FM12S_11487

XXI International Congress of Theoretical and Applied Mechanics
Warsaw, Poland, August 15–21, 2004

A Joule-Thomson Process of a Wetting Fluid Near Saturation

Thomas Loimer

Institute of Fluid Mechanics and Heat Transfer, Vienna University of Technology, Austria

The flow of a fluid with a positive Joule-Thomson coefficient through a porous membrane is considered. Upstream of the membrane, the fluid is in the state of saturated vapor. Downstream of the membrane there is cooler, unsaturated vapor. Because a saturated vapor cannot simply cool down without condensation, fronts of phase change occur. The process is described assuming local thermodynamic equilibrium and an ideally wetting liquid phase. For a sufficiently small permeability of the membrane the fluid condenses fully at the upstream front of the membrane. Liquid flows through the membrane and evaporates completely at a front within the membrane. For very small permeabilities the fluid condenses upstreams and a liquid film forms in front of the membrane. Characteristic quantities are the critical permeability, $\kappa_c = \nu_l T_1 (v_g - \nu_l) k_l / \Delta h_{lg}^2$, and a capillary number, $\mathrm{Ca}_{JT} = \mu_{JT}(\mathrm{d}p_s/\mathrm{d}T)(\Delta p_{12}/\Delta p_{cap,c})$.

View the extended summary