Electronic Transactions on Numerical Analysis.
Volume 31, pp. 110-125, 2008.

ISSN 1068-9613.

ETNA
Kent State University
http://etna.math.kent.edu

MATHEMATICAL PROPERTIES OF FLOWS OF INCOMPRESSIBLE POWER-LAW-LIKE FLUIDS THAT ARE DESCRIBED BY IMPLICIT CONSTITUTIVE RELATIONS*

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Abstract. We report on very recent developments concerning the modelling of the complex behaviour of materials within the framework of implicit constitutive theory due to K. R. Rajagopal. In this paper, we restrict ourselves to a hierarchy of power-law-like fluids. For such a class of fluids, we provide an overview of recent results concerning the mathematical analysis of the relevant boundary value problems. Mathematical results are presented for the (Rothe) time discretizations of evolutionary problems. The main purpose of this paper is to emphasize the mathematical tools involved in the theoretical analysis and to initiate the development of numerical methods for the problems presented here.

Key words. Power-law fluid, incompressible fluid, implicit constitutive theory, Rothe approximation, time discretization, weak solution, existence, regularity.

AMS subject classifications. 35D05, 35Q30, 35Q35, 76D03, 76D99.

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* Received January 31, 2008. Accepted June 23, 2008. Published online on January 21, 2009. Recommended by Zdeněk Strakoš.

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