Numerical Modeling of Saturated Boiling in a Heated Tube

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This paper describes a mathematical formulation and numerical solution of boiling in a heated tube. The mathematical formulation involves a discretization of the tube into a flow network consisting of fluid nodes and branches and a thermal network consisting of solid nodes and conductors. In the fluid network, the mass, momentum and energy conservation equations are solved and in the thermal network, the energy conservation equation of solids is solved. A pressure-based, finite-volume formulation has been used to solve the equations in the fluid network. The system of equations is solved by a hybrid numerical scheme which solves the mass and momentum conservation equations by a simultaneous Newton-Raphson method and the energy conservation equation by a successive substitution method. The fluid network and thermal network are coupled through heat transfer between the solid and fluid nodes which is computed by Chen's correlation of saturated boiling heat transfer. The computer model is developed using the Generalized Fluid System Simulation Program and the numerical predictions are compared with test data.