The Effect of Slip on Yield Stress Fluid Flow in an Elastic Tube

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1. INTRODUCTION & OBJECTIVE

In biological systems, the flow geometries with elastic nature is more adequate when compared to the rigid boundaries. Since, most of the physiological systems are elastic in nature. So the non-Newtonian fluid flow through elastic walls gives some important applications like blood flow in a small blood vessel, lymphatic vessel and cardiovascular systems to understand the evolution of pathogen due to vessel deformation. To understand the rheological properties of physiological fluids in living organisms, the elastic properties of flow geometries are taken in to the consideration. The experimental studies reveal that velocity in blood vessels largely depends on the elastic nature of the wall. Scott-Blair and Spanner (1974) reported that Herschel-Bulkley fluid model can be used at lower shear rate flow in very narrow arteries where the yield stress is high. Also the Herschel-Bulkley equation reduces to three different cases such as Bingham model, Power-law and Newtonian model for different conditions. Hence, in this paper, steady, laminar, incompressible flow of a Herschel-Bulkley fluid between two horizontal parallel elastic walls with slip condition is investigated. The power law index (n) and yield stress (τ_0) are the two parameters of the Herschel - Bulkley model. By giving different values for the above mentioned parameters, we get the Newtonian, Bingham and Power-law fluids as special cases. This paper aims at investigating the effect of yield stress parameter, elastic parameters and slip parameter on Herschel-Bulkley fluid flow in a channel with elastic walls.

2. RESULTS & HIGHLIGHTS OF IMPORTANT POINTS

The exact solutions for the flow quantities such as velocity, plug flow velocity and flux are derived. The velocity and flux are determined as a function of inlet, outlet, external pressures and the elastic property of the channel. The effect of slip and elastic parameters on velocity and flux variation are analyzed. Further when power law index, $n = 1$ and yield stress, $\tau_0 = 0$, the results deduced qualitatively agree with those of Rubinow and Keller (1972).

REFERENCES

1. G.W.S. Blair, D.C. Spanner, "An Introduction to Bioreheology", Elsevier, Amsterdam, 1974.

2. S.I. Rubinow and Joseph B. Keller, "Flow of a viscous fluid through an elastic tube with applications to blood flow", *Journal of Theoretical Biology* **35**, 299 – 313, 1972.