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ON THE GENERALISED HERSCHEL MODEL APPLIED TO BLOOD FLOW MODELLING

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This paper introduces a new rheological model of blood as a certain generalisation of the standard Herschel-Bulkley model (Herschel and Bulkley, 1926). This model is a rheological constitutive equation and belongs to the group of so called generalised Newtonian fluids. Experimental data (Yeleswarapu et al, 1998) is compared with results, obtained from the new model, to demonstrate that it allows for the best agreement together with Luo-Kuang model (Luo and Kuang, 1992; Easthope and Brooks, 1980). The new model may be easily implemented in commercial CFD codes, which is not that obvious for more complicated models such as differential, integral and rate type fluids (Astarita and Marrucci, 1974; Tesch, 2012). What is more, it allows for modelling such phenomena as the shear thinning, yield stress and constant viscosity values at high shear rates.

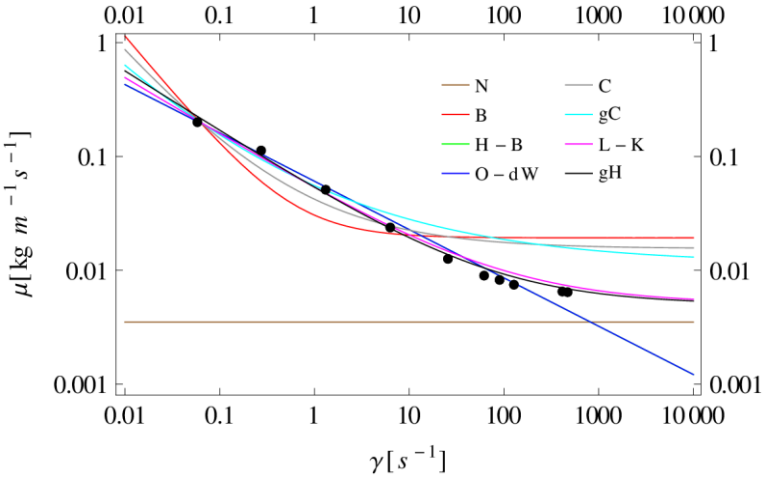

Fig. 1. Various models vs experimental data
(N – Newtonian model, B – Bingham, H-B – Herschel-Bulkley, O-dW – Ostwald-de Waele, C – Casson, gC – generalised Casson, L-K – Luo Kuang, gH – generalised Herschel)

The generalised Herschel model is given by the following definition

$$\mu = \frac{\tau_0}{|\gamma|} + k|\gamma|^{n-1} + \mu_\infty , \tag{1}$$

where μ is apparent viscosity, τ_0 – yield stress, γ – shear rate. μ_∞ stands for constant viscosity at high shear rates. k and n are rheological parameters to be determined by fitting the experimental data. Figure 1 shows comparison of various models vs experimental data for blood (Yeleswarapu et al, 1998).

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