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Abstract

An experimental apparatus to investigate pool boiling consists of a copper block heated from below by electric cartridge heaters and cooled from above by the liquid. Four imbedded thermocouples provide data for analysis to calculate the surface heat flux during the process. The experiment begins at temperatures below the saturation temperature and the copper block is slowly heated to cover the full range of boiling regimes: nucleate boiling to the critical heat flux, transition boiling, and film boiling.

Conventional analysis of the thermocouple data to produce surface heat flux relies on linear regression of the four temperatures at any time step to determine the temperature gradient. Fourier's law is then applied to compute the surface heat flux and extrapolation of the temperature gradient out to the surface results in the value of the surface temperature.

An alternative approach using Tikhonov regularization inverse heat conduction analysis is used in this study. The thermocouple farthest from the boiling surface is used as a remote boundary condition and surface heat fluxes are estimated using one, two, or all three of the remaining temperature measurements.

The IHC results are contrasted with those from the conventional analysis. The IHC results generally agree with the conventional results up until the critical heat flux with some differences during the transition to and during film boiling. The response time of the thermocouples is discussed and its impact on the IHC analysis considered.