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FLOWS OF SHEAR-THINNING MATERIALS VIA STABILIZED GALERKIN LEAST-SQUARE METHOD

Natan A. de Oliveira[a] **and Sérgio Frey**[a]

[a]*Departament of Mechanical Engineering, Federal University of Rio Grande do Sul, Sarmento Leite, St. 425, Porto Alegre, RS 90050-170, Brazil*
natan.oliveira@mecanica.ufrgs.br; frey@mecanica.ufrgs.br

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Abstract. Non-Newtonian materials are considered in several industrial applications, such as chemical and textile, oil drilling, cosmetic and food, painting and polymer injection. This applications materials have a non-linear behavior associated with the dependence of the polymeric viscosity to the flow kinematics and the stress to the elastic dominance. The presence of non-linear behavior in the polymeric viscosity causes the variation of this variable with increase or decrease of this rheological variable. And in the stress causes the increase of first normal stress difference as a consequence of the elastic presence. Considering the flow of a viscoelastic fluid based in an Oldroyd-B-like constitutive equation allowing shear-thinning behavior of the polymeric viscosity based in the Carreau-Yasuda model for pseudoplastic materials coupled with continuity and momentum equations. The present work also proposes a model for the constitutive equation that allow the shear-thinning behavior in the relaxation time, based in the Carreau-Yasuda, as considered by White and Metzner, 1983. The solution is obtained by a open-source in-house code developed by the Laboratory of Applied and Computational Mechanics (LAMAC) of Federal University of Rio Grande do Sul (UFRGS) via a three-field stabilized Galerkin least-square formulation for low- and equal-order finite element allowing a stabilized mesh-dependent in elastic dominated problem. The domain is the classical 4-to-1 planar contraction and the effect of elasticity and viscosity and relaxation shear-thinning behavior is investigated for a significative range of Weissenberg number and power-law index. The results show the good agreement for the considered elastic effect range and a significant dependence between the relaxation time and first normal stress difference.