Advanced Energetics

Exercise 03: Heat exchanger network design

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PROCESS DESCRIPTION

Figure 1 shows a process for which the minimum energy requirement has to be calculated.

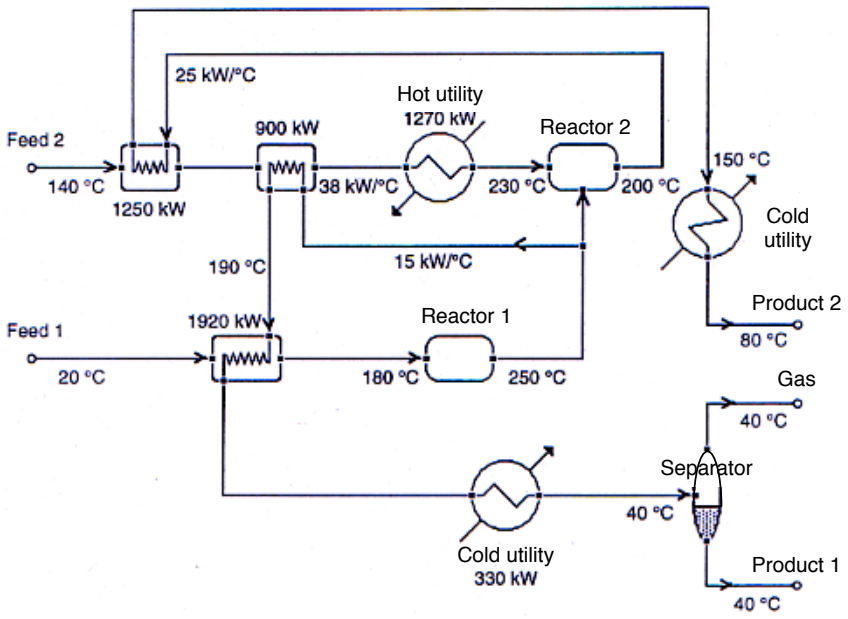

Figure 1: process flowsheet

OPERATING COSTS

- Natural gas: 0.09 CHF/kWh
- Water: 0.01 CHF/ m^3

USEFUL VALUES

- Operating time 8000 h/year
- Cooling water inlet: 25°C , outlet: 35°C
- Boiler efficiency: 85%
- Convective heat transfer coefficients: $\alpha_{cold} \approx \alpha_{hot} = 1000 W/m^2K$
- Interest rate: 8%
- Life time of heat exchanger: 20 years
- Chemical engineering plant cost index (1998) : 389.5
  Chemical engineering plant cost index (May 2009) : 509.1
- Bare module factor: 4.74 for heat exchanger
- The investment costs are given in USD (1USD = 1.02 CHF)
- Investment equation: Purchased cost $C_p = \frac{I_t}{I_{t,ref}} 10^{k_1 + k_2 log A + k_3 (log A)^2}$

QUESTIONS

1. Compute the heat exchanger network for the calculated MER applying the Pinch Design Method.
2. Evaluate the cost of the network, i.e. calculate the heat exchangers and estimate the cost using the cost formulas as given here above.

NOTE: Use the same value for ΔT_{min} as you used for the first part of the exercise.