Post-doctoral position :

Rheological properties of cohesive powders

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Location : Laboratoire réactions, génie des procédés (LRGP, Nancy, France) (50%), Laboratoire d'Energétique et de Mécanique Théorique et Appliquée (LEMTA, Nancy, France) (50%)
Salary : the gross salary is 2396 € (1845 € net income)/month
Starting date: March 1st 2019
Duration: 12 months with possible renewal for 12 additional months
Required qualifications: Applicants should have a PhD in process engineering, fluid Mechanics, physics or a related field and demonstrate a strong record of independent, creative research. Experience in process engineering of powders would be an advantageous skill.

CONTEXT:

"PowderReg" is a new project in the program European Territorial Cooperation "Interreg" funded by the European Regional Development Fund to stimulate cooperation between regions in the European Union.
The PowderReg project focuses on the optimisation of industrial processes for the treatment of granular materials. This industrial sector is well developed in the Greater Region, e.g. in the field of food technology and the chemical, pharmaceutical, and building industry. To maximise their innovative abilities, the companies require the support of the fundamental research facilities in order to improve their production processes and material refinement (e.g. steel, pharmaceuticals, ceramics, plastics, or high temperature-resistant materials) with the newly developed advanced technologies. The project relies on the interaction of the outstanding scientific and technological expertise that is found in various universities in the greater region (Université Lorraine, Saarland University, Université de Liège, Université du Luxembourg, and University of Kaiserslautern) and the associated industrial partners (NovaCarb, Granutools). The main objectives of the new cluster of excellency are the implementation of experimental equipment in the form of a demonstration plant and the development of a numerical toolbox for powder behaviour simulation, which can be used by universities and relevant companies in the Greater Region. In this way, the project will supply the tools and the expertise to characterise the different methods of feeding, conveying, and shaping of different types of industrial particles.
The aim of this project is to implement a robust experimental demonstrator using tools developed by the consortium during the last 10 years to predict the flowability of powders depending on their formulation.

RESEARCH PROJECT:

An experimental study has been performed at the laboratory LEMTA [1] in order to study the free surface flow of cohesionless granular matter down a vibrated and inclined plane. This study in collaboration with the LRGP team shows that applying well controlled mechanical vibrations allows to finely tune granular flows [1-4]. The link between the

velocity and the depth of the flow highlights a competition between gravity and vibrations driven flows.
The postdoctoral fellow will extend this study to cohesive granular matter and compare results with classical tests available in the literature.
The main objectives will be:

1. To formulate cohesive powders (lactose agglomerated powders for example) with well controlled properties using LRGP resources (granulation tools, high or low shear mixers,…)
2. To experimentally characterize the flow behavior of cohesive powders on the inclined and vibrated plane available at the LEMTA laboratory.
3. To compare vibrated and inclined plane results with classical rheological tests (shear cell, FT4, repose angle, bulk and tapped densities…) available at LRGP and LEMTA
4. To propose technical specifications for implementing the transport unit on the demonstrator.

This work will provide a better understanding of the rheology powders flows of industrial interest.

BIBLIOGRAPHY :

1. Gaudel, N., de Richter, S. K., Louvet, N., Jenny, M., & Skali-Lami, S. (2016). Granular avalanches down inclined and vibrated planes. *Physical Review E*, *94*(3), 032904.

2. Marchal, P., Hanotin, C., Michot, L. J., & de Richter, S. K. (2013). Two-state model to describe the rheological behavior of vibrated granular matter. *Physical Review E*, *88*(1), 012207.

3. Hanotin, C., Marchal, P., Michot, L. J., Baravian, C., & de Richter, S. K. (2013). Dynamics of vibrated granular suspensions probed by mechanical spectroscopy and diffusing wave spectroscopy measurements. *Soft Matter*, *9*(39), 9352-9360.

4. Hanotin, C. (2014). Rhéophysique des suspensions granulaires vibrées. PhD *Université de Lorraine*.