Sule Celasun, J Appl Mech Eng 2013, 2:3
http://dx.doi.org/10.4172/2168-9873.S1.004

OMICS Group Conferences
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International Conference and Exhibition on
Mechanical & Aerospace Engineering
September 30-October 02, 2013 Hilton San Antonio Airport, TX, USA

Numerical processing of non-newtonian fluids in isothermal and non isothermal flows

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In most polymer processing applications and in lubrication systems the changes of temperature are significant and cannot be ignored. Due to the temperature dependence of the viscosity and constitutive equation coefficients, the equations of motion and energy are strongly coupled. In general, then, the solution of the set of equations of change cannot be obtained analytically. We resolved this problem using Finite Element Method. The non-Newtonian fluid chosen is CEF model, whose constitutive equation is given through the Rivlin-Erickson tensors. The shear-strain rate, the material functions are given, Carreau formula for the viscosity coefficients is indicated. Explicit expressions of the dimensionless governing equations are calculated. Admitting combined hydrodynamic and thermal entry length solution in the asymptotic zone and neglecting energy dissipation and axial conduction term, the energy equation is obtained. The thermal diffusitivity, the wall temperature and the hot sphere temperature are supposed constant. Finally the dimensionless form of the energy equation, with the Péclet number is obtained. As temperature is increased, the zero-shear-rate viscosity decreases. Considering the "master curve" and the "shift factor" concepts, the viscosity measured at some temperature and shear rate is, according to the "Arrhenius dependence", equivalent, after correction for the temperature dependence of the zero-shear-rate, to viscosity measured at the reference temperature and the shear rate multiplied by the shift factor. We applied the same procedure as for the isothermal case using always the area coordinates and the Gauss quadrature. We have numerous simultaneous and highly non linear equations, which moreover are over determined due to the existence of the boundary conditions. Hence, we were compelled to resort to the optimisation techniques to resolve the equation system. The results obtained display the great distortion of the flow field that is possible due to thermal effects.

Biography

Sule Celasun attended the Saint-Benoit College in Istanbul. She entered the Istanbul Technical University, Mechanical Engineering Faculty and got her diploma with the "very good" mention. She performed her training in France, Turkey and Poland. She got her MS degree, and then Ph.D. degree in Istanbul Technical University with "very good" mention and congratulatory letter of the University Rector. She obtained her Post Doctoral degree at the Indiana - Purdue University in USA. She is a regular attendant of the Parallel CFD conferences and is the author of twenty-two international scientific publications. Presently, she is serving as Ass. Professor in the Istanbul Technical University, Mechanical Engineering Faculty. Her main contributions are in the domains of Parallel Computational Fluid Dynamics, Tribology and Nanotechnology.

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