



NETL Life Cycle Inventory Data

Process Documentation File

Process Name: Mountain Pass Ore Extraction
Reference Flow: 1 kg of rare earth ore, Mountain Pass
Brief Description: Fuel use and explosives emissions for mining rare earth containing ore for the Mountain Pass mine

Section I: Meta Data

Geographical Coverage: USA **Region:** California

Year Data Best Represents: 1996

Process Type: Manufacturing Process (MP)

Process Scope: Cradle-to-Gate Process (CG)

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:

None.

Tracked Input Flows:

Ammonium nitrate [Inorganic intermediate products] *[Technosphere] Ammonium nitrate for explosives*

Light fuel oil [Refinery Products] *[Technosphere] Fuel oil for explosives*

Diesel, combusted *[Technosphere] Combusted diesel for mining operations*

Tracked Output Flows:

rare earth ore, Mountain Pass [Intermediate products] *Reference flow*

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_Stage1_O_Mountain_Pass_Ore_Extraction_2014.01.xlsx*, which provides additional details regarding relevant calculations, data quality, and references.

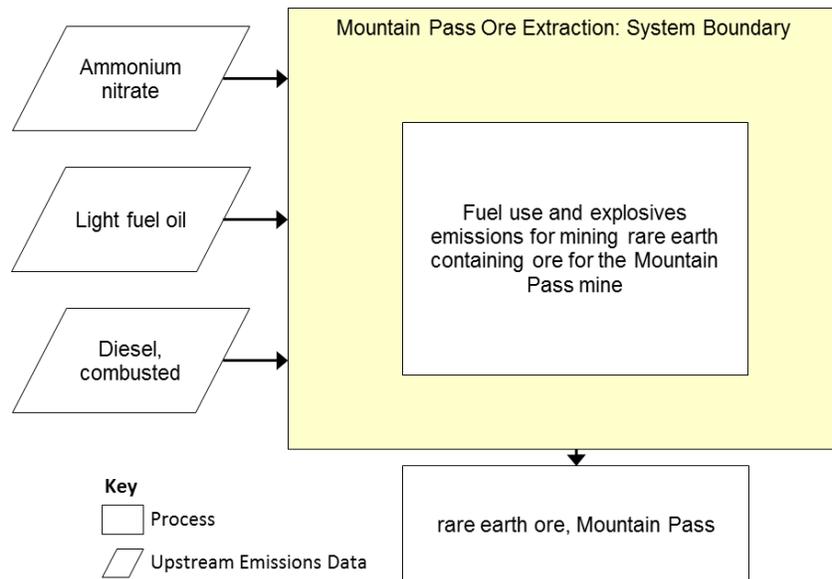
Goal and Scope

This unit process provides a summary of relevant input and output flows associated with mining ore containing bastnaesite, a rare earth bearing mineral. Inputs include combusted diesel fuel, assumed to be used in mining vehicles, and fuel oil and ammonium nitrate for explosives. The emissions reported in this process are from explosives. Diesel vehicle emissions are calculated in a separate process. The reference flow of this unit process is: 1 kg of rare earth ore, Mountain Pass.

Boundary and Description

Figure 1 provides an overview of the boundary of this unit process. Rectangular boxes represent relevant sub-processes, while trapezoidal boxes indicate upstream data that are outside of the boundary of this unit process. As shown, the upstream emissions from ammonium nitrate, light fuel oil, and combusted diesel are calculated in other unit processes. The methods for calculating these operating activities are described below.

Figure 1: Unit Process Scope and Boundary



The Mountain Pass rare earth mine is an open-pit mine that exclusively mines for bastnaesite, a rare earth-containing mineral. The Mountain Pass facility is able to process the bastnaesite to produce a variety of rare earth products, including rare earth oxides (REOs), metals, and finished alloys.

Molycorp estimates the material usage for mining will be similar to that as in 1996, one of the last couple years at full production. The data for fuel and explosives for 1996 are therefore used to estimate future use (ENSR International, 2004). While propane and gasoline use are provided along with diesel, it is assumed that diesel was used primarily for mining vehicles, and that gasoline and propane were for smaller vehicles or heating, respectively. Explosives are modeled as a mix of ammonium nitrate and light fuel oil (Buckley Powder Co., 2011). The material use is placed on a per kg mined basis for 1996, which includes overburden and rare earth ore (SRK Consulting, 2010). Emission factors are then used to estimate the emissions from explosive detonation (EPA, 1980; Department of Climate Change, 2008). Emissions from diesel combustion are calculated by another unit process.

