

Abstract Submitted  
for the DFD20 Meeting of  
The American Physical Society

**Similarity solutions of natural convection boundary layers with transpiration** NEELADRI BERA, BABURAJ A PUTHENVEETTIL, IIT Madras, Department of Applied Mechanics — We present the asymptotic, similar solutions of concentration driven, natural convection boundary layer equations with a spatially uniform transpiration ( $V_i$ ) at the wall. The characteristic scales for the species and velocity boundary layer thicknesses ( $\delta_{dc}$  and  $\delta_{vc}$ ), horizontal velocity ( $u_c$ ) and vertical velocity ( $v_c$ ) are first obtained from an order of magnitude analysis of the integral boundary layer equations. We define a pseudo similarity variable  $\eta = y/\delta_{vc}$  and a non-similarity variable  $\xi = Re_x^{5/4}/Gr_x^{1/4}$ , which is also a dimensionless blowing parameter. Considering the dimensionless stream function  $f$  and the dimensionless concentration function  $\theta$  as functions of  $\eta$  and  $\xi$ , and normalizing the variables in the boundary layer equations with the characteristic variables, we obtain the dimensionless boundary layer equation. We find complete similarity for two asymptotic cases, namely (a) when  $\xi \rightarrow 0$  i.e. small blowing velocity (b) when  $Sc \rightarrow \infty$  with small blowing velocity so that  $\theta \rightarrow 1$  inside the species boundary layer. For the all other cases non-similar solutions have to be obtained numerically to obtain the horizontal velocity profile and concentration profile over wide range of  $\xi$  and  $Sc$ .

Neeladri Bera  
IIT Madras, Department of Applied Mechanics

Date submitted: 03 Aug 2020

Electronic form version 1.4