Radiation-dominated melting and glass furnaces SUNNY CHIU-WEBSTER, JOHN HINCH, DAMTP, Cambridge University — The dominant mode of heat transfer at high temperatures is radiative. We consider a generic problem of radiative melting and show how the often-used Rosseland (or diffusion) approximation breaks down. We then formulate the full radiative heat-transfer problem. The Stefan condition used for diffusion needs to be generalized to allow for finite optical depth and incidence of the radiation from all directions. We present calculations based on an enthalpy method with melting occurring over a finite depth, which can also model multiple-stage melting of solid or granular mixtures. For glass furnaces, we calculate the rate of melting of the raw materials. We then determine how far the raw materials spread down the tank, and address a long-standing industrial question about the stability of flow in glass furnaces.

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