Abstract

The present thesis is devoted to the representation of the theory of simple fluids which is acknowledged as the most general theory that produces the linear and non-linear mechanical behavior of a wide range of fluids. Within this theory, which is a classical continuum theory, the mechanical properties of any fluid are assumed to satisfy a set of general physical principles and symmetry assumption. The constitutive equation for simple fluids is highly sophisticated such that the only type of flow that can be solved via this equations the viscoelastic fluids are reproduced by this model.

To make this constitutive equation amenable for applications, two types of expansions are considered. One of those expansions is the so called ' slow motion expansion ' or' stagnant motion expansion ' that lead to a constitutive equation of the differential type. In this equation, the stress tensor is represented as a functional of a set of kinematical tensors, ' Rivilin-Ericksen ' with a set of coefficients which are assumed to reproduce the mechanical properties of fluids, the second expansion is performed in terms of what is called memory integral. The linear viscoelasticity, which higher order tensor gives the non- linear properties.

A comparison of the above mentioned expansions, with some of the successful pragmatic models, like Oldroyd [37] and Giesekus [44] models is made which showed that such models are, in fact, more convenient for practical uses.

A solution of a boundary value problem concerning the flow of an Oldroyd-B fluid in circular pipes under different types of axial pressure gradient is performed is performed. The results for the velocity distribution stand in agreement with the obtained results in the present work.