NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Watertube or Firetube Industrial Boiler 150,000 lbs/hr Capacity, Construction

Reference Flow: 1 piece (pcs) of Watertube or Firetube Industrial Boiler 150,000 lbs/hr capacity

Brief Description: This unit process quantifies the total mass of steel required for the construction of a single 150,000 lbs/hr capacity watertube or firetube boiler. The boiler is assumed to be comprised entirely of steel plate.

Section I: Meta Data

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

Year Data Best Represents: 2011

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:

N/A

Tracked Input Flows:

Steel Plate, BF (85% Recovery Rate) [Metals]	*Steel plate from blast furnace used to construct boiler, assumes 85% recycled/recovery rate*

Tracked Output Flows:

Watertube or Firetube Industrial Boiler, 150,000 lbs/hr capacity [Construction]	*Construction of a single Nationwide Boiler Incorporated 150,000 lbs/hr capacity watertube or firetube industrial boiler*

Section II: Process Description

Associated Documentation

This unit process is comprised of this document, as well as the data sheet (DS) *DS_Stage2_C_Watertube_or_Firetube_Boiler_150000_lbs_hr_2012.01.xlsx,* which provides additional details regarding calculations, data quality, and references as relevant.

Goal and Scope

The scope of this process encompasses the materials and weights of those materials necessary to construct a single 150,000 lb/hr capacity watertube or firetube boiler, used in SWRC biomass energy conversion. The process is based on the reference flow of 1 piece of watertube or firetube boiler, 150,000 lb/hr capacity, as described below, and as shown in **Figure 1.** The boiler is assumed to be constructed entirely of steel, other materials are assumed 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, all steel considered in this unit process was assumed to be steel plate.

This process is used during LC Stage #3 to assist in the energy conversion of short rotation woody crop (SRWC) biomass feedstocks. These assembly unit processes quantify the fraction of each piece of equipment needed under LC Stage #3 to convert 1 kg of harvested (LC Stage #1) and transported (LC Stage #2) biomass.

Boundary and Description

Construction of the boiler is based on manufacturer specifications for a Nationwide Boiler Incorporated, 150,000 lb/hr capacity watertube or firetube industrial boiler. The boiler is used to covert harvested woody biomass into energy.

Figure 1 provides an overview of the boundary of this unit process. Emissions related to the physical assembly of the boiler (e.g., that are emitted while putting together the components of a boiler, 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 boiler (e.g., steel plate) 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 boiler constructed in this unit process is incorporated into the energy conversion processes for LC Stage #3 for SRWC biomass.

The total weight of a boiler was readily available but reliable data for the material breakdown of boiler subcomponents was not. Therefore, the boiler was assumed to be composed entirely of steel plate (Steel plate, BF (85% Recovery Rate) [Metals]).

Table 1 shows relevant properties and assumptions used to calculate the amount of steel plate contained in a single boiler. Total weight for one boiler is estimated to be approximately 58,967 kg (130,000 lbs) (Nationwide Boiler Incorporated 2011). Based on the assumption that the boiler is constructed entirely out of carbon steel, the total weight is assigned to this material. **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 sheet.

Figure 1: Unit Process Scope and Boundary

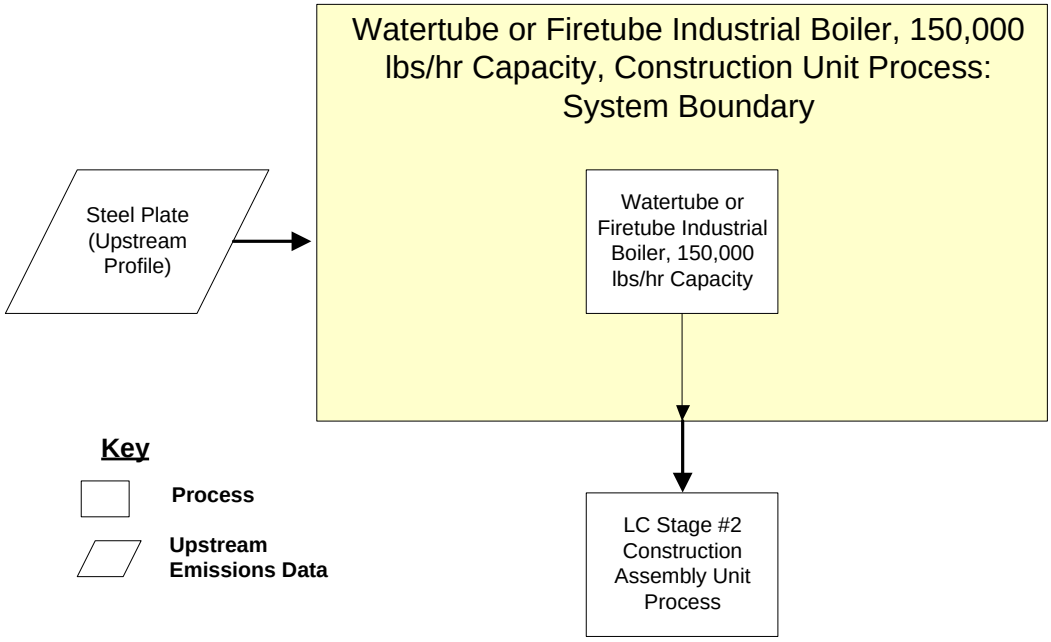

Table 1: Properties of the 150,000 lb/hr Capacity Watertube or Firetube Industrial Boiler

Total Weight of Single Boiler	Weight	Reference
One Boiler Weight, kg (lbs)	58,967 (130,000)	Nationwide Boiler Incorporated 2011
Total Steel Plate in One Boiler, kg (lbs)	58,967 (130,000)	NETL Engineering Judgment

Table 2: Unit Process Input and Output Flows

Flow Name*	Value	Units (Per Reference Flow)
Inputs		
Steel Plate, BF (85% Recovery Rate) [Metals]	**58,967**	**kg**
Outputs		
Watertube or Firetube Industrial Boiler, 150,000 lb/hr capacity [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

Nationwide Boiler Incorporated 2011 — Nationwide Boiler Incorporated. 2011. Guidelines for Preparing for a Temporary Steam Plant. Available at: http://www.nationwideboiler.com/pdfs/guidelines_contingency_plan.pdf Accessed February 27, 2012.

Section III: Document Control Information

Date Created: May 3, 2012

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 (2012). *NETL Life Cycle Inventory Data – Unit Process: Watertube or Firetube Boiler, 150,000 lbs/hr, Construction*. U.S. Department of Energy, National Energy Technology Laboratory. Last Updated: May 2012 (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.