THE MODIFICATION OF EKMAN-DARCY LAYER BY THE IMPOSITION OF AN AXIAL VELOCITY

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Abstract: The effect of normal blowing on a linear, steady, axisymmetric Ekman Darcy boundary layer on an infinite flat plate is investigated. The problem is governed by three parameters namely Ekman layer $E(=\upsilon / L^2\Omega)$,the rotational Darcy layer $\Lambda = (\upsilon / \mathrm{k}\,\Omega)$, and the injection Rossby number $\mathrm{R}(=U / \mathrm{L}\,\Omega)$ in the triangular parameter region $(E/\Lambda)^{1/2} \ll R \ll (E\Lambda)^{1/2}$. When $E^{1/2} \ll R \ll O(1)$ the Ekman Darcy layer blown up by the injection of fluid, and it became an inviscid to the lowest order. Injection and porous terms balance each other giving rise to a new boundary layer of thick ness $O(R/\Lambda)$, which may be called linear injection Darcy layer. This new layer support more mass flux than Ekman Darcy layer. The vertical mass flux in to the new layer decreases with porous medium, because of the stiffly effect of porosity. This injection Darcy layer is characterized by dispersive and diffusive length scales for $\Lambda \ll O(1)$ and merges with the interior region $E^{1/3} \ll R \ll (E/\Lambda)^{1/2}$ when $R \ll \Lambda$ the other parametric ranges are clearly identified where in the injection Darcy layer R/Λ merges smoothly with Ekman layer, injection layer and Ekman Darcy layer. In addition to the exact solutions, asymptotic solutions are also given for $\Lambda \ll O(1)$ and $\Lambda \gg O(1)$ to understand the problem more systematically and physically.