# Creating Successful Products Through Flow Rate Control

## Material Flow Solutions, Inc.

One of the three most costly problems experienced in processing plants that handle bulk solids is the lack of ***flow rate control***. Uncontrolled flow rate results in erratic flow of key ingredients in processes where component control is critical. Often bulk solid materials (especially powders) exhibit one of two behaviors. These powders can store air for long periods of time. In this condition, the bulk material literally flows like water, limited only by the acceleration of gravity through converging flow channels. This condition results in very high flow rates. However, these same powders, when they lose entrained air, compress during flow through a process vessel, causing gas to be squeezed out of the bulk material.

As this compressed material reaches the outlet, it must expand. However, the lack of air within the solids voids causes a negative gas pressure gradient and results in an upward flow of air which retards the solids flow rate. Often these limiting flow rates are several orders of magnitude lower than aerated flow rates. Thus, a material capable of fast flow dribbles out of the process vessel outlet, causing serious production limitations. In addition, the bimodal nature of powder flow often results in flooding and flushing behavior where material oscillates between fast and slow flows – making process control difficult. From a product standpoint we must create or develop a product with a low affinity for air storage and a low resistance to gas flow through the bulk. This requires a low compressibility combined with a high permeability to maximize the flow rate through process equipment and minimize flooding and flushing events.

At Material Flow Solutions, we measure the density and permeability of bulk materials and use this information to compute expected flow rates in a variety of process unit operations. We also use particle size distribution information, cohesive flow properties, particle scale friction and fluid viscosity and density information to determine the optimal particle size, moisture contents and surface treatment that will optimize the limiting flow problems experienced with powders. Approaching flow rate issues in this manner allows us to scale product properties to behavior experienced in full scale plants. Thus, we perform lab scale testing and design products to behave properly in full scale processes.

***PRACTICAL APPLICATIONS*** of ***controlling flow rate*** include, but are not limited to:

- Selecting optimal PSD for maximum flow rate into tablet presses
- Using flow aids to increase flow of cements and powders lime
- Modifying the cohesive nature of ash materials to maximize the flow rate
- Reducing clay surging in agglomeration feed

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