

In the present thesis we study and compare different viscoelastic rate-type fluid models capable of describing response of geomaterials such as asphalt. Using new thermodynamic approach proposed by Rajagopal and Srinivasa (2000) we derive several classes of non-linear viscoelastic models that generalize standard Oldroyd-B and Burgers models. We show that the new models achieve better results in fitting experimental data with asphalt than the previously considered models (Oldroyd-B, Burgers, Rajagopal and Srinivasa (2000)). In particular they are able to capture the behavior of asphalt observed recently in experiments (torque overshoot and two relaxation mechanisms), which is not possible to describe by the other models. Using both the standard and the newly derived models we compute full simulations of viscoelastic flow with the finite element method in fixed domains and incorporating the Arbitrary Lagrangian-Eulerian description also in deforming domains. For example, we study rolling of asphalt or creation of ruts in the road with the real material parameters obtained by fitting the experiments.