UNIVERSITÀ DELLA CALABRIA
DIPARTIMENTO DI **INGEGNERIA INFORMATICA, MODELLISTICA, ELETTRONICA E SISTEMISTICA**

AVVISO DI SEMINARIO

Il Prof. Mojtaba Ghadiri della University of Leeds (UK), Visiting Professor presso il Dipartimento di Ingegneria Informatica, Modellistica, Elettronica e Sistemistica, terrà, nell'ambito delle attività del Progetto di Eccellenza, il seguente seminario.

Cohesive Powder Flow: Trends and Challenges in Characterisation and Analysis

Mojtaba Ghadiri

School of Chemical and Process Engineering, University of Leeds, Leeds, UK

Martedì 19 marzo 2019, ore 15:30

Aula Seminari DIMES, Cubo 42C V piano

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Abstract

Powder processing and manufacturing operations are rate processes for which the bottleneck is cohesive powder flow. Diversity of material properties and sensitivity to environmental conditions, such as humidity and tribo-electric charging, make its prediction very challenging, but highly desirable particularly when addressing a powder material for which only a small quantity is available.

Characterisation of bulk powder failure for flow initiation (quasi-static) is well established, although empiricism is still the order of the day. There are a number of commercial devices as well as some developed in-house, which can shear a powder bed and provide information on bulk density, cohesion, internal angle of friction, unconfined yield stress, etc. However, these bulk flow parameters are all sensitive to strain rate, but in contrast to quasi-static test methods, there is no shear cell which can characterise the bulk parameters in the dynamic regime. There are only a handful of instruments available for powder rheometry, the most prominent ones being FT4 of Freeman Technology[1,2], Powder Rheometer of Anton Paar[3], and the Couette powder rheometer developed in academe[4]. In these devices the bulk resistance to motion can be quantified as a function of speed of shearing (strain rate), but the challenge is relating it to the physical and mechanical properties of constituting particles.

In this work the case of FT4 is analysed. FT4 measures the work done on the powder by a penetrating and rotating impeller. The prevailing shear stresses and strain rates have been calculated by numerical simulations, based on Discrete Element Method and Computational Fluid Dynamics, from which the bulk friction coefficient and apparent shear viscosity are predicted as functions of the dynamics of the system. The outcome of the analysis will be presented for a number of cases, such as varying degree of interparticle adhesion, influence of drag of the medium (air), particle shape, and mixtures of powders with different properties.

Speaker: Professor of Chemical Engineering at the University of Leeds, UK, with research activities on Particle Technology, and focussing on the link between bulk particulate solids behaviour and single particle properties with the aid of simulations by combined DEM and CFD. Application areas of interest are cohesive powder flow and fluidisation, size reduction and enlargement, environmental effects and electrical phenomena in particulate systems. For details of the current projects, collaborators and publications please see the following web pages: Group's web page: http://ghadiri-group.leeds.ac.uk/.

[1] Hare, C., Zafar, U., Ghadiri, M., Freeman, T., Clayton, J., Murtagh, M.J., Analysis of the dynamics of the FT4 powder rheometer. Powder Technology 285 (2015), pp. 123-127.

[2] Vivacqua., V., López, A., Hammond, R., Ghadiri, M., DEM analysis of the effect of particle shape, cohesion and strain rate on powder rheometry, Powder Technology 342 (2019) 653-663.

[3] Salehi, H., Sofia, D., Schütz, D., Barletta, D., Poletto, M., Experiments and simulation of torque in Anton Paar powder cell, Particulate Science and Technology, 36 (2018) 501-512.

[4] Tardos, G.I., McNamara S., Talu I., Slow and intermediate flow of a frictional bulk powder in the Couette geometry, Powder Technol. 131 (2003) pp. 23–39.

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