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Dust Free Zones in Natural Convection Boundary Layers Over Horizontal Plate K K PRASOON, MS Scholar, IIT Madras, ANUBHAB ROY, Assistant Professor, IIT Madras, BABURAJ PUTHENVEETTIL, Professor, IIT Madras — We present a study on the dust free region above hot horizontal surfaces of uniform temperature in natural convection and propose relations to predict its height in the limit of small particle inertia. Trajectory analysis of the particles inside the flow field revealed the existence of two special trajectories, called separatrices, originating from a saddle point and forming the boundary of the dust free region. These separatrices follow a curve of constant η, denoted as η_{df}, where η is the boundary layer similarity variable. An equation developed for the separatrices showed that η_{df} is a function of Prandtl number, Pr, and the thermophoretic number, Th. Scaling laws are developed for η_{df} using the boundary layer equations of Rotem and Classen corresponding to the asymptotic cases of Pr, i.e, $Pr >> 1$ case and $Pr << 1$ case. Interestingly these scaling laws obtained for the asymptotic cases of Pr are found to be valid even for the intermediate Pr regime except for intermediate $Pr > 1$ in the large η limit. Brownian effects on the particles are neglected for the entire analysis. Gravitational effects are also ignored for the major portion of the work except for the initial discussions on the effect of inclusion of gravitational term.

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