



**3 years Ph.D. position at
Laboratoire Ondes et Milieux Complexes
UMR 6294 CNRS-Université du Havre Normandie
53 rue de Prony
76058 Le Havre – France**

Application deadline: July 1st 2017

Dates: October 2017 – October 2020

Elongational viscosity and drop dynamics of viscoelastic polymer solutions

Context:

The Laboratoire Ondes et Milieux Complexes, affiliated to Le Havre University and the CNRS (UMR 6294), is specialized in Engineering Science (Processing of Composite Materials, Marine Hydrodynamics and Submarine Acoustics, Non Destructive Evaluation and Testing by Ultrasounds, Porous Media and Geo-Environment) and Applied Physics (Phononic Structures, Reactive Processes in Plasmas, Hydrodynamic Instabilities and Turbulence). Most of research topics are investigated through an experimental approach, while quite few groups work on numerical modelling and theories. The laboratory is composed of more than 100 people (57 permanents of which 46 Lecturers and Professors). Each year, there are about 30 Ph.D. students, 5 postdoc researchers and more than 10 invited foreign researchers. The laboratory participates to training of Master's students for research initiation.

Subject of the thesis:

In many situations, it is sought to atomize complex liquids, for example in agriculture, during the ejection of sneezes or in the combustion of fuel containing additives, etc. Most of the liquids we are considering are solutions of polymers. These liquids have viscoelastic properties, *i.e.* their elongational viscosity is larger than three times the shear viscosity. Moreover, these fluids are characterized by relaxation times, which have a strong influence on the fracture processes. The sizes and distributions of drops differ very strongly from Newtonian fluids. It is the objective of this thesis to develop methods and techniques to predict these phenomena.

The aim of this project is to improve the results already obtained on viscoelastic fluid flows [1]. It is proposed to carrying out extensional rheology measurements for polymer solutions in different concentration regimes. Extensional viscosity measurements will be carried out using an elongational rheometer [2]. These measurements will necessarily be complemented by surface tension measurements. Further activities of this thesis will be to study the dynamics of the drops when stretching a filament. This configuration revealed "drop on string" instabilities when the polymer concentration is high [3] as depicted on the figure below.

Candidate:

The candidates must have or expecting a degree in a relevant subject: Engineering, Fluid Mechanics, Physics, or Chemistry. Motivation for experimental fluid dynamics is welcome and background in theoretical/numerical fluid dynamics is desirable. Excellent written and oral communication skills, including the ability to publish and present scientific results, are essential.

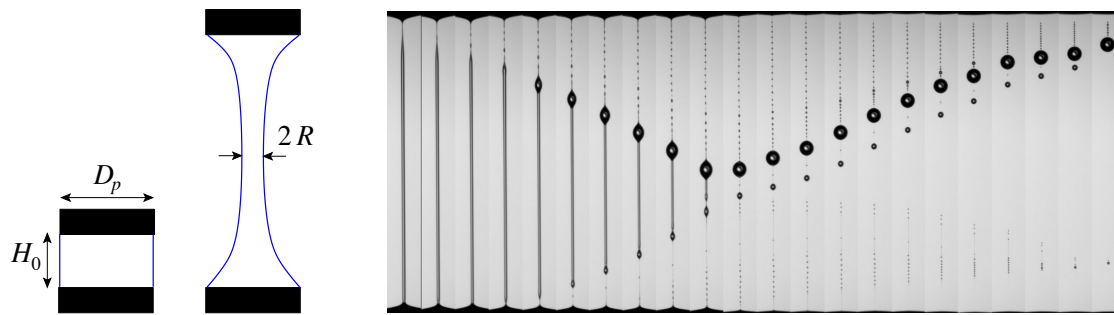


Figure: Time evolution of a viscoelastic filament evolution revealing the drops on string instability

- References: [1]. N. Latrache *et al.*, *Phys. Rev. E* 93, 043126, 2016; Y. Bai *et al.*, *Phys. Rev. E* 92 031001(R) 2015; N. Latrache *et al.*, *Phys. Rev. E* 86, 056305, 2012; O. Crumeyrolle *et al.*, *Phys. Fluids*, 14(5) 1681, 2002
 [2] M. Stelter *et al.*, *J. Rheol.* 44(3) 2000; S. J. Haward *et al.*, *Biomacromolecules*, 13, 1688-1699, 2012; F.J. Galindo-Rosales *et al.*, *J. Rheol.* 59(1), 193-209, 2015
 [3] B. Keshavarz *et al.*, *Phys. Rev. Lett.* 117, 154502, 2016

Supervisor: Jorge Peixinho (jorge.peixinho@univ-lehavre.fr)

Co-Supervisor: Olivier Crumeyrolle (olivier.crumeyrolle@univ-lehavre.fr)

Ecole doctorale SPMII - ED351: <http://spmii. formations.univ-rouen.fr>

Salary: The Ph.D. monthly salary before taxes is around 1600 €