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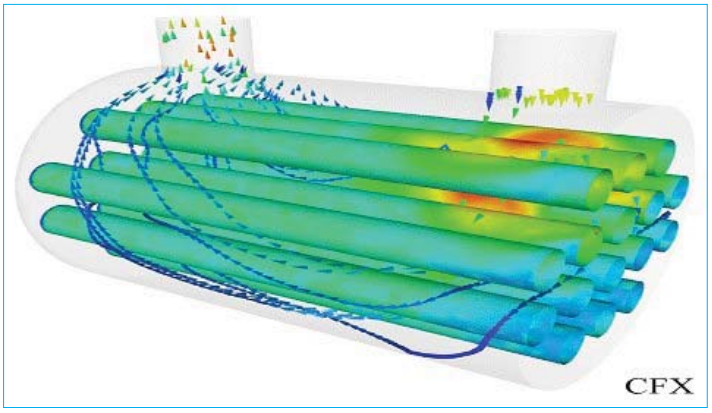
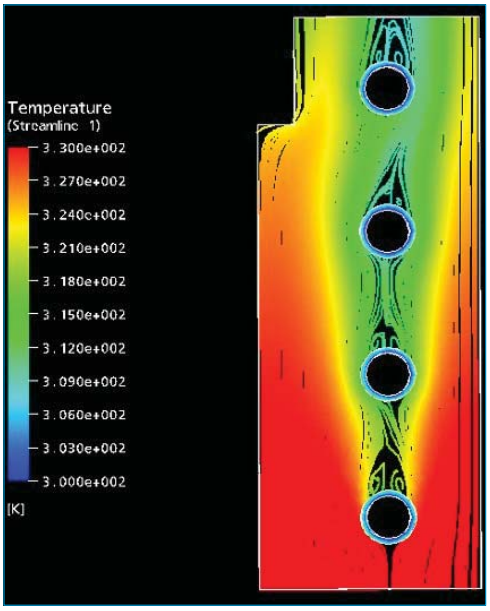
Case Study



Heat Exchanger: Conjugate Heat Transfer Analysis



Conjugate Heat Transfer for Heat Exchanger Designs

Heat Transfer & Heat Exchanger Analysis

Heat transfer is a typical application for engineering analysis and is routinely requested as part of CAE Associates' CFD consulting services. For example, heat exchangers, turbine blades, combustors, furnaces, and electronic package cooling devices all require heat transfer analysis as part of the overall system engineering analysis. Very often, the heat transfer analysis includes both fluid and solid components to constitute a conjugate heat transfer analysis (CHT). For this specialized type of heat transfer analysis, the solid and fluid domains are solved simultaneously, where the solid/fluid interface serves as a mechanism to allow the heat transfer. The temperature of the interface is determined by the energy balance of the convective fluid and the conductive solid.

The figure on the left represents a typical shell tube conjugate heat exchanger analysis. The incoming high temperature fluid passes through an array of tubes, which carry cooling fluid. The energy balance on the tube surface, which eventually determines the surface temperature and heat flux, indicates the effectiveness of the tube location, size, cooling flow rate, and the overall cooling scheme. The resultant wall heat transfer characteristic can easily provide an engineering assessment of the overall success of the heat exchanger.

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Haet Transfer & Heat Exchanger Analysis / *Continued*

For example, the conjugate heat transfer analysis shown on the right is used to assess the overall cooling efficiency of the heat exchanger design. In this case, the cooling tubes are aligned in a straight line from bottom to top. The incoming high temperature fluid enters from the bottom of the domain. The flowfield solution for the heat exchanger analysis shows that the wake of the first cooling tube spreads over the remaining tube regions, resulting in greatly diminished cooling efficiency for the downstream tubes. A redesign can be achieved based on the information provided by the conjugate heat transfer analysis.

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