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A SELF SIMILARITY SOLUTION FOR A COUPLED CHANNEL FLOW

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Coupled free-flow and porous medium flow systems arise routinely in environmental settings and industrial applications such as overland flow interactions with groundwater aquifers, evaporation from soil influenced by wind, fluid-flow through filters, and water-gas management in fuel cells. Due to the wide range of applications, researchers have given considerable attention to study flow over porous media. This study aims to get physical insight to the applications of coupled flow at different values of permeability parameters. A channel is considered where the bottom of the channel is occupied by a porous media and the top of the channel is occupied by a free flow region. The flow between the channels is assumed to be steady-state, incompressible, and Newtonian. Thus, the flow in the free region is described by the fully developed Navier-Stokes equation at small Reynolds number. Darcy/Brinkman equation is used to obtain a meaningful insight into the physics of flow in porous media. Coupled boundary conditions are used to describe the interphase flow. The goal here is to find similarity solutions of the governing equations for the flow between the channel. Similarity solutions can be obtained by reducing, at least to one, the number of independent variables that describe a problem. The velocity and the shear stress distribution have been investigated for different values of permeability parameter and thickness ratio. Moreover, the similarity results are compared with the analytical solutions of the governing equations.

Keywords: Brinkman/Dracy Equation, Coupled Flow, Navier-Stokes Equations, Porous Media, Similarity solution.