GRANUTOOLS™

POWDER FLOW CHARACTERIZATION

Characterizing powders rheology and triboeletric properties for continuous manufacturing applications

Sebastien Depaifve[1], Aurélien Neveu[1], Filip Francqui[1], Geoffroy Lumay[2]
[1]GranuTools, Rue Jean-Lambert Defrêne, 107, 4340 Awans, Belgium
[2]GRASP Laboratory, CESAM Research Unit, University of Liège, Belgium

Introduction

Minimizing the variability in the feeding process of pharmaceutical powders (API and excipients) is a key challenge in continuous manufacturing (CM) to ensure good/acceptable and consistent product quality[1]. It is known that the flowing properties of powders influence drastically the process consistency. In particular, the triboelectrification of powders is known to influence the material flowing properties and can lead to serious complications[2]. Therefore, there is a crucial need to precisely characterize the flowability and to assess the triboelectrification behavior of powders.

In continuous manufacturing applications, powders are processed in different conditions of stress state and flow field (hopper, feeders,...). Therefore, it is important to study the flow properties of pharmaceutical powders as a function of the processing conditions. To this end, we used a GranuDrum to gain better understanding of the influence of the processing conditions on the rheology and flow properties of powders. In parallel, we used a GranuCharge instrument to measure the initial charge and the triboelectrification of powders after flowing through a pipe, similarly as the feeding process in CM.

Rheological behaviour

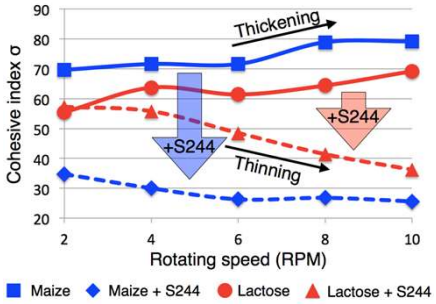
- **GranuDrum**: automated powder flowability measurement instrument based on the rotating drum method.
- The drum rotates around its axis at various rotating speeds (1 - 70 rpm).
- The air/powder interface is analysed with an algorithm to measure both the **cohesion** and the **flowing angle** of the powder at each rotating speed.
- Monitoring the evolution of the flowability as a function of the rotating speed allows measuring the **rheology** of the powders.

Triboelectric behaviour

- **GranuCharge**: instrument to measure the **electrostatic charges** created in a granular material during a flow through a selected material.
- The sample flows through a V- tube to a Faraday cup. The V-tube is an assembly of two tubes (L = 350mm and Ø = 47mm with a 90° angle). For the present study, 316L stainless steel has been selected.
- The total electric charge (Q) of the powder is measured **before** and **after** the flow through the V-tube. Then, the **charge density** (q = Q/m), where m is the sample mass, is calculated.

PVC, S.S., Aluminium, Glass, PE, ...

Results

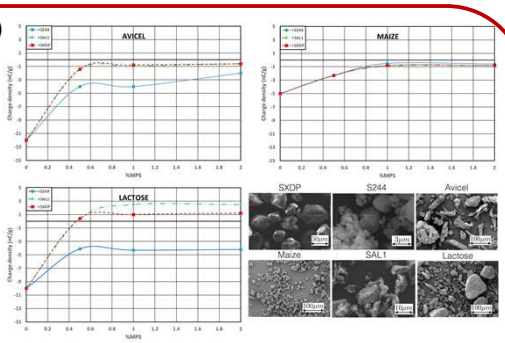


- Addition of MPS reduces the **cohesion** in the powders.
- Addition of MPS modifies the **rheology** of the powders.
- Addition of MPS improves the **flow properties**.

(a) **(b)**

High triboelectrification

Low triboelectrification



- **Low triboelectrification reduces the feeding variability** in a CM process (Figure a)[1].
- **Addition of MPS** improves the performances of powders by **reducing the electrostatic charges** created during the processing.

Conclusions

- The GranuDrum instrument allows measuring the **flowability** and the **rheology** of pharmaceutical powders.
- We show that **additives** (Mesoporous Silica) are able to **modify the rheology** of powders.
- The GranuCharge instrument allows measuring the **triboelectrification** of pharmaceutical powders flowing through different materials (Stainless steel, PVC, PE, ...).
- We show that small amount of **additives** (MPS) can significantly reduce the **electrostatic charges** of excipients.

References

1. Allenspach, C., *et al*. (2021). Loss-in-Weight Feeding, Powder Flow and Electrostatic Evaluation for Direct Compression Hydroxypropyl Methylcellulose (HPMC) to Support Continuous Manufacturing. *International Journal of Pharmaceutics*, 596, 120259.
2. Schockmel, J., *et al*. (2017) How tribo-electric charge modify powder flowability. *Annual Transactions of the Nordic Rheology Society*, 25, 17-21.
3. Lumay, G., et al. (2019) Influence of mesoporous silica on powder flow and electrostatic properties on short and long term. *Journal of Drug Delivery Science and Technology*, 53, 101192.