ACTIVE LEARNING EXERCISE: ε-NTU Discovery Session

The effectiveness-NTU (*ε-NTU*) method not only gives us an easy way to perform heat exchanger *analysis* problems, it gives us physical insight into the performance of HXRs. The basis of this insight is that the *effectiveness*, *ε*, tells us how well our HXR performs compared to the theoretically best heat exchanger. Using the *ε-NTU* relationships (equations and charts), answer the following questions.

(1) What is the possible range for effectiveness? (Holy cow, that's easy!)

(2) For a given *NTU* and *C*, which heat exchanger construction/flow direction combination has the highest effectiveness?

(3) How does effectiveness vary with *C*?

(4) For what value of *C* is effectiveness at its maximum?

a. How does this value of *C* for ε_{max} vary with HXR type? flow direction?

b. For this value of C, what does this mean for one of the fluid's $m_{dot}c_p$ value? What does it mean about this fluid *physically*?

(5) If $NTU < 0.3$, which equation would you use for ε? Why?

(6) Let's say you are thinking about increasing the effectiveness of your HXR by increasing its UA value. You can do this in two ways:

a. You can increase flowrate(s) which increases h(s) and thereby U. But that means increasing your operational cost. (Bigger Δp means bigger pumping power required.)

b. You can increase A, but that increases the capital cost of the HXR. (Bigger A means more material to build the HXR.)

By consulting the ε -NTU charts, come up with a criterion by which you can determine whether it is worth the increase in either operational or capital cost to increase your UA. (Hint: Think about where UA shows up in the ε-NTU method.)