

ABSTRACT

A Study of Some Viscoelastic Flows

Karim David Andrew Rahaman

About five decades ago, some fluid phenomena were observed which could not be explained on the basis of the classical Newtonian theory. These fluids, known as non-Newtonian fluids, show a multitude of phenomena which appear quite bizarre when compared to the familiar behaviour of Newtonian fluids. One such class of non-Newtonian fluids are those known as viscoelastic fluids and, as the name suggests, are fluids which possess a certain degree of elasticity in addition to viscosity.

There are various types of viscoelastic fluids; one class is that known as upper-convected Maxwell (U.C.M.) fluids, some examples are Oldroyd B fluids and Boger fluids. Unfortunately, there is a lack of information in the literature on the flow properties of this class of viscoelastic fluid. As a result, detailed investigations have been made into its behaviour under different flow conditions. In particular, the flow behaviour of U.C.M. fluids subjected to different types of pressure gradients through ducts with various geometries are looked at. Some drag flows are also examined in cases where the U.C.M. fluid is contained in the annular region between two concentric circular cylinders and also in and around

hollow and solid circular cylindrical rods which are moving both longitudinally and torsionally. In each case, expressions for the velocity field and other associated quantities have been obtained and where possible, comparisons made with Newtonian fluids. This is done so as to get better insight into the rheological properties and in some cases, make available results that should be of interest to experimentalists.