

Question #78606

A double pipe heat exchanger has an effectiveness of 0.5 when the flow is counter-current and the thermal capacity of one fluid is twice that of the other fluid. Calculate the effectiveness of the heat exchanger if the direction of flow of one of the fluids is reversed with the same mass flow rates as before?

Answer:

Since the flowrates of the fluids remain the same, the overall heat transfer coefficient U is the same too. Thus, the NTU (number of transfer units) is the same for both cases:

$$NTU = \frac{UA}{C_{min}}, \quad (1)$$

where A is the heat transfer area,

C_{min} is the smaller heat capacity of the two fluids.

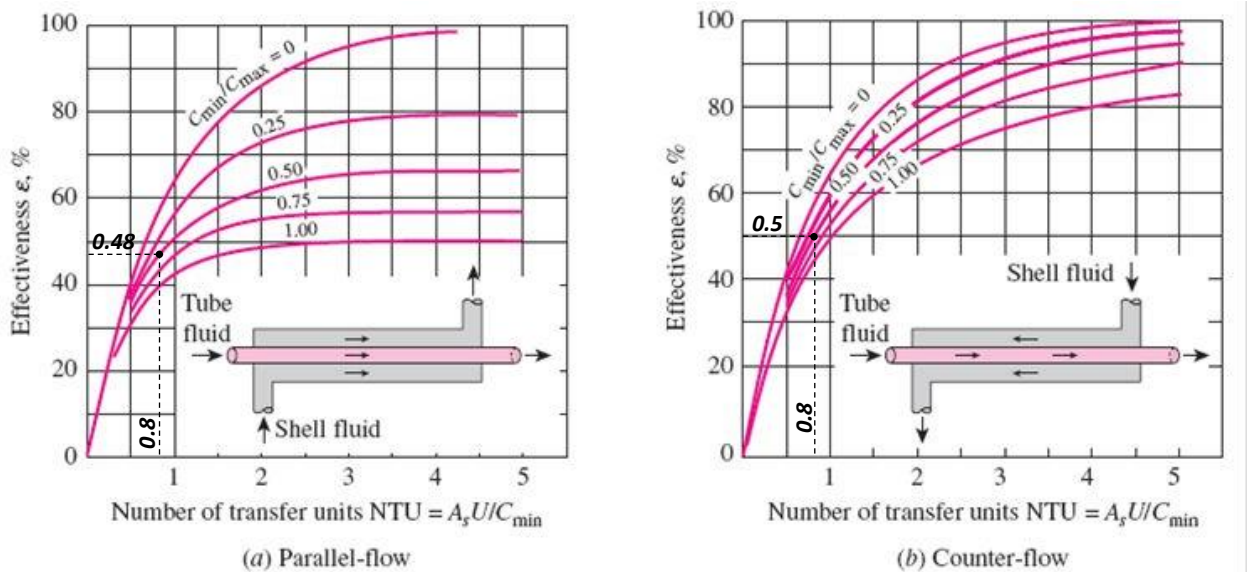


FIGURE 1. The charts for $\epsilon = f(NTU, C_{min}/C_{max})$

The dependencies of the effectiveness from NTU and C_{min}/C_{max} ratio for the parallel-flow and counter-flow double pipe heat exchangers are shown in Figure 1. In our case the maximum to minimum thermal capacity ratio is 0.5. Thus, from Figure 1b we can define $NTU = 0.8$ for the counter-flow. Now, from the Figure 1a we can define the effectiveness of the parallel-flow heat exchanger

$$\epsilon = 0.48 = 48\%.$$