NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Heater treater

Reference Flow: 1 kg of Crude oil processed in heater treater

Brief Description: The use of a heater-treater to remove water from produced oil.

Section I: Meta Data

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

Year Data Best Represents: N/A

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:

API	*[deg API] API of the crude oil being produced. Heavy Venezuelan crude has an API of just over 10, and Bakken crude can be around 42.*
Entrained_H2O	*[dimensionless] The volume fraction that is entrained water*
Feed_temp	*[deg F] The temperature of feed, which contains entrained water*

Treat_temp	*[deg F] The temperature at which the oil-water stream is treated*
Crude_SH	*[btu/bbl-F] The specific heat of the crude oil*
Water_SH	*[btu/bbl-F] The specific heat of water*
Heat_loss	*[dimensionless] Heat loss directly from the oil-water emulsion*
Hfuel_use	*[btu/btu] Fuel use required with natural gas or NGL, accounting for losses. Assumes 80% efficiency.*
Efuel_use	*[kWh/MMBtu] Fuel use required with electricity, accounting for losses. Assumes 98% efficiency.*
Gas_heat	*[boolean] Select 1 if a gas fired heater is used*
Electric_heat	*[boolean] Select 1 if an electric heater is used*
NG_fuel	*[boolean] Select 1 if natural gas is used in the gas fired heater*
NGL_fuel	*[boolean] Select 1 if NGLs are used in the gas fired heater*
H2O_rem_eff	*[dimensionless] The efficiency of the heater treater to remove entrained water*
N2	*[dimensionless] Mole fraction of nitrogen in associated gas stream*
CO2	*[dimensionless] Mole fraction of carbon dioxide in associated natural gas stream*
C1	*[dimensionless] Mole fraction of methane in associated natural gas stream*
C2	*[dimensionless] Mole fraction of ethane in associated natural gas stream*
C3	*[dimensionless] Mole fraction of propane in associated natural gas stream*

C4_plus	*[dimensionless] Mole fraction of butane and higher hydrocarbons in associated natural gas stream*
H2S	*[dimensionless] Mole fraction of hydrogen sulfide in associated natural gas stream*

Tracked Input Flows:

Natural gas, combusted in boiler [Natural gas]	*[Technosphere] Natural gas heat source for the heater-treater*
LPG, combusted in boiler [Natural gas products]	*[Technosphere] NGL heat source for the heater-treater*
Electricity [Electric power]	*[Technosphere] Electricity heat source for the heater-treater*
Water Treatment for Heater Treater [Valuable substances]	*[Technosphere] Treatment of produced water*
Heater treater emissions [Intermediate product]	*[Intermediate product] Emissions of associated gas from heater treater*

Tracked Output Flows:

Dehydrating, crude oil heater treater [Valuable substances] *Reference flow*

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_Stage1_O_Heater_treater_2013.01.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 use of a heater-treater to remove entrained water after the extraction of crude oil. A heater-treater is used for low API crude oils when gravity separation and emulsion chemicals cannot remove all water from the oil-water stream. The reference flow of this unit process is: 1 kg of Crude oil processed in heater treater

Boundary and Description

When free water is removed from the extracted crude oil at an early stage in the processing scheme, the produced oil will often possess unacceptable levels of emulsified water content. Crude oil dehydration is accomplished by gravitational/chemical means, but if this default method is not sufficient, the use of a heater treater removes the entrained water via the application of heat.

Since heater treaters are not suitable for removing large amounts of water, removing a large fraction of the free water prior to heat treatment considerably reduces the energy required during the production separator. Specifically, 350 BTU is required to heat 1 bbl of H_2O by 1°F, whereas 150 BTU is required to heat the equivalent amount of oil by 1°F. Nevertheless, a heater treater may be "required to reduce the water content to a level acceptable for transportation and sale," (El-Houjeiri *et al.,* 2013).

As shown in **Figure 1**, this unit process is not set up with an input oil/water mix flow and an output of dehydrated oil. Instead, this process is designed to provide the service of crude oil dehydration by use of a heater treater. It calculates the amount of energy used and the amount of water treatment needed. In order to use this unit process, it must be called by another process to treat a specific amount of crude oil.

A list of key parameters and properties used to determine energy use is included in **Table 1**.

