

# PROCESS AND POWDER TECHNOLOGY SOLUTIONS

*Research and  
Development*



## ACTIVITIES AND SKILLS

The powder technologies and the processes engineering platform bring together research and development on the behaviour of powders, prevention/characterisation of nanomaterials and more generally gas-solid processes.

Using a multidisciplinary and multi-scale approach, we support companies for training, research and development of processes adapted to their needs.

## SERVICES

- RESEARCH AND DEVELOPMENT PROJECTS
- PROJECT EXPERTISE AND MONITORING
- SERVICE PROVISION
- TRAINING

## RESEARCH AND DEVELOPMENT THEMES

- PHYSICAL, TEXTURAL, MORPHOLOGICAL CHARACTERISATION AND FLOWABILITY OF POWDERS (MICRONIC, SUBMICRONIC AND NANOMETRIC)
- SOLVENT-FREE SOLID SYNTHESIS
- BIOMASS CHARACTERISATION
- GAS-SOLID FLUIDISATION METHODS: HYDRODYNAMICS, REACTION, ATTRITION, COATING AND NUMERICAL MODELLING
- DESIGN, DETECTION, SAMPLING AND CHARACTERISATION (MARKING AND ELECTRONIC NOSE) OF EXPOSURE TO NANOMATERIALS
- MINIATURISATION OF FLUIDISED BED PROCESSES

*With 25 years of experience, our team offers its services to the industry in research and development, and quality services with rigorous methodologies, which guarantee reliable results.*

# CHARACTERISATION OF PHYSICAL AND TEXTURAL PROPERTIES OF POWDERS

## MEASUREMENT OF THE SIZE DISTRIBUTION AND THE MORPHOLOGY OF POWDERS FROM MILLIMETRES TO NANO-PARTICLES

- Dispersing, chemical and mechanical deagglomeration of the agglomerates.
- Procedures and measurement methods adapted to each powder size (macro-micro-nano).
- Analysis of the particle shape.
- Statistical analysis of data.



**MASTERSIZER 3000-MALVERN :**  
*0.01  $\mu\text{m}$  - 3.5 mm*



**ZETASIZER NANO S-MALVERN :**  
*0.3 nm - 10  $\mu\text{m}$*

**ZEISS MICROSCOPY  
APHELION SOFTWARE -  
HEATING STAGE**



## TEXTURAL ANALYSIS OF POWDERS

- Measurement of the true and apparent density of powders.
- High-rate surface characterisation (mesopores and micropores): specific surface area, pore distribution, total pore volume.
- Mercury porosimetry analysis: pore size distribution, total pore volume, mean diameter and information on the pore geometry.



**GAS PYCNOMETRY,  
AccuPyc 1330 MICROMERITICS**

**MERCURY INTRUSION  
POROSIMETRY (AutoPore III),  
MICROMERITICS**



**3FLEX AND TriStar II,  
MICROMERITICS**



*Our priority: To provide rigorous and innovative solutions for the*

# CHARACTERISATION OF POWDER FLOWABILITY PROPERTIES

## POWDER SHEAR STRESS CELLS

- Measurement of flow properties and cohesion of powders.
- Study, analysis and evaluation of the different types of flow.
- Determination of the flow function.
- Measurement of the angle of friction at the wall
- Design of silos.
- Measurement of permeability, consolidation and aeration of the powder bed.



**RING SHEAR TESTER RST-XS :**  
**D. SCHULZE**



**POWDER RHEOMETER-FT4 :**  
**FREEMAN TECHNOLOGY**

## POWDERS FLOWABILITY TESTING PLATFORM: QUALITY CONTROL

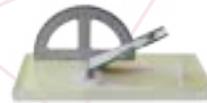
- Quantify, class, control and compare the type of powder flows.
- Measurement tests: angle of slide and angle of repose.
- Measurement of packed and non-packed densities: Hausner index.
- Powder dispersion test.



**BULK AND TAPPED DENSITIES**



**ANGLE OF REPOSE**



**ANGLE OF SLIDE**



**SILOS TESTER**



**DISPERSIBILITY**

## DESIGN AND COATING OF SOLIDS WITHOUT SOLVENTS, MECHANOSYNTHESIS, MECHANOFUSION AND SPRAY DRYING

- Micro and nano-coating of materials.
- Production of composite materials: mechanosynthesis and mechanochemistry.
- Host / guest particles mechanofusion.
- Solids production-spray drying technology.
- Analyses, control and optimisation.



PLANETARY BALL-MILL  
PM 100, RETSCH



HIGH-SHEAR BATCH MIXER  
'PICOMIX', HOSOKAWA MICRON



VIBRATORY MICRO-MILL  
PULVERISETTEO, FRITSCH



BÜCHI, SPRAY DRYER B-290

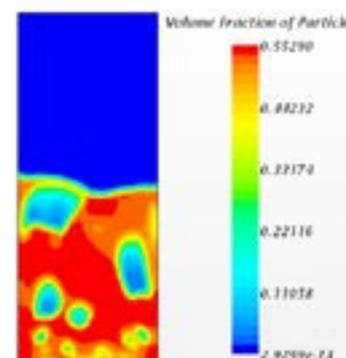
## DEVELOPMENT OF FLUIDISED BEDS PROCESSES: MICRO-MESO AND NANOPOWDERS

- Design, numerical modelling of fluidised bed processes.
- Experimental and theoretical studies: hydrodynamics, heat transfer and reaction.
- Particle degradation study and analysis (attrition).
- Solid preparation: granulation.
- Development, experimental and theoretical study of miniaturised fluidised beds.



CFD-FLUIDIZED  
BED

FLUIDIZED BED



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