NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Coal Cleaning

Reference Flow: 1 kg of Coal

Brief Description: The amount of electricity required to power equipment used for cleaning coal at underground and surface mines as well as accounting for coal loss during production activities.

Section I: Meta Data

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

Year Data Best Represents: 1998-2002

Process Type: Extraction Process (EP)

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	☐ Other
Releases to Water:	☐ Inorganic	☐ Organic Emissions	☐ Other
Water Usage:	☐ Water Consumption	☐ Water Demand (throughput)	
Releases to Soil:	☐ Inorganic Releases	☐ Organic Releases	☐ Other

Adjustable Process Parameters:

Electricity_F	*[kWh/kg] Baseline coal cleaning electricity per unit of clean coal*
waste_base	*[dimensionless] Fraction of mined coal that ends up as waste*
waste_course	*[kg/kg] Adjustable parameter - Course wastes from coal processing*

waste_fine	*[kg/kg] Adjustable parameter - Fine wastes from coal processing*

Tracked Input Flows:

Electricity [Electric Power]	*[Technosphere] Amount of electricity required to power equipment used in cleaning coal at underground and surface mines.*
Coal, handled [Intermediate Product]	*[Technosphere] Coal input to the cleaning process; accounts for all losses during production*
Coal, preparation, water [Intermediate flow]	*[Technosphere] Connection with coal prep water use unit process*

Tracked Output Flows:

Coal, cleaned [Intermediate Product]	*Reference flow*
coal cleaning waste, course [Intermediate products]	*Intermediate product to waste treatment*
coal cleaning waste, fine [Intermediate products]	*Intermediate product to waste treatment*

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_Stage1_O_Coal_Cleaning_2013.02.xlsx*, which provides additional details regarding relevant calculations, data quality, and references.

Goal and Scope

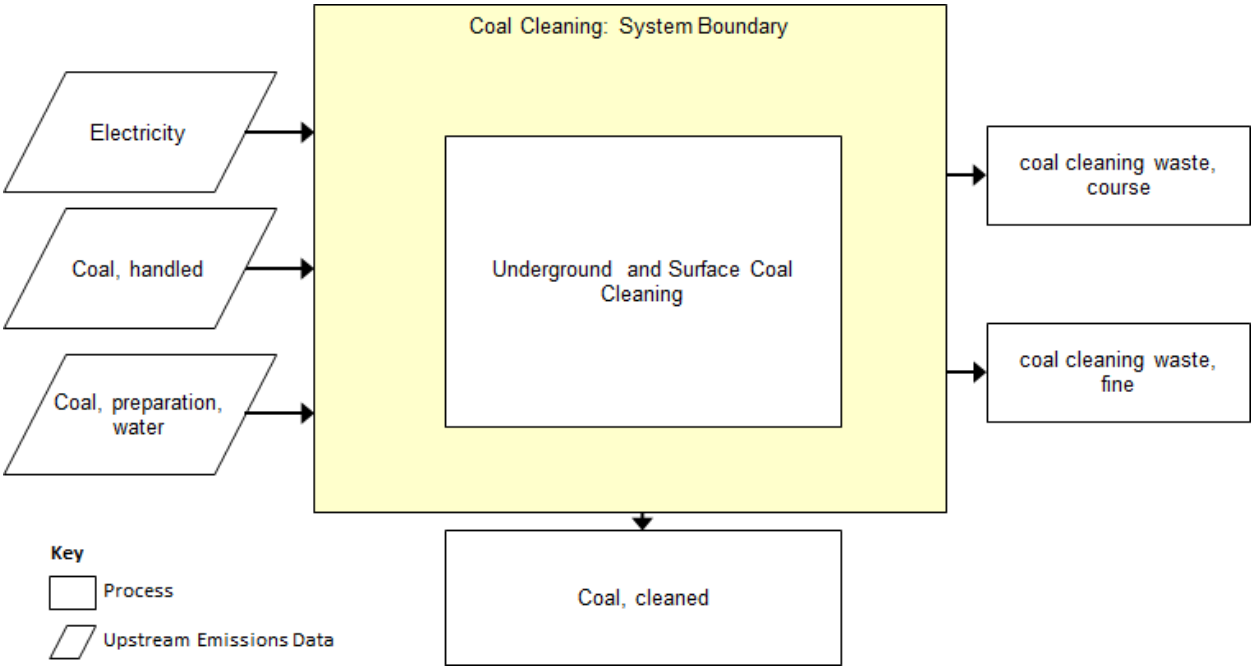
This unit process provides a summary of relevant input and output flows associated with the amount of electricity required to power equipment used for cleaning coal at underground and surface mines. A centrifuge, flotation machine, screens, and magnetic separator are the pieces of equipment used to clean coal. The process also accounts for the solid wastes that are incurred during the production and processing steps to scale upstream activities for one kg of coal at the entrance to the RMT gate. Inputs are electricity, coal, and the water use and quality associated with 1 kg of cleaned coal. All of these items are also adjustable parameters to measure uncertainties. Cleaned coal and the course

and fine wastes are the outputs. The unit process is based on the reference flow of one kg of coal. The relevant flows of this unit process are described below and shown in **Figure 1**.

