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FM10 Flow through Porous Media.

Stability analysis of Hadley-Prats flow with non-uniform thermal and solutal gradient with concentration based internal heat source.

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ABSTRACT

This study concentrating on the importance of non-uniform inclined solutal and thermal gradient with concentration based internal heat source on the linear and nonlinear (energy functional) stability analysis of Hadley-Prats flow in a horizontal porous medium layer. The nonlinear stability analysis is done by using the recent energy functional technique. Darcy's model is deployed for the porous medium which is considered to be isotropic and homogenous. A linear and nonlinear stability analysis is conducted and transverse or longitudinal roll disturbances are examined. The dimensionless emerging eigenvalue problem is cracked numerically with fourth order Runge-Kutta and shooting methods for both cases of disturbances i.e. longitudinal and transverse rolls. In both the cases of linear and nonlinear stability theories, the onset criterion for all possible modes is derived analytically. Critical value of wave number and critical value of vertical thermal Rayleigh number R_z are identified. It is understood that the preferred mode at the onset of convection is longitudinal stationary mode. This subcritical instability region is identified between the linear and energy thresholds in the

parameter space of the problem considered. Extensive interpretation of the solutions relating to the onset of convection is provided. The study is relevant to geophysical flows and materials processing systems. For the fixed horizontal thermal Rayleigh number, increasing the value of internal heat source parameter destabilize the system and favours to the convection to commence.

KEYWORDS: *Thermo-convective instability; Double diffusive convection; Porous medium; Energy stability analysis; internal heat generation, horizontal porous layer; eigenvalues; critical wave number; Lewis number; materials processing; mass flow.*