Improved heat transfer predictions for air-cooked heat exchangers

ABSTRACT

Fanless operation of an air-cooled heat exchanger may be a valid design option to reduce energy consumption and improve safety. However, running the exchanger with its fans turned off can have several negative consequences, the worst being tube blockage due to freezing and the transmission of vapor due to the exchanger's inability to condense it (1). Thus, reliable performance predictions for air-cooled heat exchangers operating without fans (as a percentage of normal duty) are important to designers and operators. So how should the design of a forced-draft air-cooled heat exchanger account for the effect of natural convection during fanless operation? If one assumes that the bundle depth is the only height for which a density-induced draft must be calculated, the design is likely to be too conservative by up to 75%. On the other hand, using the Doyle and Benkly (2) method to predict the effect can result in under-design by as much as 70% (3). This article presents a formula for estimating the effective plume-chimney height above a forced-draft air-cooled heat exchanger (Figure 1) for still, ambient conditions. It then outlines a step-by-step iterative method for solving the relevant heat transfer and pressure drop equations.