Boundary and Description

Figure 1 provides an overview of the boundary of this unit process.

Figure 1: Unit Process Scope and Boundary



Coal cleaning is performed to separate coal from other materials (rock, dirt, clay, etc.) contained in run-of-mine (raw) coal (U.S. Department of Energy and National Mining Association, 2002). The amount and type of materials to be removed is dependent on the particular coal seam being mined, and the forms of that removed material (course or fine slurry wastes) are dependent on the type of coal cleaning processes that are used.

The cleaning process and energy requirements are based on the data provided in Chapter 2 of the Energy and Environmental Profile of the U.S. Mining Industry developed by the U.S. Department of Energy's Energy Efficiency and Renewable Energy division and National Mining Association (U.S. Department of Energy and National Mining Association, 2002). The process therein serves as a generic coal preparation facility for an eastern U.S. underground mine and contains a centrifuge, flotation machine, screens, and magnetic separator. BCS, Incorporated (BCS) developed the

data by integrating the U.S. Department of Energy's Energy Information Administration's 1997 Coal Industry data into the Western Mining Engineering, Inc.'s SHERPA Mine Cost Software to create 2002 estimates. BCS also used Mine and Mill Equipment Cost, An Estimator's Guide to develop the data.
It is assumed that all equipment uses electricity, and the electricity requirement was calculated by dividing the sum of the equipments' energy requirements, in Btu per ton, by the appropriate conversions to obtain the electricity needed in kWh per kg of cleaned coal (U.S. Department of Energy and National Mining Association, 2002). It is also assumed that these energy requirements are applicable to processing coal from a surface mine. The electricity factor is an adjustable parameter in the DS file, so the item could be adjusted to measure uncertainty. One key piece of information missing in the discussion of the energy requirements is how much solid waste is generated from processing the coal. **Figure 2-3** of the report shows that waste is 15 percent of the material produced in mining (U.S. Department of Energy and National Mining Association, 2002). Due to lack of specific information, it is assumed that the energy requirements for coal cleaning are based on a run-of-mine coal containing 15 percent waste. The unit process will scale the electricity usage according to the amount of waste produced relative to the assumed 15 percent baseline.

The default course and fine waste flows are based on a "realistic" process for Illinois No. 6 coal (Bhagwat, 2009). As mentioned above, the amount of waste generated by a specific facility is highly depended on the source of the coal, so data for a specific facility should be used if at all possible, particularly if life cycle results are sensitive to the results of this process. If no other data is available it is recommended that the 15 percent baseline value is used, which is provided by the parameter *base_scaler*. These flows should be sent to processes to either account for the burdens to dispose of them or make use of the products, such as concrete manufacturing.

The amount of raw coal input to the process is based on producing 1 kg of cleaned coal, thus it is the sum of: 1 kg of cleaned coal and the course and fine waste flows.

Water use and emissions are accounted for separately in a Water Use and Quality unit process, which is linked through the input flow, *Coal, preparation, water [Intermediate flow]*. The input flow is statically defined as 1 kg to match the reference flow of this unit process of 1 kg cleaned coal; therefore, the upstream water use and quality unit process should use the same reference flow (i.e., input and output flows scaled to 1 kg of cleaned coal rather than raw coal input).

This unit process parameterizes key variables, which allow for evaluation of data uncertainty when used in a life cycle model.

Table 1 shows the input and output flows of this unit process. Additional details regarding input and output flows, including calculation methods, are contained in the associated DS sheet.

Table 1: Unit Process Input and Output Flows

Flow Name	Value	Units (Per Reference Flow)
Inputs		
Electricity [Electric Power]	1.04E-03	kWh/kg
Coal, handled [Intermediate Product]	1.44E+00	kg/kg
Coal, preparation, water [Intermediate flow]	1.00E+00	kg/kg
Outputs		
Coal, cleaned [Intermediate Product]	1.00E+00	kg
coal cleaning waste, course [Intermediate products]	3.64E-01	kg
coal cleaning waste, fine [Intermediate products]	7.18E-02	kg

* **Bold face** clarifies that the value shown *does not* include upstream environmental flows.

Embedded Unit Processes

None.

References

U.S. Department of Energy and National Mining Association. 2002. *Energy and Environmental Profile of the U.S. Mining Industry : Chapter 2 Coal*. U.S. Department of Energy. http://www1.eere.energy.gov/manufacturing/resources/mining/pdfs/coal.pdf.

Bhagwat, S.B., 2009, Estimation of coal-cleaning costs—A spreadsheet-based interactive software for use in the estimation of economically recoverable coal, in Pierce, B.S., and Dennen, K.O., eds., The National Coal Resource Assessment Overview: U.S. Geological Survey

Section III: Document Control Information

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Revision History:

27MAR14 Added solid waste flows and changed scaling for materials/energy

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