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Convection onset in colloidal suspensions of particles LAYACHI HADJI, University of Alabama — A particulate medium model is used to investigate the onset of Rayleigh-Bénard convection in a colloidal suspension of inert solid particles. The model accounts for the effects of thermophoresis, sedimentation and Brownian diffusion. Depending on the size of the particles, the problem has up to four time scales. These are due to thermal diffusion, particle diffusion, particle migration due to thermophoresis, and sedimentation. The ratios of these time scales lead to the emergence of three parameters, one of which is the Lewis number τ. The smallness of the latter makes the differential eigenvalue system governing convection onset singular. The other two are the density number Γ and the dimensionless migration velocity β. For a given experimental set-up, β can be viewed as a function of the particles' radius. A combination of asymptotics and numerical computations is used to capture the effect of the resulting thin particle concentration boundary layers on the leading order threshold values of the Rayleigh number R_c. Results, which are depicted as function of Γ and β, reveal a non-monotonic dependence of R_c on β. The curve $R_c(\beta)$ is bimodal and it exhibits a maximum ${R_c}^M$, the value of which increases very sharply with Γ while the critical wavelength decreases, at β values that correspond to nano sized particles. This implies that experimental parameters can be controlled so that the mixing of a small amount of nano size particles has a substantial stabilizing effect.

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