The Australian Society Of Rheology, Inc.

2020-21 Rheology Lecture Series

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The Australian Society of Rheology is presenting a national series of lectures, which is open to anyone interested in the flow and deformation of matter. The next event in the series will be held online.

Calendar details

Date:	**Tuesday, September 21, 2021**
Time:	5:00 PM to 6:30 PM (Melbourne, Australia)
Event Registration Link:	https://www.eventbrite.com.au/e/australian-society-of-rheology-seminar-21-september-2021-registration-168900761725

Invited lecture

Prof Marco Ellero

(Computational Fluid Dynamics, Basque Centre for Applied Mathematics, Spain)

Presentation Title: Simulating the rheology of particle suspensions with non-Newtonian matrices

Abstract: In the first part of this talk I will focus on a possible mechanism for the shear-thinning typically observed in non-colloidal suspensions interacting with a 'nominally-Newtonian' matrix. Shear thinning – i.e., a reduction in suspension viscosity with increasing shear rates – is understood to arise in colloidal (Brownian) systems from a decrease in the relative contribution of entropic forces. However, the shear-thinning phenomenon has also been also reported in experiments with large non-colloidal particles where Brownian motion is negligible, and its origin is still an open theoretical question. I will propose a weakly non-Newtonian model of interparticle lubrication forces to explain shear thinning in these non-colloidal suspensions. I'll show that "hidden" shear-thinning effects of the suspending medium, which occur at the large shear rates experienced by the fluid locally in the narrow gaps between close particles, can lead to significant shear thinning of the overall suspension. In this context, I will also discuss separately possible effects due to interparticle flow slippage and frictional contacts on the resulting rheological behaviour. In the second part of the talk, I will focus on non-colloidal suspension interacting with highly elastic fluids, such as Boger liquids. Three-dimensional numerical simulations of this complex particulate system undergoing simple shear flow are performed and compared with experimental data available in the literature using different constant-viscosity Boger fluids. It is found that at small shear rates the relative suspension viscosity exhibits a plateau at every concentration investigated. By increasing the applied shear rate, shear-thickening is observed which is related to the extensional thickening of the underlying viscoelastic matrix. Origin of the shear-thickening in these viscoelastic suspensions will be discussed in relation to microstructural change occurring in the viscoelastic matrix.

Speaker's biography

Marco Ellero is Ikerbasque Professor of Computational Fluid Dynamics at the Basque Centre for Applied Mathematics (Bilbao, Spain). He is working as the main coordinator of "Computational Mathematics" division and Head of the research "CFD: modelling and simulation". He is also working as an Honorary Professor at the Zienkiewicz Centre for Computational Engineering (Swansea University, UK) and member of the Institute of Non-Newtonian Fluid Mechanics (INNFM, UK). He received his Ph.D. in Theoretical Physics at Technical University Berlin in 2004. After his professional qualification in fluid mechanics from Technical University Munich in Germany, he was appointed as an Associate Professor at Swansea University, UK. His research interests deal with the theoretical modelling and numerical simulation of complex fluids, particulate systems, and multiscale flow phenomena with a particular focus on biofluid mechanics, microfluidics, and rheology. Prof. Ellero's major focus is on the development of new models based on Lagrangian multiscale particle-methods and the design of efficient parallel algorithms for the analysis of complex flows. He was Principal Investigator for several projects in Germany, UK, and Spain. He is referee for many national and international journals, including Journal of Non-Newtonian Fluid Mechanics, Journal of Fluid Mechanics, Journal of Computational Physics, Journal of Chemical Physics, Journal of Rheology and Physics of Fluids. He is member of European Rheology Society (ERS), Spanish Rheology Society and the European Community on Computational Methods in Applied Sciences (ECCOMAS). He has been elected as a member of the International Community for Mesoscopic Methods in Engineering and Science (ICMMES) and he is currently in the Scientific Committee of the Joint Research Lab in Offshore Renewable Energy (JRL-ORE) in Spain.

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