Shell & Tube Heat Exchanger Performance and Fouling — Report

DOCUMENT

Plant / project	**Example Plant**
Equipment tag / system	**E-101**
Calculation / document no.	**CALC-HX-001**
Revision	**0**
Prepared by	**Your name**
Checked by	**—**
Date	**28-Oct-2026**
Calculation basis	Duty from the enthalpy change of each stream (PlantCalcKit fluid library): hot Diesel / gas oil (typical), cold Light crude oil (typical) · Shells in series, each 1 shell / 2+ tube passes × 2 · LMTD with F factor; clean re-rating by ε-NTU · Flows: Both flows measured; duty: Average of hot and cold duty · Fouling rate: From days since the last cleaning
Status	**✓ Inputs OK · ℹ️ 7 default value(s) in use: hot outlet pressure, hot api gravity, hot watson characterisation factor k, cold outlet pressure, cold api gravity, cold watson characterisation factor k, operating hours per year**

KEY INPUTS

Input	Unit	Value used
Mass flow (hot)	kg/h	60,000
Inlet temperature (hot)	°C	250.0
Outlet temperature (hot)	°C	170.0
Inlet pressure (absolute or gauge – pick the unit) (hot)	bar g	10.00
Outlet pressure (hot)	bar g	10.00
Mass flow (cold)	kg/h	100,000
Inlet temperature (cold)	°C	140.0
Outlet temperature (cold)	°C	192.0
Inlet pressure (absolute or gauge – pick the unit) (cold)	bar g	18.00
Outlet pressure (cold)	bar g	18.00
Number of shells in series	—	2
Heat transfer area (total, all shells; outside of tubes)	m²	440.0
Clean overall heat transfer coefficient	W/m²·K	300.0
Design fouling resistance (total, both sides)	m²·K/W	0.000700
Design duty	kW	4,000
Operating hours per year	h/yr	8,000
Value of the lost duty (cost of make-up heat or cooling)	per MWh	30.00
Cost of one cleaning (incl. lost production)	—	25,000

Days in service since the last cleaning	days	300

RESULTS — STREAMS

Stream result	Unit	Hot	Cold
Inlet temperature used	°C	250.0	140.0
Outlet temperature used	°C	170.0	192.0
Inlet phase	—	Liquid	Liquid
Outlet phase	—	Liquid	Liquid
Mass flow used	kg/h	60,000	100,000
Enthalpy change (outlet − inlet, absolute value)	kJ/kg	213.36	131.77
Mean specific heat over the exchanger	kJ/kg·K	2.6670	2.5341
Duty of the stream	kW	3,556.0	3,660.4

RESULTS — PERFORMANCE

Result	Unit	Value
Heat balance error (hot − cold) ÷ average	%	-2.9
Duty used for U	kW	3,608.2
Duty as % of the design duty	%	90.2
LMTD (counter-flow basis)	K	42.47
LMTD correction factor F	—	0.8945
Mean temperature difference (F × LMTD)	K	37.99
Overall heat transfer coefficient — actual	W/m²·K	215.9
Cleanliness factor (U actual ÷ U clean)	%	72.0
Fouling resistance — actual (1/U − 1/U clean)	m²·K/W	0.001299
Fouling resistance as % of the design allowance	%	185.6
U at the design fouling (service U)	W/m²·K	247.9

RESULTS — CLEAN RE-RATING AND COST OF FOULING

Result	Unit	Value
Duty if the exchanger were clean	kW	3,914.6
Duty at the design fouling	kW	3,748.3
Duty lost to fouling (clean − actual)	kW	306.5
Hot outlet temperature if clean	°C	163.2
Cold outlet temperature if clean	°C	196.4
Tube-side velocity	m/s	1.17
Energy lost per year at the present fouling	MWh/yr	2,452
Cost of the lost duty per year (present fouling)	per yr	73,603
Payback of one cleaning (cleaning cost ÷ present daily loss)	days	124
Fouling rate used	m²·K/kW per month	0.1318
Optimum cleaning interval (lowest total cost)	days	273
Days left to the optimum (negative = overdue)	days	-27
Total cost per year at the optimum interval	per yr	67,145

