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Nonsimilarity solutions for non-Darcy mixed convection from horizontal surfaces in a porous medium

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Abstract: Non-Darcy mixed convection in a porous medium from horizontal surfaces with variable surface heat flux of the power-law distribution is analyzed. The entire mixed convection regime is divided into two regions. The first region covers the forced convection dominated regime where the dimensionless parameter ??f = Rax*/Pex 2 is found to characterize the effect of buoyancy forces on the forced convection with K?? ????/v characterizing the effect of inertia resistance. The second region covers the natural convection dominated regime where the dimensionless parameter ??n = Pex/Rax *1/2 is found to characterize the effect of the forced flow on the natural convection, with (K??????/v) Rax *1/2/Pex characterizing the effect of inertia resistance. To obtain the solution that covers the entire mixed convection regime the solution of the first regime is carried out for ??f = 0, the pure forced convection limit, to ??f = 1 and the solution of the second is carried out for ??n = 0, the pure natural convection limit, to ??n = 1. The two solutions meet and match at ??f = ??n = 1, and Rh* = Gh*. Also a non-Darcy model was used to analyze mixed convection in a porous medium from horizontal surfaces with variable wall temperature of the power-law form. The entire mixed convection regime is divided into two regions. The first region covers the forced convection dominated regime where the dimensionless parameter ??f = Rax/Pex 3/2 is found to measure the buoyancy effects on mixed convection with DaxPex/?? as the wall effects. The second region covers the natural convection dominated region where ??n = Pex/Rax 2/3 is found to measure the force effects on mixed convection with DaxRax 2/3/?? as the wall effects. Numerical results for different inertia, wall, variable surface heat flux and variable wall temperature exponents are presented.