Figure 1: Unit Process Scope and Boundary

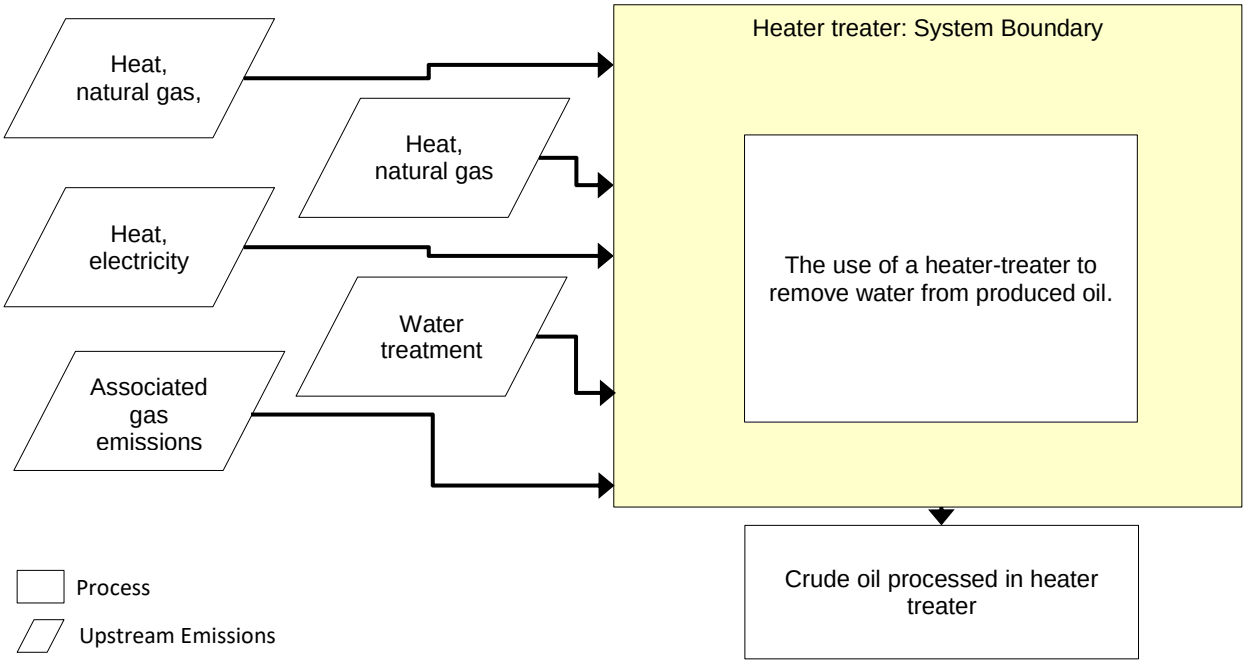

Table 1: Properties for Total Heater Treater Duty

Property	Value	Source
Specific heat of oil	150 Btu/bbl - °F	Manning and Thompson 1995
Specific heat of water	350 Btu/bbl - °F	Manning and Thompson 1995
Treating temperature	165°F	Manning and Thompson 1995
Feed temperature	90°F	Manning and Thompson 1995
Heat loss	0.02	Manning and Thompson 1995

Table 2: Unit Process Input and Output Flows

Flow Name	Value	Units (Per Reference Flow)
Inputs		
Natural gas, combusted in boiler [Natural gas products]	**0.15**	**MJ**
LPG, combusted in boiler [Natural gas products]	**0.00E+00**	**MJ**
Electricity [Electric power]	**0.00E+00**	**kWh**
Heater treater emissions [Intermediate product]	**9.41E-10**	**kg**
Outputs		
Dehydrating, crude oil heater treater [Valuable substances]	**1.00**	**kg**

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

Embedded Unit Processes

None.

References

El-Houjeiri *et al.* 2013 — El-Houjeiri, H.M., McNally, S., and Brandt, A. R. 2013. *Oil Production Greenhouse Gas Emissions Estimator OPGEE v1.1 DRAFT A: User guide & Technical documentation.*

Keesom *et. al.* 2009 — Keesom, W., Unnasch, S., & Moretta, J. (2009). *Life cycle assessment comparison of North American and imported crudes*; Alberta Energy Research Institute.

Manning and Thompson 1995 — Manning, F.S.; Thompson, R 1995. *Oil processing, Volume 2: Crude oil;* Pennwell: Tulsa, OK

Lee, Stephanie 2011 — Lee, Stephanie. (2011). *2007 Oil and Gas Industry Survey Results - Final Report*. Air Resources Board (ARB)

NIST 2011 — NIST. (2011). *Thermophysical Properties of Fluid Systems.*

EPA 2011 — EPA. (2011). *SPECIATE Version 4.3*. In Environmental Protection Agency (Ed.). Washington, D.C.

Section III: Document Control Information

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