NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Brine Evaporation Pond

Reference Flow: 1 kg of Brine Wastewater

Brief Description: This process captures the inputs and outputs for filtering and evaporating brine wastewater from solvent extraction of rare earths elements.

Section I: Meta Data

Geographical Coverage: United States **Region:** California

Year Data Best Represents: 2010

Process Type: Auxiliary Process (AP)

Process Scope: Gate-to-Gate Process (GG)

Allocation Applied: No

Completeness: All 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:

water_frac	*[kg/kg] kg of water per kg of brine wastewater*
hcl_frac	*[kg/kg] kg of HCl per kg of brine wastewater*
naoh_frac	*[kg/kg] kg of NaOH per kg of brine wastewater*

dehpa_frac	*[kg/kg] kg of DEHPA per kg of brine wastewater*
kero_frac	*[kg/kg] kg of kerosene per kg of brine wastewater*
Th_content	*[kg/kg] kg of thorium per kg of brine wastewater*
U_content	*[kg/kg] kg of uranium per kg of brine wastewater*

Tracked Input Flows:

Brine Wastewater	*Reference Flow*

Tracked Output Flows:

NaCl, to waste storage	*Solid Waste*
DEHPA, to waste storage	*Liquid Waste*
kerosene, to waste storage	*Liquid Waste*
Hydrochloric acid, to waste storage	*Liquid Waste*
Evaporated Water	*Air Emissions*
Thorium, to waste storage	*Solid Waste*
Uranium, to waste storage	*Solid Waste*

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *Copy of DS_Stage1_O_brine_evaporation_2014.01.xlsx*, which provides additional details regarding relevant calculations, data quality, and references.

Goal and Scope

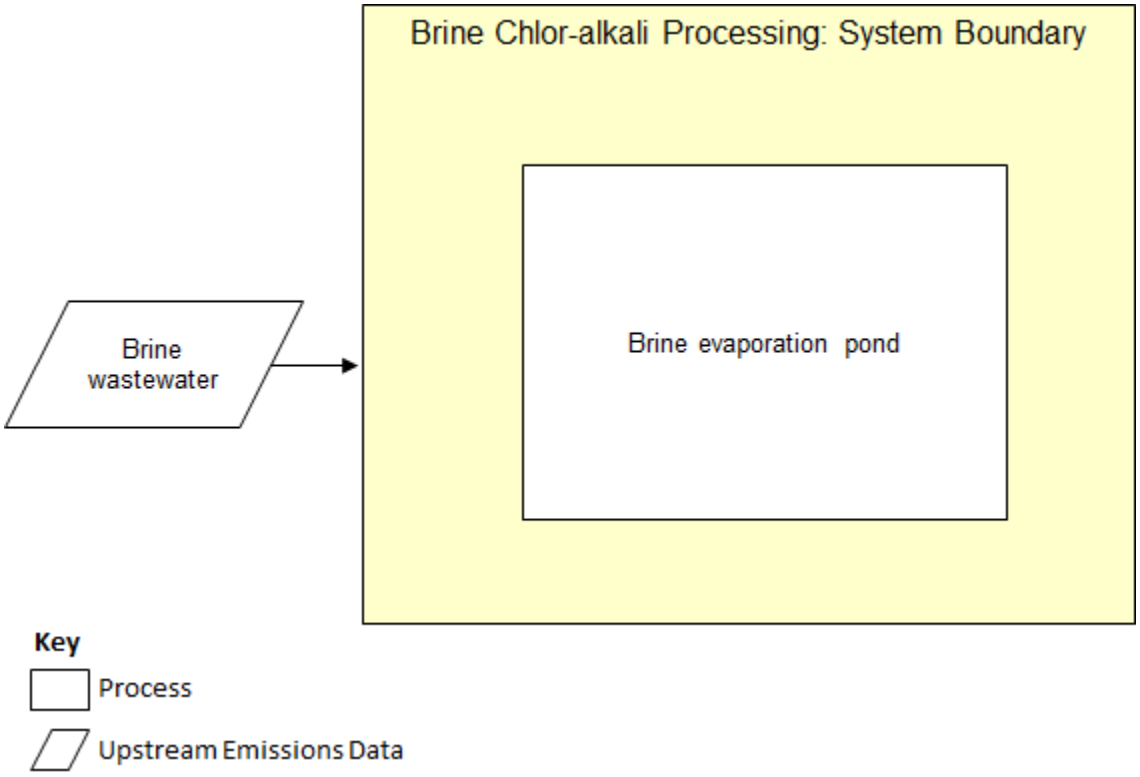
This process captures the inputs and outputs for filtering and evaporating brine wastewater from solvent extraction of rare earth elements. This unit process provides a summary of relevant input and output flows associated with filtration and disposal of wastewater brines. The process takes place in a two steps,

filtration and evaporation. The reference flow of this unit process is: 1 kg of Brine Wastewater

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 the brine waste water are calculated in another unit process. The methods for calculating these operating activities are described below.

Figure 1: Unit Process Scope and Boundary



This unit process covers the disposal of wastewater from rare earth metal solvent extraction. The solvent extraction process uses sodium hydroxide to neutralize the hydrochloric acid in the wastewater, producing a brine solution (ENSR International,

2004). This solution is then filtered to remove solvents and disposed of in an evaporation pond (Molycorp, 2005).

The default composition of the wastewater stream is based on annual consumption values listed in an environmental impact report for the Molycorp Mountain Pass facility (ENSR International, 2004).

Parameters are provided for thorium and uranium content of the waste water. The default values are calculated based on the thorium content of Mountain Pass bastnaesite and the crustal average of uranium multiplied by the amount of ore mined to get a kg of rare earth mineral concentrate in the default flotation process (Olson et al., 2014; NETL, 2014; Winter, 2014). The implication is that all of the thorium and uranium in the mined ore follows the same process chain as the rare earths but is separated at the solvent extraction stage and disposed of in this process.

Table 1: Unit Process Input and Output Flows

Flow Name	Value	Units (Per Reference Flow)
Inputs		
Brine Wastewater	1.00	kg
Outputs		
NaCl, to waste storage	1.27E-01	kg
DEHPA, to waste storage	5.18E-04	kg
kerosene, to waste storage	4.20E-03	kg
Hydrochloric acid, to waste storage	1.67E-01	kg
Evaporated Water	7.01E-01	kg
Thorium, to waste storage	1.34E-03	kg
Uranium, to waste storage	2.74E-05	kg

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

Embedded Unit Processes

None.

References

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

Molycorp, 2005	Molycorp (2005) Revised Waste Discharge Requirements For Molycorp, Inc., Mountain Pass Mine and Mill On-site, Lined Evaporation Ponds Apptendix B: Proposed Onsite Evaporation Pond Flow Diagram
NETL, 2014	NETL (2014). NETL Life Cycle Inventory Data – Unit Process: Froth Flotation - Version 01. U.S. Department of Energy, National Energy Technology Laboratory. Retrieved from www.netl.doe.gov/LCA
Olson, J.C., Shawe, D.R., Pray, L.C., Sharp, W.N. (1954).	Rare-Earth Mineral Deposits of the Mountain Pass Disctrict San Bernardino County California. Washington, D.C.: US GPO. Retrieved July 15 from http://pubs.usgs.gov/pp/0261/report.pdf
Winter, 2014	Winter, M.J. (2014). Uranium: geological information. Retrieved July 15, 2014 from http://www.webelements.com/uranium/geology.html

Section III: Document Control Information

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