FINDINGS AND RECOMMENDATIONS

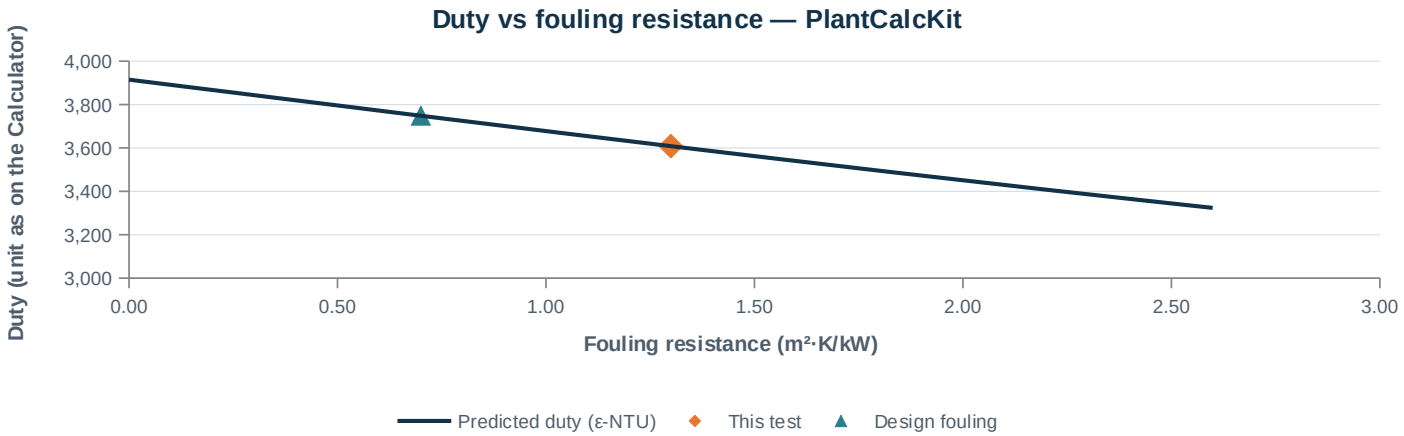
⚠ **Correct soon**

Fouling resistance 0.001299 m²·K/W is above the design allowance 0.000700 m²·K/W: the exchanger cannot reach its design duty at design conditions.

⚠ **Correct soon**

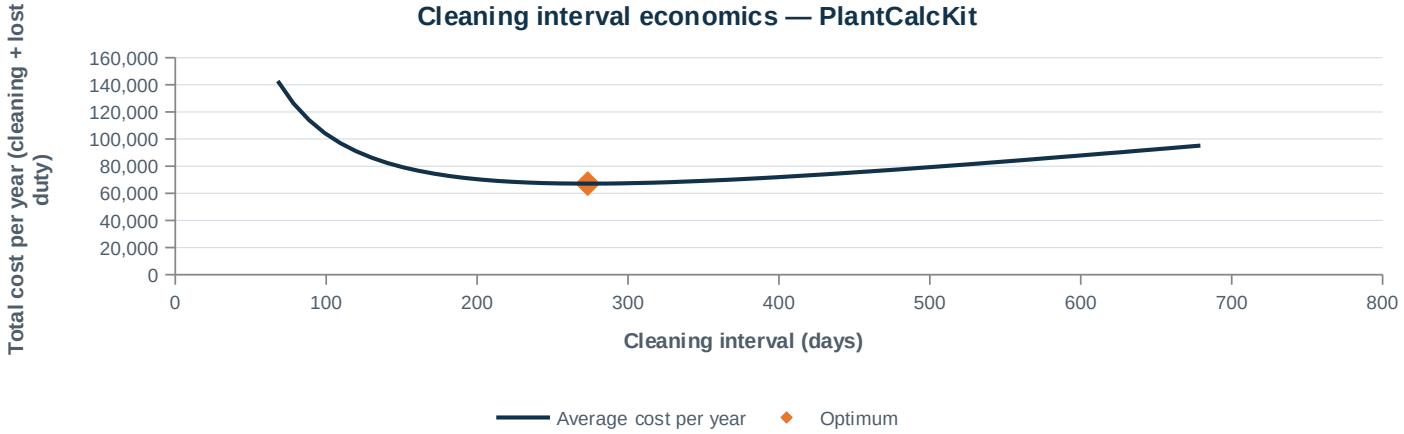
Cleaning is overdue on cost grounds: optimum interval 273 days, in service 300 days. Present loss 73,603 per year.

CHARTS



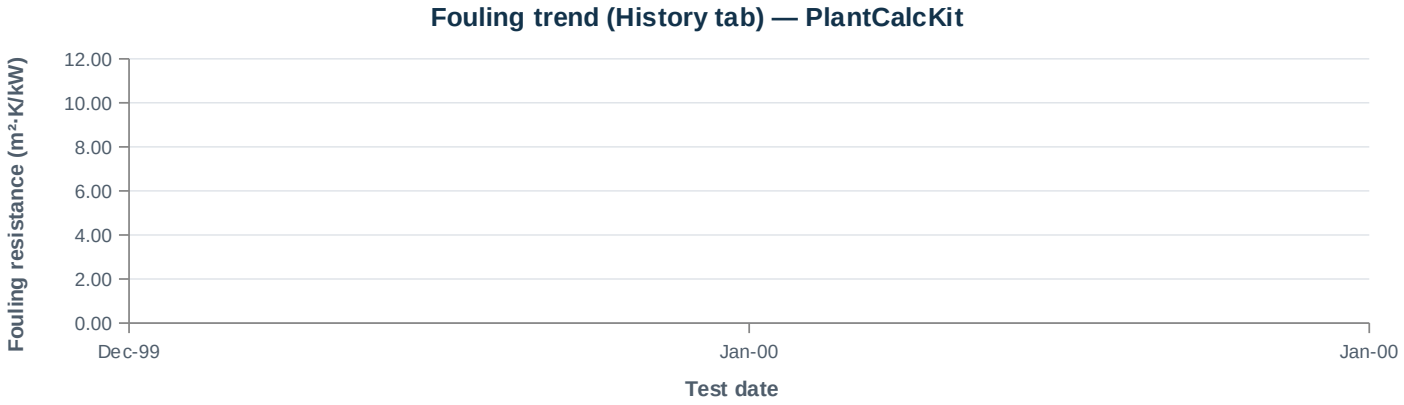
Observations — duty and fouling

[Write your observations here]



Observations — cleaning interval

[Write your observations here]



Observations — fouling trend

[Write your observations here]

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