

An oscillatory-flow heat exchanger was designed, built, and tested to demonstrate a novel way of providing high axial heat flux with no net bulk mass transfer, based on exact solutions for unsteady laminar fluid flow and heat transfer in tubes. A test device was constructed as a 250-mm-long matrix of 42 tubes, each of 3 mm inner diameter, and its performance was assessed in an oscillatory-flow loop. The device was tested experimentally with several fluids, over a range of oscillation frequencies, and its performance shown to be in fair agreement with its theoretical potential. For this particular design, the effective axial thermal conductivity was about 30,000 times greater than the fluid molecular conductivity, and its heat flux per unit temperature difference of around 70,000 W/m²K was comparable to that achieved in existing high heat-flux approaches such as submerged liquid-jet impingement