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Stokes' second problem for an Oldroyd-B fluid in a porous half space BALRAM SUMAN, NAZISH HODA — A modified form of Darcy's law is used to study the flow of Oldroyd-B fluids in a semi-infinite porous domain bounded by an oscillating plate. A close form analytical expression is obtained using Laplace transform, which suggests that depending upon the choice of natural and forced frequencies markedly distinct velocity fields can be observed. The fluid oscillates in time with a frequency which is same as the plate frequency. However, there exists a phase lag that increases with increasing distance from the plate. At a fixed distance from the plate, the phase-lag increases with increasing Reynolds number, Re = $U\sqrt{K/\phi}/\nu$, and Wiessenberg number, Wi = $\lambda \mathrm{U}^2/\nu$, and decreasing viscosity ratio, $\beta = \lambda_t/\lambda$, where U is the amplitude of plate oscillation, K and ϕ are permeability and porosity of the porous media, υ is the kinematic viscosity, and λ_t and λ are retardation and relaxation times, respectively. This is consistent with our analytical prediction that the phase-lag is pronounced when Wi $\mathrm{Re}^2 >> \beta^2$. The phase lag also decreases with decreasing Strouhal number, St = $\nu \omega/\mathrm{U}^2$ where ω is the plate oscillation frequency, and it vanishes in the limit of St = 0. Furthermore, the fluid velocity increases with increasing β and Re, and decreasing distance from the plate. Away from the plate the fluid velocity shows a strong transient effect where the amplitude of oscillation either increases or decreases with time depending upon Re, St, and β.

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