Extended Surface Heat Transfer From And Thermal Stress In Radial Fins

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Abstract

Radial fins are widely used in industrial applications to enhance heat transfer. Exact solutions are available for radial fins of simple profiles such as rectangular, concave and convex parabolic, hyperbolic and triangular. However, such solutions may be cumbersome for use in everyday applications as they invariable require evaluation of various Bessel and modified Bessel functions. This presentation demonstrates how COMSOL Multiphysics® can be used to quickly and accurately evaluate temperature distributions, heat transfer, and stress conditions in radial fins of arbitrary profiles. In practice, radial fins are used in array configurations attached to cylindrical tubes and vessels of specific wall thickness. Sharp temperature gradients are usually encountered where the radial fins attach to the wall of the process equipment resulting in undesirable thermal stress concentrations at such locations. The presentation elucidates how the COMSOL® software can be used to model heat transfer and thermal stress in fin arrays for a variety of equipment configurations. The computed thermal results for single radial fins of rectangular cross section are in excellent agreement with those obtained from the exact solution involving Bessel functions. Similar calculations can be readily performed for radial fins of any curved profile. Figure 1 shows the calculated temperature distribution and von Mises stress distribution for an array of fins of rectangular profile. The detailed thermo-elastic behavior of more complex fin array configurations is equally easily handled using the software.

Figures used in the abstract

Figure 1