
PROBLEM 12-13N QUESTION

Nucleate Boiling Initiation And Termination On A Heat Exchanger Tube

A heat exchanger tube is immersed in a water cooling tank at 290K, as illustrated in Fig. 1. Hot water (single phase, 550K) enters the tube inlet and is cooled as it flows at 2 kg/s through the 316 grade stainless steel tube (19 mm outside diameter and 15.8 mm inside diameter). Neglect entrance effects.

- Compute the length along the horizontal inlet length of the tube where nucleate boiling on the tube O.D. is initiated.
- Compute the length where nucleate boiling on the tube O.D. is terminated.

The heat transfer coefficient between the outer tube wall and the water cooling tank is 500 for single phase conditions and 5000 for nucleate boiling conditions. The wall superheat for incipient nucleation is 15°C for this configuration. Estimate and justify any additional information you need to execute the solution.

Fluid Properties of Inlet Water
(assume they stay constant)

$K \equiv$ Thermal Conductivity = 0.5 W/m°C

$\rho \equiv$ Density = 704 kg/m³

$\mu \equiv$ Viscosity = 8.69x10⁻⁵ kg/ms

$C_p \equiv$ Heat Capacity = 6270 J/kg°C

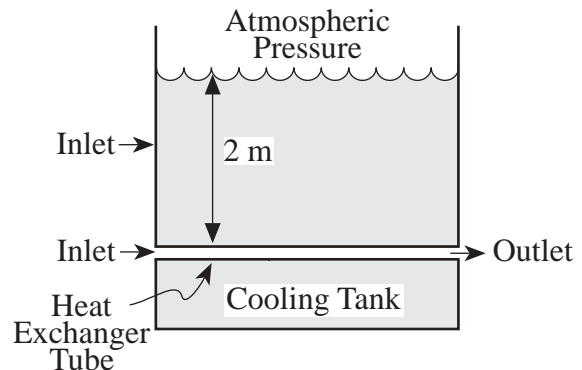


Figure 1