NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Proton Exchange Membrane, Construction

Reference Flow: 1 piece of PEM, construction

Brief Description: Material inputs associated with the construction of a proton exchange membrane (PEM) electrolysis facility.

Section I: Meta Data

Geographical Coverage: United States **Region:** N/A

Year Data Best Represents: 2017

Process Type: Installation Process (IP)

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:

stack_lifetime

[years] Lifetime of PEM stack.

BOP_lifetime

[years] Lifetime of PEM balance of plant (BOP).

Tracked Input Flows:

Titanium

[Technosphere] Titanium input, scaled to reference flow.

Stainless Steel

[Technosphere] Stainless steel input, scaled to reference flow.

Nafion

[Technosphere] Nafion (membrane) input, scaled to reference flow.

Activated Carbon

[Technosphere] Activated carbon input, scaled to reference flow.

Iridium

[Technosphere] Iridium input, scaled to reference flow.

Platinum

[Technosphere] Platinum input, scaled to reference flow.

Low Alloyed Steel

[Technosphere] Low alloyed steel input, scaled to reference flow.

High Alloyed Steel

[Technosphere] High alloyed steel input, scaled to reference flow.

Plastic

[Technosphere] Plastic input, scaled to reference flow.

Electronic Material

[Technosphere] Electronic material input, scaled to reference flow.

Adsorbent and Lubricant

[Technosphere] Adsorbent and lubricant input, scaled to reference flow.

Concrete

[Technosphere] Concrete input, scaled to reference flow.

Aluminum

[Technosphere] Aluminum input, scaled to reference flow.

Copper

[Technosphere] Copper input, scaled to reference flow.

Tracked Output Flows:

PEM, Construction

[Reference flow]

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) DS_C_*PEM_Electrolysis_Construction_2022.01.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 the construction of a PEM electrolysis facility in Germany. The facility consists of a PEM stack system and building materials. Functional unit is one construction PEM facility.

Boundary and Description

This unit process provides a summary of materials required to construct a PEM electrolysis facility. Operation and maintenance (O&M) is not included within the boundary of this unit process.

Nafion (a polymer material made by DuPont) is the most commonly used proton exchange membrane. Cells are connected electrically in series and hydraulically in parallel to make up a stack. The lifetimes of the stack and the balance of plant were assumed to be 7 and 20 years, respectively, though these can be adjusted as parameters in this profile (Bareiß et al. 2019).

The material and details were pulled from Bareiß et al. (2019). The plant construction profile is generic and representative of state-of-the-art low-temperature PEM electrolyzers of the year 2017.

Inputs and outputs have been scaled to a reference flow of 1 piece of PEM, construction.

Figure 1: Unit Process Scope and Boundary

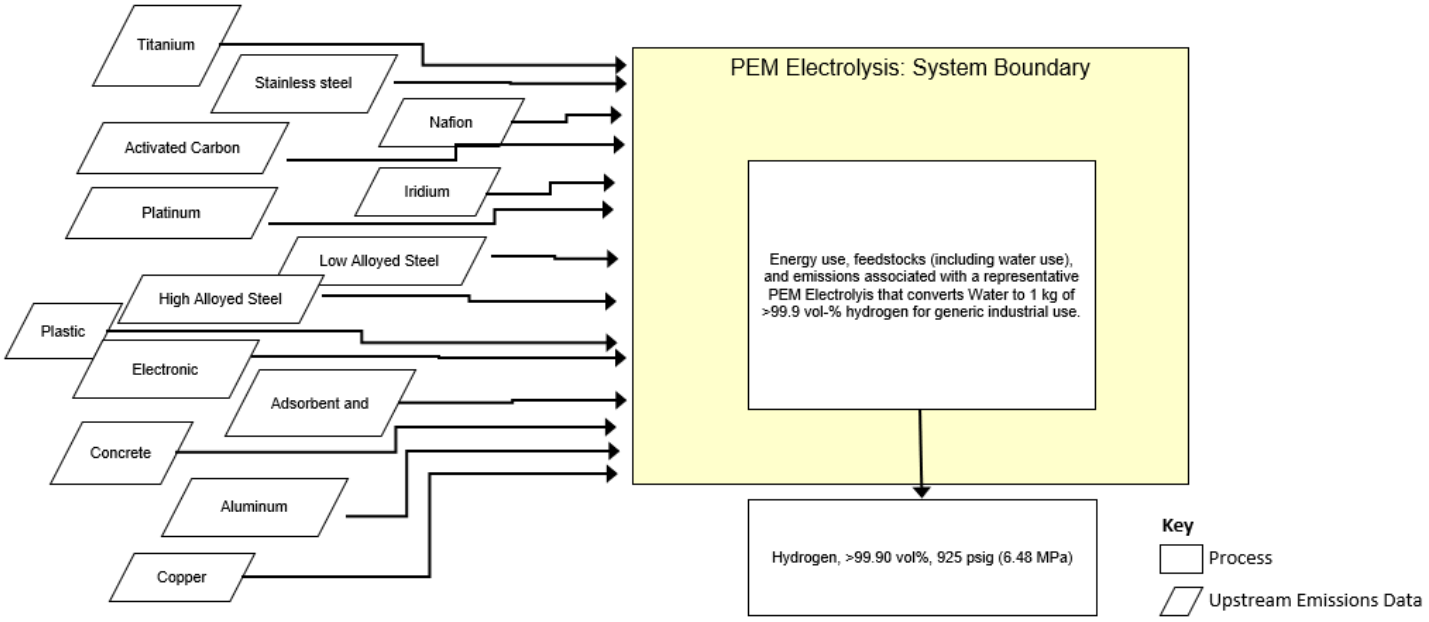
Titanium
Stainless steel
Nafion
Activated Carbon
Iridium
Platinum
Low Alloyed Steel
High Alloyed Steel
Plastic
Electronic
Adsorbent and
Concrete
Aluminum
Copper
PEM Electrolysis: System Boundary
Energy use, feedstocks (including water use), and emissions associated with a representative PEM Electrolyis that converts Water to 1 kg of >99.9 vol-% hydrogen for generic industrial use.
Hydrogen, >99.90 vol%, 925 psig (6.48 MPa)
Key
Process
Upstream Emissions Data

Table 1: Parameters

Parameter Name	Expected Value	Low	High	Units	Description
stack_lifetime	7			years	Lifetime of PEM stack.
BOP_lifetime	20			years	Lifetime of PEM balance of plant (BOP).

Embedded Unit Processes

None.

References

Bareiß, K., de la Rua, C., Möckl, M., & Hamacher, T. (2019). Life cycle assessment of hydrogen from proton exchange membrane water electrolysis in future energy systems. Applied Energy, 237, 862-872.

Section III: Document Control Information

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Revision History:

None Yet

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