Institute of Mechanical, Process and Energy Engineering, Heriot-Watt University

PhD Opportunity

Project title: Modelling of Gas-Solid Flows with Tribocharging

Advisor: Dr. Ali Ozel

Applicants are invited for a three-year Ph.D. studentship in the field of chemical and mechanical engineering within the School of Engineering and Physical Sciences at Heriot-Watt University, Edinburgh.

Project description: It has been known for centuries that materials tend to charge electrically when they come into mechanical contact. This charging, known as triboelectric charging, or tribocharging for short, is observed naturally in the large electric fields observed in dust devils and sand storms as well as in everyday circumstances, such as the tendency of air balloons to stick to hair or sweaters upon rubbing against them. Triboelectric charging also has significant industrial implications. Tribocharging creates hazards and inefficiencies in many gas-solid flow systems, from conveying pipes to polymerization reactors. Gas-solid flow systems are used in almost every major industry, from energy and fuel production to chemicals and food production to pharmaceutical manufacturing. In all of these cases, the hydrodynamics of the gas-solid flows strongly influence the overall efficiency and safety of the system, and the hydrodynamics can be altered significantly by tribocharging and resulting electrodynamic forces. Currently, the connection between the macroscopic behaviour of gas-solid systems and tribocharging is poorly understood due to the complex nature of these flows and the lack of understanding of the triboelectric charging. Via computational modelling and experimentation, the Ph.D. student intends to expose how these flows cause charge to build up on particles, and in turn, how the charge on particles affects the flow behaviours. These insights will inform industries which utilize gas-solid flows on how they can avoid hazards and inefficiencies associated with tribocharging, or even utilize this charging to their advantage.

Requirements: The successful applicant should have a first class or upper second-class honours degree or equivalent qualification in chemical engineering, mechanical engineering or applied mathematics. They should have a good background or interest in fluid mechanics, kinetic theory of granular flows, discrete element modelling, simulation and programming (C/C++, MATLAB, Python, Linux OS, HPC). Experience in using and programming in LAMMPS and/or OpenFOAM software will be plus.

We are looking for an enthusiastic and self-motivated individual, who is able to work independently. We expect the applicant to be an active group participant and enjoy working within a multi-disciplinary research group.

This scholarship is available for UK and EU candidates. For informal enquiries about this project and other opportunities, please contact Dr. Ali Ozel by email at a.ozel@hw.ac.uk.