Forced convection in a mushy layer JEROME NEUFELD, JOHN S. WETTLAUFER, Yale University — The effect of an external shear flow on the convective instabilities inherent to the directional solidification of a dendritic mushy layer is investigated using a linear stability analysis. The external flow is coupled to advective perturbations in the liquid and to flow in the mush through a perturbed mush-liquid interface. A complete numerical solution of the stability of the system is performed and we find the critical porous medium Rayleigh number as a function of both the external flow speed and the wavenumber of the interfacial perturbations. By neglecting convection in the liquid and solving only for the pressure perturbations on the corrugated mush-liquid interface induced by the external flow a reduced model can be constructed and solved semi-analytically. These theoretical results are compared with experimental results obtained in a laboratory flume in which an ammonium-chloride solution was solidified from below.

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