



Influence of induced magnetic field and heat transfer on peristaltic transport of a Carreau fluid

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ABSTRACT

The effect of an induced magnetic field on peristaltic flow of an incompressible Carreau fluid in an asymmetric channel is analyzed. Perturbation solution to equations under long wavelength approximation is derived in terms of small Weissenberg number. Expressions have been constructed for the stream function, the axial induced magnetic field, the magnetic force function, the current density distribution and the temperature. Trapping phenomenon is examined with respect to emerging parameters of interest.

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1. Introduction

The peristalsis comes from a Greek word peristaltikos which means compressing and clasping. Hence peristalsis is a process by which transport of fluid occurs through a distensible tube when progressive waves of area contraction and expansion propagate along its length. Such process is very common in physiology and industry. The biomedical instruments, for instance the blood pumps in dialysis and the heart lung machine involve the mechanism of peristalsis. In order to avoid contamination of the outside environment, the process of peristaltic transport of a toxic liquid in nuclear industry is quite useful.

Since pioneering works of Latham [1] and Shapiro et al. [2], the peristaltic motion has been extensively studied in both mechanical and physiological situations under different conditions. Mention can be made to some interesting recent studies [3–15] in this direction. However, the interaction of peristalsis in presence of an induced magnetic field and heat transfer has not been accorded much attention. Concept of heat transfer analysis is very useful in accessing the blood flow rate through the initial thermal conditions and the thermal clearance rate. The flow of blood can be estimated by a dilation technique. In this process, heat is either injected or generated locally and the thermal clearance is monitored. Specifically the bioheat transfer plays a vital role in destroying undesirable tissues, hyperthermia, laser therapy and cryosurgery [3]. Recently, Mekheimer [16,17] examined the peristaltic transport of couple stress and micropolar fluids under the influence of an induced magnetic field. Hayat et al. [18] have discussed the induced magnetic field effects on peristaltic flow of a third order fluid in symmetric channel.

In this communication, the interaction of peristalsis with an induced magnetic field and heat transfer has been studied for the motion of a Carreau fluid in an asymmetric channel. The flow modeling is based upon the constitutive, continuity, momentum, energy, Maxwells' and induction equations. Series solutions are presented. Variation of pertinent parameters on the flow quantities are sketched and discussed.

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