The 8th European Congress on Computational Methods in Applied Sciences and Engineering
ECCOMAS Congress 2022
5-9 June 2022, Oslo, Norway

Rheological properties of a two-phase system with second-order suspending fluid using a cell model approach

L. Escott[1] **and H. Wilson**[2]

[1] Coventry University, Design Hub, Puma Way, Coventry, CV1 2TT, United Kingdom, ad7948@coventry.ac.uk

[2] UCL, Department of Mathematics, UCL, Gower Street, London WC1E 6BT, United Kingdom, helen.wilson@ucl.ac.uk

Keywords: *Suspensions, Multi-phase systems, Rheology, Applications*

Two-phase systems, identified by suspended media of either particles or droplets into a solvent background fluid, has been a topic of interest for rheology and mathematics for the last half a century. More recently, investigations into the material functions for a dilute suspended phase with a weakly-linear background flow profile have been conducted, in particular where the suspending medium is a second-order fluid [1]. Further, numerical simulations have shown that shear stress, in particle suspensions with complex background fluid matrix, has local maxima and minima in close proximity to the suspended phase [2]. A cell model technique is applied to the suspension, which consists of a uniform spherical shell, attributed to each individual particle or droplet. We intend, with this approach, to derive behaviour at further concentrations than the initially dilute conditions, which are used for the analysis. The bulk rheology of the system is calculated, with a dependence on cell radius, which we match in semi-empirical fashion via a known and accepted model for viscosity in each choice of suspended phase. We present the results for viscometric functions under an imposed xy shear flow, using a perturbation series approach about a small magnitude of viscoelasticity, and where applicable, capillary number. We will see that one may use the cell model to derive rheological properties, which show good correlation to experimental and numerical data across a wide range of suspended volume fraction and further parameters [3].

REFERENCES

[1] D. L. Koch and G. Subramanian, The stress in a dilute suspension of spheres suspended in a second-order fluid subject to a linear velocity field. *J. Non-Newtonian Fluid Mech.*, Vol. **138**, 2006.

[2] J. Einarsson, M. Yang and E. S. G. Shaqfeh, The Einstein viscosity with fluid elasticity. *Phys. Rev. Fluids*, Vol **3**, 2017.

[3] L. J. Escott and H. J. Wilson, Investigation into the rheology of a solid sphere suspension in second-order fluid using a cell model. *Phys. Rev. Fluids*, Vol. **5**, 2020.