Problems from chapter 3

3.5

A cross-flow heat exchanger with both fluids unmixed is used to heat water (c_p = 4.18 kJ/kg·K) from 40°C to 80°C, flowing at the rate of 1.0 kg/s. What is the overall heat transfer coefficient if hot engine oil (c_p = 1.9 kJ/kg·K), flowing at the rate of 2.6 kg/s, enters at 100°C? The heat transfer area is 20 m^2. (Note that you can use either an effectiveness or an LMTD method. It would be wise to use both as a check.)

3.7

Consider a counterflow heat exchanger that must cool 3000 kg/h of mercury from 150°F to 128°F. The coolant is 100 kg/h of water, supplied at 70°F. If U is 300 W/m^2K, complete the design by determining reasonable value for the area and the exit-water temperature.
[A = 0.147 m^2.]

3.16

A particular cross-flow process heat exchanger operates with the fluid mixed on one side only. When it is new, U = 2000 W/m^2K, T_{cin} = 25°C, T_{cout} = 80°C, T_{hin} = 160°C, and T_{hout} = 70°C. After 6 months of operation, the plant manager reports that the hot fluid is only being cooled to 90°C and that he is suffering a 30% reduction in total heat transfer. What is the fouling resistance after 6 months of use? (Assume no reduction of cold-side flow rate by fouling.)