

Refrigerant Inside Pipe

A circular tube with radius 15cm it's trapped inside a squared tube with length 50cm. Inside the circular tube, we find Refrigerant 134a that has to be cooled from 1MPa and 70°C to 40°C. The cooling water inside the squared tube enters at 5MPa and 0°C and leaves with a higher temperature. Knowing that the mass rates are proportional with the area in which the fluids flow, what is the exit temperature of the water?

Answer: 3.1°C

Explanation:

$$A_{refrigerant} = \pi r^2 = 706cm^2$$

$$A_{water} = L^2 - \pi r^2 = 1793cm^2$$

$$\dot{M}_{r(h1-h2)} = \dot{M}_w \cdot (h4 - h3)$$

From the table of the refrigerant $h1 = 303.87$ kJ/kg and $h2 = 271.04$ kJ/kg. From the table for water at 5MPa $h3 = 5.03$ kJ/kg and $h4$ must be calculated. $h4 = h3 + (h1 - h2) \cdot (\frac{A_{refrigerant}}{A_{water}})$. This value must be interpolated, and final temperature of water will be 3.1 degree Celsius.