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Core Annular Flow Theory as Applied to the Adiabatic Section of Heat Pipes[1] AISHWARYA RATH, MORRIS R. FLYNN, University of Alberta — Core annular flow theory is used to model the parallel flow of fluids of different phases and has been applied to industrial applications from bitumen hydrotransport to sub-aqueous drag reduction. Here we consider the extension of core annular flow theory to the study of the adiabatic section of heat pipes. Our aim is to develop a first-principles estimate of the conditions necessary to maximize the (counter) flow of liquid and vapor and, by extension, the axial flow of heat. Both planar and axisymmetric geometries are examined. Moreover, we consider heat pipes either containing or devoid of a wick. In these two respective cases, the peripheral return flow of liquid is driven by capillarity and by gravity. Our model is used to predict velocity profiles and the appropriate pressure gradient ratio (vapor-to-liquid). We further obtain estimates for the optimum thickness of the liquid layer. Note finally that when the liquid flow occurs via capillary pumping, there is a minimum surface tension below which the wick cannot supply a sufficient flow of liquid. We characterize this critical point in terms of e.g. the viscosity ratio, the density ratio and the wick depth, porosity and permeability.

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