Flowability Control through Product Design

Material Flow Solutions, Inc.

One of the three top reasons for poor process operation is the development of stagnant zone or hang-ups – ***poor flowability***. These events come in two general types. The material either arches across outlets or forms stable ratholes in process equipment as it discharges. In either case, an unwanted free surface is formed in the unit operation and the controlling flow property is the unconfined yield strength. Thus, changing the yield strength of the material can help mitigate flow problems caused by arching or ratholing. The question is: how can the product be modified to prevent arching and ratholing and ***enhance flowability***?

From a particle point of view, unconfined yield strength (a bulk property) represents resistance to flow caused by the collection of inter-particle forces, such as adhesion, between particles and friction between particle surfaces. The sum of all forces acting in the right direction is proportional to the bulk unconfined yield strength. Thus, any tool that reduces these forces can be used to mitigate flow problems. A variety of methods can be used to decrease inter-particle forces.

At Material Flow Solutions, we measure the cohesive flow properties along with key particle scale properties such as particle size distribution, particle shape, and particle roughness. These are coupled with forces caused by liquid penduals or liquid films and used to create models that predict bulk behavior from first principles. Approaching product design in this manner allows us to suggest changes in particle scale properties that will reduce flow problems caused by cohesive effects. With these tools, engineers can design a product that will flow through the process without resorting to costly scale-ups. Process behavior can be designed into the product at formulation stages, quickening the time to market.

PRACTICAL APPLICATIONS of ***flowability control*** include, but are not limited to:

- Drug segregation mitigation using changes in cohesive flow properties
- Rathole prevention of detergents caused by optimal particle size selection
- Identification of key particle scale morphology that cause increased strength in bulk drug mixtures
- Use of flow aids in reducing cohesive effects in powdered limestone and other applications

MATERIAL FLOW SOLUTIONS, Inc.
7010 NW 23rd Way, Suite A
Gainesville, FL 32653