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Mixed convection over nonisothermal horizontal surfaces in a porous medium: The entire regime

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Abstract: Flow and heat transfer characteristics of mixed convection from horizontal surfaces in a saturated porous medium are investigated. Two conditions of surface heating were considered, a variable wall temperature (VWT) in the form Tw(x)-T?? = axn and a variable surface heat flux (VHF) in the form qw(x) = bxm. Two different nonsimilarity parameters ??(x) = 1/[1+(Rax/Pex 3/2)1/3] and ??*(x) = 1/[1+(Rax*/Pex 2)1/4] for VWT and VHF cases, respectively, due to the nonuniform heating conditions, are found by nondimensionalizing the governing equations. The nonsimilarity parameters cover the entire regime of mixed convection from the pure forced convection limit at ?? = 1 (or ??* = 1) to the pure free convection limit at ?? = 0 (or ??* = 0). The resulting transformed governing equations are solved by a finite difference scheme. Numerical results for both VWT and VHT boundary conditions, including velocity and temperature profiles and local Nusselt numbers, are presented for selected values of the exponents n and m. Simple and accurate correlation equations valid for the entire mixed convection regime are also presented for the local and average Nusselt numbers.