Particulate matter (PM) emissions are calculated using annual estimates provided by Molycorp. In the report, multiple sources of PM are listed throughout the site, but only the sources that are involved directly with extraction are used. The same report also estimates air toxics based on an analysis of overburden. These same concentrations are used to estimate the metals to air emissions in this unit process (ENSR, 1996).

Future estimates of total mine production are used to scale the material input and emission factors and then divided by the amount of rare earth ore production to place all flows on the reference flow basis – 1 kg of rare earth ore, which would then be sent to a crushing and milling process.

Minimum and maximum values are provided for both total mined and the ore mined. These represent the minimum and maximum value for each. Care should be taken

when varying these to make sure that the total mined is greater than the ore mined.

Table 1 shows the relevant input and output flows in the Mountain Pass Ore Extraction unit process.

Table 1: Unit Process Input and Output Flows

Flow Name	Value	Units (Per Reference Flow)
Inputs		
Ammonium nitrate [Inorganic intermediate products]	1.72E-03	kg
Light fuel oil [Refinery Products]	9.25E-05	kg
Diesel, combusted	5.13E-06	kg
Outputs		
rare earth ore, Mountain Pass [Intermediate products]	1.00E+00	
Carbon dioxide [Inorganic emissions to air]	2.93E-04	kg
Nitrogen oxides [Inorganic emissions to air]	1.38E-05	kg
Sulphur dioxide [Inorganic emissions to air]	1.72E-06	kg
Carbon monoxide [Inorganic emissions to air]	5.85E-05	kg
Dust (PM10) [Particles to air]	2.96E-04	kg
Arsenic (+V) [Heavy metals to air]	2.96E-10	kg
Beryllium [Inorganic emissions to air]	1.48E-09	kg
Cadmium [Heavy metals to air]	1.48E-10	kg
Copper (+II) [Heavy metals to air]	9.48E-09	kg
Lead (+II) [Heavy metals to air]	1.30E-08	kg
Manganese (+II) [Heavy metals to air]	1.27E-07	kg
Mercury (+II) [Heavy metals to air]	2.96E-11	kg
Nickel (+II) [Heavy metals to air]	7.41E-09	kg
Selenium [Heavy metals to air]	2.96E-09	kg
Silicon dioxide (silica) [Particles to air]	1.73E-07	kg
Zinc (+II) [Heavy metals to air]	1.63E-08	kg

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

Embedded Unit Processes

None.

References

Buckley Powder Co. (2011). Material Safety Data Sheet - ANFO BP. Retrieved 3/20/14 from <http://www.buckleypowder.com/PDFs/BPC%20MSDS%20ANFO-Waterblock.pdf>

Department of Climate Change (2008). National Greenhouse Accounts (NGA) Factors. Retrieved 3/20/14 from <http://www.globalbioenergy.org/bioenergyinfo/bioenergy-and-climate-change/detail/en/c/4155/>

ENSR International (1996). Molycorp Mountain Pass Mine Expansion Project, Mountain Pass, California, Draft Environmental Impact Report. Camarillo, CA: ENSR International.

ENSR International (2004). Final Environmental Impact Report for Molycorp, Inc. Mountain Pass Mine 30-Year Plan. Camarillo, CA: ENSR International.

EPA (1980). AP 42: Fifth Edition, Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources, Chapter 13: Miscellaneous Sources. Retrieved 3/20/14 from <http://www.epa.gov/ttn/chief/ap42/ch13/index.html>

SRK Consulting (2010). Engineering Study for the Re-Start of the Mountain Pass Rare Earth Element Mine and Processing Facility Mountain Pass, California. Retrieved March 20, 2014 from <http://www.sec.gov/Archives/edgar/data/1489137/000095012310065239/d74323fwfwp.htm>



Section III: Document Control Information

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Original/no revisions

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