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ASSESSMENT OF AN EXPLICIT FINITE ELEMENT SCHEME TO SIMULATE VISCOELASTIC FLOW

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In recent papers the first author and collaborators studied the mathematical properties of a scheme to solve incompressible flow equations expressed in terms of velocity, extra-stress tensor and pressure, represented by classical piecewise linear finite elements. The scheme is explicit in the sense that the time integration to solve transient problems or the iterative procedure to determine a stationary solution, are carried out in such a way that the velocity and extra-stress components are computed node by node. The pressure in turn is determined by solving a Poisson equation derived from the momentum equation. Since the method is naturally applicable to the case of viscoelastic flow, the purpose of this work is to check its performance in such a framework, taking as a model an upper convected Maxwell fluid. Two types of numerical experiments are presented. First we assess the convergence properties of the scheme by solving viscometric flow problems whose analytical solution is known. Then we show numerical results obtained with the scheme in the solution of more challenging benchmark. In this framework a comparison is conducted with other numerical approaches based on finite differences or finite volumes. Some results available in the literature obtained with such methods serve as a basis for the validation of this finite element scheme.