

# Numerical simulation of non isothermal viscoelastic flows in non circular pipes

## Localisation :

Centre d'Énergétique et de Thermique de Lyon (CETHIL)  
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**Mots clés :** Heat transfers, polymer materials, numerical modeling and simulation, continuum mechanics, viscoelastic fluids

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## Sujet de thèse :

**Contexte :** Convective transfer in laminar flow of nonlinear fluids has not been the subject of many investigations with the exception of round pipes and the case of inelastic shear-thinning fluids in tubes of rectangular cross-section. Heat transfer with viscoelastic fluids has been declared to be a new challenge in heat transfer research in the early nineties (Hartnett, 1992), but only limited progress has been made. The physics of the phenomenon has not been entirely clarified.

Signer and co-workers have recently investigated convective heat transfer behavior of a class of non-affine and non-linear viscoelastic fluids in straight tubes of non-circular contour in pressure gradient driven laminar flow and under constant wall flux conditions. They developed analytical calculations based on an asymptotic series in terms of the Weissenberg number  $Wi$ . Their results, valid only for very low Weissenberg number, showed an interesting asymptotic behavior of the heat transfer coefficient versus the fluid elasticity.

**Objectifs :** The PhD thesis proposed aims at performing similar studies by using numerical simulation. Finite Differences methods will be used to develop a specific 3D numerical model. Due to the constitutive models of viscoelastic fluids, the hyperbolic nature is added to the governing equations which are the incompressible Navier-Stokes equations based on the extra stress tensor. Numerical methods used for both the elliptic and hyperbolic equations should be used. It is expected that the numerical approach can overcome the difficulties encountered in the analytical calculation and extend to the cases of higher Weissenberg. The results obtained can be used to design an experimental bench, allowing to confront the theoretical results with measurements on the one hand, and on the other hand they can lead to original technical solutions for the heat transfer enhancement in polymer processing, electronic system cooling, etc.

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**Prérequis :** Mécanique des fluides, Rhéologie des fluides non linéaires, méthodes numériques, transferts thermiques,

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## Encadrement de la thèse :

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**Financement :** Thèse pouvant être financée par un contrat doctoral de l'École Doctorale MEGA à l'INSA de Lyon, après audition du candidat par un jury de l'École Doctorale.

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**Procédure :** Transmettre par e-mail votre CV, votre lettre de motivation ainsi que les noms de références qui pourront vous recommander

### **References:**

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