Post-doctorate position at IFPEN-Lyon (France)

“CFD-DEM modeling of Pneumatic Transport of non-conventional solids”

Location:

IFP Energies nouvelles (Solaize, Rhône, France), Process Design and Modeling Division – Chemical Engineering and Technology Department (R124)

Supervisor / Contact:

Dr. Mathieu Morin, Dr. Jean-Lou Pierson et Dr. Sina Tebianian
Chemical Engineering and Technology Department
IFP Energies nouvelles - Etablissement de Lyon
Rond-point de l'échangeur de Solaize
BP 3
69360 Solaize

Tel: 04 37 70 32 12
Mail: mathieu.morin@ifpen.fr; jean-lou.pierson@ifpen.fr; sina.tebianian@ifpen.fr

Topic / position:

Waste recovery is one of the main pillars of the energy transition. The energy needs associated with environmental issues require the use of new energy sources and the development of eco-efficient processes for recycling waste. In this context, thermal and/or catalytic solid waste treatment processes (urban, biomass or plastics) have become an essential step in their recovery process in a sustainable development and circular economy approach. The most common operations in bulk material processing and handling are dosing, weighing, drying, grinding, sieving, mixing, storage and conditioning. In the vast majority of cases, these operations are linked together by pneumatic conveying which becomes a key step in the process.

The PHOBARS project (*Pneumatic Handling Of Bio And Recycled Solids*) aims at studying the pneumatic transport of non-conventional powders resulting from plastic wastes or second-generation biomasses. Those particles are more challenging to convey and were less investigated in the literature. A lack of knowledge on the relationship among the properties of particles, the operating conditions, the dimensions and configuration of the installations, and the performance of the operation results in difficulty of design of transport lines. There is therefore a need to better understand and model the behaviour of these so-called non-conventional powders during pneumatic transport in order to better control and optimize their implementation and transformation processes.

As a part of the project, multi-scale modelling of experimental results according to different approaches such as Euler-Euler (TFM), Euler-Lagrange (DEM-CFD) or hybrid Euler-Lagrange (Multi-Phase-Particle in Cell, MP-PIC), is utilized to take into account the effect of gas/particle and particle/particle interactions on transport dynamics.

CFD-DEM simulation of pneumatic conveying is increasingly used for modelling and analyzing key phenomena such as flow regimes and their transitions, particle attrition, electrostatic forces, *etc*. Despite the still very limited number of particles that can be treated by this approach, it remains the only one capable of giving a detailed description of the hydrodynamics of the operation by integrating all the interactions which take place within the system.

The objective of this postdoc project is to perform CFD-DEM simulations to study the effect of particles shape and electrostatic phenomena on pneumatic transport of solids. The results will be compared to experimental data with the aim of developing numerical models capable of predicting gas/solid flow behaviour with various types of non-conventional solids and determining at which conditions the common TFM or MP-PIC approaches may be used without losing significant information on the flow dynamics. Phase diagrams of pneumatic conveying (ΔP vs. gas velocity for different solid flow rates) will then be plotted. The developed models would also be used for (i) acquiring information on complex phenomena and operating conditions that are difficult to treat experimentally, (ii) extrapolating pneumatic transport on a large scale (from pilot to industrial scale), (iii) establishing design rules and (iv) troubleshooting and optimizing the operation of the installation.

The simulation will be performed for vertical and horizontal flow. The data relative to ΔP, particle velocity, concentration, particle-particle and particle-wall forces will be collected for each simulation. In addition to the typical forces acting on particles such as gravity, particle-particle contact and gas-particle interaction, the electrostatic forces will also be included. In addition to phase diagrams, further effort will be dedicated to find the common properties/parameters that define the transition from one flow regime to the other.

Candidate profile:

The candidate should have a PhD in Chemical or Mechanical Engineering with knowledge of multiphase flow. Extensive experience with CFD-DEM is required. The candidate must be autonomous and pragmatic. Knowledge of other CFD tools is also appreciated.

Duration and remuneration :

1.5 year contract. Gross salary of around 3150 euros/month + welcome bonus.

To Apply:

Please send your Resume, Motivational letter, Two reference letters and a copy of the first page of PhD dissertation reporting the completion date.