NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Ethanol Transport Pipeline, Construction

Reference Flow: 1 piece ethanol transport pipeline/kg fuel transported

Brief Description: This unit process creates a pipeline for ethanol transport. It is assumed that the pipeline is made solely from carbon steel. All values are normalized to 1 kg of fuel transported.

Section I: Meta Data

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

Year Data Best Represents: 2005

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:

Pipeline Length (Pipeline_Length)	*Total transport distance of pipeline*
Fuel Quantity (kgfuel)	*Total quantity of fuel transported through the pipeline during the study period*

Tracked Input Flows:

Steel, pipe welded, BF (85% Recovery Rate) [Metals]	*Carbon steel pipe, welded, assumes 85% recovered/recycled steel*

Tracked Output Flows:

Ethanol Transport Pipeline [Construction] *Reference flow*

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_Stage4_C_Pipeline_Ethanol_Transport_2010.01.xls*, which provides additional details regarding relevant, calculations, data quality, and references.

Goal and Scope

This unit process quantifies the materials used for the construction of a finished pipeline for use in transport of ethanol from the fuel production facility to a bulk storage facility within Life Cycle (LC) Stage #4 of an ethanol production LCA.

This unit process is combined with other LC Stage #4 construction, installation, and operation unit processes under an assembly process for the stage. The ethanol flows through the pipeline which is created in this unit process to a bulk storage facility; after being stored in the bulk storage facility, the ethanol is splash mixed with gasoline in a tanker truck for transport to the refueling station. The fuel is stored at the refueling station until it enters the vehicle fuel tank for combustion during LC Stage #5. Carbon steel welded pipe is considered to be the sole input flow for the construction of the indicated pipeline. All other materials are assumed to be negligible.

Boundary and Description

Figure 1 provides an overview of the boundary of this unit process. Emissions related to the physical assembly of the pipeline (e.g., emitted while putting together and welding the pipe) are calculated outside the boundary of this unit process, based on proprietary profiles available within the GaBi model. Installation, removal, and operation of the pipeline are not considered in this unit processes.

It is assumed that the transport pipeline is made solely of carbon steel. The steel used for construction of the pipeline is assumed to be Welded Steel Pipe, Blast Furnace Production with an 86.9 percent recovery rate (IISI 2008). Valves and fittings are assumed to add an additional 10 percent to the total pipe weight.

The length of the fuel transport pipeline is assumed in the study to be 100 miles. This distance is an adjustable parameter in the unit process to allow for variation during sensitivity analysis. The study period (for this process is assumed to be 30 years) is integrated into the calculation of total ethanol quantity to be delivered over the pipe lifetime. This value is also adjustable.

The pipeline diameters were calculated according to the physical characteristics of ethanol, the flow rate of ethanol, and the interior surface roughness of steel pipe. Plant

output is representative of all cases studied for ethanol, which range from 60 to 70 MM gal/yr (3900 to 4600 BPD).

The mass per unit length (kg/m) for various pipe diameters are from the Engineering Tool Box's table of Steel Pipe Dimensions- ANSI Schedule 40 (Engineering Tool Box 2005).

Table 1 shows relevant properties and assumptions used to calculate the amount of carbon steel pipe used. **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 Inputs, Outputs, and Boundaries

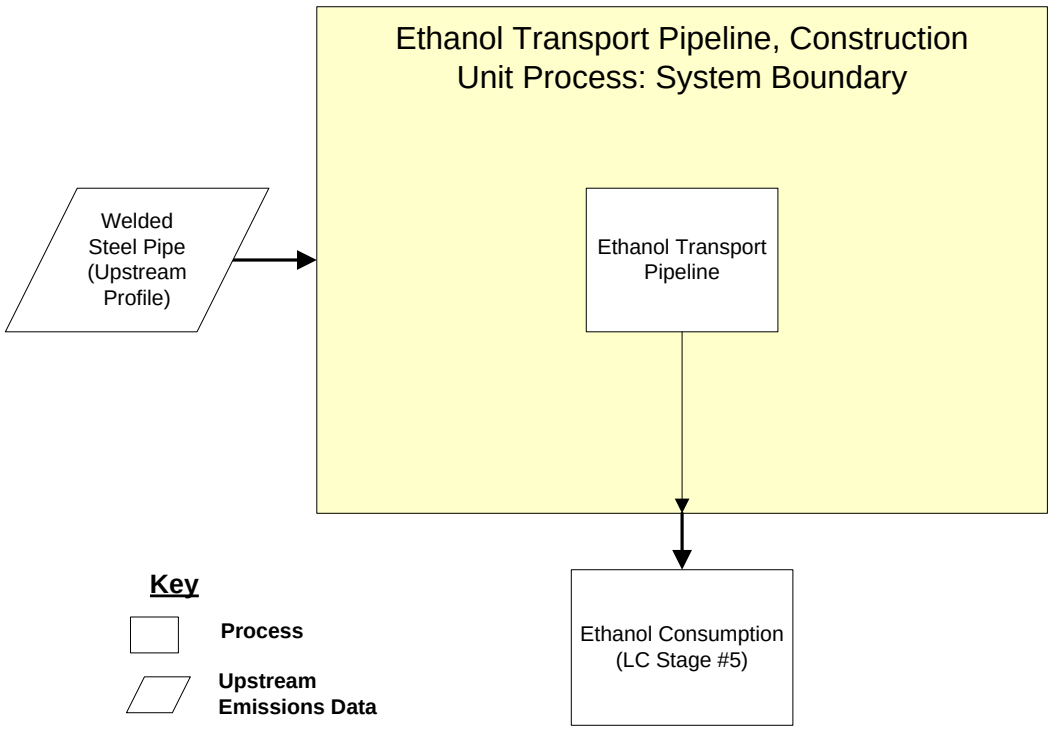

Table 1: Properties of the Ethanol Transport Pipeline

Property	Value	Reference
Ethanol plant capacity, m3/day (bpd)	794.9 (5,000)	NETL Engineering Judgment
Plant output, m3/day (bpd)	731.3 (4,600)	NETL Engineering Judgment
Plant capacity factor, %	0.96	NETL Engineering Judgment
Pipe lifetime, yrs	30	NETL Engineering Judgment
Pipe diameter, m (in)	0.127 (5)	NETL Engineering Judgment
Pipe weight, kg/m (lb/ft)	28.23 (18.97)	Engineering Tool Box 2005

Table 2: Unit Process Input and Output Flows

Flow Name*	Value	Units (Per Reference Flow)
Inputs		
Steel, pipe welded, BF (85% Recovery Rate) [Metals]	**0.00086498**	**kg**
Outputs		
Ethanol Transport Pipeline	1	pcs/kg fuel

* **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

Engineering Tool Box 2005	Engineering Tool Box. 2005. Steel Pipe Dimensions- ANSI Schedule 40. Engineering Tool Box. http://www.engineeringtoolbox.com/ansi-steel-pipes-d_305.html (Accessed February 13, 2010).
Renewable Fuels Association 2005	Renewable Fuels Association. 2005. Fuel Ethanol: Industry Guidelines, Specifications, and Procedures. http://www.ethanolrfa.org/objects/pdf/newRFA%20Fuel%20Ethanol%20960501.pdf (Accessed February 13, 2010).

Section III: Document Control Information

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