Heat Transfer

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Practical Lecture 5

24. A fluid condenses at the temperature of 50°C ($h = 3500\,\mathrm{W\,m^{-2}\,K^{-1}}$) when circulating inside a steel pipe ($k = 50\,\mathrm{W\,m^{-1}\,K^{-1}}$) with an external diameter of 25 mm. The thickness of the tube is 1 mm. A fan provides an air flow at 25°C perpendicular to the tube ($v_\infty = 20\,\mathrm{m\,s^{-1}}$), the convection coefficient being equal to $50\,\mathrm{W\,m^{-2}\,K^{-1}}$. In order to increase the heat exchange, it was decided to place annular fins with a thickness of 1.5 mm and a width of 1 cm, the spacing between the fins being equal to 5 mm.
    Justify whether the fins should be placed inside or outside the tube. For the case you considered to correspond to the one of the greatest increase of heat exchange, calculate:
    (a) the heat rate exchanged per unit length of the pipe prior to the placement of the fins;
    (b) the heat rate exchanged per unit length of the pipe after placement of the fins.

29. A bar with 2.5 cm diameter, 1 m length and $20\,\mathrm{W\,m^{-1}\,K^{-1}}$ thermal conductivity, is fixed on two supports maintained at 50°C. The bar is exposed to air at 300°C. Determine the temperature at the middle of the bar and the total rate of heat transfer from the air to the bar assuming that the convection coefficient is $50\,\mathrm{W\,m^{-2}\,K^{-1}}$.

31. (Homework) A quadrangular chip with 16 mm length of side, has 16 aluminium fins of 2 mm diameter and 15 mm length, placed with a quadrangular arrangement with longitudinal and transverse pitches of 4 mm. A fan promotes an air flow at 25°C, where the convection coefficient is $110\,\mathrm{W\,m^{-2}\,K^{-1}}$. What is the maximum power of the chip that prevents its supposedly uniform temperature to excess 75°C.