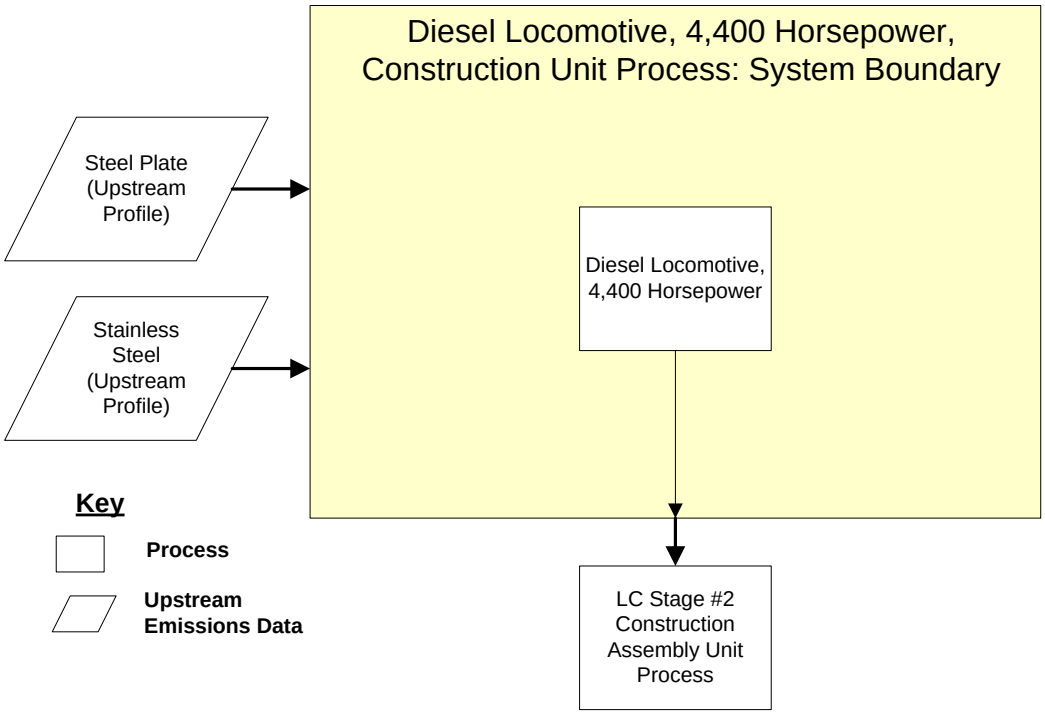

Table 1: Properties of the Diesel Locomotive

Total Steel Weight for One Locomotive	Weight	Reference
One Locomotive Weight kg (lbs)	188,241 (415,000)	GE Transportation 2008
Percentage of Steel Plate	90%	NETL Engineering Judgment
Percentage of Stainless Steel	10%	NETL Engineering Judgment
Total Steel Plate in One Locomotive kg (lbs)	169,417 (373,501)	NETL Engineering Calculation
Total Stainless Steel in One Locomotive kg (lbs)	18,824 (41,500)	NETL Engineering Calculation

Table 2: Unit Process Input and Output Flows

Flow Name*	Value	Units (Per Reference Flow)
Inputs		
Steel plate, BF (85% Recovery Rate) [Metals]	**169,416.75**	**kg**
316 Stainless steel cold rolled [Metals]	**18,824.08**	**kg**
Outputs		
Diesel Locomotive, 4400 Horsepower [Construction]	1	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 1.

Embedded Unit Processes

None.

References

GE Transportation 2008 — GE Transportation. 2008. *The Evolution Series Locomotives*. General Electric Company. http://www.getransportation.com/na/en/docs/806527_20020%20-%20B%20Evo[1][1].Series.lores.pdf (Accessed August 14, 2008).

Section III: Document Control Information

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